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NorwLobster:

Proceedings from a workshop on Norway lobster fisheries in the Nordic countries, held in Copenhagen 13th and 14th of May 2024

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Report Summary
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Title	**NorwLobster: Proceedings from a workshop on Norway lobster fisheries in the Nordic countries, held in Copenhagen 13th and 14th of May 2024**		
Authors	Gunnar Þórðarson and Sigurjón Arason		
Report no.	25-24	Date:	6. September 2024
Project no.	62635		
Funding:	AG fisk (Nordic Council's working group for fisheries cooperation)		
Summary:	There is considerable variation between countries how the species (Nephrops) is caught. Some countries rely largely on creeling (pot fishing) while bottom trawling is the common approach in other regions. Most common in Scandinavia is a combination of both systems, trawling in open sea and deep water, and pot fishing within fjords in shallow water. There are no considerable conflicts between the two groups. There are pros and cons in both trap fishing and trawling for Nephrops. Both methods have some environmental impact, and both affect the Nephrops stock. Both methods need to respond to increased demands on awareness in environmental issues and sustainable fishing. The effects of bottom trawling on potential habitat destruction were discussed. Recent developments in fishing gear technology were introduced and evaluation on future directions explored. Common outcome from the meeting was a need for further research and lack of knowledge on stock assessment and biology. Another outcome was the need for all stakeholders to share information and increase cooperation in the future. Participants agreed on the severity of the black market for Nephromas, and the damage it does for the value chain, and making stock assessment insignificant. Discharging is another important point regarding running an economical sustainable fishery. Homepage: https://norwlobster.com/		
keywords:	*Norway lobster, nephrops norvegicus, pot fishing, creeling, burrows*		

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1 Introduction

Norway lobster (*Nephrops norvegicus*), often referred to as langoustine or Nephrops, is found in the north-eastern Atlantic Ocean and North Sea as far north as Iceland and northern Norway, and south to Portugal. It is found in the Mediterranean Sea and is common in the Adriatic Sea. Due to its ecological demands for particular sediments, Nephrops has a very patchy distribution, and is divided into over 30 populations. These populations are separated by inhospitable terrain, and adults rarely travel distances greater than a few hundred metres. The distribution of Nephrops is shown in figure 1 (FAO, 2024a).

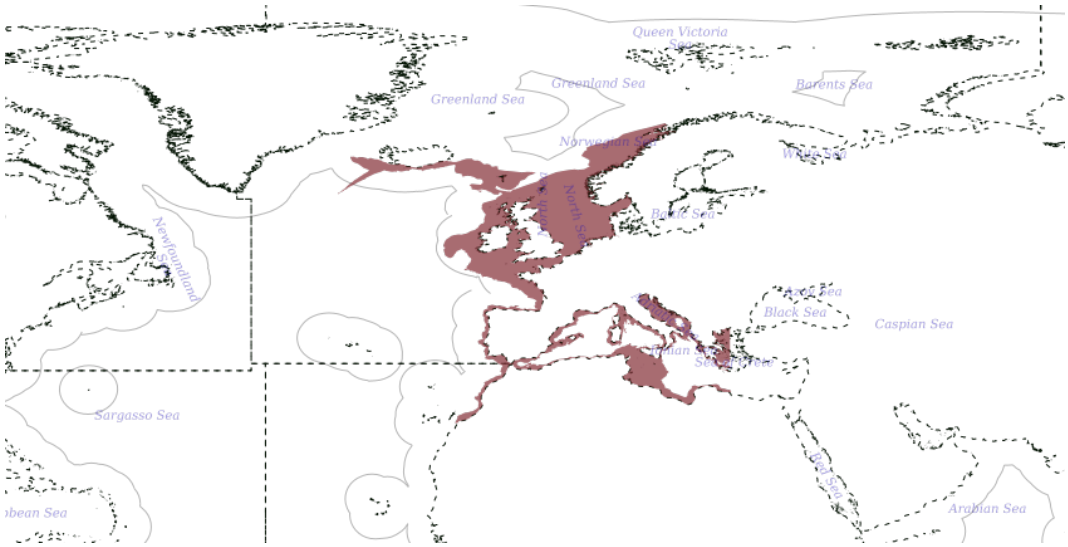

Figure 1: Geographical distribution of Norway lobster (Nephrops norvegicus)

Nephrops fisheries are important for many European coastal regions with annual catches ranging from 40 to 75 thousand tonnes of this extremely valuable species. The fishery peaked in 2007 but has experienced a decline in recent years, as shown in figure 2 (FAO, 2024a).

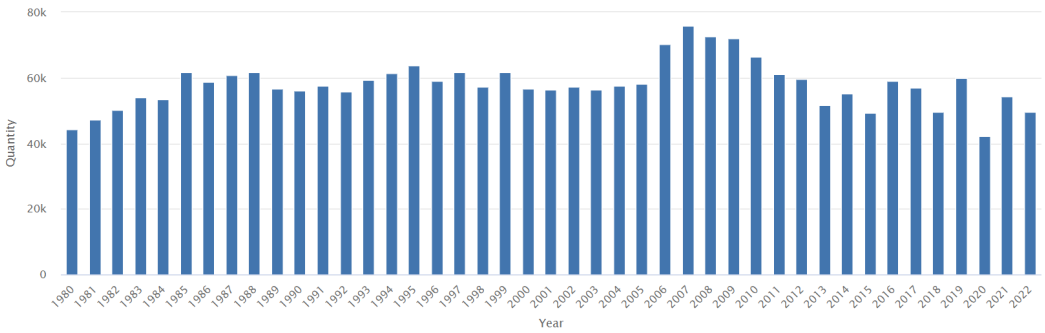

Figure 2: Global catches of Norway lobster (live weight)

In 2022 the UK represented 58% of total landings of Nephrops, followed by Ireland with 13% and Denmark with 10% (FAO, 2024b). The fishery is important for the Nordic countries, at least in certain areas, where the Nephrops industry plays a major role in the livelihood for many fishing communities. The largest impact is in Denmark where the catches have been relatively stable in recent years at

around 4.000 – 6.000 tonnes. The fishery has as well been relatively stable in Sweeden at 1.500 – 1.900 tonnes, and in Norway at around 500 tonnes. The fishery is of lesser importance for the Faroese seafood industry, as the annual catches only amount to 15 – 30 tonnes. The Icelandic fishery has experienced a total collapse in the last decade, from an excess of 2.000-ton annual catches to a total moratorium.

Nephrops fisheries in the Nordic countries are presently experiencing uncertainty with changing climate, acidification, changes in stock size, distribution, development in gear and vessels, regulatory changes such as the implementation of the EU landing obligation, and many more. At the same time there are immense opportunities to nurture the Nordic Nephrops fishery by promoting sustainable management and maximising economic gain through Nordic cooperation and networking. The Nordic Council's working group for fisheries cooperation (AG fisk) is aware of these challenges and opportunities and did therefore fund a research and innovation project to facilitate networking and further cooperation between Nordic researchers, fishermen and other stakeholders. The highlight of the project was a workshop held in Copenhagen 13-14 May 2024 where many key stakeholders shared knowledge and discussed various challenges and opportunities. This report contains an overview of presentations and discussions at the workshop (see https://norwlobster.com/).

Figure 3 - Workshop participants.

2 The workshop

The workshop was held in The Best Western Plus Airport Hotel in Copenhagen on 13th and 14th of May 2024. Twenty-one participated in the workshop, five from Iceland, eight from Norway, three from Sweden and five from Denmark.

The workshop on 13th of May was divided into three main sections:

1. Fishing and production
2. Stock trends, assessment, and management.
3. Fishing gear

Followed by session on the 14th of May, with more scientific approaches. The later session with one to four participants from each country was used to analyse the outcome from the day before and try to answer key questions that were presented in the meeting agenda (meeting agenda).

