Seasonal Migrants and Traditional Ecological Knowledge in a Region of Risk: The Pulse Seine Fisheries in Limfjorden, Denmark, c. 1740-1860

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INTRODUCTION

Bang!... Bang!... Bang!....Every summer night in the 18th and 19th centuries, this repetitive, loud noise ripped through the still twilight in the Limfjord in northern Denmark. The sound came from a long wooden club, known as a 'pulsekølle,' used by fishermen to catch the much sought-after freshwater eel (*Anguilla anguilla*). The pulsekølle was about three metres long, made from a stick with an approximately 20 cm wide, concave hole at one end. The eel fishermen would drive the club downwards with great force. This produced loud bangs as the concave end of the club penetrated the surface of the water. The function of the clubs was to frighten eels from their hiding places near the bottom of the relatively shallow Limfjord estuary. A pair of boats, each with two fishermen, would be ready to catch the eel in a seine net drawn between the two boats as soon as the eel began to swim more freely in the water column.[1]

In the belief that the eel would be frightened by the noise and subsequent shock wave in the water column, these clubs were a curious and necessary part of one of the few commercially significant eel fisheries in Europe before the advent of modern industrial fishing. The most important eel fishery before about 1850 was probably that of the Comacchio lagoons in Italy,

[1] H. Matthiessen, *Limfjorden: Fortoninger Og Strejflys,* (Copenhagen: Gyldendal, 1936).

which yielded about 500-1000 tonnes a year.[2] Another commercially important eel fishery was the supply of fresh and live eels from the Netherlands to London. This distinct fishery, which dates to the 15th century, continued until the outbreak of the Second World War, when Dutch fishmongers were no longer able to land eel on the Thames quays in the heart of London.[3]

Although not previously recognised in the international literature, the Limfjord eel fishery has a Danish language historiography in which a particular narrative is prominent: Pulse seine fishing is closely associated with the summer season (24 June - 24 August), when every year hundreds of fishermen from the adjacent North Sea coast migrated to the Limfjord to catch eels. They fished at night in quiet waters, while during the day they stayed in farmhouses around the fjord, where they rented space to clean and prepare their nets in exchange for eels. In the words of several commentators, virtually all adult men left the home parishes to take part in the eel fishery. This was first mentioned in the scholarly literature by zoologist Henrik Krøyer in a manuscript from the 1850s.[4] This was echoed by Strandgaard in 1888, and by Pinholt in 1921.[5] In 1928 the memoirs of Karen Thuborg, who had lived in Harboøre all her life, were published and contained the same story, possibly influenced by previous writings.[6] Even as recently as 2019, this story has

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[2] V. Aschonitis et al., 'Long-term Records (1781–2013) of European Eel (*Anguilla Anguilla L.*) Production in the Comacchio Lagoon (Italy): Evaluation of Local and Global Factors as Causes of the Population Collapse', *Aquatic Conservation: Marine and Freshwater Ecosystems* 27, no. 2 (2017), 502-520. W. Dekker, 'The History of Commercial Fisheries for European Eel Commenced Only a Century Ago', *Fisheries Management and Ecology* (2018).

[3] P.J.E.M. v. Dam, 'Eel Fishing in Holland: The Transition to the Early Modern Economy', *International Journal of Maritime History* 15, no. 2 (2003), 163-175. Ysbrand Nicolaas Ypma, *De Geschiedenis Van De Zuiderzeevisserij*, Report no. 27. Publicaties van de Stichting voor het bevolkingsonderzoek in de drooggelegde Zuiderzeepolders. (Amsterdam: Drukkerij Planeta, 1962).

[4] Krøyer, *Limfjordsfiskeriets*.

[5] H.C. Strandgaard, 'Om Udvandringen Fra Agger Og Harboøre', *Samlinger Til Jysk Historie Og Topografi* 2, no. 1, (1886-1888), 115-123. J.G. Pinholt, 'Vestkystfiskeri Og Havfiskere Gennem Et Halv Århundrede. Særlig Med Hensyn Til Harboøre', *Hardsyssel Årbog* 15 (1921), 87-111.

[6] Thuborg, *Harboøre*.

been repeated in Poulsen's Stormflod, based as it was on what has been a dominant narrative until now.[7]

This narrative has risen since the early 1800s based on anecdotal evidence. The pulse seine fishery was tightly regulated, with every seine being checked and certified by the local district bailiff on shore before fishing commenced. We present the first in-depth analysis of all preserved certificates for the 18th-19th century pulse seines, totalling over 2,100. This allows for a substantial revision of the existing account and the introduction of a fresh narrative, where the relative presence of migrant fishermen was waning over an 80-year period.

We then take a closer look at who the migrant fishermen were, and what drove them into the Limfjorden area to fish during the summer months. Comparing fishing licences with a novel demographic database for the migrant fishermen's home parishes, we suggest that summer eel fishing was not as essential to the North Sea fishermen's survival as evident from the abovementioned narrative. Moreover. In the final discussion this novel interpretation of the Limfjorden pulse seine fishery is situated in a context of varying strategies of economic pluriactivity in a region of risk

BACKGROUND AND MATERIAL

The Limfjord played an important role as Denmark's main fishing area in the early modern period. The Limfjord is present day Denmark's largest estuary. Water flows into the Limfjord from more

[7] B. Poulsen, *Stormflod,* (Aarhus: Aarhus Universitetsforlag, 2019).

than 7,600 square kilometres, or one sixth of Denmark's catchment area.[8] However, freshwater eels swimming towards Europe from their spawning area in the Sargasso Sea can only enter the Limfjord through two natural points. Today, the Limfjord is a strait connected to the North Sea via a narrow opening known as Agger Tange to the north and Harboøre Tange to the south, both of which are sandy isthmuses. The eastern entrance at Hals, a small town where the easternmost part of the Limfjord meets the Kattegat Sea, served as the sole access point for eel and other fish migrating in and out of the Limfjord from approximately 1100 AD to 1825.The western entrance was blocked by the unbroken sandy isthmus known at the time as Limfjordstangen, which separated the salty (3.5% salinity) North Sea from the brackish (1-1.5% salinity) water in the western part of the Limfjord. This means that salinity in the Limfjorden rose during the time period assessed here.

The most significant fishery in the Limfjord was the herring (*Clupea harengus*) fishery located in the eastern section of the estuary until 1830.[9] While herring fishing was dominant in the eastern part of the estuary during spring, eel fishing took place throughout the year across the Limfjord region. Eels were caught using traps, seines, prism-shaped push nets, and in the small rivers flowing into the Limfjord, more permanent installations like weirs were utilised. Regulations concerning the use of certain spears and traps were established from the 13th century onwards, and it has been subjected to extensive fishing activities since at least the 15th century.[10] In winter, when the brackish Limfjord froze over, a fishery for eel with hooks on lines via holes in the ice

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[8] Naturstyrelsen, *Vandplan 2009-2015 Limfjorden. Hovedvandopland 1.2.*, (Copenhagen: Miljøministeriet. Naturstyrelsen, 2014).

[9] J.R. Dahl, L. Thomsen and B. Poulsen, 'Nibes Nedgang Efter 1829 - Katastrofe, Resiliens Og Kystnær Migration', *TEMP-Tidsskrift for Historie*, no. 25 (2022). B. Poulsen, P. Holm and B.R. MacKenzie, 'A Long-Term (1667-1860) Perspective on Impacts of Fishing and Environmental Variability on Fisheries for Herring, Eel, and Whitefish in the Limfjord, Denmark', *Fisheries Research* 87, no. 2-3 (2007), 181-195.

[10] M. C. Nielsen, 'Om Det Gammeldags Aalefiskeri i Limfjorden Ved for Himmerland', *Fra Himmerland Og Kjær Herred* 1 (1914), 45-54.

was facilitated by the ice cover. In autumn, lights on small boats might entice eels to come closer, allowing fishermen to spear them with an eel plug.[11] Nonetheless, the pulse seine fishery was the most highly regulated among the Limfjord eel fisheries, and therefore, it produced the largest amount of source material.

Today, it is well known that all European freshwater eels travel thousands of kilometres from their spawning grounds in the Sargasso Sea to Europe and back to complete their life cycle.[12] Yet, until well into the 19th century, it was commonly held in Denmark that like most other fishes the eel spawned somewhere much nearer to where the adult specimens were caught. In was widely believed that the eel grew out of the mud at the bottom of fjords and inlets. Another theory held that the fish, viviparous eelpout (*Zoarces viviparus*), which used to be commonly found in Danish waters, was in fact the mother of the common freshwater eel, hence its name, eelpout.[13]

These popular beliefs led to fears that, as early as the 1500s, the loud bangs of the clubs would disturb and possibly destroy the mysterious young eels. As a result, the use of pulse seines was restricted to a two-month period from 24 June to 24 August. Pulse seine fishing was banned for the first time in 1515, but the fishery seems to have continued unabated.[14]

In 1741, a government commission travelled through each parish along Limfjorden's more than 750 kilometres of shoreline. The commission noted that indeed there were cases of abuse in the pulse seines fisheries: Sometimes the mesh size of the nets was so tight that small eel the width of a pen feather could not escape the seines. As a second concern the small meshes and the practice

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[11] H. Rasmussen, *Limfjordsfiskeriet Før 1825. Sædvane Og Centraldirigering* (København: Nationalmuseet, 1968).
[12] B. Poulsen, *Global Marine Science and Carlsberg - the Golden Connections of Johannes Schmidt (1877-1933),* Brill, 2016).
[13] Rasmussen, *Limfjordsfiskeriet.*
[14] Matthiessen, *Limfjorden*. Rasmussen, *Limfjordsfiskeriet.*

of banging the pulse seine clubs were perceived as destructive for the spawning of freshwater species such as pike, perch, whitefish, and bream. Finally, the loud bangs were held responsible for scaring adult fish into fainting, so that they would turn upside down in the water column and drift to the sea surface.[15]

The perceived abuse is the likely background for why the pulse seine fishery was prohibited several times. The most recent instance took place between 1750-1760. However, there was a significant exception to the moratorium. Fishermen who resided on the isthmus, the Limfjordstangen, separating the Limfjord from the North Sea were permitted to fish with their pulse seine in the then-fjord. The rationale behind this decision was primarily social. It was widely acknowledged that the fishermen on the west coast, who resided near the North Sea and relied on it for their livelihoods, were impoverished. They also resided in an area with limited options to supplement their income through farming on sandy coastal soils. From a strategic perspective, the Danish government supported communities with a significant population of skilled seafarers who could join the Danish navy when necessary.[16]

The enforcement of the fishing regulations was the responsibility of the district bailiffs in the approximately 100 parishes surrounding the Limfjorden area. As of 1760, the pulse seine fishery was opened to residents within the Limfjord, while most other regulations on mesh sizes, fishing seasons and fees for obtaining licenses remained in effect. This required each group of four pulse seine fishermen to have their equipment inspected by the local district bailiff prior to fishing. The bailiff verified the mesh sizes using brass measures and certified the nets as intact and

[15] Limfjordsmuseet, Holger Rasmussens Arkiv, no. 40A. 13-15.
[16] H. Rasmussen, 'Vodfiskeri', in *Dansk Fiskeri Før Industrialiseringen*, ed. Morten Lundbæk (Odense: Nationalmuseet, 1975), 35-76.

functional. A fee was charged by the bailiff from the fishermen after successfully completing the inspection, marked by nailing a tin marker to the gear.[17] During the allotted period between 24 June and 24 August, the bailiff would revisit the fishing grounds to verify which individuals were actually engaged in fishing and their location. These actions were duly documented, and in numerous cases, these documents have been conserved to date in the regional and municipal records from the Limfjorden region.

