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Baited pots as an alternative fishing gear in the Norwegian fishery for Atlantic cod (*Gadus morhua*)

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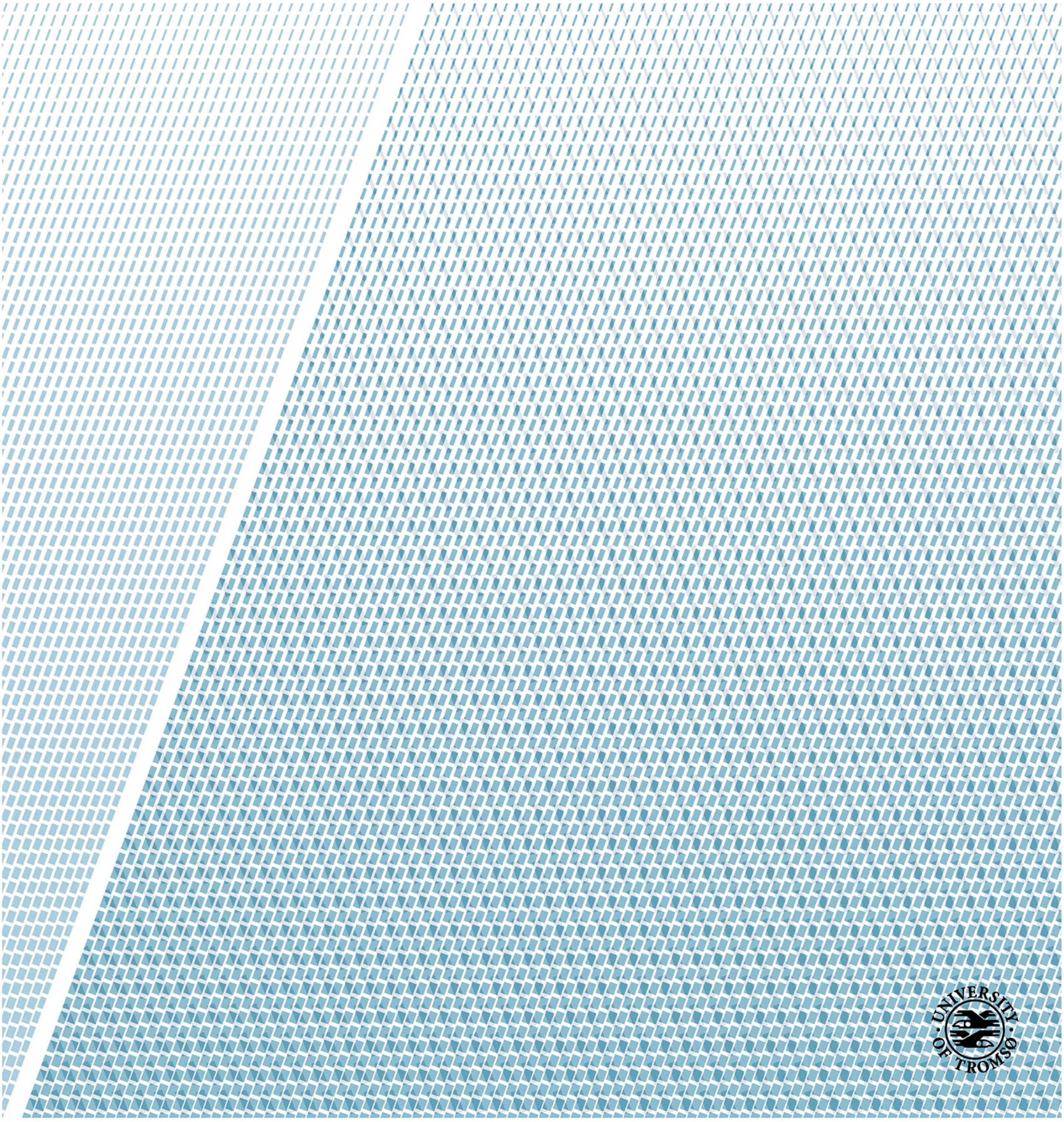

Summary

The main objective of this thesis has been to record the degree of efficiency in two different types of pot designs, both constructed for catching cod (*Gadus morhua*). The two types of technologies were a Canadian cod pot developed by Centre for Sustainable Aquatic Resources (CSAR) at the Fisheries and Marine Institute of Memorial University of Newfoundland Canada and a Norwegian two-chamber pot developed by the Norwegian Institute for Marine Research. For having the possibility of comparing catch rates and as an indicator of the amount of target species and possible by-catch available in trial areas, bottom gillnets were used. Our results show low catch rates in both types of pots, with a high degree of variation. The highest catch rates produced by the pots are caught inshore with low sea current conditions. Both pot types have interesting by-catch profiles and the quality of catch is superior. Analyses of cod behaviour in relation to the pot structures indicated possibilities for further utilisation of vision stimuli in pot fishing, which could possibly result in higher catch rates.

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Your curiosity and interest has been inspiring to me and I hope by writing this thesis I have answered some of your questions.