At the workshop an overview was presented of the development and future direction for fishing gear used by Nephrops fisheries In the Nordic. There is considerable variation how the species is caught within and between countries. Some countries rely largely on creeling (pot fishing – baited traps) while bottom trawling is the common approach in other regions, others have a combination of these methods. The EU Common Fisheries Policy's (CFP) landing obligation has had significant effect on

Nephrops fisheries, as Minimum Conservation Reference Sizes (MCRS) and definitions of “high survival rate” have been heavily debated. The effects of bottom trawling on potential Nephrops habitat destruction were discussed. Recent developments in fishing gear technology were evaluated and future directions explored. The workshop also provided an overview of the current methodology of stock monitoring, as well as stock assessment In the Nordic countries, both for trawling Nephrops and pot fishing.

Lecturers at the workshop were from Denmark, Norway, Iceland, and Sweden. The presenters in the first session; Fishing and Production were:

- Sigurdur Olafsson, Nephrops captain from Iceland.
- Poul Melgaard Jensen, Manager from Denmark, was absent.
- Guldborg Søvik, from Institute of Marine Research, Norway
- Carina Iselin Bruland, Askøykreps (IMR, Norway)
- Peter Ronelöf Olsson, Sveriges Fiskeres Produccentorganisation, SFPO, Sweden.

In session two, Stock Trends, Assessment and Management were:

- Jacob Kasper, Fisheries Ecologist, Marine & Freshwater Research Institute, Iceland.
- Fabian Zimmermann, Institute of Marin Research, Norway
- Kristian Landmark Skaar, fisheries Directorate, Norway
- Jørgan L. S. Hansen, DCE Åarhus Universitet, Denmark
- Andreas Sundelöf, SLU Aqua, Sweden

In session three, Fishing Gear were:

- Haraldur Arnar Einarsson, Fisheries Ecologist, Marine & Freshwater Research Institute, Iceland.
- Svend-Eric Andersen, Formand for Danmarks Fiskeriforening, Denmark
- Tiago Malta, DT Aqua, Denmark
- Kristian Landmark Skaar, Section of environment, the Directorate of Fisheries – Norway
- Jørgen Runehell, Trawl Fisher, Sweden
- Andreas Sundlöf SLU Aqua, Sweden

In session four, Sigurjon Arason, Matis/University of Iceland, told the story about the beginning of fishing Nephrops in Iceland.

In the discussions on the 14th following lecturers gave presentations:

- Guldborg Søvik, from Institute of Marine Research, Norway
- Andreas Sundlöf SLU Aqua, Sweden
- Jacob Kasper, Fisheries Ecologist, Marine & Freshwater Research Institute, Iceland

The agenda for the workshop was as follows:

AG FISK 2024
CONFERENCE PROGRAMME

NORWEGIAN LOBSTER 13-14TH OF MAY 2024

Promoting sustainable management and maximizing economic gain from fisheries of Norway Lobster in the Nordic region

MONDAY THE 13RD OF MAY 2024

08:30 – 9:00 OPENING

Opening words
08:30, Gunnar Thordarson, Cairperson, Matís
08:40 Nephrops fisheries: Nordic and European perspectives Sigurjon Arason

09:00 – 10:30 SESSION 1 – FISHING AND PRODUCTION

Representatives from each country presents results and trends for the fisheries in their respective country.

Questions to be addressed and discussed:

1. Should lobster fishing be conducted all year or is it necessary to rest the fishing grounds for part of the year?
2. How has the development been in fishing technology and its effect on the fishing areas?
3. What are stakeholders concerns and perceived risks?
4. Fishermen's general opinion on stock assessment and their experience.
5. What are the opinions of fishermen to MCRS (Minimum Conservation Reference Size)
6. What is fisherman's opinion on fishing gear, trawl vs. pots.

09:00 Sigurdur Olafsson, captain (Iceland)
09:20 Poul Melgaard Jensen, Direktør (Denmark)
09:40 Guldborg Søvik, Institute of Marine Research and Carina Iselin Bruland, Askøykreps (IMR, Norway)
10:00 Peter Ronelöv Olsson, Sveriges Fiskares Producentorganisation, SFPO, (Sweden)
10:20 Discussions

10:30 – 11:00 Coffee break

11:00 – 12:30 SESSION 2 – STOCK TRENDS, ASSESSMENT AND MANAGEMENT

Representatives from each country presents results and trends for the stocks in their respective country.

Questions to be addressed and discussed:

1. The trends of the managed stock units within the Nordic countries will be discussed.
2. Comparison of potential factors that contributed to the recruitment collapse within the Nephrops population in Icelandic fisheries.
3. Discussion about the possible and complex interaction of environmental, biological, and human influences.
4. How is stock assessment worked out in each country?

Nordic Co-operation

5. Comparison of methodologies for assessing Nephrops population size, such as trawl swept area, underwater television (UWTV), and other approaches, delineating their respective strengths and weaknesses.
6. The CFP landing obligation has had significant effect on Nephrops fisheries, as Minimum Conservation Reference Sizes (MCRS) and definitions of "high survival rate" have been heavily debated.
7. Does ocean acidification affect the Nephrops stocks?
   Threats and challenges due to climate change and resilience of the different stocks will be addressed

ADDRESS

11:00 Jacob Kasper, *Fisheries Ecologist/Marine & Freshwater Research Institute* (Iceland)
11:20 Fabian Zimmermann, Institute of Marine Research and Kristian Landmark Skaar, Fisheries Directorate (Norway)
11:40 Jørgen L S Hansen, DCE Århus Universitet (Denmark)
12:00 Karin Kataria (Swedish Agency for Marine and Water Management) (Sweeden)
12:20 Andreas Sundelöf, SLU Aqua (Sweden)
1240 Discussions

13:00 – 14:00 Lunch break

14:00 – 15:00 SESSION 3 – FISHING GEAR

Representatives from each country presents results and trends for the fisheries in their respective country.

1. Recent developments in fishing gear technology will be evaluated and future directions explored.
2. Is trawling damaging the Nephrops habitat?
3. Is it realistic to ban trawling and use only pots to catch Nephrops for commercial fishing and production?
4. Mix of trawling and pots?
5. Big boats and heavy gear? Is it profitable?

ADDRESS

13:30 Haraldur Arnar Einarsson, Marine & Freshwater Research Institute (Iceland)
13:50 Svend-Erik Andersen, Formand for Danmarks Fiskeriforening (Denmark)
14:10 Tiago Malta, DTU Aqua (Denmark)
14:30 Kristian Landmark Skaar, Fisheries Directorate and Jørgen Runehell, trawl fisher (Sweden)
14:50 Andreas Sundelöf SLU Aqua (Sweden)

STORIES FROM HÖFN Í HORNAFIRÐI

Sigurjón Arason, Matís/University of Iceland

15:30 – 16:00 DISCISSOONS AND CLOSING REMARKS

TUESDAY THE 14TH OF MAY 2024

09:00 – 12:00 SESSION: MANAGEMENT OF STOCK UNITIS WITHIN THE NORDIC COUNTRIES

09:00 Sum up from yesterday meeting
09:20 Guldborg Søvik, Institute of Marine Research and Carina Iselin Bruland, Askøykreps (IMR, Norway)
09:40 Kai Ulrich Wieland (Denmark)
10:00 Andreas Sundelöf, SLU Aqua (Sweden)
10:20 Jacob Kasper, *Fisheries Ecologist/Marine & Freshwater Research Institute* (Iceland)
10:40 Round up

3 Opening

Gunnar Thordarson from Matis in Iceland opened the workshop by welcoming the participants on behalf of Matís as project leader and AG fisk as funding body. He expressed his appreciation for the dedication and contributions from the workshop attendees, and excitement for the agenda. The attendees were a wide group of individuals with broad knowledge and experience, and good results can be expected from the meeting.

3.1 Nephrops fisheries: Nordic and European perspective

Sigurjón Arason is a senior researcher at Matís, professor emeritus at University of Iceland, presented the Nephrops fisheries and markets, with Nordic and European perspective. He introduced the global catching of Nephrops, from 1950 until 2015, see Figure 4.