Thus, this paper analyses the empirical data available in the Danish Public Records Office, which is a particularly rich source regarding the impact of the loud bangs of pulse seine clubs on the marine environment. All preserved records regarding the fishing control of the Limfjorden pulse seine fisheries between its reopening after 1760 and c. 1840 are examined. All records have been examined for their suitability to be included in a database, containing data for 2,147 certificates issued for licensed pulse seine fishing in the years 1761-1841.[18]

Most of the records in the database show the date and year when the local authorities inspected the fishermen's activities. The name of at least one fisherman from each group of four is mentioned along with their place of origin. In 18th century Thisted County, the name of all four fishermen was listed. Nevertheless, the first fishermen on the list are perceived as the spokesperson and leader of their group. The migrant fishermen from the North Sea region were operating at distant locations during summer. While it was possible to sail back home within a day or two, they usually continue fishing for the entire two-month fishing season. Far from home, the fishermen

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[17] A. Hjorth Rasmussen, *Jens Væver Og Det Jyske Ålevodfiskeri: Limfjordsfiskerne Og Jagten På Sjællands Ål* (Løgstør: Limfjordsmuseet, 1991).

[18] Rigsarkivet, *Journalsager, Fiskerisager (1804-1840) 396: 1805 K - 1840 K.* Rigsarkivet, *Forskellige Sager (1822-1841)*. Rigsarkivet, *Indberetninger Om Ålefiskeriet (1794-1804) 830-831*. Rigsarkivet, *Fortegnelser Over Tinglæste Fæstebreve M.M. (1839-1854)*. Rigsarkivet, *Synsforretninger Over Pulsvåder i Limfjorden (1751-1831) 502: 1751 – 1831*.

relied on accommodation close to the estuary banks for drying and repairing their nets. They lodged with local farmers around the Limfjord, and most records in the database provide the name and location of the host. Although the record formatting appears intended to support the influx of migrant fishermen, the records themselves also contain information on the addresses and fishing locations of non-migrant fishers. This enables an evaluation of the extent of eel fisheries carried out by both temporary migrants and the inhabitants of the Limfjorden.

Danish ethnologist Holger Rasmussen analysed a snapshot of a few years of pulse seine fishing around c. 1750.[19] Yet this is the first study to take advantage of the full archival collections of pulse seine records from almost a century of fishing. After 1841, such records were not consistently preserved, although this fishery persisted until the 1860s, when it was mainly substituted by Danish seine fisheries, discussed below.

In the following section, the database serves as the foundation for estimating the scope and size of the pulse-seine operation. We will then examine the demographic characteristics of migrant fishermen from the North Sea coast in comparison to other known groups of Danish fishermen. This leads to a broader discussion of how coastal settlements, such as those in the Agger and Harboøre parishes, coped with both rough weather, and outright disasters through various activities, including summer fishing for eel.

[19] Rasmussen, *Limfjordsfiskeriet.*

THE SCALE OF PULSE SEINE FISHERIES

The pinnacle of the Limfjord eel fishery was during the first half of the 20th century, with annual catches ranging from 600-1000 metric tonnes per year around the turn of the century. The prominent fishing areas included the parishes of Jegindø, Fur and Hvalpsund. Modernisation of the fishery occurred after World War One with the introduction of cotton nets and motorised vessels and winches; however, this did not result in an increase in annual eel catches.[20] Further back in time, estimates of catch levels are harder to come by.

Substantial quantities of eels were salted in barrels for export from the port of Aalborg between 1801 and 1845. During this period, export data is available for Aalborg, the most significant town in Limfjord. All eastbound traffic destined for the Kattegat Sea had to be declared at Aalborg's customs office. The salted eel trade was able to piggyback on the existing trade in herring, the main marine export. In the early 19th century, the amount of eel exports from Aalborg varied significantly, ranging from a few tonnes to over 100 metric tonnes (see figure 1).[21] Further back in time, it is known that in 1746, 49 barrels, equivalent to about 5 tons, of salted eel were imported into Aalborg.[22]

Insert figure 1 here.

Aalborg was possibly the most crucial centre for exporting Limfjord products in the first half of the 19th century, yet other options for international trade were found along the North Sea coast. For example, German eel traders sailed up along the Jutland west coast from the Hamburg

[20] A.L. Lund Jacobsen, 'Limfjordens Fiskeri 1890-1925: Biologi, Økonomi Og Forvaltning', (University of Southern Denmark, 2003).
[21] Poulsen, 'A Long-Term (1667-1860) Perspective'.
[22] H. N. Krøyer, *Limfjordsfiskeriets Historie*, (1850).

region and traded directly with fishermen in the westernmost sections of the fjord[23]. In addition, a long tradition existed for overland exports of smoked and salted eel from the Limfjord to towns situated further south in Denmark and into Schleswig and Holstein. Loaded onto horse-drawn carts, a seasonal role emerged for small traders who specialised in this trade.[24] These individuals, known as "eel-whippers," purchased fresh eel from fishermen during the summer months. Subsequently, they would smoke the eels and bundle the final product with 20 eels per string. Up to 8,000 eels were loaded onto a cart drawn by a horse, which was then transported to market towns for end consumers to purchase.[25]

The limited export data for figure 1 indicates a crisis in the Limfjord eel fisheries during the late 1820s. This conclusion is reinforced by multiple historical references pertaining to the pulse seine fisheries. For example, in 1827, the eel certificates template remained empty in various districts, except for a note explaining that the pulse seine fisheries had been cancelled due to a significant bloom of jellyfish (Aurelia aurita).[26] Only four nets in the entire district were fished by migrant fishermen. The remaining active fishermen deployed their pulse nets in the waters around Fur, located in the interior of the estuary. Possibly, the Fur area was less affected by jellyfish. Visiting the Limfjord in the 1820s, natural historian Henrik Beck noted that the incredible amounts of jellyfish made it impossible to fish for eel. Yet, he also noted that there was indeed an abundance of eel around Fur, so the signal as it pertains to abundance is mixed.[27]

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[23] K. Thuborg and H. Ussing, *Det Gamle Harboøre* (KCopenhagen: Schønberg, 1928).
[24] S. Sørensen and T. Leegaard, *Ålen - En Underlig Fisk. En Historie Om Ålens Betydning for Thyboerne* (Nors: Museum Thy & Forlaget Knakken, 2018).
[25] Krøyer, *Limfjordsfiskeriets.*
[26] Rigsarkivet, *Journalsager, Fiskerisager (1804-1840) 396: 1805 K - 1840 K.*
[27] Det Kongelige Bibliotek, 'KB. Beck. Add. 314-319. H. Becks Samlinger Til Limfjordens Topografi Og Historie'.

Other contemporary comments included a longer newspaper report from 1827 which attributed the poor state of the eel fisheries to the recent breach of the Limfjordstangen between the North Sea and the Limfjorden. While jellyfish may or may not have inhabited the Limfjorden before the breach, they suddenly found an excellent habitat flowing with the current into the Limfjorden with the prevailing westerly winds. The weight and density of the jellyfish posed a problem for the eel fishermen. Even in modern fisheries, these small creatures, consisting of 98% water, can exert such weight on fishing nets that they break and cause damage to the gear.[28] It is therefore entirely plausible that the jellyfish were to blame.

For at least a decade, if not longer, following the breach of 1825, the eel fisheries have been in crisis.[29] In 1832, Gerhard Faye, the county sheriff in Thisted, issued a questionnaire to all the parish and district bailiffs in his county, requesting information on the eel fisheries, including pulse seines and other gear types. The responses were unanimous: jellyfish invasions had devastated the eel fisheries, but there was also a significant decline in the number of eels in the area.[30] Indeed, it is plausible that the adult freshwater eel had become accustomed to the brackish water in the western part of Limfjorden prior to the opening to the North Sea in 1825. As a catadromous species, the eel adjust to whatever sweet water habitat they find in Europe after they long journey from the Sargasso Sea, but once there, they like the habitat to remain stable, until they reach the age, when it is time to return to the Atlantic Ocean.[31] Reports indicate that the

[28] B.R. MacKenzie and B. Poulsen, 'Fishing and Jellyfish Eradicate Fish 180 Years Ago', (ICES C.M. 2010).
[29] B. Poulsen, 'Between Adaptation and Mitigation: The Nineteenth-Century North Sea Storm Surges and the Entangled Socio-Natural Transformation of the Limfjord Region, Denmark', *Journal for the History of Environment and Society,* 6, (2021), 129-157.
[30] Rigsarkivet, 'Rentekammeret. 2426.215. Indkomne Breve Vedrørende Limfjordsfiskeriet, 1831 – 40'.
[31] F. W. Tesch and N. Rohlf, "Eel Biology," (2003).

salinity shift between the two waters caused resident eels, as well as sweet water fish such as pike and perch, to flee the estuary and seek refuge in the small streams that flow into Limfjorden.

At any rate, the Limfjord eel fishery provides a distinct demonstration of a fully commercialised fishery for eel during the pre-industrial era, specifically before c.1850. Full-time and part-time fishermen actively fished using advanced equipment during the summer season. They sold their catch to intermediaries who catered to a considerable and long-lasting global market in Denmark and Northern Germany. However, the amount of eel caught in the Limfjord prior to c. 1850 was significantly lower than the numbers reported in later periods. Regarding fishing intensity, the use of the pulse seine fisheries enables a more detailed examination.

MIGRANT AND RESIDENT FISHERMEN

Figure 2 displays seasonal migration patterns in the pulse seine fisheries. The eel certificates from 1761 to 1833, based on 1.968 cases, reveal the home parish of the fishermen and the parish where the actual fishing occurred. Several patterns emerge from this data.

Pulse seine fisheries were carried out in 50 of 100 parishes that bordered the Limfjord in Denmark. Fishermen participated from 40 of these parishes, but the majority resided in the Agger and Harboøre parishes bordering the North Sea, and the small island of Fur in the central part of the fiord. Fishing activities were mostly concentrated in certain areas of the central part of the Limfjord.

Virtually all fishers, who fished in a parish outside of their residence, hailed from the Agger and Harboøre parishes along the North Sea coast, although in a few instances fishermen from

Vorupør parish north of Agger, and Ferring parish south of Harboøre also fished in the Limfjorden. The preferred lodging location for these fishers was the central region of Limfjorden. In the Thisted and Tilsted parishes, located north and facing the Thisted Bredning area of the Limfjorden, the Agger fishermen were the most active by far. The relative and absolute intensity of fishermen fishing in their home parish versus the amount fishing in parishes away from home is shown as a Sankey chart on figure 2.

Insert figure 2 here.

This confirms Holger Rasmussen's findings (1968) for the mid-18th century that fishermen from Agger in the Thisted county went fishing in other parishes in the same county, while the island of Mors, also in Thisted county was visited by fishermen also from Harboøre operating from bases on the southward facing shores of Mors.[32]

With the pulse seine database at our disposal, we can determine that fishermen from Harboøre predominantly fished the beaches of Ringkøbing County bordering the southern coast of Limfjorden. The Agger fishermen did not go to parishes in other counties. As a result, during their summer migrations, fishermen from neighbouring Agger and Harboøre would only encounter each other off the coast of Mors Island. The whereabouts of the migrant groups from Agger and Harboøre respectively, are shown on the panels of map 1. Considering that Agger and Harboøre parishes are neighbouring parishes, but located in separate counties, the geographical dispersal suggests that the political boundary of a county had a real impact on where fishermen from the two different parishes went fishing in summer.

[32] Rasmussen, *Limfjordsfiskeriet*.

Insert map 1 here.