To all my student colleagues at the University of Tromsø, thank you for five fantastic years. To my old folks and Kristine, thank you for always being there.

Tromsø, Norway 14th of May 2014

Leonore Olsen

Definition of terms

Parlet: Inner entrance of the Nor-pot retaining fish in upper chamber of pot

Mesh size: Also called “opening of mesh”. Defined as the longest distance between two opposite knots, when mesh is fully extended

Mesh length: The distance between the centres of two opposite knots, when fully extended

Boxplot: Upper quartile (Q3): 25% of data is larger and 75% of data is lower, than this value

Boxplot: Lower Quartile (Q1): 25% of data is lower and 75 % of data is higher, than this value

Boxplot: Inter quartile range (IQR): Q3-Q1

Boxplot: Upper Whisker: Represents variability of the upper 25 % of data that is above the upper quartile. Maximum value is defined as still within the 75 % quartile + 1.5 IQR

Boxplot: Lower whisker: Represents variability of the lower 25 % of data that is below the upper quartile. Minimum value is defined as still within the 75 % quartile – 1.5 IQR

Boxplot: Outliers: Data values that are 1.5 ± IQR above or below the upper or lower whisker respectively

NEA cod: North East Arctic cod

CC: Coastal cod

Cod: North Atlantic cod, not limited to a specific population

n of indiv.: Number of individuals

kr: NOK

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1.0 Introduction

Focus on maintaining high value throughout the Norwegian production chain for cod (*Gadus morhua* Linnaeus, 1758) is increasing. High quality landings are a precondition for this to be achievable. Quality of cod before landing varies between different types of fishing gear and fishing methods. In the Norwegian cod fishery north of the 62°N, gillnets are the most common gear type and 32% of cod landings are caught with this type of gear (Råfisklaget 2013). Akse et al. (2013) studied the quality of Norwegian fresh landed cod and found that cod caught in gillnets had the highest frequency of quality reducing damages. Deficient bleeding, bruising that caused bloodspots in flesh and deep gear marks had a high frequency in net-caught cod. These quality reducing damages are mainly caused due to the catch principle of gillnets. The same study showed that cod caught with longlines or jig, both had lower frequencies of quality damages compared to gillnets.

Baited pots are a nearly ideal alternative technology for catching cod, with a high degree of species selection and superior quality of fish (Pol et al. 2010).
Catching cod with pots is interesting in reference to increasing the quality of landings and thus creating a base for a high-quality and high-value production. In addition to the quality aspect and the high degree of species selection, we believe that additional advantages of pot technology can be highly beneficial for the coastal fleet, and for cod as an export product. One advantage is that pots are easy to use and fishing with pots is energy efficient as it requires less fuel (Suuronen et al. 2012). Thus, with satisfying efficiency, pot technology can be regarded as a fuel-efficient, low cost and low-impact fishery. Another advantage is the possibility for eliminating the risk of ghost fishing by using bio degradable twine (Suuronen et al. 2012), which could give marketing advantages in addition to being a generally environmental way of fishing, with low potential of undesirable side effects. Moreover, provided satisfactory catch efficiency, the pot technology can also be an alternative to longlines, which is a gear type that caught 7.5% of Norwegian cod landings in 2012 (Råfisklaget 2013). The use of pots instead of longlines could reduce production costs, as the amount of bait needed is lower in pots in addition to an elimination of the need of having an industry on land preparing the gear.

We tested the catch efficiency of two different types of baited cod pots and compared them with catch rates for gillnets. The pot types include a Canadian cod pot developed by fisheries technologists at Centre for Sustainable Aquatic Resources (CSAR) at the Fisheries and Marine Institute, Memorial University of Newfoundland Canada and a Norwegian two-chamber pot, developed by the Norwegian Institute for Marine Research. The pot technology from Canada (from now on referred to as the NL-pot) has been chosen due to its commercial status in the Canadian coastal fishery for cod; some coastal vessels use this technology for their entire cod quota (Walsh and Hiscock 2005). The Norwegian pot (from now on referred to as the Nor-pot) has a more compact and lighter structure than the NL-pot, and is non- commercial (i.e. is not used in a commercial fishery that is targeting commercial quotas). It is on the other hand a very interesting alternative to the NL-pot due to its light construction and easy handling. Both of the pot types were initially designed for targeting cod.

The main objectives of this study have been:

Does pots catch cod efficiently and is the degree of efficiency high enough to compete with gillnets?

Are the catch rates of both types of pots the same, or is one of them more efficient for catching cod?

What is the size range of cod caught in pots compared to gillnets?

1.1 Fishing for gadoids using pot technology

1.1.1 Behaviour in relation to stationary fishing gear

The most important factors affecting catch efficiency of stationary fishing gear is fish availability, vulnerability and mobility (He 2011). Fish populations are heterogeneous, resulting in an unequal vulnerability for individuals towards any given method of fishing (Hamley 1975). Within a population there will be variation in size, sex, condition, behaviour and habitat (Hamley 1975). For these reasons the fishing gear will not fish equally on the whole population, and thus results in gear selection.