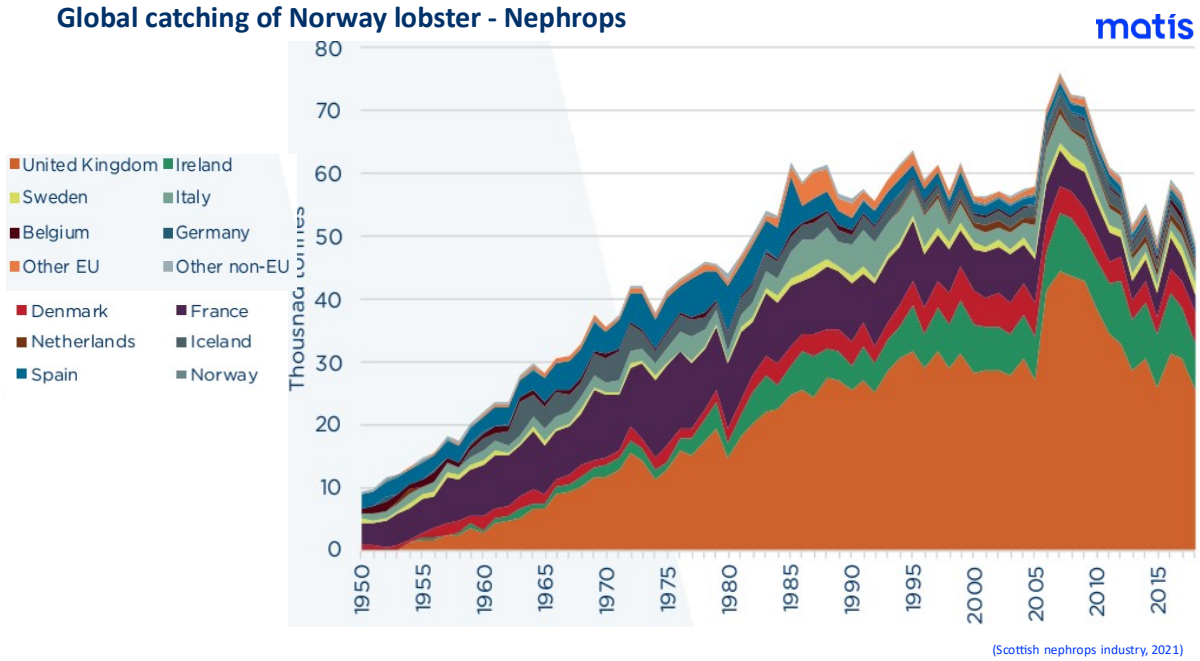

Figure 4 Global catching of Norway lobster - Nephrops from 1950 - 2015

4 Fishing and Production

In this session experts on fishing and production discussed opportunities and challenges in Nephrops fishing in the four countries. Trying to highlight their focus on fishing and the effects of fisheries management and regulation by governments. Also, their views on different fishing gears and types of fishing. The following questions were used to frame in the subject of the session:

- Should Nephrops fishing be conducted all year or is it necessary to rest the fishing grounds for part of the year?
- How has the development been in fishing technology and its effect on the fishing areas?
- What are stakeholders concerns and perceived risks?
- Fishermen's general opinion on stock assessment and their experience.
- What are the opinions of fishermen to MCRS (Minimum Conservation Reference Size)
- What are the opinions of fishermen on fishing gear, trawl vs. pot fishing?

Sigurdur Olafson, veteran captain and boat owner from Iceland started the session to introduce the Nephrops industry in Iceland. The Icelandic fisheries is only by trawling. The fishing started in the 1950's, with small boats with small engines and light trawling gears, fishing around 20 gross tons. From 60's to the 90's the boats got bigger, around 100-200 Gt, with larger fishing gear and trawling door around 250 kg. But still the trawl was the size that it was ingested by a force. After 1990 the Nephrops business got more commercialised with larger stern trawlers towing two trawls at the time resulting in fewer fishing vessels with increased productivity and more value creation within the Nephrops business.

There are captains believing that the stock started to decline after this development, but fishing has been banned in Iceland for three years because of the crash in the Nephrops stock.

To pull two trawls there is a need for high towing power to square two trawls, heavy doors of up to two tones each, spiralling up large quantities of mud and affecting the Nephrops' habitat. The Nephrops live in holes (burrows), and such a large intervention could destroy their habitats, believe some captains. The old school captains also believe the new technology, GPS, echosounders etc, have also had a large influence on the stock, leaving no options for the Nephrops to escape the fisheries.

Figure 5 Fishing onboard Sigurdur Olafsson SF 44

The decline of the Nephrops stock in Iceland started around 2010 (Marine & Freshwater Research Intitute , 2024), just after this development, and have been devastating since with almost a crash in ten years' time! For a long time, the Nephrops season in Iceland was only three months from late May to August at the same time as the summer vacation of the teens from school. The season increases from three months to eight in short period of time!

From 2008, powerful stern trawlers have been in use, fully equipped using two large trawls and some heavy load between the doors to keep the gear at the bottom, independent of weather conditions. The main Nephrops fishing grounds in Iceland are on the Southwest, South and the Southeast coast.

These captains believe in natural causes for the stock decline, but also believe it could be human intervention. Though being supporters of Marine & Freshwater Research Institute (MRFI) science and the use of Under Water TV (*UWTV) surveys for stock assessment, It Is their opinion that this such a survey should have been done before the fishing ban.*

Figure 6 Codend full of lobster on Sigurdur Olafsson SF 44

Guldborg Søvik from Institute of Marine Research in Norway and Carina Iselin Bruland, a Nephron captain in Norway explained the business in their country.

In Norway Nephrops is caught by pots and trawl, without much conflict between the two fishing methods. Pots are used mainly within fjords while Nephrops trawling is restricted to deeper water and offshore areas. There are more conflicts between pot fishing and shrimp fishing, especially due to a large increase in recreational pot fishing. Nephrops fishing in Norway is considered small business, with little attention from government and small funding for research. Total landings in the past years have been around 500–600 tonnes following a substantial increase during the last decade, mainly driven by increases in landings in Mid-Norway from pot fishing.

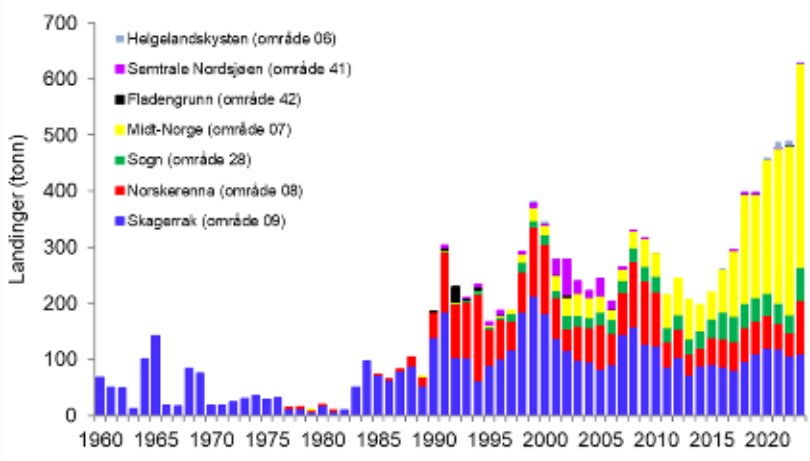

Figure 7 Landings of Nephrops in Norway, divided to areas.

Nephrops fishing in Skagerrak is done by trawl and pots, in Norwegian Deep by trawls offshore and pots inshore, and by pots along the coast and in fjords further north. Nephrops fishing by pots is done by smaller vessels during the whole year. There is no limit on the number of pots for commercial fishers, while recreational fishers have a limit of 20 pots per person. The fishermen are required to check their gear at least once a week and usually bring the Nephrops alive to shore. Nephrops landed with pots tend to be of better quality and fetch higher prices than those caught with trawls, as they can be exported alive to countries like Spain. The pot fishery consists of small boats (mostly <12m) with a crew of one or two per boat, and though the pots are lifted by hydraulic winch, there is considerable manual labour needed on board.

Figure 8 Nephrops pot fishing vessel.

Around 350 boats are fishing more than 100 kg of Nephrops annually, around 75 of these are trawlers (mostly bycatch fishery from boats that trawl for shrimp or fish) and the rest are fishing by pots. A directed trawl fishery for Nephrops (mesh size 70–90 mm mesh size in cod-end) is only found in southern Norway, in Skagerrak.