However, this database contributes to existing knowledge by revealing that nearly half of the fishermen engaged in the Limfjorden pulse seine fishery are not migrants from the North Sea region. Additionally, the fishermen residing in the Limfjorden parishes fished exclusively in their immediate areas. Among the bases used for fishing with pulse seines, the small island of Fur emerged as the most active. Several crews from Harboøre visited Fur annually. However, during the investigated period in this paper, local farmer-fishermen also became involved in eel fishing on Fur to such an extent that they constituted the third largest group of eel fishermen.

The data indicates that the residents of Fur used pulse seines solely around their own island. Some also fished from nearby parishes such as Harre, Lihme, Roslev, Vile and Sæby, but the beaches of these parishes were all within a few hundred metres to 5-8 kilometres of their homes on Fur.

The database reveals that fishing intensity was unequally distributed in the western region of Limfjorden with the main areas of pulse seine fishing being concentrated in two areas not far from each other.

The Agger migrants, as well as the locals, gravitated towards Thisted Bredning, while Harboøre fishermen tended to accompany local fishermen in the waters surrounding Fur Island. It appears that these two regions provided the most fertile fishing areas.

Previous analysis by Rasmussen (1968) relied on information from a limited time span in the mid-18th century. However, the pulse seine database enables a more comprehensive understanding of the temporal evolution of fishing intensity. Figure 3 gives the number of pulse

seines in use per year from 1761-1841. It is worth noting that prior to 1797, archives only contained information from Thisted county parishes. From 1797 onward, data includes parishes along the Limfjorden from all three counties, Thisted, Ringkøbing, and Viborg, which were involved in pulse seine fisheries. There is no indication that pulse seine fisheries ever took place in the eastern part of the Limfjorden, east of Løgstør. Therefore, when interpreting figure 3, the yearly figures do not reflect the progression in total numbers throughout this 80-year period.

Insert figure 3 here.

The figure accurately depicts a higher level of interest in the pulse seine fishery during the 1760s compared to the subsequent decades before 1800. It also highlights two notable peaks of interest in eel fisheries during the early 1800s, specifically in the first decade and the first half of the 1820s. The trends between c. 1800-1820 are distorted by years of missing data points. However, the decrease from the mid-1820s can be attributed to the concerns about the poor fishing observed in the previous section.

There is no way to determine how many eel certificates have been lost in the past. However, whenever a register exists for a specific year, it is complete. Thus, if one fishing location is recorded for a particular year, it provides an accurate portrayal of all seines in that area during that year. The lists include resident and migrant fishermen in the same format. Figures 4 and 5 offer reliable evidence for the comparative growth of pulse seine operations by resident fishermen versus those of migrants from the North Sea, over an 80-year period.

Throughout the 18th century, the migrant fishermen were the primary force in the pulse seine fisheries, despite the noticeable interannual variations in intensity. In the first decade of the 1800s, resident and migrant fishermen were nearly equally represented, whereas during the period

after about 1830, the pulse seine fisheries were controlled by the fishermen who lived year-round along the shores of the Limfjorden.

Insert figure 4 here.

Insert figure 5 here.

This transition from a migrant-dominated fishery on the west coast to a Limfjorden-resident-dominated fishery is a noteworthy development that warrants further scrutiny of the fishermen in the database, as well as the socio-environmental context both inside and outside of the Limfjorden.

PROFILING SEASONAL MIGRANTS

According to numerous modern and subsequent analysts, the summer eel fishery signified, in the words of Danish historian Hugo Matthiessen: '…a glimpse of sun in the dire and dour life of the ocean dweller. They lived their best life whilst lodging with local farmers along the Limfjorden.'[33] This excerpt presents a dominant narrative that romanticises the idea of fishermen from the west coast coming into the fiord during summer as strangers entering a milder and friendlier area. Brøndlund, a contemporary Thisted district bailiff in 1806, considered eel fishing to be a cause of gluttony, drunkenness, idleness, and even lust among the inhabitants of his area. He complained that only fishermen from Agger and Harboøre should fish for eels.[34]

[33] Matthiessen, *Limfjorden.*
[34] Rasmussen, *Limfjordsfiskeriet.*

The regulation seems to have served as a prompt for this narrative as they were the exclusive fishers granted permission between 1750-1760. This version illustrates that the commencement of the eel season signalled a mass departure of adult men from the parishes Agger and Harboøre. As stated in the opening section of this paper, this is until now the dominant narrative, but one being revised here.

In 1741 a government commission traversed the 750 kilometres of Limfjord shoreline and registered all fisheries they came across, including the eel fisheries. According to the records of 20th century ethnologist Holger Rasmussen no less than 174 seines were used, and with four men to man a seine, this is an intensity of almost 700 fishermen. 4-500 of these were migrant fishermen from the North Sea shore.[35] However, on a closer reading of the diary entries from the government commission, we find this number to be exaggerated.

On Monday 17 July, the commission made it to Harboøre parish, where they noted that the residents possessed a total 30-36 pulse seines to be used in various parts of the Limfjorden. But the records don't say that they saw any of the seines. The same goes for the next day on 18 July, where the state in Agger parish, resident fishermen are in possession of 32 pulse seines, yet we are not informed that they actually saw the gear with their own eyes. The reason for this is that mid-July the fishermen using the seines are away fishing elsewhere in the fjord. Indeed, during the rest of their journey, the commission records an estimated 33-40 pulse seines in operation in the western parts of the Limfjorden. These should not be added to one listed for Harboøre and Agger, as these are the same gear, mentioned twice. Following this, the total number of pulse seines in the

[35] Limfjordmuseet: Holger Rasmussen Arkiv, no. 40A. 13-15'.

Limfjord did not exceed 90-110 seines, or the equivalent of c. 400 men's fishing. The migrant fishermen accounted for c. 60% of this number. But what drove them into the Limfjorden?

By combining the database on pulse seining with a database on the demographics of the inhabitants of Agger and Harboøre parishes, we can look at this question in more detail. Figure 6 shows the presence in the pulse seine fishery of several named fishermen from Agger parish. In the pulse seine database, the fishermen are identified by name and place of residence. Sometimes father, grandfather and grandson have the same name, and it also happens that there is more than one person with the same full name from the same place each year. However, when checked against the demographic database, it is possible to identify and distinguish most of the fishermen from Agger and Harboøre.

One such migrant fisherman was Joseph Sørensen from Sønder Aalum in Agger parish. Sørensen was born in the small settlement of Toft, further south of the isthmus. In 1790 he married one Voldborg Poulsdatter from Sønder Aalum and they settled on a small homestead in the sandy dunes of Sønder Aalum. The couple had seven children born between 1791 and 1800, but only four survived. The cadastral maps also show that the family owned a minimum of agricultural land with almost no profit, so in effect he was first and foremost a fisherman and not a farmer. Sørensen appears ten times in the Pulse Seine database as the lead fisherman in a crew of four. The first time was at the age of 36. We don't know with whom he went fishing, but for five years, 1802-1806, he went to a settlement called Faartoft in the parish of Thisted. During those five summers he stayed with a local farmer named Ole Westergaard. For the next ten years Joseph Sørensen was absent from the pulse seine fishery. This absence is most likely due to missing data from 1808-09 and 1811-1815. In 1816 the records show that he was back in Faartoft. But this time the crew was based with another farmer, Jens Jensen. They returned to Faartoft for seven years in a row, staying

with three different farmers. The last time was in 1822, and the following year Joseph Sørensen died at the age of 59.[36]

Insert figure 6 here.

Joseph Sørensen was 36 years old when he first appeared as a lead fisherman and has been using a pulse seine for 20 years, probably every summer with a few exceptions. He is by far one of the best represented fishermen in the pulse seine data. However, comparable life trajectories are evident across the dataset. Even though such fishermen are a minority, they provide valuable insights into the remaining fishermen documented in the records. Fishermen like Joseph Sørensen relied heavily on the pulse seine fishery each summer, while others only participated in it a few times in their lifetime. Some individuals may have been part of a crew without any registration of the remaining members, in which case they don't show up in the records. However, for most of the men, the tendency is clear. This is evident when comparing the number of participants in the pulse seine fishery with the number of adult men in their home parish. Table 2 shows select years, from where the dataset is complete, while we also know the exact population for Agger parish. This indicates a wide range of participation. This trend differs significantly from the conventional narrative.

Insert table 1 here.

Insert figure 7 here.

Furthermore, a certain tendency emerges. Some settlements on the Limfjordstangen are better represented than others. The dataset contains 2,288 registrations of a fisherman from Agger

[36] C. Andersen, Limfjordstangens Demografi, 1780-1880, (2023).

parish, of which 731 (32 pct.) has been identified. Alone 71 pct. of the lead fisherman has been identified, giving us a good insight into who they were and where they came from. Figure 7 shows a high concentration of fishermen from Sønder Aalum, but also the small settlement Vester Agger, just south of Sønder Aalum. The two settlements of Øster Agger and Thyborøn are also relatively well represented but compared to the size of the population of the two settlements, Thyborøn is remarkably absent. Likewise, Nørre Aalum is relatively well represented due to its small size.

Sønder Aalum, Nørre Aalum and Vester Agger all had one thing in common. They were located in the sandy dunes at Limfjordstangen, with almost no agricultural land. Surrounded by sand, the families had no other choice but to leave their homes during the summer, when the higher nearshore sea temperatures drive the haddock, cod, and plaice further away from the reach of the coastal fishermen. Furthermore, another characteristic of the fishermen stands out.

The pulse seine database, combined with the local census data for 1787, 1801, 1834, 1840 and 1845, allows us to estimate the age of the typical fisherman who migrated to the Limfjord. Knowing whether these were the young and strong or the older fishermen gives an additional perspective on how the eel season should be viewed: A much-needed break from the hard life on the barren and windy North Sea coast, or a necessary journey to supplement the annual income with cash earnings from eels?

The average age of the fishermen from Agger parish, which had the highest proportion of full-time fishermen in the census, varied between 38 and 48 years of age between 1787 and 1845, with 1787 being a possible outlier (48 years) (Table 1).

The age of migrant fishermen in the pulse seine fisheries was consistently higher than the average age in the censuses. Most of the information is available for the first fisherman mentioned

in each certificate, who is on average 49.5 years old from Agger and 47.9 years old from Harboøre. The second, third and fourth fishers are only slightly younger. Another way of approaching the age of those actively fishing off the coast of the North Sea is to check for the age of those who drowned. Ships wrecking almost never happened in the Limfjorden, so the ones that drowned, did so in the North Sea. In Harboøre parish 33 men drowned between 1820-1863. Their average age was a mere 34.4 years old. In Agger parish 34 men drowned in the same period, averaging an age of 33.4 years. This suggests that perhaps the older fishermen were less involved in the fisheries on the west coast vis-a-vis the Limfjorden fisheries.

Insert table 2 here.

To make sense of the age data for the fishermen from Agger and Harboøre, it is worth looking at other sources for similar occupational groups. The Danish census of 1834 lists the occupation of some 2,841 people, where fishing is included. Most, but not all, parishes are included in the downloadable database from the Danish Public Records Office.[37] This includes full time fishermen as well as variations of farmer-fishermen. Their average age is 44 years. Some caution is needed though, when comparing with the average age of pulse seine fishermen. On one hand the censuses tend to give a conservative estimate smaller than the actual amount of people engaged in the fishing.[38] On the other hand, the census may be biased towards including individuals who do not actually fish due to their age, yet they still retain their status in the census tables. This suggests that fishing in the estuary of Limfjorden was an activity suited for older fishermen and provided a more peaceful environment. Drowning, for instance, was extremely uncommon during

[37] Rigsarkivet, Dansk Data Arkiv, *Folketælling 1834*.
[38] P. Holm, 'Kystens Erhverv Og Bebyggelse, 1500-2000', in: P.G. Møller, P. Holm and L. Rasmussen (eds.), *Aktører i Landskabet*, (Odense: University of Southern Denmark Press, 2000).

summer months on the Limfjorden. This is because the waves and winds are not nearly as harsh as they can be when fishing off the North Sea coast for the remainder of the year.