The mobility of fish is affected by a number of biotic and abiotic factors. Migration patterns of cod is characterized by diurnal activity where swimming speed is higher and swimming range is longer during the day (Løkkeborg and Fernö 1999). Løkkeborg et al. (1989) recorded bait behaviour in cod and haddock (*Melanogrammus aeglefinus* Linnaeus, 1758) in a natural environment, and found seasonal differences in the diel activity. The study showed that cod had a peak in activity rhythm in the morning and afternoon and thus showed a bimodal distribution in September whilst in December the rhythm was unimodal with only one peak at sunrise. This distribution of activity during the 24 hours cycle corresponded with the local photoperiod in both seasons and a lower proportion of observed cod responded to bait at night than during the day (Løkkeborg et al. 1989). These findings suggest that the dial activity of cod could reflect variations in feeding motivation.

Ambient sea temperature is another important factor influencing mobility of fish in addition to distribution and swimming capacity. In most ectothermic fishes the swimming speed will increase with temperature to a given maximum and then decrease as thermal stress initiates (Stoner et al. 2006). Decreased swimming speed and range in addition to change in vertical and horizontal distribution patterns caused by sea temperature, can directly affect the catch efficiency of a stationary fishing gear (Stoner 2004). This essentially means that temperature as a single abiotic factor may decrease or increase vulnerability of fish in relation to the fishing gear.
Swimming speed is, in addition to being temperature dependant, related to fish size (He 2011). Larger fish with a wider geographical distribution can therefore cover larger search areas and thus have a bigger probability for encountering the stationary fishing gear.

The behaviour of fish in relation to stationary fishing gear is going to be affected by intrinsic factors i.e., "*conditions or states wholly belonging to the individual*" (He 2011 p. 91). The most obvious intrinsic factor is fish size (length). Larger fish have higher endurance at sustained swimming speeds. The cross- sectional muscle area of these larger individuals, produce enough energy for the sustained speed and does not activate any white muscle fibres and thus avoids metabolic exhaustion. Larger fish therefore have a larger geographical distribution. If one relates soaking time to the geographical distribution of bigger fish, this can suggest that stationary gear may have an "*intrinsic*

size selection property" (He 2011 p. 189) as a result of larger fish being better able to reach the fishing gear and become available (vulnerable) for catching.
Motivational state is a factor that will vary individually between fish. Motivational state will be affected by fish constantly evaluating of trade-offs (He 2011). Assuming that an individual cannot maximize outcomes in all situations, it must choose a combination of gain and win, and this combination will vary with the individual motivational states of the fish. Engas et al. (1998) discussed that differences in motivational states results in behaviour differences in cod and therefore contribute to between-haul variations in bottom trawling for cod. Motivational state is in general poorly understood, but there is evidence for physiological condition to affect motivational state (He 2011). Nøttestad et al. (1996) provided evidence using sonar and echo-sounder observations that the shoaling dynamics of herring (*Clupea harengus* Linnaeus, 1758) changed during the course of the spawning season. Relative density in shoals, swimming speed, shape of shoal and vertical distribution changed in relation to different stages in the spawning cycle. Robinson and Pitcher (1989) found that coordinated swimming in herring shoals was compromised and changed into to a more individualistic swimming- and search behaviour at low supply of food.

The physiological state of a fish changes in relation to spawning cycle, but also with feeding, starvation and migration, and will have a profound effect upon stationary and baited fishing gear through its effect on motivation and behaviour. Reaction of fish can also be adapted due to previous individual experience in similar situations. Fish have the ability to learn from past experience, which can affect the individual motivation towards both bait and stationary fishing gear (He 2011).

1.1.2 Fish behaviour in relation to baited pots

Function of baited pots is firstly based on attracting fish followed by discouraging escape, i.e. retaining fish (Pol et al. 2010). Being a passive type of gear, catch efficiency of pots is highly dependent on fish behaviour. Furevik and Løkkeborg (1994) recorded species dependent behaviour in gadoids during a behaviour study of fish in relation to pots. Individuals of cod and ling (*Molva molva* Linnaeus, 1758) would have a search-orientated behaviour around the pot and on occasion butt against the netting of the pot. The tusk (*Brosme brosme* Linnaeus, 1758) was more careful and approached the pot slowly and in a more carefully manner. The tusk showed a calm behaviour inside the pot, whilst the cod was more active. The authors therefore suggested that cod has higher probability of escaping. Species dependent behaviour results in different degree of vulnerability towards the pot and thus affects the selection of the pot

When utilizing bait for attracting fish, the length of time the pot is actually fishing is determined by the release rate and the duration of the bait. Whitelaw et al. (1991) observed that numbers of fish in the vicinity of the pot declined after the bait was depleted. This indicates that fish behaviour in captivity can change and go through phases, which again affect the catch efficiency. When approaching baited gear, like pots, fish is more likely to do this approach counter- current (Furevik and Løkkeborg 1994; Whitelaw et al. 1991). Fernö et al. (1986) registered higher activity towards baited longlines with increasing current, recording that 80-90% of all fish swam up-stream. In addition, Furevik and Løkkeborg (1994) also registered that the fish surrounding pots stayed close to the pot in the downstream area, regardless of orientation of the pot entrance. If the entrance of the pot is not orientated down- current, most of the fish will not be able to locate it. In addition to locating the entrance, the fish must also be willing to enter the pot for it to be retained (caught in pot). In a study, Rose et al. (2005) recorded behaviour of sablefish in relation to pots with a high-frequency sonar camera. Of 2000-5000 fish recorded in the camera field, only between 9 and 10 entered the pots. This shows that high availability of fish is not necessarily followed by high vulnerability.