Peter Rondelöv Olsen from Sveriges Fiskeres Productntorganisation (SFPO) went through the story and situation in Swedish Nephrops industry. The Swedish have a long history of fishing Nephrops. It is caught by trawls and pots, and for pots fishermen this is kind of way of life business. The best time for fishing Nephrops is by night, especially the last week before the full moon. Around 100 boats are trawling for Nephrops and 100 fishing in pots.

Only half of the MSY trawling quotas are caught, and the main reason is the problem with by-catch, especially cod, which is forbidden to fish in many fishing areas. Grids are common to use to push the larger fish out of the gear to prevent by-catch.

Figure 9 Fishing gear for Nephrops with grid and opening for bycatch.

The Swedish fishermen were surprised by the scale of fishing in Iceland, using large vessels with gigantic gears, with high oil consumption and cost. In their calculation the oil must be free of charge to make value out of such fishing.

Fishing in trawl and pots goes well together and both gears are necessary in the Nephrops fisheries. There are no conflicts between the two methods.

5 Stock Trends, Assessment and Management

In this session experts in stock trends, assessment and management discussed their view on biological and human influence on the Nephrops stock in the four countries. Comprising the different methodologies in the Nordic and how this assessment worked out in each country. Wat seam to be working well and what must be done differently and were resources are needed in research and development. The following questions were used to focus on the session subjects:

- The trends of the managed stock units within the Nordic countries will be discussed.
- Comparison of potential factors that contributed to the recruitment collapse within the Nephrops population in Icelandic fisheries.
- Discussion about the possible and complex interaction of environmental, biological, and human influences.

- How is stock assessment worked out in each country?
- Comparison of methodologies for assessing Nephrops population size, such as trawl swept area, underwater television (UWTV), and other approaches, delineating their respective strengths and weaknesses.
- The CFP landing obligation has had significant effect on Nephrops fisheries, as Minimum Conservation Reference Sizes (MCRS) and definitions of “high survival rate” have been heavily debated.
- Threats and challenges due to climate change and resilience of the different stocks will be addressed.
- Minimum Conservation Reference Sizes.
- Does ocean acidification affect the Nephrops stocks?

The Danes and Swedish have had cooperation in their ICES survey protocols, using UWTV surveys for stock assessment. Areas identified through combination of fishing activity and substrate information, with approximately 200 stations sampled per year (in spring), counting according to protocol. It Is coordinated under ICES Working Group on Norwegian Nephrops surveys (WGNEPS). This method of using burrow counting is based on the theory that one Nephrops is in each burrow. The estimate is that discard survival rate (used to calculate total number of dead removals) is 25%.

SLU Aqua in Sweden are using UWTV – abundance (Survey) for stock assessment and are using sustainable harvest rate 7.9%. Trawling survey Is also used measuring individual weights – average (onboard sampling raised to total catch) and discard survival (used to calculate total number of dead removals) 25%.

In Norway functional unit» vs. biological stock vs. population Is used, with small stock units based on fleet structure, bottom habitat while genetics show little to no difference.

Fabian Zimmermann from Institute of Marine Research explained the system of Nephrons fishing in Sweden have been developing and where it stands today.

There has been continuous decrease in the number of vessels in the Swedish commercial fishing fleet. The number of vessels decreased from 1377 vessels in 2013 to 937 vessels in 2023. Anyone who wants to fish professionally and sell their catch needs a fishing license and fishing permits. In addition to fishing license, certain fishing permits are necessary when fishing for example pelagic species, cod, shrimp and nephrops (separate permits for trawl and pots).

Fishing methods in the Swedish nephrops fishery include trawl, trawl with grid and pots. Sweden has relatively small shares of TAC for cod and other demersal fish quotas, as compared to nephrops. A relatively high degree of selective fishing methods/gears is therefore necessary in the Swedish nephrops fishery. Around 110 vessels have a permit for fishing Nephrops with trawl, of which around 27 must use grid. It is common to combine Nephrops fisheries with northern prawn fisheries i.e. start the Nephrops fisheries after northern prawn. Around 100 vessels have a fishing permit for Nephrops with pots.

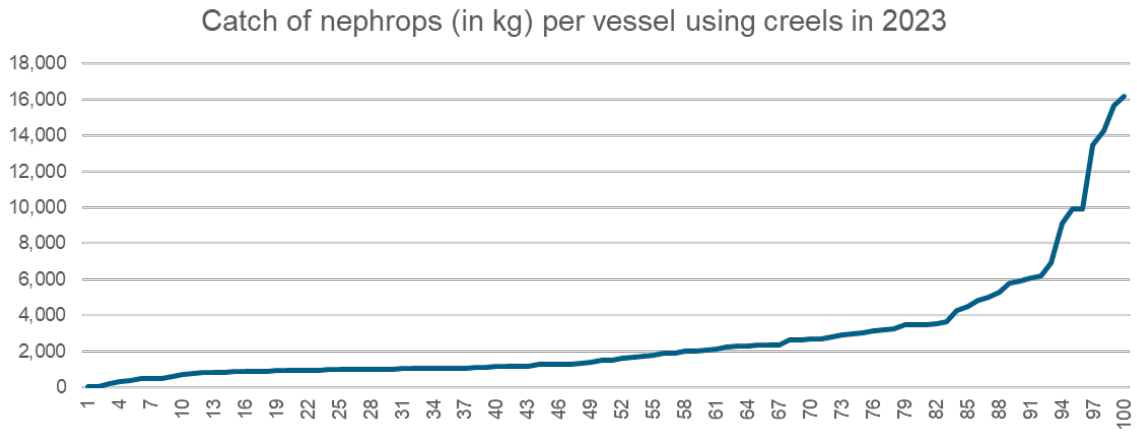

Figure 10 Catch of Nephrops Kg/pr vessel using pots in 2023

Average vessel length is around 9,5 meters and minimum catching need to be at least 800 kg. annually to get renewed permit.

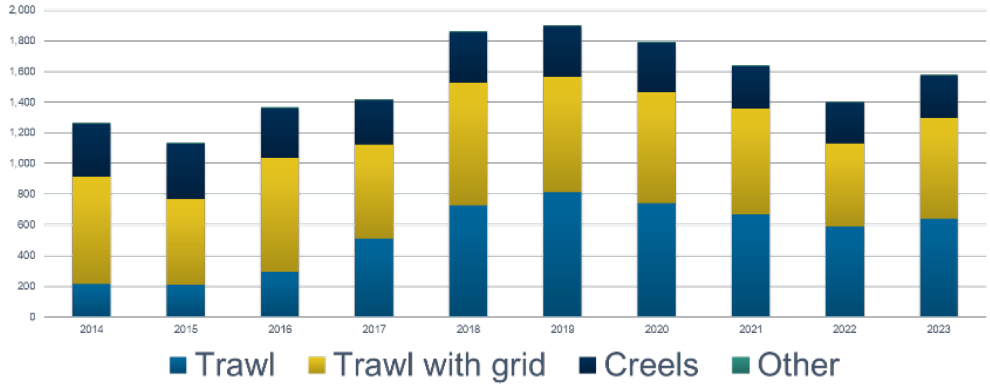

Figure 11 Catches of Nephrops per gear type in 2023

The Swedish are only catching around 50% of the Nephrops quota, mainly because of bycatch, especially because of cod fishing ban.