TRANSFER OF TECHNOLOGY AND KNOW-HOW

Given the gradual shift in the use of pulse seines from migrant fishermen to Limfjorden residents between 1761 and 1841, it is pertinent to consider the extent to which this reflects a transfer of technology and know-how, as illustrated by the pulse seine database.

The seines were made from hemp and there is only reason to believe that initially in the 1760s the fabrication of the nets was first and foremost done by the migrant fishermen in advance of travelling to the fishing grounds in summer. Typically, nets would be approved off by the local authorities, but in rare cases the nets were indeed not approved by the bailiff. In the 1760s, data was available for around half of the seines. Of this sample, approximately half were "sealed at the end of the fishery," meaning they were suitable for use in the following season. The remaining half were considered unusable and discarded at the end of the season. This pattern suggests that a pulse seine fishery's lifespan was roughly two seasons. In rare instances, the local government may indicate their inability to inspect the quality of a fishing net at season end due to its sale to other regions of Limfjorden like Fur or Mors for local utilisation. This indicates that the purchase of used seines presented a tangible method for transmitting seine technology from North Sea fishermen to those around Limfjorden. Limfjorden accommodated numerous fishermen even prior to the 1760s, making it effortless for an adept netmaker to adopt the practical knowledge of repairing pulse seines.

With regards to the sharing of know-how, in most fisheries, it is advantageous to maintain secrecy regarding the most lucrative fishing locations. Valuable information is primarily shared among family members and within the local communities.[39] Regardless of the relationship between migrants and residents, there is evidence to suggest that seasonal migrants generally had positive interactions with resident fishermen and farmers. Only a few genuine conflicts are documented, despite the significant policing efforts by the various district bailiffs. During the 1690s, there was a dispute between fishermen from Harboøre and inhabitants of Lundø.[40] Again in 1839, the pulse seine fisheries sparked a violent altercation off the island of Mors.

Bang…bang…bang…! On the otherwise peaceful night of 18th May, the residents of Thissing Vig in the south-western part of Mors were disturbed by the sound of pulse seine fisheries. Despite being off-season, twenty fishermen in ten boats from Harboøre had trespassed into the locals' bay, where they traditionally used stationary gear such as traps, pots, and pound nets for fishing purposes. This intrusion threatened to damage the locals' fishing equipment already deployed in the water and thereby their means of livelihood. A group of local fishermen rowed out to meet the newcomers. A physical confrontation ensued, with the Harboøre fishermen coming out on top. Several local fishermen suffered severe bruises, one was knocked unconscious and bleeding from the head. Another local farmer fishermen, Christen Pedersen Nors, sustained such severe injuries that his life was at risk, forcing him to remain in bed for an extended period.[41] The Nykøbing Mors local court sentenced four migrant fishermen to twenty days in prison each, while a few others received a substantial fine for fishing out of season. The physical altercation, in the

[39] B. Poulsen, 'Talking Fish: Co-Operation and Communication in the Dutch North Sea Herring Fisheries, C. 1600–1850', in *Beyond the Catch: Fisheries of the North Atlantic, the North Sea and the Baltic, 900-1850*, eds. L. Sicking and D. Abreu-Ferreira (Leiden: Brill, 2008), 387-412.
[40] Rasmussen, *Limfjordsfiskeriet*.
[41] B. Poulsen, 'Nordsøens Indbrud i Limfjorden – En Kompleks Naturkatastrofe?', *Politiken Historie*, 26-33.

meantime, was settled between the two groups of anglers themselves.[42] Thereby social order was restored, but not the order of fishing rights versus the natural environment.

The North Sea fishermen's legal counsel, Prokurator Gjerulf argued, that the Harboøre fishermen frequently suffered from natural disasters in the form of storms and flooding of their land. Adding to the misery, their previous fortune with the eel fishery had run out since the intrusion of saltwater in 1825, bringing with it enormous quantities of jellyfish. Gjerulf concluded that the fishermen were forced to fish out of season if they wanted to have any luck before the jellyfish bloom in the summer.[43]

A more neutral observer, natural historian Henrik Krøyer noted in the 1850s that the authorities became less strict in the 1840s and 1850s with regards to the regulation of pulse seine fisheries. This he attributed to a reduction in the catchability of the eel and the practical challenge of fishing in an estuary brimming with jellyfish. Moreover, Krøyer noted that local authorities found the fishing regulations to be overly severe and burdensome to enforce.[44]

The eel fisheries were plagued by a shortage of eels and difficulties in catching them. If necessity is indeed the mother of invention, then the western part of the Limfjorden in the mid-19th century possessed all the prerequisites for innovative solutions. This is precisely what happened when the region became the hub for developing the so-called Danish seine. It was initially invented in 1848 by farmer-fisherman Jens Væver and proved an instant success. The Danish seine technique is based on the methods employed in pulse seine fishing. Væver observed that by substituting one boat with an anchor, he could leverage the anchor to draw the seine in a

[42] Rigsarkivet, *Sager Til Justitsprotokoller, 1840-41*.
[43] Rigsarkivet, *Justitsprotokoller.*
[44] Krøyer, *Limfjordsfiskeriets*.

prolonged circular motion, extending out from the anchor. This proved to be a more productive fishing method, as the single boat could fish a sizable area in all directions from the anchor by repetitively pulling the nets.[45]

While Væver originally intended to use the gear for plaice fisheries, the technique gained prominence in the eel fisheries in the Limfjord. Over a few decades until 1880, the Danish seine became the primary gear type, with more than 300 seines in use in the fjord alone.[46]

SEASONAL MIGRANTS FROM A REGION OF RISK

Over a period of eighty years, from 1760 to 1840, Limfjordstangen experienced eight major storm surges and three minor ones. In 1741, a government commission reported that the isthmus experienced almost annual floods during Christmas time, implying that the coastal families were accustomed to the risks associated with living by the North Sea.[47]

Storm surges, coastal erosion, and sand drift constantly reshaped the coastal terrain of Limfjordstangen during the 18th and 19th centuries, resulting in a hazardous region of risk. A so-called region of risk is defined as a region with frequently recurring natural hazards of a similar type, where the population is characterised by anticipation, preparedness, and memory from the experience of repeated disasters.[48] Many scholars argue that knowledge and experience are

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[45] Hjorth Rasmussen, *Jens Væver.* A. Hjorth Rasmussen, *Drivvod i Danmark. Dansk Fiskeri i Stilstand Og Mobilitet I, 1871-1888* (Esbjerg: Fiskeri- og Søfartsmuseet, 1988). B. Andersen, 'Fiskeriet i Limfjorden', *Nordisk Tidsskrift for Fiskeri* 7 (1882), 91-93.
[46] Hjorth Rasmussen, *Drivvod.*
[47] O. Nielsen 'Skodborg og Vandfuld Herreder. Historiske-topografiske Efterretninger om Skodborg og Vandfuld Herreder', (Copenhagen: Otto G. Wroblewskis Forlag, 1894.
[48] F. Mauelshagen, 'Flood Disasters and Political Cultura at the German North Sea Coast: A Long-Term Historical Perspective', *Historical Social Research / Historische Sozialforschung* 32, no. 3 (2007), 133-

embedded in the coping strategies to prevent future hazards from turning into a real disaster. Likewise, it became part of the households' traditional ecological knowledge and thus impacted the daily life of the fishermen and their families.[49] In this case, we may add that the occupational hazards of crippling injuries and drowning associated with sea fishing underlines, how this was indeed a region of risk for these coastal communities.

More traditional socio-economic studies of coastal societies emphasise that flexibility, seasonality, and mobility can be seen as some of the main characteristics of pre-modern coastal societies. All three characteristics were crucial in daily life for households, particularly those pursuing a household strategy marked by plural activity. Fishing or shipping may be the primary occupation in combination with agriculture. Historian Poul Holm argued that it is impossible for any marine household to survive without keeping a small number of animals and a piece of arable land.[50]

Indeed, during the first half of the 19th century, the amount of arable land dimished dramatically, as it is shown on Map 2. Map 2 shows the quality of the soil in Agger parish before and after 1825, where the parish was hit by several storm surges. The range of soil fertility is measured on national scale, where most farmland in Denmark lay in the area of 25-40. In Agger no soil was more fertile than to score of '15'. The two panels show the reduction of soil fertility around the

144. B. v. Bavel et al., *Disasters and History: The Vulnerability and Resilience of Past Societies,* (Cambridge: Cambridge University Press, 2020). K. Hewitt, *Regions of Risk. A Geographical Introduction to Disasters*, (Addison Wesley Longman Harlow, 1997).

[49] J.G. de Freitas, M.R. Bastos and J.A. Dias, 'Traditional Ecological Knowledge as a Contribution to Climate Change Mitigation and Adaptation: The Case of the Portuguese Coastal Populations', In: Leal Filho, W., Manolas, E., Azul, A., Azeiteiro, U., McGhie, H. (eds) *Handbook of Climate Change Communication: Vol. 3. Climate Change Management*, (Switzerland: Springer, 2018).

[50] P. Holm, *Kystfolk: kontakter og sammenhænge over Kattegat og Skagerrak ca. 1550-1914*, (Esbjerg: Fiskeri- og Søfartsmuseets Forlag, 1991).

settlement of Thyborøn. This settlement was not well represented in the pulse seine data before 1818 as these households hold the best agricultural land within the parish. But after four storm surges between 1818 and 1825, their land was deteriorated, and within this period there was an increase in the number of pulse seine from Thyborøn.[51]

In a recent article, historian Camilla Andersen argued that use of plural activities was indeed one of the main coping strategies used by the fishermen from Agger and Harboøre parishes to cope with the changing coastal landscape and the hazards in the region of risk.[52] However, the combination of activities was determined by the natural conditions of the settlement and especially sand drift had ruined the agriculture soil throughout the 17th and 18th century at some settlements on the isthmus. This left some households more dependent on fishing than others.

Figure 7 shows a very variable presence in the pulse seine fishery in the first half of the 19th century. One factor contributing to this is the absence of data, suggesting that certain fishermen participated very infrequently, such as the substantial gap observed in Agger between 1811-1815. But a valuable sample from Harboøre parish between 1808 and 1827 has been preserved, where presumably all certificates in Sallingland district have been preserved, providing us with precise details on the participation of each fisherman involved in a period of 20 twenty years. Just as in Agger parish, it varies how often a fisherman is registered as the lead fisherman and no single tendency emerges. Some are present a few years in a row and then return after a couple of years. Some only participate for a year or two, and never return as the lead fishermen. In other cases, there is a long continuous presence.

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[51] C. Andersen, *En foranderlig tilværelse ved kysten: At leve i et risikoområde. En miljøhistorisk undersøgelse af modstandskraft, sårbarhed og tilpasning på Limfjordstangen, 1760-1875*, Aalborg Universitet: 2023.
[52] C. Andersen, 'Tilpasning og fleksibilitet i et foranderligt kystlandskab i 17-1800-tallet', *TEMP - Tidsskrift for Historie,* 24, (2022), 89-110.

As figure 9 shows, it was in fact more common only to participate as a lead fisherman once or twice in a lifetime than to be a lifelong participant like Joseph Sørensen. Some may have been registered as a crew member in another year, but it is highly unlikely that someone who was once a lead fisherman and returns three years later in the same position has been fishing as a crew member on another boat during that time. Likewise, none of the fishermen, not even the best-represented fishermen, are continuously represented.

Insert figure 8 here.