1.2 Behaviour of fish in relation to bait

Baited fishing gear utilises the feeding behaviour of fish (He 2011). Løkkeborg (1998 p. 371) found that *"a higher proportion of fish encountered by the bait odour plume located baits than that of fish that were out of range of the odour plume"*. This indicates that bait is highly important when trying to attract cod to stationary fishing gear. The degree of success, i.e. the efficiency of the baited gear, therefore depends upon the feeding behaviour of the target species, but most importantly on feeding motivation and sensory- and locomotion abilities (Stoner 2004). The vulnerability towards baited gear will vary with species specific behaviour but also a range of other factors like temperature, amount of light and photoperiod, sea current, availability of prey in area and presence of resources that act as competitors to the bait (Stoner 2004; Stoner and Ottmar 2004).

Fish detect chemical stimuli through at least two channels: olfaction (smell) and gustation (taste). Nearly all fish use olfaction for detecting prey and for gathering chemical information of their surroundings. The olfactory system has lower thresholds for chemical substances, and it is therefore believed that it is this system that initiates feeding (and search) process. The gustatory system is more selective and is believed to provide something more of a final sensory evaluation. Arousal to attractants is solely determined by the whether the chemical attractants exceeds the physiological threshold of the fish. The arousal to attractants is therefore not affected by motivational states (He 2011; Pitcher 1993). Vabø et al. (2004) investigated the search behaviour of fish by looking at it in two separate phases. Random search for relevant stimuli was referred to as *plume-search* whilst search post-olfactory stimulus was referred to as *bait-search*. The study showed that for plume-search, moving at an angle against current gave the best results. For bait-search, a counter-current search performed better than a gradient-based search. Olfactory arousal is often followed by rheotaxis (upstream search), although in migrating and spawning cod, vision stimuli has been suggested to be more important than olfactory stimuli (Løkkeborg and Johannessen 1992).

Earlier we have mentioned that ambient sea temperature impacts effect on swimming activity and range. Temperature is additionally directly connected to feeding motivation in ectothermic fish. With increasing temperatures the metabolic rate and gastric evacuation rates also increases. Decreasing temperatures has the opposite effect. Hunger and the motivation for feeding can therefore be closely affected to temperature (Stoner 2004).

Abundance, density and composition of ambient prey in surrounding areas of baited fishing gear can affect the feeding motivation of fish. Stoner (2004 p. 1453) predicts that prey can in general have two different effects on fish that is aimed to be caught by baited gear:

1) *"Abundance of suitable prey can affect hunger levels and feeding motivation"*
2) *"Abundance of chemical cues from prey (or other organic compounds) can mask or compete with bait cues"*

Stoner (2004) states that hunger levels and feeding motivation might be the most important and most relevant mechanism in baited fishing gear and that this is highly susceptible to change with ambient prey abundance.

1.2.1 Current knowledge on bait/chemical attractants

Current knowledge identifies amino acids to be the most important feeding attractant compound for fish at present time; although low molecular weight metabolites, like nucleotides and organic acids, have also shown to be potent olfactory stimulants, especially when acting together (He 2011). Ellingsen and Døving (1986) identified feeding stimulants in shrimp for cod and found that the amino acid glycine was the most potent single stimulant (two unidentified substances were also highly potent). Johnstone and Mackie (1990) found through laboratory investigations that amino acids from long-finned squid (*Loligo forbesii* Steensrup, 1857) were the major feeding stimulant in for juvenile cod.

The rate of diffusion in water is low and a chemical stimulus can travel with current for long distances. In practice this means that the chemical stimuli from a baited gear lasts long in both time and space, depending on rate of release, dilution by degree of turbulence, decrease of concentration with increasing distance from source and chemosensory capability of the target fish (He 2011; Pitcher 1993).

1.2.2 Types of bait in Norwegian longline fishery

The bait types used in the Norwegian cod fishery outside Lofoten and Finnmark varies with season. These seasonal changes are due to change in feeding motivation during spawning season of cod. In Lofoten when fishing NEA cod (North East Arctic cod), deep sea shrimp (*Pandalus borealis* Krøyer, 1838) is the most common bait (Vollstad 2014). When fishing cod in summer on the Finnmark coast, the most utilized bait type in this season is Mackerel (S*comber scombrus* Linnaeus, 1758) and Saury (*Cololabis saira* Brevoort, 1856). Some autoliners prefer particular types of bait due to difference in degree of function of the auto line system; autoliners with the Select Fish system prefer squid (*Todarodes sagittatus* Lamarck, 1798), whiles other use a mix of Mackerel, Saury and Squid or Herring, Saury and Squid, depending on prices and availability. Saury is generally known for lasting longer on the hook, (without falling off) as opposed to

Herring. Saury is therefore seen as better type of bait and in some cases this type is therefore preferred.