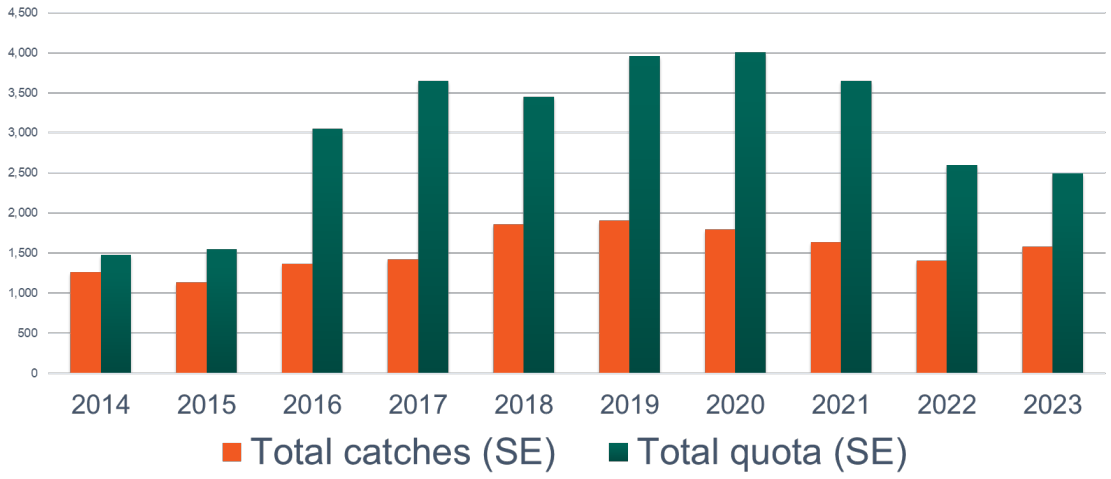

Figure 12 SE Nephrops quota and total catches (thousand kg)

Before 2017 there were catch limits not compatible with the landing obligation. Nephrops quota was divided between gear groups: pots (around 30% of quota), trawl with grid (around 45% of quota) and trawl without grid (around 25% of quota). EU effort regime played a crucial role for fishing effort with trawl without grid.

From 1971 a system of annual individual fishing opportunities was introduced, aimed to facilitate for fishermen and give fishermen opportunity to transfer quotas to be able to comply with the LO-compliance challenge. The EU effort regime was simultaneously abolished and individual transferable quotas with certain limitations. This would give fishermen the opportunity to plan the fishing throughout the year. Expectations of a future ITQ-system. Changes in relative fishing effort with different gears was observed after 2017 and also affected by the simultaneous abolishment of the EU-effort regulations.

SwAM (Swedish Agency for Marine and Water Management) has proposed that an ITQ-system (Individual Transferable Quotas) should be introduced in the Swedish demersal fisheries, including the nephrops fishery (both pots and trawl).

In consultation with the producer organisations, a design of such a system has recently been proposed. No legal mandate to implement the system, waiting for response on the proposal.

The agency believes that such a system can contribute to a simpler and more transparent allocation system with better possibilities for more profitable fishing.

Fishing rights for Nephrops may not be transferred from fishermen fishing with creel to fishermen fishing with trawl. Fishing opportunities may however be transferred between the creel and trawl segments after a certain date (decided annually, and only annual transfers – no transfer of fishing rights). Aims to facilitate efficient quota utilization. New rules about “a minimum required level of quota” in order to use a certain trawl gear. This means that, for a fisherman to use trawl without grid, certain minimum quantities of the different bycatch quotas will be required. The possibility to apply for “new establishment” without having to buy fishing rights to retain the right for fishing licence there

is a minimum catch of 100 kg a year for pot fishing. Some fishermen set their pots just to retain this right and stop then fishing.

Kristian Landmark Skaar from Fisheries Directorate in Norway explained the management of Nephrops fisheries in Norway. The challenges and opportunity facing the industry there.

For management of Nephrops in Norway there are few regulations in general to limit the outtake or the effort in the fishery. Directorate of Fisheries "keep an eye" on the stock and periodically assess whether there is a need to introduce regulations.

There are some challenges from a quota management perspective in Norway regarding Nephrops quota utilization, with mixed fishery, unbalanced quotas, and discard incentives. Possible to combine high quota utilization and compliance of the landing obligation.

Figure 13 Fishing grounds for Nephrops in Skagerrak

For nephrops fishery with pots there are overall advantages from the management perspective, such as the relatively low share of bycatches and how to handle the claimed “lack of space” issue. There are a generalisation renewal of fishermen needed in the nephrops fishing in Norway.

There are few regulations to limit the outtake or the effort for Nephrops fishery in Norway fisheries management. In general, they "keep an eye" on the stock and periodically assess whether there is a need to introduce regulations. Minimum size of 13 cm (TL) (MCRS). Trawling is commercial fishing, but fishing by pots can also be recreational fishing. Trawling is in Skagerrak, but pot fishing is mostly on the West coast inside fjords and in shallower water. There is not much conflict between the two fishing methods, but more between pot fishing and shrimp fishing.

Trawl fishing is only allowed with 120 mm mesh size in direct fishery, except in Skagerrak, where it is with 70 mm with sorting grid or 90 mm with SELTRA-panel. Bycatch in shrimp fishery – allowed with a gap of maximum 15 cm in the sorting grid to retain Nephrops.

Jacop Kasper, a fisheries ecologist from Marine and Freshwater Institute of Iceland (MFRI) explained the fisheries management in his country.

Nephrops is the only species in Icelandic waters. It Is the most common species in the Atlantic Ocean, living for up to 25 years. The sexually dimorphic is 7-8 cm for males, and 5-6 cm for females. It spawns once every two years in Iceland (biennial), but the norm is every year in warmer waters.

Fishing grounds are in the southeast to the southwest of Iceland, with historically less than 50 boats fishing, but much fewer recently, around nine vessels.

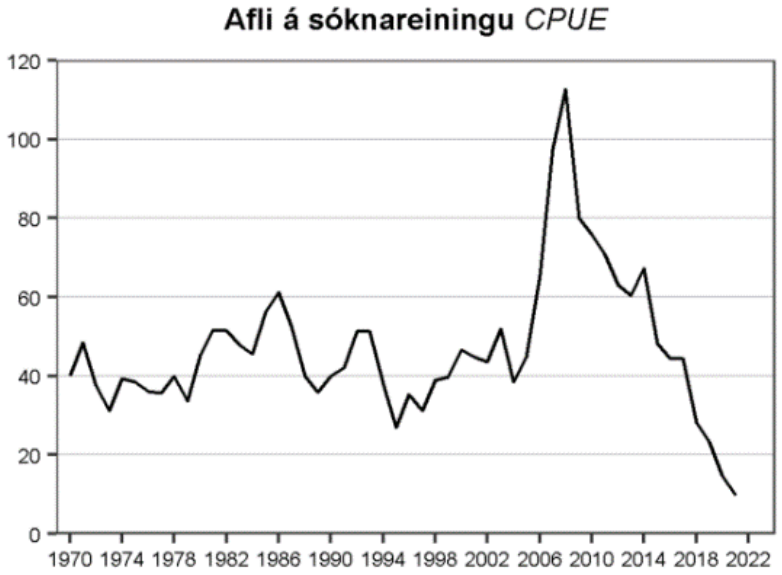

Figure 14 Catch per unit effort (CPU)

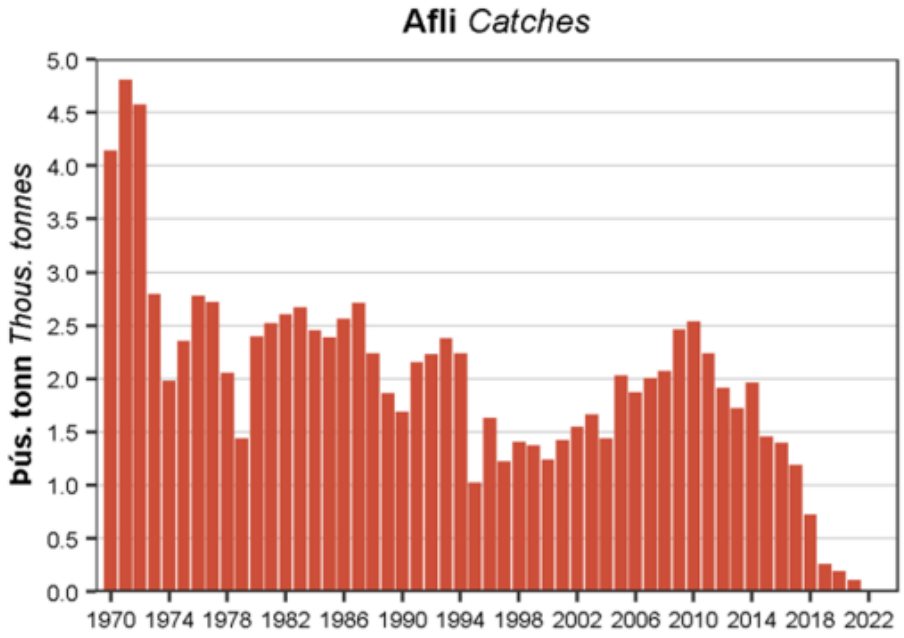

Figure 15 Nephrops catching in Iceland.