The high occurrence of an infrequent, or even rare presence in the data makes fishermen like Joseph Sørensen interesting. That is, because when similar life course is compared a tendency emerge in relation to the risks associated with living by the sea. Settlements with little or no agricultural land due to the sand drift have a more frequent attendance in the data. The same can be said about Harboøre parish. Figure 9 shows all identified settlements in Harboøre parish from 1797 to 1841 (39 pct.). From a total of 437 lead fishermen in that period, one in four came from Langerhuse (24 pct.). The land consisted of sandy soils, where families, virtually all smallholders, owned very small land plots. This was also the case for the three settlements of Sønder Aalum, Nørre Aalum, and Vester Agger. Households within these settlements were therefore more affected by the risk from living by sea than the rest of the population within the region of risk and therefore depended more on the regulated summer fishery. Especially at a time when the use of the fishery among fishermen from Limfjordstangen was in decline, as argued above.

Insert figure 9 here.

Living in a region of risk these families were used to responding to and adapting to the environment. Even though a lack of agricultural soil can be viewed as a vulnerability in the plural

activity of a household, these families relied on the pulse seine fishery as a supplement, making them more resilient to changing landscape being less dependent on the land use. It was necessary. The high average age of the fishermen suggests that these families relied heavily on the pulse seine fishery. Some kept fishing as migrants until into their seventies, which is highly unusual for any historical fishery.

The pulse seine fishery was a part of the traditional ecological knowledge on Limfjordstangen. Unlike the residents from Fur and other parts of the Limfjord, the migrant fishermen from Limfjordstangen had an uninterrupted legacy of fishing with the pulse seines, and for some households it became essential in the annual cycle of the plural activity. But the 19th century marks a shift in the use of this tradition. Whereas the pulse seine fishery in the second half of the 18th century mainly was dominated by a great number of North Sea fishermen, the pulses seine fisheries was to a greater extent as hitherto assumed particularly used by fishermen in need from Limfjordstangen in the first half of the 19th century due to the lack of agricultural land. We thus see this as an essential part of the coping strategy to leave home for eight weeks in the summer and migrate into the Limfjord to take part in the seasonal eel fishery.

Part of the explanation can be found in the enclosure movement, with a change from tenant farmer to freeholder at the beginning of the 19th century. The Limfjord isthmus was divided between all the inhabitants, but there was a big difference in the land each household was allocated. In Agger Parish, they tried as far as possible to divide the plots equally between each family. However, as mentioned earlier, some of the settlements were located on very sandy soils, while others had a small amount of agricultural land that allowed for animal husbandry, which was enough to supply the household. Instead, the pulse seine fishery provided the families with cash to buy the necessary products that the family could not produce themselves.

In neighbouring Harboøre parish the situation was slightly different. Here, many farmers had larger and better plots of land in the central parts of the parish, while the inhabitants of Langerhuse only had very small plots of land close to the sandy dunes right off the volatile shoreline. With the transition to freehold ownership in the early 1800s, households became more dependent on their land and less dependent on the pulse seine fishery during the summer. The profits from the use of the land did no longer belong to the landlord.[53] This gave rise to the potential of supplying the winter fishery with agricultural products in the summer. The pressure to leave home to go pulse seine fishing may well have lessened. Yet, in some cases, small landholdings and sandy soils were not sufficient to supplement the fruits of offshore fishing. Here, pulse seine fishing remained an essential part of the household's plural activity, despite its potential to be less profitable than in the 18th century. The direct link between soil performance and the use of pulse seine fishery is even clearer after a storm surge. We know from repeated reports that agricultural land was degraded by a layer of sand after a storm surge, which reduced agricultural yields. This coincides with an increase in the number of pulse seines from Limfjordstangen actively fishing in the fiord, as shown in Table 1. After the two storm surges in 1825, participation in the eel fishery went from 68,3 percent to 87,2 percent of adult in Agger parish between 1824 and 1826. This indicates that the pulse seine fishery served as additional pluriactivity in times of crisis for a larger part of the population within the region of risk.[54]

As we saw above, the repetitive jellyfish blooms in the Limfjord post-1825 further exarcerbated the sense of crisis, as it hampered the possibility to fish with the pulse seines. Whether the eels themselves became fewer or not is debatable, but the chance of catching them in desired

[53] C. Andersen, *En foranderlig tilværelse*.
[54] C. Andersen, *En foranderlig tilværelse*.

numbers without destroying ones gear, certainly dwindled after the jellyfish entered the equation of whether to fish or not.

CONCLUSION

Coastal inhabitants in Northern Europe during this period frequently derived their livelihoods from various economic activities. This study has investigated the unique practice of pulse seine fishing for eels, which formed an essential component of the diverse household economy in an area susceptible to the severe impacts of storms and surges from the North Sea.

For centuries, the Limfjord in north-west Denmark was home to a large and strictly regulated eel fishery. Focusing on the tightly regulated pulse seine fishery has enabled us to provide a substantial revision of the dominant narrative of this fishery. This is a story where the pulse seine fishery was dominated by hundreds of seasonal migrants - fishermen from the North Sea parishes of Agger and Harboøre. They flocked to the Limfjord shores every summer to fish for eel. This tale is often told as a story of want, but it is also a story of poor fishermen living their best of times in the mellow landscape surrounding the Limfjord area. The current narrative primarily draws on written, qualitative evidence spanning back 200 years, complemented by Holger Rasmussen's analyses into the state of the Limfjorden fisheries in the decades from 1741-1760s.

Following the development of the eel fishery across the full century from c. 1740-1850 we can conclude that indeed the fishery was a specialty for migrant fishermen in the latter half of the 18th century. However, resident farmer-fishermen in parishes along the banks of the Limfjord

gradually took over as the more typical groups of pulse seine fishermen. Describing the role of traditional ecological knowledge, we document how acquisitions of used seines provided a concrete transfer of know-how from the migrant fishermen to the residents around the Limfjord. We can infer that these groups shared a good relationship for the most part, although there were some distinct instances where conflicts arose.

We then focused our analysis on migrant fishermen. It emerged that most seasonal migrants originated from the poorest parishes in terms of soil quality and livestock. However, in this specific group, it seems that the seasonal migration occurred out of necessity. The group did not embark on trips every summer, and the majority of the leaders in a team of four pulse-seine fishermen only led their crew once, twice, or thrice in some years. Moreover, their demographic profile suggests that the typical seasonal migrant was older than the average active fishermen, with some individual fishermen fishing well into their seventies. We saw in the section on the disruptions caused by the jellyfish blooms that they were such a hassle that they entered the court arguments during the settlement of the brawl in the late 1830s.

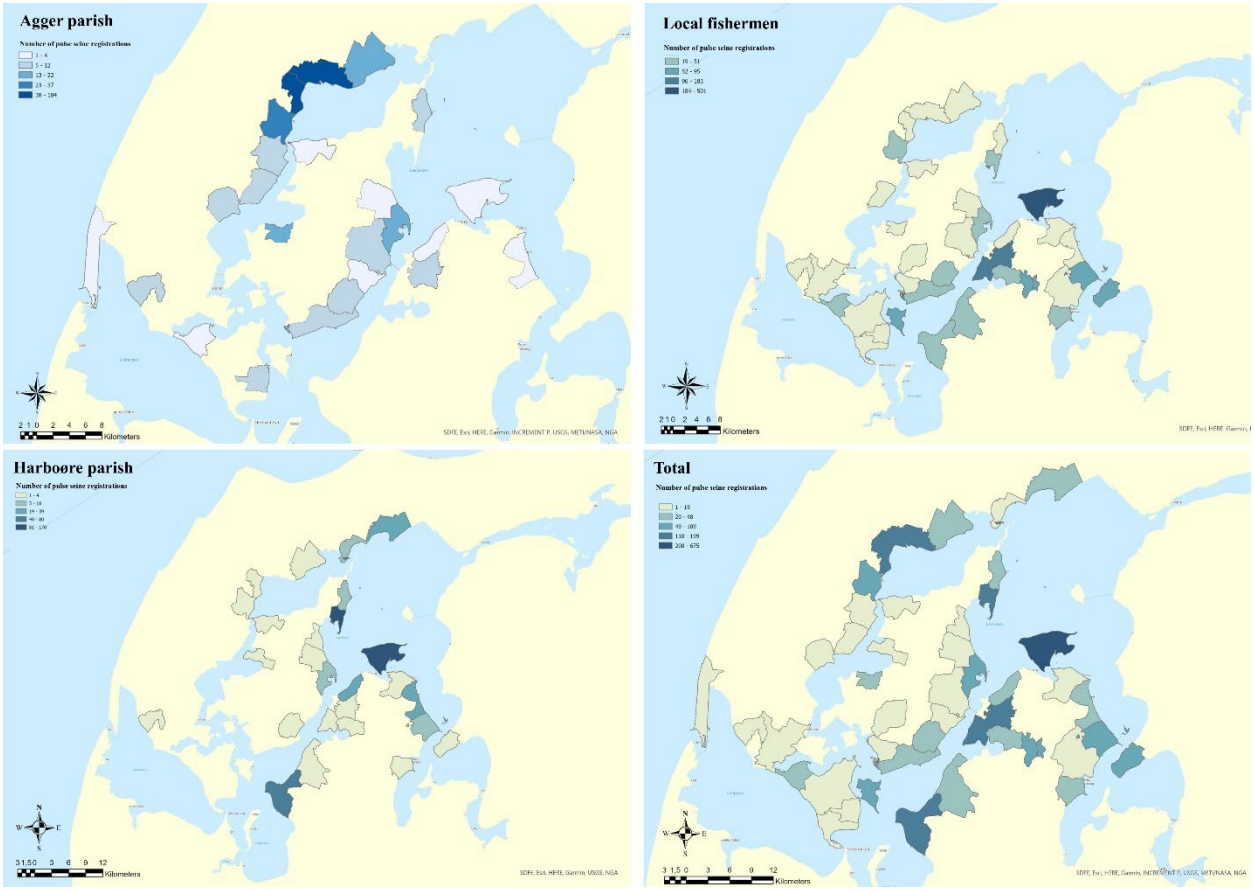
It is difficult to measure accurately the impact of the fishing intensity in the Limfjord. We now know from the history of fishing regulations as well as the surviving records, that overall, the pulse seine fisheries attracted more fishermen in the latter half of the 18th century following the abandonment of the limited entry system in 1760, where after everyone who wished to do so, could pay for having fishing gear approved to enter the pulse seine fisheries.