2.0 Methodology

Research trials for the thesis were conducted on the University of Tromsø research vessel "Johan Ruud" over three different periods. Trial one and two were conducted in February (11-15) and May (21-24) of 2013, followed by trial three in February (6-14) of 2014. The trial dates in February of 2013 and 2014, coincided with the spawning season of the target species NEA cod, as our aim was to ensure high abundance of cod in the trial area. The trip in May was conducted in an inshore area, targeting CC (Coastal cod)

2.1 Rigging of research vessel and choice of trial area.

The R/V Johan Ruud is a stern trawler build in 1976 (Fartøyavdelingen 2014). It is used for multipurpose research activities such as fisheries, marine biological, geological and oceanographic surveys in both open waters and along the coast. The rigging of Johan Ruud is best suited for trawling. Therefore a platform was installed on board to be able to haul the pots and bottom nets in a proper manner. A hydraulic deck mounted hauler, was part of the gear handling equipment on board. These two components in addition to a rail roller, gave a satisfactory system for hauling the bottom nets and untangling the fish but also for hauling both types of pots. When hauling the Canadian pots, an ordinary hydraulic crane (Hiab-type) for lifting the structures on board was used. For deployment of the three different types of gear, the trawlramp was used.

The trials in February 2013 and parts of the trial in February 2014 were conducted on the cod banks west of Tromsø (Figure 17 and Figure 18 in Appendix I). This reason for this was that the commercial vessels in the area were producing high catch rates and the crew on board knew the area well. The trial of May 2013 and parts of the trial in February 2014 was done inside a fjord system, south east of Tromsø (Figure 19, Figure 20 and Figure 21 in Appendix I.). There were no commercial vessels fishing in the area at the time, but the crew on board knew the area well, and knew that there traditionally were aggregations of CC in the area.

2.2 Limitations

The research quota for February 2014 was four tonnes of cod with by-catch of haddock at 1.5tonnes and one tonne of Pollock (*Pollachius virens* Linné, 1758). The quotas for the other trials were in the same size range. Catches must obviously not exceed this limit, which was kept in mind when designing the trials. For two of the trials the quota was more than sufficient, but for the 2014-trial the abundance of NEA cod in the area was immense and we were forced to adjust the experimental design to avoid exceeding the quota limit; twelve bottom nets divided in two links caught 1.5 tonnes of cod in total and gave no opportunity to further use gillnets in the area. At the time the coastal fleet was fishing heavily in the area and we had no opportunity to move the gear. In addition the pots have limitations towards bathymetry, i.e., when fishing with pots the bottom needs to be relatively flat. These limitations gave us no other opportunity than to only use the pots and assume that the catch in gillnets would be the same for each of the trial days as for the first. This assumption was confirmed by nearby fishing boats, as they were catching 2-3 tonnes per day.

The vessel used for all the three trials was, as mentioned, a research vessel and a specific period and time was assigned for us to do the research. Consequently, we had to adjust the choice of fishing grounds accordingly, which gave challenges in relation to abundance and availability of cod. In February 2013, the location of the trial coincided with a period of high abundance of capelin (*Mallotus Villosus* O.F Müller, 1776), west of the fishing grounds for cod. This resulted in cod migrating further west towards the capelin, where neither the coastal fleet nor we, could follow. The trial was conducted as planned, but this was not the best timing for the trial, especially when considering the fact that the coastal fleet did not even go out fishing in this period. They waited for two or three days for the cod to come back east before they put their gear in the water again. Seasonal variations like abundance, temperature, spawning cycles, food access and others can all affect fish behaviour and therefore affect the catch efficiency of the gear (Stoner 2004). Because of this, results for each of the trials have been analysed individually.

Fish distribution in an area is heterogeneous and variable in both time and space (Stoner 2004). This is inevitable and impossible for us to quantify, but the soak time of gear was around 24 hours (see section 2.4) and distances between gear, in addition to length of fleets were all designed to give the best foundation possible for comparative data and standardising as many variation factors as possible.

Due to low catches in the pots, we have been forced to pool length data. This has been done for all three types of gear, and length data from all three trials are included in these analyses.

For the trial of February 2014, we have made an interaction plot, where catch rates for each gear is dependent on sea current conditions. The sea current in the different areas varies with a range of factors throughout the 24 hours of the day, but to be able to make comparisons, we have simplified the current conditions into two categories: current, and no current. The "no current" conditions are used to describe the current conditions for a fjord area, compared to "current" conditions in the offshore area. The relative difference in sea current conditions between these two locations of fishing, we consider to be great enough to do this type of simplification and categorization of sea current conditions.