Fisheries have been closed since 2022 after periods of low recruitment. Before the closure the catches where down and the catch per unit effort (CPUE) decreased. The changes were in all areas, from southwest, Westman islands and to the southeast.

It looks like low recruitment when looking at length surveys of animals, a shift in the length frequency larger ones and very few small ones. Overfishing would not cause this to happened, so scientists at MFRI believe this is caused by some natural causes.

There are diurnal large fluctuations in Nephrops catching, but also in in other systems. For more information the behaviour of Nephrops was monitored with acoustic tags (al., 2015) showing that catch surveys are not reliable for abundance measurements.

Experiments carried out on RV Bjarni Sæmundsson in autumn 2020.

Trawl surveys do not provide a reliable index on which to base the assessment, but UWTV can give more information, but with the “One animal per burrow" assumption (Farmer, 1971).

Figure 16 Nephrops in burrow.

Burrow density have been increasing in Southeast Iceland and estimated density increased after moratorium, but no UWTV surveys were performed in 2022 and 2024. There is a need for further research in burrow counting method, started in Iceland in 2016, and many questions to be answered, such as does burrow density differ among fishing grounds, and what if burrow increase is due to lack of disturbance and not increase in abundance?

Moratorium extended for two more years while burrow density increased, recruitment has not responded or very little. A new length survey starts in Iceland late May 2024.

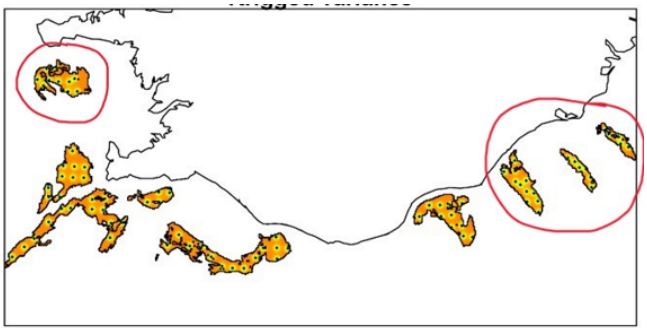

Figure 17 Fishing grounds for Nephrops in Iceland, the red circles are area closed in 2019 (Marine & Freshwater Research Intitute , 2024).

In figure 13 is a map of fishing grounds of Nephrops in Iceland marked in yellow. The easternmost and the westernmost zone was closed in 2019 as first action to protect the Nephrops. In 2022, after Nephrops fishing was banned, the closure was increased and since then all trawling has been banned in the four Nephrops fishing areas that are inside the red circles. There are three areas in the east, Lóndypi, Hornafjarðurdypi and Breiðamerkurdypi and then Jökuldypi in the west, those areas are included in the red circles.

Today a regulation (regulation No. 186/2020 (Food, 2024)) that prohibits all trawling in these areas in the east, that is within the red circles, and is valid until 15th of March 2026. The other areas, which are also Nephrops fishing areas, are open to general trawling. There was criticism on why the conservation was not spread more, for example every other yellow zone (ca 11 yellow zones) for the whole of the south rather than closing the easternmost three but no conservation elsewhere.

6 Fishing Gear

Experts on fishing gears explained the development of gear for Nephrops fishing in the four countries. Discussed the two main techniques of catching, trawling and pot fishing. Whether one method is better or worse, or both methods were valid. Following questions were used to focus on the session subjects:

- *Recent developments in fishing gear technology will be evaluated, and future directions explored*. The development of gear used in the nephrops fishery has significant potential for a large improvement. However, progress requires time, funding, and industry cooperation.
- *Is trawling damaging the Nephrops habitat*?
- Yes, all bottom fishing gear impacts marine life. However, solely blaming trawling for the decline of the Icelandic nephrops stock is inaccurate. Fisher activity contributes to stock collapses.
- *Is it realistic to ban trawling and use only pot fishing to catch Nephrops for commercial fishing and production?*
- Relying solely on pots for nephrops harvesting could pose unforeseen environmental challenges in the Icelandic fishery. Significant improvements in management and observation systems would be needed. Alternatively, advancements in trawling methods could mitigate its environmental impact compared to other gear types.

Haraldur Anar Einarsson fishing gear expert from MFRI reported research in Nephrons trawling gear in Iceland. Development on the trawl have been to minimize bycatch, but captains in Iceland have not been interested in using this innovation. He explained the Underwater Television (UWTV) and research of Nephrons habitat. He discussed the ecological impact of the two main types of fishing gear on the species, trawl, and pots.

In Iceland, bottom trawling is almost the only method used in nephrops fisheries due to the open ocean fishing grounds, which are subject to rough seas and deep waters, making the use of pots impractical. MFRI did develop a square window on the top panel as a device to decline high rate of haddock bycatch in 1992 and is still mandatory to use within the nephrops fishery. But bycatch of undersized haddock has often been a problem in the Icelandic nephrops fishery. Several experiments have been conducted by MFRI for improving species and size selectivity, like using two vertically positioned cod-ends, with and without separation panels in front, and grids with different spacings between the bars. However, fishermen have been reluctant to use such devises, claiming that the bycatch adds value, which they do not wish to avoid.

Two significant deficiencies impact the accuracy of landing numbers of nephrops. The unknown discard rate of small nephrops and the bypass landings for the sale of larger nephrops on the black market.

Since MFRI started to use the UWTV sledge to count the number of nephrops burrows then simultaneously an estimation on trawl marks visible on nephrops fishing grounds have been evaluated. The institute has classified trawl marks into six types:

A. Higher hill on one side of the furrow (door mark).

B. U or V shaped.

C. Wider and flatter bottom than type B, representing weight between trawls.

D. Two hills or furrows close to each other.

E. Wavelike furrows composed of smaller furrows.

F. Other types.

And for estimating potential ages of the furrows four stages:

1. Distinguished- structure if fresh and detailed.
2. Started to erode – structure blurs.
3. Eroded – structure is rounded, and soil deposited in mark.
4. Uncertain – maybe just a bottom feature.

The density of bottom fauna like sea pen are used as well as indicator for trawl impact on the bottom. In 2016, approximately 71% of stations had at least one mark, with an average of 2.5 furrows per station. Each year the counts and evaluation on the trawl furrows are registered with the UWTV survey and trends show a decline in the number of furrows, especially in closed areas.

There are pros and cons to using any fishing gear in all fisheries. With a standard nephrops trawl, the Catch Per Unit Effort (CPUE) could be around 40 kg/h in the Icelandic ground, meaning that catching 100 tons would require about 2,500 hours of towing. If we give us around 100 meters between the

trawl doors, the swept area might cover over 116 square kilometres, and the doors could have covered some 4 -8 square kilometres. The total area of the Icelandic nephrops fishery ground is over 6000 square kilometres. The bycatch rate is usually high when using nephrops trawl, and potential high discard rate is a fact, even never estimated in the Icelandic nephrops fishery. However, there are clear opportunities to develop better nephrops trawls to mitigating the bottom impact significantly and declining unwanted bycatch lead to lower rate of discarding altogether.

With nephrops pots, a realistic Catch Per Unit Effort (CPUE) could be around 0.3 kg/pot. To catch 100 tons, about 333,000 pots would need to be hauled, requiring around 15-30 tons of bait. The footprint on the seabed would be around 0.025 – 0.050 square kilometre. Loss of pots with results of ghost fishing would be unlikely to lesser than 1% number of hauled pots. If not recovered by a well-organized system those ghost gear would be affecting the environment for several months or years. However, there is no bycatch, and the discard rate is very low, if any. There are also opportunities to use by-products from other fisheries for bait. For mass fishery with pots, it is extremely important to implement stringent management practices to minimize gear loss and prevent ghost fishing.

Questions raised by the meeting organisers:

Recent developments in fishing gear technology will be evaluated, and future directions explored. The development of gear used in the nephrops fishery has significant potential for a large improvement. However, progress requires time, funding, and industry cooperation.

Is trawling damaging the lobster habitat?