If the Limfjorden provided a stable catchability of eel in the summer months, it is counterintuitive that during an entire century, the living conditions on the Limfjordstangen were deteriorating due to the frequent storms. Thus, the attraction of spending one's summer fishing for

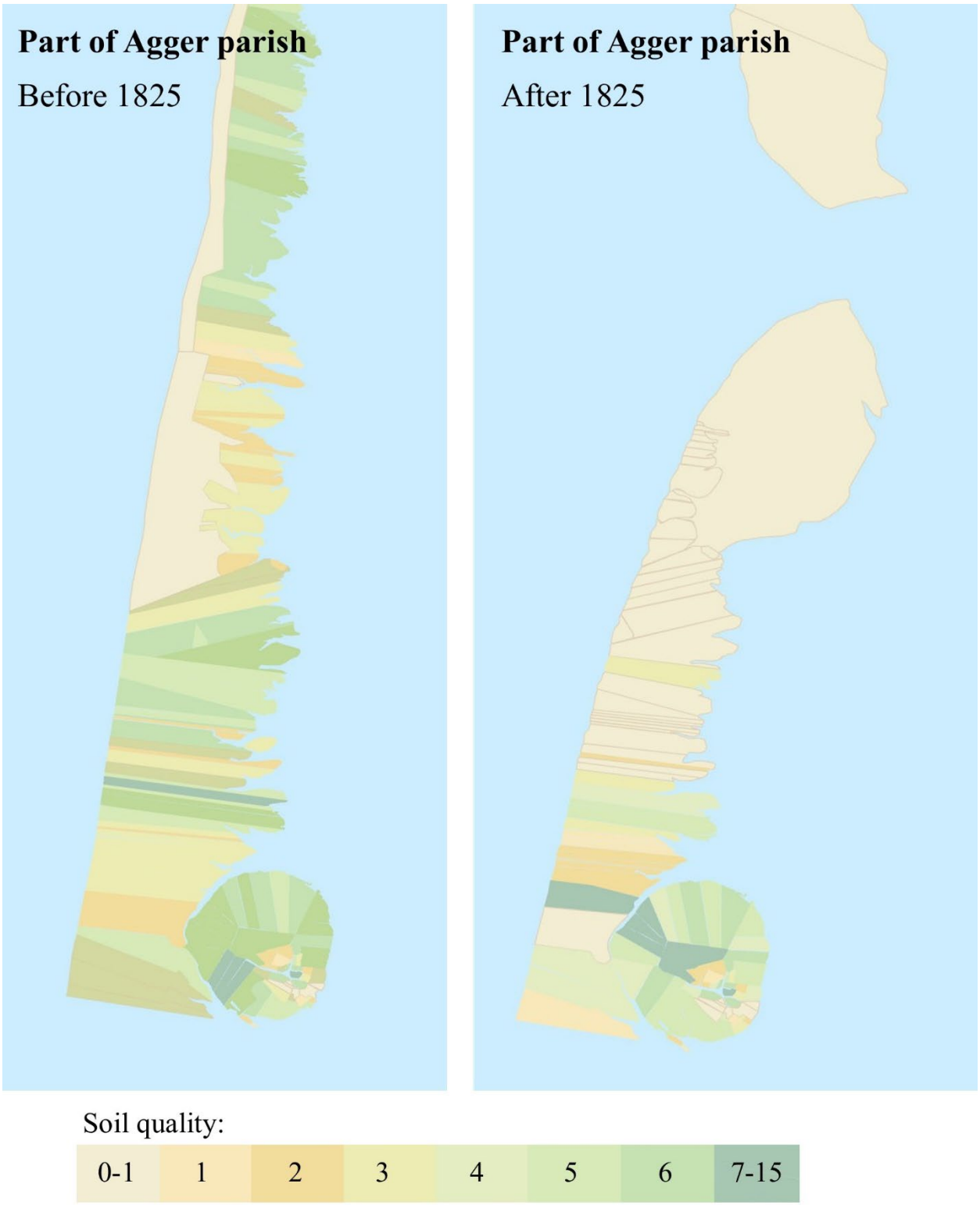
eel in the Limfjorden was in relative decline. This suggests that the fishing conditions for eel were in decline, also before the breach of 1825.

Still, others did take part in the pulse seine fishery in the 19th century, as many different fishermen are present in the database. However, for those families and settlements with the highest representation, there is a significant correlation between a lifelong presence in the migrant pulse seine fishery and the absence of arable soils at home. The pulse seine fishery was integral to these households' coping strategy when living in a region of risk by the sea.

MAPS



Map 1. The four panels of the maps reveals the intensity of each fishing locations in the fjord for fishermen from 1) Agger parish, 2) Harboøre parish, 3) local residents and 4) the total pulse seine fishery, 1761-1841. Lyneborg & Andersen in Andersen, 2023a.



Map 2. The map shows the quality of the soil in Agger parish before and after 1825, where the parish was hit by several storm surges. The range of soil fertility is measured on national scale,

where most farmland in Denmark lay in the area of 25-40. In Agger no soil was more fertile than to score of '15'. Andersen, 2023a; Andersen, 2023b.

TABLES

Year	Number of pulse seine	Total number of crew members	Male population in Agger Parish working in fishery	Participation in the pulse seine fishery
1800	17	68	84	81,0 %
1801	12	48	84	57,1 %
1804	11	44	84	52,4 %
1817	13	52	83	62,7 %
1824	14	56	82	68,3 %
1825	16	64	82	78,0 %
1826	17	68	78	87,2 %

Table 1 shows the percentage of the male population from Agger Parish who participated in pulse seine fishing during selected years where the data set is complete.

Year	Avr. age
1787	48,3
1801	45,9
1834	43
1840	38,4
1845	42,5

Table 2. Average age of fishermen in Agger parish in censuses 1787-1845.

FIGURES

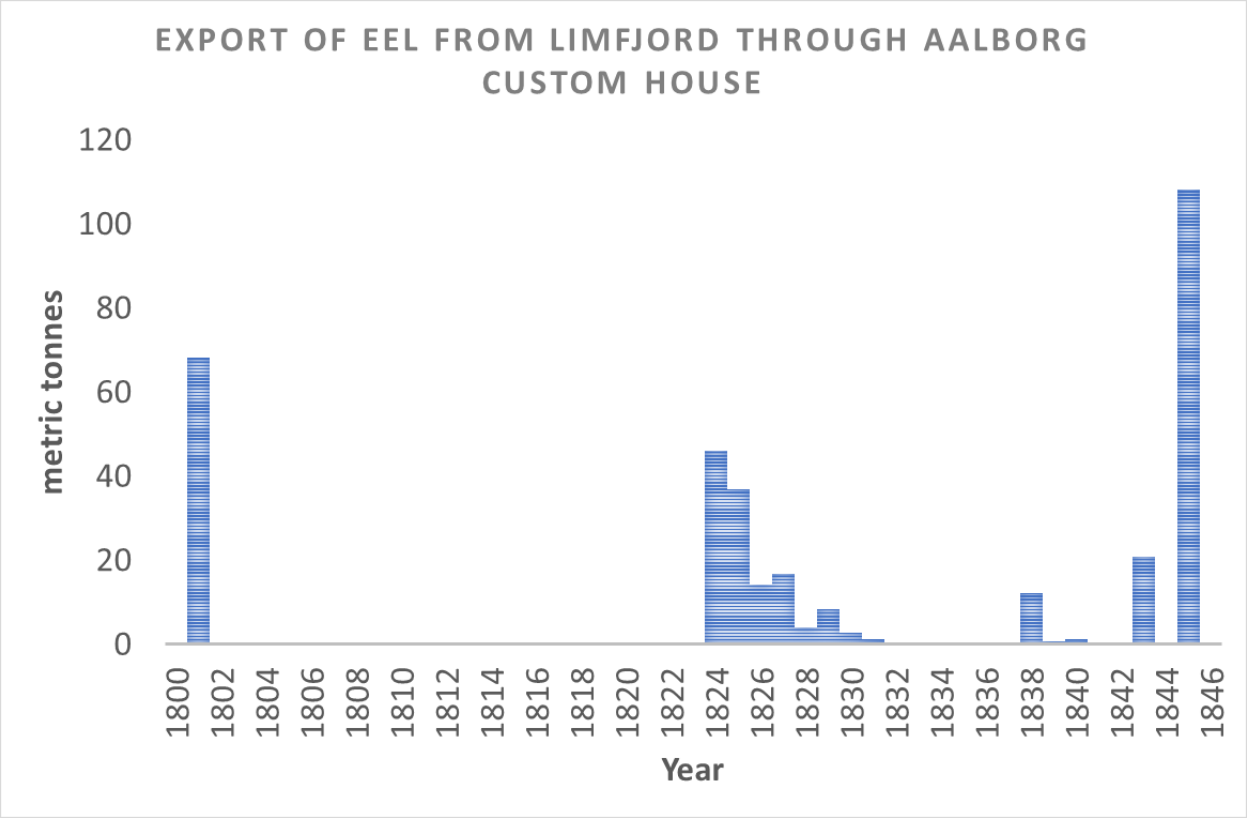


Figure 1 illustrating the years, where data for eel export figures (n: 13) exists for the town of Aalborg.

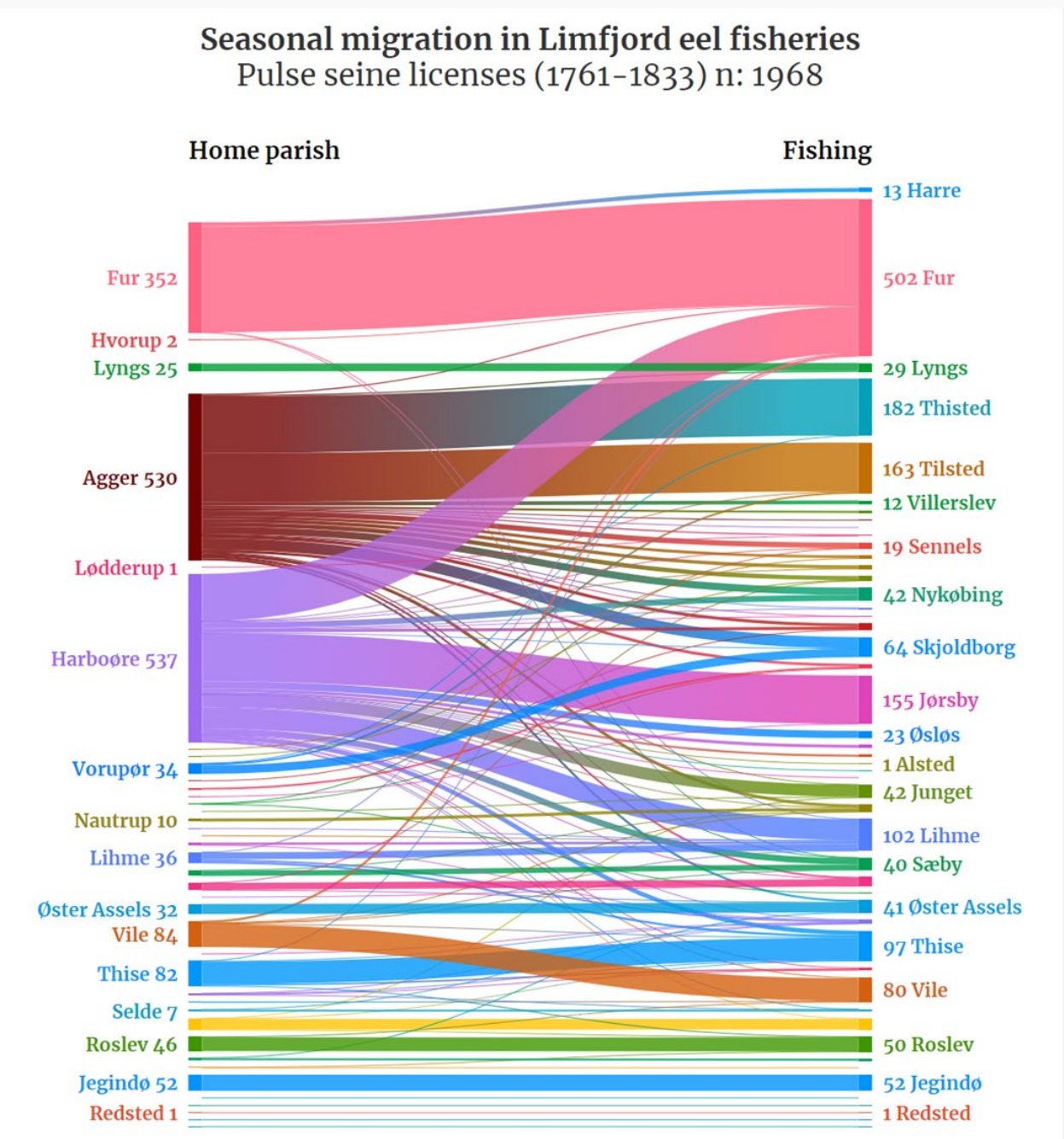


Figure 2. Illustrating the relative and absolute intensity of fishing in one's home parish versus migrants fishing in parishes away from home. The illustration is set up to reduce the number of overlaps. Therefore, it does not reflect for instance geographical distance between the various parishes.