2.3 Specifications of all gear types

2.3.1 Gillnets

Bottom nets were used as verifier for fish in the area and as species indicator. Gillnets that we used were identical to the ones used in the commercial fishery for cod at the time. All net types used in the trial had the exact same specifications except for a difference in mesh size; for being able to catch a wide species and size selection range, both 78mm and 93mm mesh were used. In practise we varied between the two mesh sizes in a consistent pattern, i.e., every other gillnet in the fleets were of the 78mm and

Table 1. Specifications for both types of bottom gillnets.

Gear components	Specifications
Hanging ratio	0.55
Mesh size	78mm
Mesh size	93mm
Twine colour	Yellow
Thread diameter	0.5mm
Headrope	Scanfloat 17mm/80g
Footrope	Danline w/lead 10mm
Depth	50 meshes

93mm mesh type (Figure 31 and Figure 32 in Appendix I). Different mesh size affects the height of the two versions of nets, i.e. the net with 78mm mesh size would gain an effective height of ca. 3.4 m at a hanging ratio of 0.55. The effective height of the nets with 93mm mesh size would be ca. 4.0 m. Twelve bottom nets were rigged into two fleets of six nets in each. The number of nets and the length of the fleets were adapted to the length of the pot fleets for the best comparison performance between the gear types. With the chosen type of experimental design, we were able to do comparisons between two gillnets with different mesh size to one single pot.

Selection in gillnets

The experimental design of this trial is done through using gillnets as an population indicator and we therefore assume that gillnet has a known selectivity (Hamley 1975). Thus, we can compare catches by knowing that gillnets catch fish *around* a given length and size and providing an indicator of the species composition in the area.

Bottom gillnets are in general known for having a high degree of size selectivity (Erzini et al. 2003; Santos et al. 2002). Although the selectivity of gillnets is well established, there are a range of different factors that contributes to the degree of this selectivity (Hamley 1975). In general we can state that gear design and capture mechanisms are the overall largest influences upon size and species selectivity of gillnets (He 2011). As in other netting based fishing gear, the mesh size determines to a great extent the size composition of the catch (Fridman and Carrothers 1986) and may be the most important design feature in relation to size selectivity. The relationship between fish size and mesh size was early discussed by Baranov (1948), who formulated the *principle of geometric similarity,* where he states that the catch process of gillnets is depended upon fish size relative to the mesh size. This axiom have later been discussed and criticized (Hamley 1975), but despite its probable over-simplification of the selectivity process, it is a useful way of understanding selectivity for gillnets. Gillnet selection is characterised by a narrow selection- range, i.e. a small distance in length between the smallest and largest fish caught. Due to the linear relationship between fish length and the fish circumference we can predict what size range of fish we are likely to catch with different mesh sizes. The size range for gillnets will vary *around* an optimum (length of fish with the highest catch frequency) as opposed to a trawl selectivity curve were all fish *above* a given size is restrained. The length variation in gillnets is constrained to a maximum of 2-3% of fish that vary more than 20% from the optimum. This is to be interpreted as a narrow selection range and a high degree of size selectivity (Larsen 2003).

Gear design features, excluding mesh size, affect mainly the efficiency of the gillnet (the height of the selection curve), but may also impact the selectivity (height and mode of curve) (Von Brandt 1975). Gear design features are many and varied, but the most important ones have been listed by Clark (1960) and include hanging ratio of net, twine material (strength, diameter, colour and elasticity), shape and compressibility of fish body (other than pectoral area) and fish behaviour patterns. The horizontal (headrope) hanging ratio of gillnets is defined as $\mathrm{E} = \frac{L}{L_0}$. L is the hung length of the netting and L_0 is the length of the same netting when fully extended (Fridman and Carrothers 1986). The hanging ratio is therefore in relation to the opening angle of the mesh. The gillnet design used for this trial has an E of 0.55. This ratio is common in Norwegian cod fisheries and results in tight netting and a high degree of mesh opening. A lower hanging ratio and a higher degree of "slackness" in the net, have been found to result in entangling of fish rather that the fish being gilled and therefore have been stated to have a poorer size selectivity (He 2011).

As earlier mentioned, catch mechanisms also have an effect upon size and species selectivity. Hovgård and Lassen (2000 p. 7) explains the basic four of these capture mechanisms: "*gilling (caught with the mesh behind the gill cover), wedging (caught by the largest part of the body), Snagging (Caught by the mouth or teeth or other part of the head region) and entangling (Caught by spine, fins, or other parts of the body as a result of struggling".* Fish may be caught by more than one of these mechanisms, but which method catches the largest quantity, is heavily influenced by the already mentioned different design features of the gear (Clark 1960).

Choice of small twine diameters in the gillnet has the effect of more fish being caught but also results in poorer selectivity (Hovgård and Lassen 2000). Gillnets used in this trial has a twine diameter of 0.5mm. This twine diameter is regarded as a medium twine type in this type of fisheries. Presently, in cod fisheries, twine between 0.5mm-0.7mm is commonly used, whilst 0.4mm is a minimum by regulation. Due to the high abundance of cod in the area during the period of the trials, 0.7mm twine was preferred by many fishers. Using this 0.5mm twine size therefore gave good selectivity and satisfying size of catches.