Yes, all bottom fishing gear impacts marine life. However, solely blaming trawling for the decline of the Icelandic nephrops stock is inaccurate. Fisher activity contributes to stock collapses.

Is it realistic to ban trawling and use only traps to catch Nephrops for commercial fishing and production?

Relying solely on pots for nephrops harvesting could pose unforeseen environmental challenges in the Icelandic fishery. Significant improvements in management and observation systems would be needed. Alternatively, advancements in trawling methods could mitigate its environmental impact compared to other gear types.

Kristian Landmark Skaar from Fisheries Directorate in Norway discussed the development of fishing gear for Nephrons concerning ghost fishing and how to prevent bycatching.

The Norwegians have been developing escape holes with degradable cotton thread to prevent ghost fishing, introduced in Nephrops pots in 2022. This is a 4 mm cotton thread with no core, with around three months durability. Also working on introducing of escape gaps/panels to allow undersized Nephrops (MCRS) to escape from the pots. It is a gap with a height of 23 mm and can sort out undersized Nephrops. Preferable with escape gaps which can be mounted in old/used pot fishing. They have mandatory gear registration, positions of gear sets, also for the recreational fishery of Nephrops in pots.

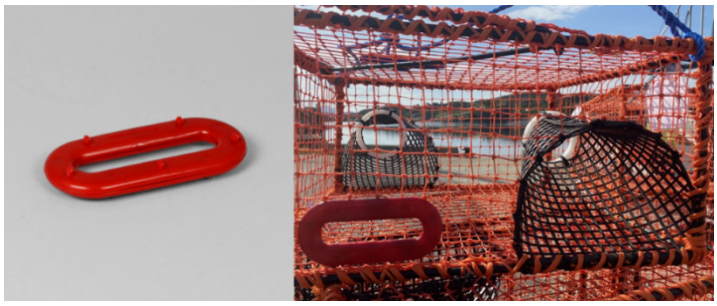

Figure 18 Escape holes for Nephrops pots

It is mandatory to report of positions of the gear (pot fishing, long line, nets), to allow other fishermen to see other sets and soak time. These are contact information connected with the chard and is also used by the coast guard and authorities. In recreational fishery, there is gear limitation with maximum 20 pot fishing, 3 mm cotton thread and marking of pots.

For commercial pot fishing there are regulation of weekly duty to look after pots, at least once every seven days. The pots must have escape holes with degradable cotton thread, so the hole opens approx. 3 months' time in the sea, to prevent ghost fishing. There are rules regarding marking buoys and reporting positions of the gear sets (with some exceptions). Also working on introducing of escape gaps/panels to allow undersized Nephrops (MCRS) to escape from the pots. It is a gap with a height of 23 mm and can sort out undersized Nephrops. Daylight can have negative effects on the Nephrops' eyes and might get blinded. For recreational fishing there are gear limits of 20 pots but subject to the same other requirements as commercial fishing. There could though be a risk that the escape gaps/panels sink down in a muddy bottom, this needs to be further investigated.

New study published in February 2024 "Bottom trawling kiss up to half of the benthic animals in the sea" clamed bottom trawling affect ecosystem for marine life and spoils the seabed. It causes loss of biodiversity to loss of ecosystems services affecting the Nephrops and other sea animals. The report was done by the Denmark´s Nature Conservation Association in Copenhagen.

After research in Kattegat's seabed, a trawling area of 9000 m2, the conclusion was that total loss of biomass, caused by trawling, were up to one million tons. In his conclusion around 30% of the area needs trawl-protection. However, this gives no guaranty of stopping the loss of biodiversity. These areas should be placed in donor areas. It is needed to set an upper limit of per quota trawled area. Possibility of seasonal closure during benthos spawning and in case of hypoxia.

To preserve collapsed demersal fish community in 2004 the" trawl limit" was moved two Nautical miles from baseline to four Nautical miles. Additional restrictions such as seasonal closure of recreational and gillnet fishery within the 4nm limit was also implemented.

Designated exceptions remained – trawl areas inside trawling areas and shrimp fishing areas.

Created incentives for gear uptake – both for trawling with sorting grids and pots.

Nephrops grids are mainly used inside the new trawl border, outside the 4nm. The main reason for using grids is to protect very week cod stock in the southern Kattegat.

In Sweden there have been conflict between trawling and trap fishing, mainly because lack of space for the latter. In 2004 the non-trawl areas were expanded to protect demersal species, giving trap fishing of Nephrops opportunity to expand. Later economic modelling suggests an improvement of both economic and environmental indicators (net present value and benthic Impact) of increasing the non-trawlable areas to expand trap opportunities. But there is still management problem how to regulate access, effort restrictions and transferability of quotas.

The pots connected to a string anchored to the seabed, around 30-70 pots, with around 10-15 meters between them. The total length of the string can be between 300-900 meter long. The fishermen use salted herring for a bait. Average catch per pot Is around 50-250 grams of Nephrops.

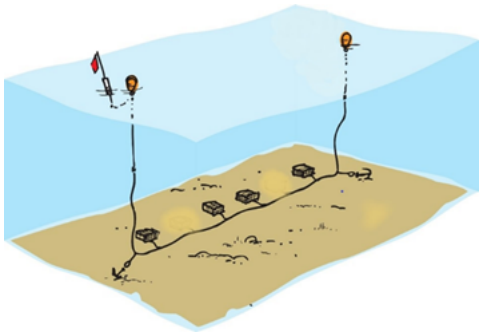

Figure 19 Stance figure of pots fishing gear

Approximately one quarter of the pot fleet consists of vessels from 10-12 meters. Some of the fishermen also engaged in crab potting, fishing for Norwegian Nephrops, mackerel, and herring with passive gear. Depth distribution are approximately 30 to 110 meters, but most ports are put at 40-80 meters. There are no major problems with scavengers reported. Pot fishing is giving higher prices than the trawl landings, with one fifth of landing weight but a quarter of the total landing value.

Landings are generally increasing, with decreasing effort. LPUE shows mixed responses, mostly indices have gone down. The average sizes have increased up to the year 2015, but a sharp drop following change in MCRS. Effects of decreased recruitment followed by an increase in landings. Challenges include resolution of reporting and habitat details.

With nephrops pots, a realistic Catch Per Unit Effort (CPUE) could be around 0.3 kg/pot. To catch 100 tons, about 333,000 pots would need to be hauled, requiring around 15-30 tons of bait. The footprint on the seabed would be around 0.025 – 0.050 square kilometre. Loss of pots with results of ghost fishing would be unlikely to lesser than 1% number of hauled pots. If not recovered by a well-organized system those ghost gear would be affecting the environment for several months or years. However, there is no bycatch, and the discard rate is very low, if any. There are also opportunities to use by-products from other fisheries for bait. For mass fishery with pots, it's extremely important to implement stringent management practices to minimize gear loss and prevent ghost fishing.

DTU Aqua, section for Fisheries Technology, have been working on a technological development of gear, techniques, and methods to contribute to promoting economic and environmental sustainability in the fishing industry, and which can support society's need to regulate fishing. Fisheries Technology

are working with a diverse research team on this subject to implement ecological and economic sustainable fisheries.

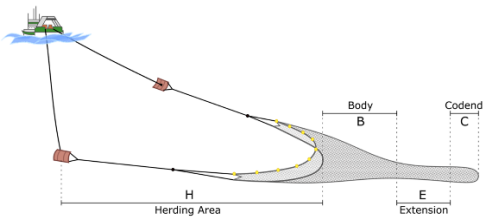

Figure 20 Layout for Nephrops trawl gear.

The aim is to maintain or increase catch of Norwegian Nephrops above MCRS length and to reduce bycatch of other species, especially cod.

Topless trawl is found to be effective at selecting species that swim up in the water column, when trying to evade a trawl, like haddock, pollock, hake and whiting. Cod swims up to a lesser extent and an effect was only achieved when the low height trawl design was used. Topless trawl has no effect on Nephrops and flatfish. The topless trawl is half of standard trawl height.

Using scaring floats in a modified SELTRA panel, significantly reduced cod from the catch, around 70%. Plaice with length of 27 cm was also avoided, around 30%, and catches of pollock, whiting, haddock, lemon sole also were reduced.