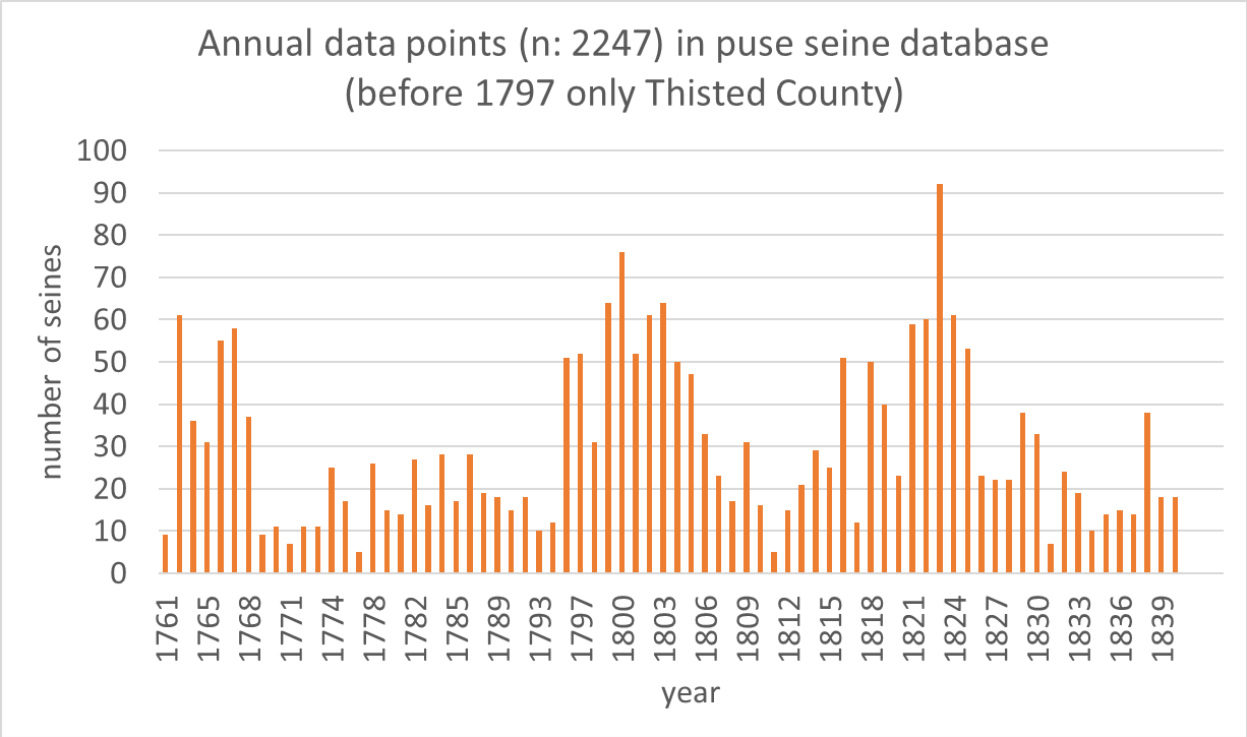


Figure 3. showing the annual number of seines found in the preserved records for Limfjorden covering certificates from 1761-1841. Before 1797, records cover the Thisted County area only.

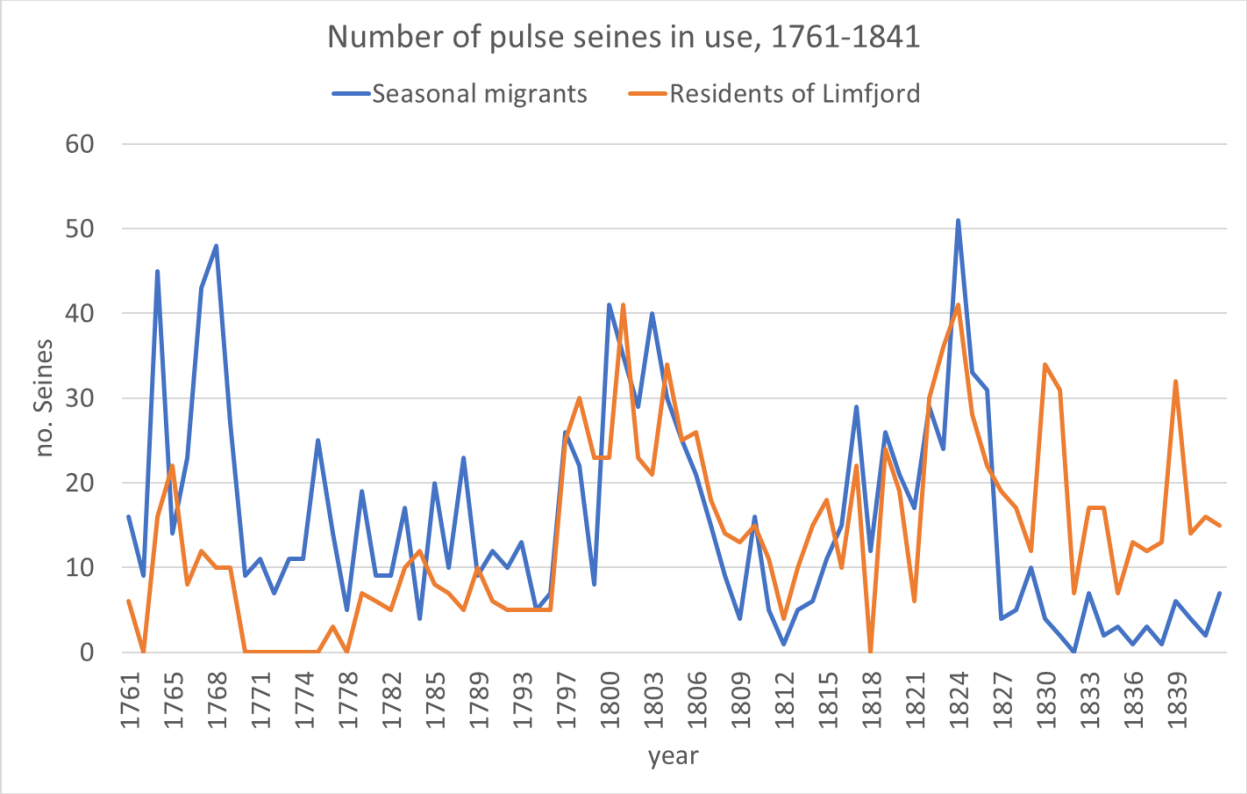


Figure 4. The number of pulse seines registered annually across the Western Limfjorden from 1761-1841.

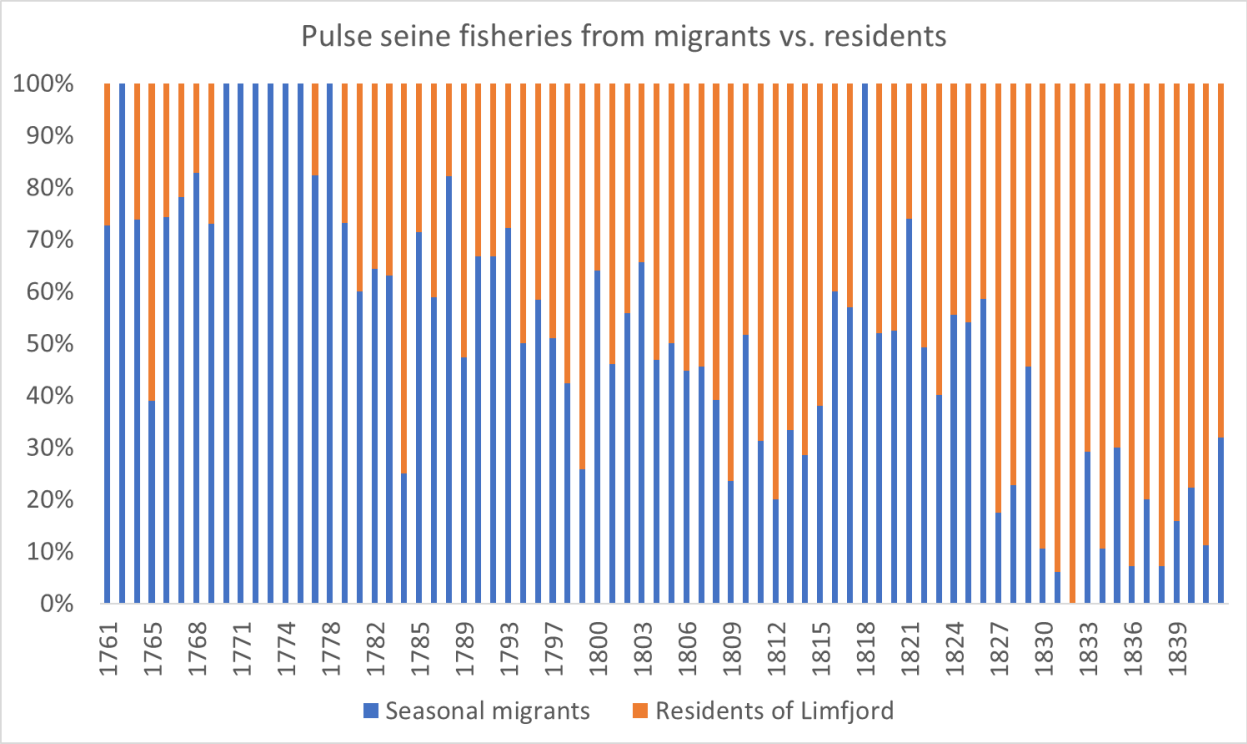
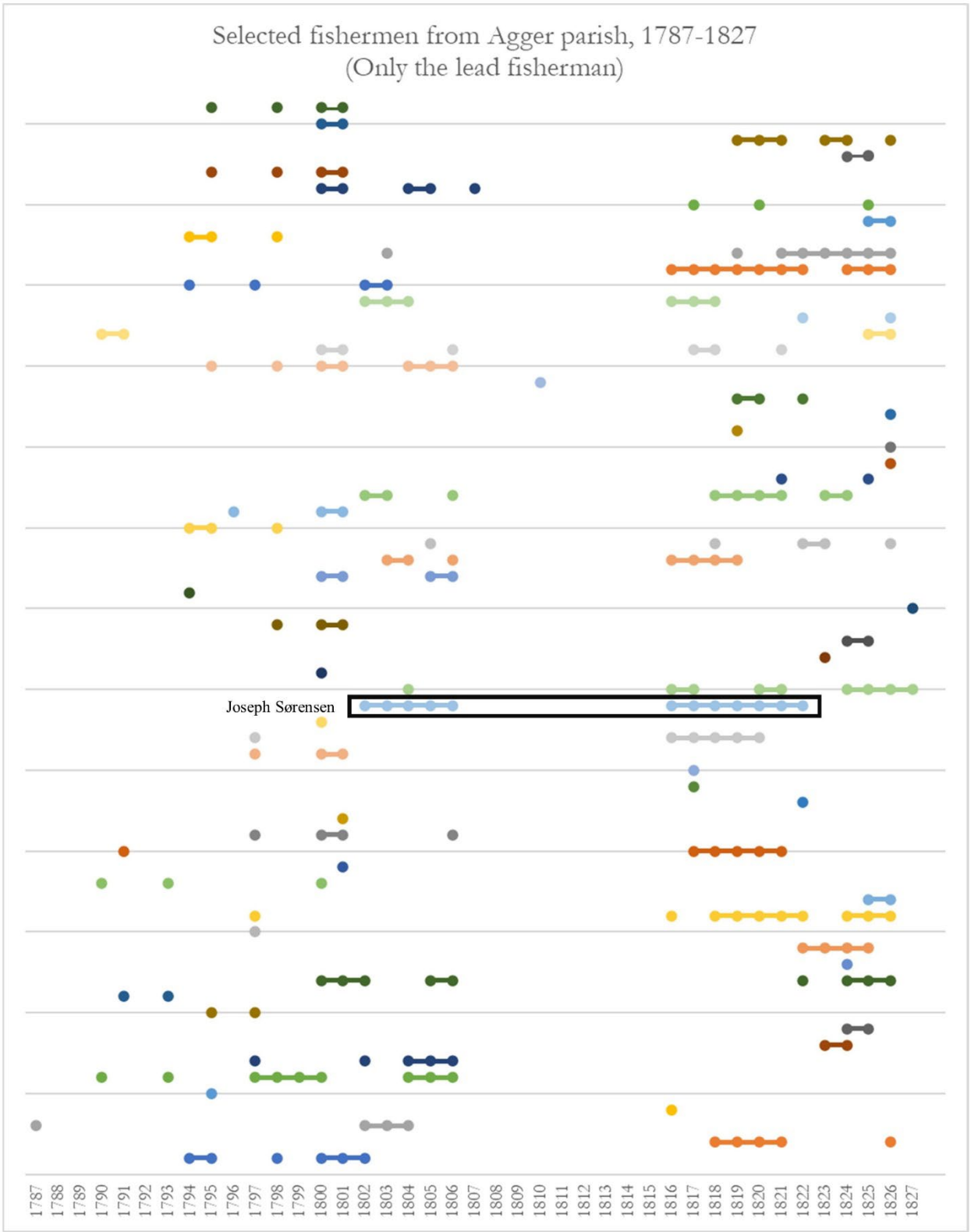