Today, using thin monofilament in gillnets is more common than multifilament or natural fibres (He 2011). Choice of twine affects both the colour and the “softness” of the net. Monofilament gillnets have lower visibility in water compared to multifilament and therefore is considered a better choice. The degree of “softness” of the net and its movement in the water is highly affected by twine type. Multifilament is a material that increases “softness” which results in more entangling of fish.

2.3.2 Norwegian two- chamber pot (Nor-pot)

The Nor-pot is a two chamber pot with a collapsible and light structure (Figure 1 and Figure 2). The construction is made of a 14mm circular steel frame at bottom with two more identical frames made in 10mm circular aluminium at top and middle. The collapsible feature of the pot is a result of only rope seems in corners is holding the frames together.

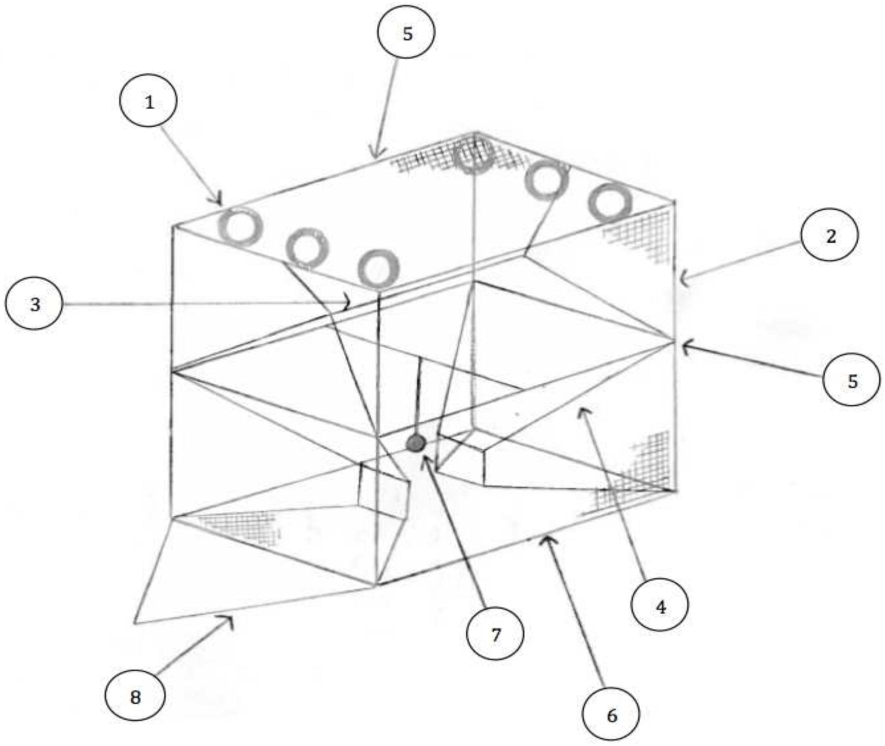


Figure 1. Nor-pot with corresponding numbers to Table 2. Sketch is not to scale and inspired by Furevik et al. (2010).

Zippers provide easy access to the bait bags. The bait bags are installed in the pot by clips.

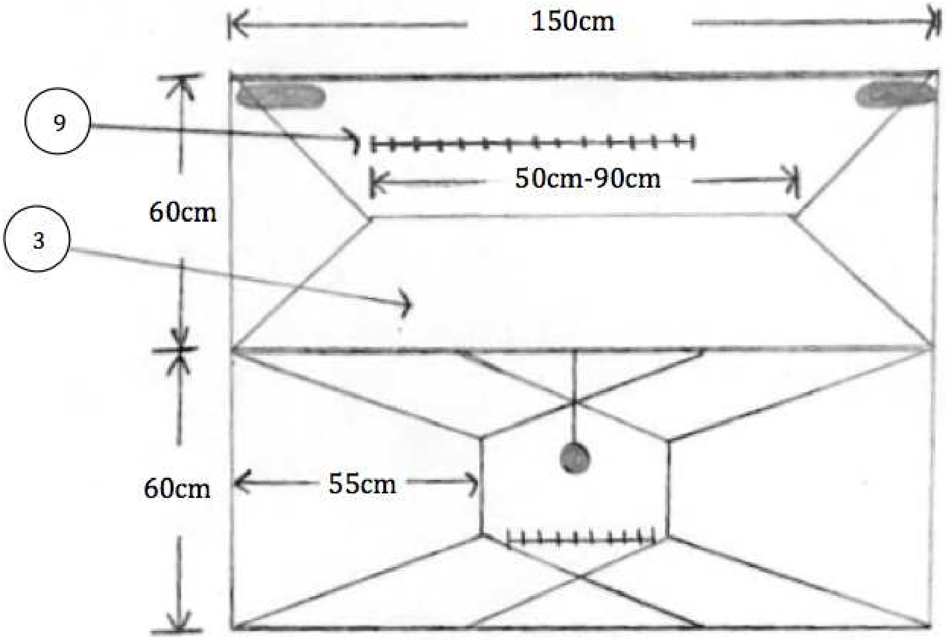


Figure 2 Nor-pot with corresponding numbers to Table 2. End view with corresponding measurements shown in Figure 26 in Appendix I. Sketch is not to scale and inspired by Furevik et al. (2010).