Diamond opening was also tested, a large diamond-shape opening at the top to ensure that the tension is equal in all sections and to ensure that the section remains stable with no need for additional floats and weight.

Bottom escape window was also tested avoiding around 70% of the cod bycatch and bycatch of other round and flatfish was reduced, without affecting catches of the Nephrops.

A real-time process of fishing was tested, with information on what is caught while fishing being reported to the bridge, giving opportunities of decisions-based fishing. Each haul in the testing were around 16-32 km long, but this is with high operational cost. The aim is to move the fishing from blind to an informed process in the future, giving information on which species is caught, if target species Is present and if the size of the target species Is acceptable.

Electronic monitoring Is another future option, offering the possibility to document entire catches, a shift toward a more detailed control and enforcement can potentially facilitate a more flexible and simple management framework.

Fleet level assessments of impacts have been monitored to see if relate sediment resuspension to carbon release can be quantified and used as an input to ecosystem models. Using self-adjusting semi-pelagic trawl doors for demersal fisheries reduced fuel consumption during fishing operations by around 16%.

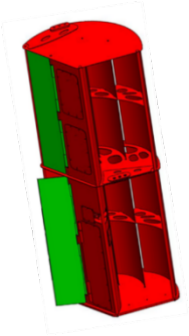

Figure 21 Self-adjusting semi-pelagic trawl door

Also, the use hydrodynamics forces to push the target species (e.g. Norway Nephrops) from the bottom of the seabed, up to the trawl will also be test in the next couple of years by DTU.

7 The beginning of catching Norway Nephrops in Iceland - stories from Hofn i Hornafirdi

Sigurjon Arason, Chief Engineer/Professor emeritus, tolt the story of beginning of fishing Nephrons in Iceland, but his father was a pioneer in early fifties last century fishing Nephrops in Iceland, from Hofn in Hornafirdi, on the Southeast of Iceland. This was by trawling with small boats, around 20 gross tons size, and small bottom rope trawl.

Figure 22 Norwegian Nephrops from Hofn

In 1954, KASK (Coop of Hornafjordur) received a license for one boat to catch Nephrops with a bottom troll (trawl). The catch was very small and there were constant failures. There were a few more attempts to catch Nephrops before 1959. Sigurjons father had gained knowledge in handling bottom troll from his work on side-trawlers. He said to the Coop manager: "I am very interested in this catching and firmly believed that there was a catchable amount of Nephrops at the southeast coast".

The first year, 1959, two Nephrops trolls (trawls) from Denmark were tried out. The trolls were made of hemp and the durability was short. After 1960 nylon trolls came with a better durability. At first, towing was only done in “Breiðamerkurdýpi”, and in the beginning it was towed for one to one and a half hour at a time, as the towing areas were unknown. They got into a lot of trouble with the Danish trolls. The troll was so narrow that it was difficult to get the Nephrops into the bag. They spent 2-3 hours to take the troll onboard and shaking the Nephrops out of it.

Sigurjons mother helped his father to make some improvements of the trolls. When they went back catching it was completely different, the catch was good, and the Nephrops was big and beautiful.

Figure 23 Hafbjorg, one of the first Nephrops fishing vessel in Iceland

When most were caught, they landed three times a week and they usually had a full hold and the Nephrops was on the deck too. The most they got was five tons of whole Nephrops after two days in the early years. The Nephrops were landed whole at the beginning and did not stack well and required a lot of storage space. In 1964, fishermen began to take the Nephrops apart on board and only Nephrops tails were landed. Sometimes they lost the troll along with the trawl door. They hit a rock that did not come under the depth-sounder. They did not have asdic or radar in the boat at that time. His father was asked if they had eaten the Nephrops themselves when he first went fishing. "Yes, yes, we did. We cooked the Nephrops on board. We ate it boiled with potatoes and tomato sauce."

People´s attitude toward Nephrops fishing in the early years were negative, and many had no believe in this Nephrops catching. A few local boats were fishing with the Danish seine during this time, and some captains made fun of Hafbjörg's (Sigurjons father boat) crew "and their damn crab junk". The Nephrops was also called, grasshopper or the rat of the sea! In those years, the larger boats from Hornafjordur were fishing herring in the summer and fall, but around 1966 most of them had stopped after the herring collapse.

After that, the number of local Nephrops catching boats increased, but these were large boats and well equipped with navigational and fish-finding equipment and with larger engines than Hafbjörg.

In 1963, the first marine research was carried out on the María Júlía (guard ship) to search for new Nephrops catching grounds, investigate the distribution of Nephrops and tagging Nephrops.

8 Management of stock units within the Nordic countries

Nine participants met in the morning of 14th of May, to wrap up and conclude the three sessions at the workshop the day before. Guldborg Søvik, Institute of Marine Research and Carina Iselin Bruland, Askøykreps (IMR, Norway), Andreas Sundelöf, SLU Aqua (Sweden), Jacob Kasper*, Fisheries Ecologist/ Marine & Freshwater Research Institute* (Iceland), Haraldur Arnar Einarsson *Marine & Freshwater Research Institute* (Iceland), Gunnar Thordarson, Matis, Sigurjon Arason, Matis/University of Iceland.

Attendees agreed that the black marked for Norwegian Nephrops was a major problem for the fisheries in the Nordic countries, especially in Iceland. With a large black market, there is a great uncertainty of how much the actual catch is, which is a fundamental knowledge for the fishing management and decision on how much to fish and using MSY. It is fundamental for maximizing the value of the fisheries and to secure the sustainable fisheries of the Nephrops.

Discharging is another important point for running an economical sustainable fishery.

Another important outcome from the workshop is little tension between fishermen in the Nordic countries using pot fishing or trawl. The main view there was a need for both types of fisheries, and these two methods occur on separate fishing grounds, pot fishing are used within fjords on a shallow water but trawling out in the open ocean on a much deeper water. It seems that there are more conflicts and tension between pot fishing Nephrops and shrimp fishery, which is more inside fjords on shallow water.

There are pros and cons in both trap fishing and trawling for Nephrops. Both kinds have some environmental impact, and both affect the Nephrops stock. Both types need to respond to increased demands on increased awareness in environmental issues and bring fishing to more sustainability. To use newer techniques and methods to minimize environmental impact. To use new trawling gear to minimize damage to Nephrops' habitats. To use selective gears to prevent catching to young animals, and or fishing unwanted species. Pot fishermen need to control and record fishing areas and avoid ghost fishing with lost pots.

One of the conclusions from this workshop was the idea of using the brake in Icelandic Nephrops fisheries, to prepare for upcoming fisheries, which could be in some few years' time. A workshop with the government, scientists, fishermen and producers where the new fisheries would be prepared. Discuss what is needed to for rules and regulations, or/and attitude changes within stakeholders in the fisheries. How can the Nephrops fishing in Iceland be more sustainable and profitable in the future? What is needed to make this fishing more environmentally friendly to maximize the value within the business.

9 Conclusion

It was the common opinion of the meeting guests that more information is needed on stock assessment and on the Nephrops biology. More research is needed and cooperation between parties involved. The general outcome from this workshop was the opinion meeting partners that having a dialogue between stakeholders, government, scientists, captains, and research groups is of the outmost importance. To share information and minimize suspicion between stakeholders. This dialogue can lay a foundation of greater knowledge and cooperation collaboration that will benefit everyone and could be the foundation of more value creation within the Nephrons fisheries.

The common opinion of the participants was that black market for Nephrops would be one of the main threats for the stock. It seems to be a widespread problem in the Nordic fisheries and is causing all sorts of problems. This is a big problem in Iceland, and meeting guests were sure this confuses all stock

assessments and is also very unhealthy for the economy. The product caught for the black market is often with low quality and is not handled on a correct way. Frozen slowly in insufficient way and sold cheap on the black market. According to the nature of the matter, no one knows what quantity is involved, making stock assessment difficult.

Another important matter is discharge, were smaller and cheaper Nephrops is throwed overboard and not reported. Bycatch is also a problem where it is discharged because fishermen do not have quota for it.

10 Acknowledgements

The project management wants to thank everybody contributed to this project, spent their time and effort to make this workshop possible. The management also wants to thank AG Fisk for its support, without this a project like this would not be possible.

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