Figure 5. The relative number of pulse seines fished by seasonal migrants from Agger and Harboøre parishes relative to pulse seines fished by residents of the Limfjorden.


Selected fishermen from Agger parish, 1787-1827
(Only the lead fisherman)
Joseph Sørensen
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
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1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827

Figure 6 showing the fishermen most frequently represented in the dataset from Agger Sogn, 1787-1827, including Joseph Sørensen from Sdr. Aalum.

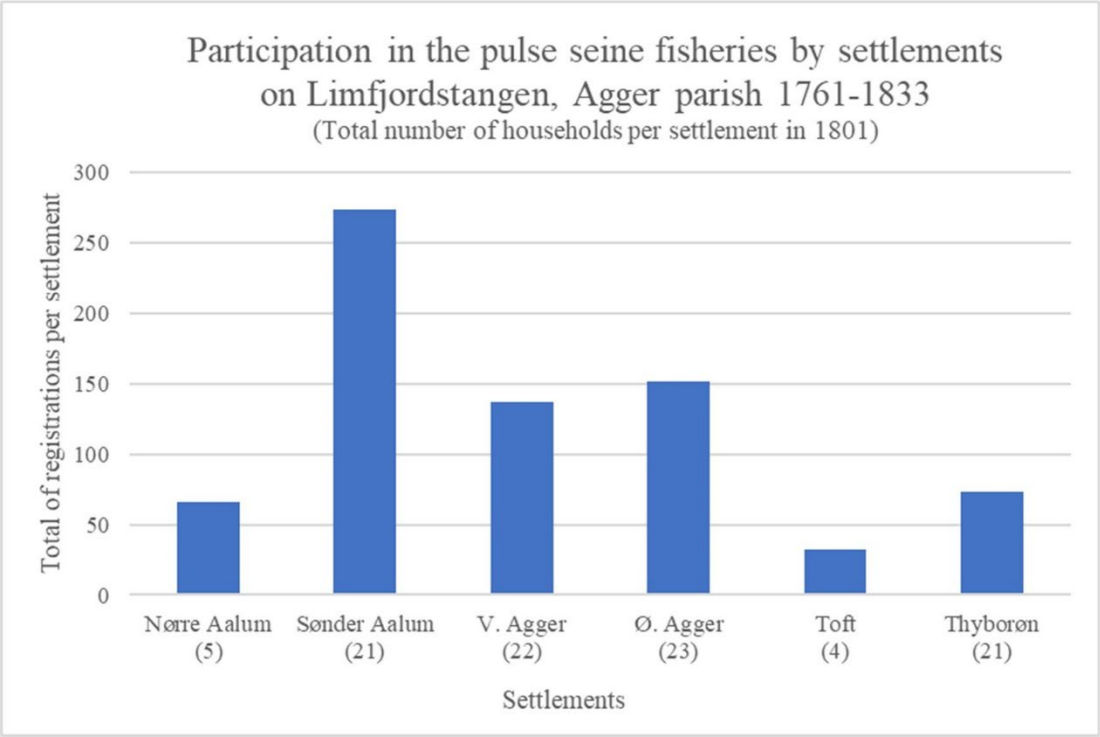

Figure 7 shows the participation in the pulse seine fisheries from each settlement in Agger Parish, 1761-1833.

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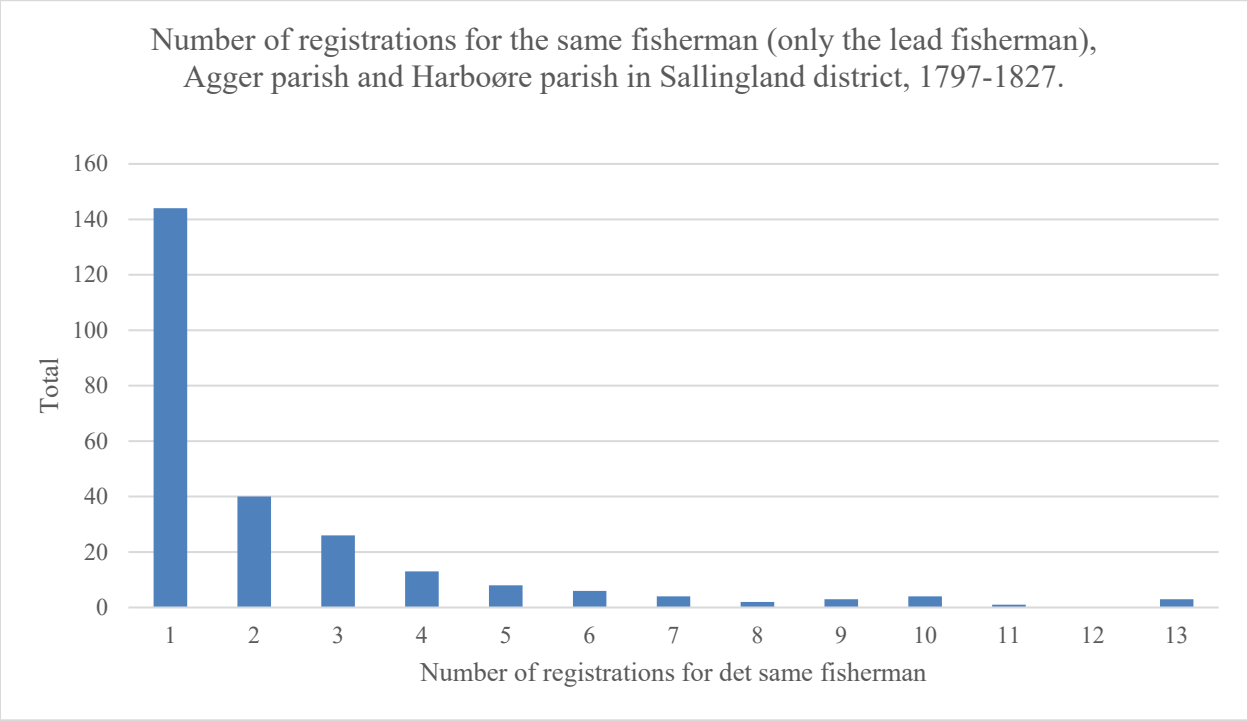

Figure 9 shows the number of registrations in the pulse seine fishery for the same fisherman at Agger and Harboøre parishes from 1797 until 1827.

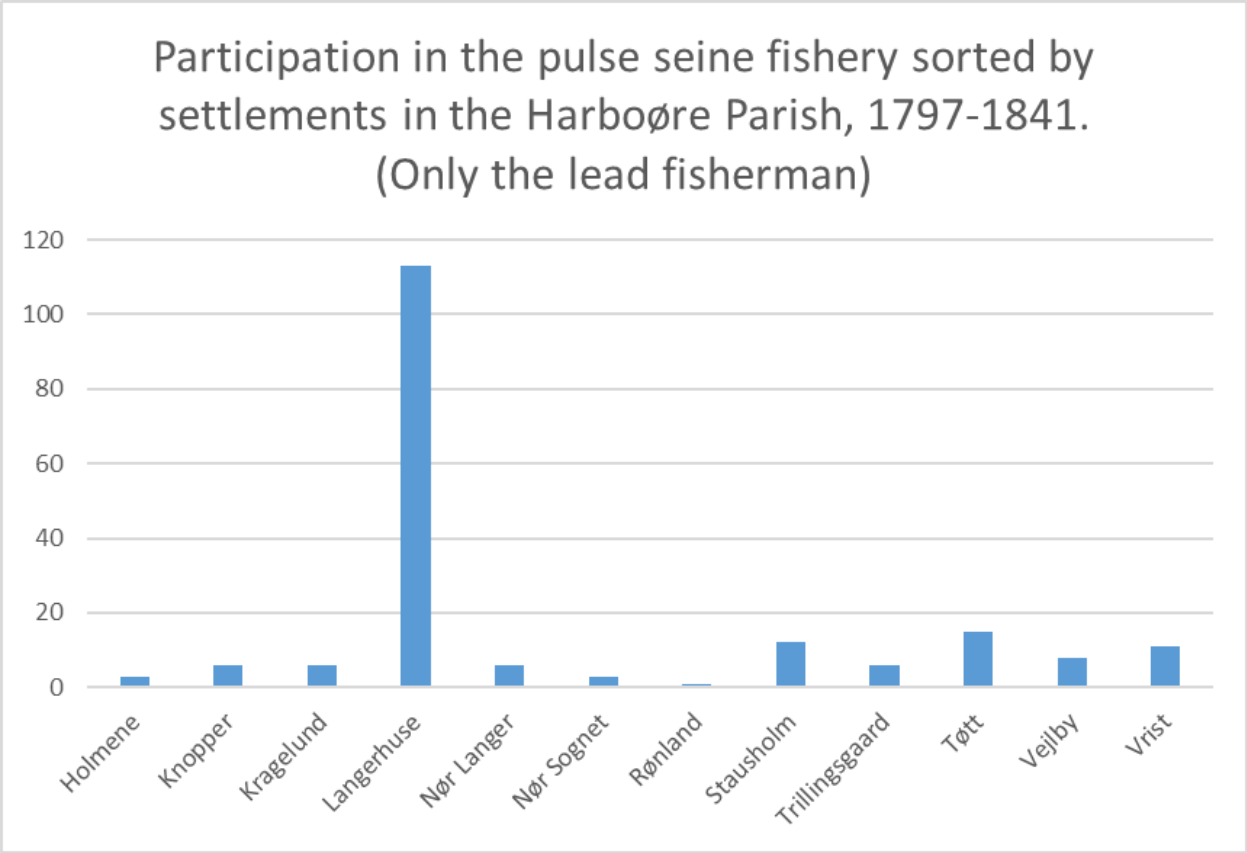

Figure 9 illustrating the participation in the pulse seine fisheries from each settlement in Harboøre Parish, 1797-1841.