The steel frame of the pot is producing weight and together with float rings on top of the pot, the distribution of weight prevents the pot from landing upside-down at the bottom when deployed.

Table 2. Specifications for Nor-pot.

Gear components	Specifications
1	Rosendal Floatring: 205mm in diameter/46mm thick Floating capacity: 475grams
2	Main net: Black polyamide No. 14. Single knot 28.5mm bar length. Mesh size 57mm
3	Parlet entrance
4	Main entrances: Polyamide monofilament (transparent) 25mm bar length. 50mm mesh size
5	Aluminium frame 10mm
6	Steel frame 12mm
7	Bait bag with clip lock system
8	Attachment line
9	Zipper

The entrance of the Nor-pot is made by monofilament exclusively. It is made from four panels of 50mm mesh and attached to the internal walls within the pot with monofilament twine for maintaining position and form although the pot is collapsed under storage and transportation on board.

2.3.3 Newfoundland pot (NL-pot)

The NL-pot is a much larger and heavier structure that the Nor-pot. The NL-pot is larger (see measurements in Figure 4) in both length and width in addition to a large volume created by a floating roof (cod- end) (Figure 25 in Appendix I). It is believed that the cod-end is serving as an additional volume for the fish to retreat, creating space for avoiding stress and predation in addition to being helpful when emptying the pots (Walsh 2013). One trawl float is used for floating the cod-end (number 4 in Figure 3) in addition to oval gillnet floats (not included in Figure 3 or Figure 4, see **Table 3** for further specifications). The rigid structure of the NL-pot consists of a bottom frame, which is connected to a pivot point that connects the side frames (Figure 4 and Figure 24 in Appendix I). These rigid structures are built exclusively of round stock steel. Pivot points create the collapsible feature of the pot structure, giving the possibility for storage on board smaller fishing vessels in addition to easy storage on land.

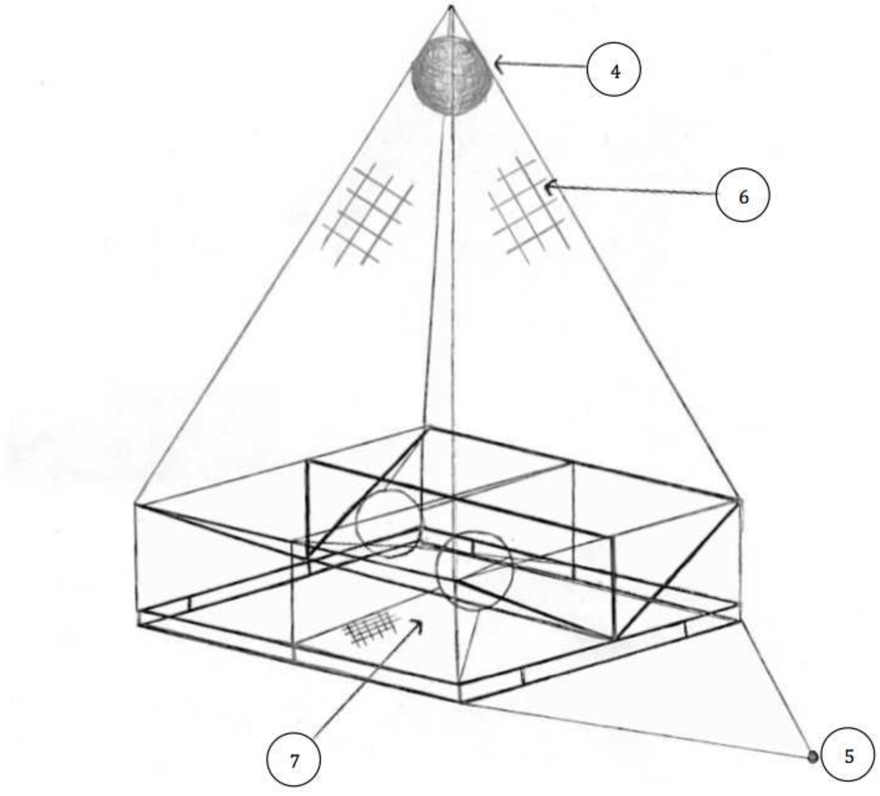


Figure 3. Sketch of NL-pot with floating roof (cod-end). Numbers corresponds to Table 3.

The entrance of the NL- pot is made by white braided polyamide (see further details in **Table 3**), which narrows into a steel ring (Figure 22 in Appendix I). The steel ring is covered by steel "triggers" which the fish has to force through before entering the pot (Figure 23 in Appendix I). The triggers are hinged at top of the steel ring with help of a flat plastic bar. The triggers can only be moved inwards and thus retain the fish and prevent escape.

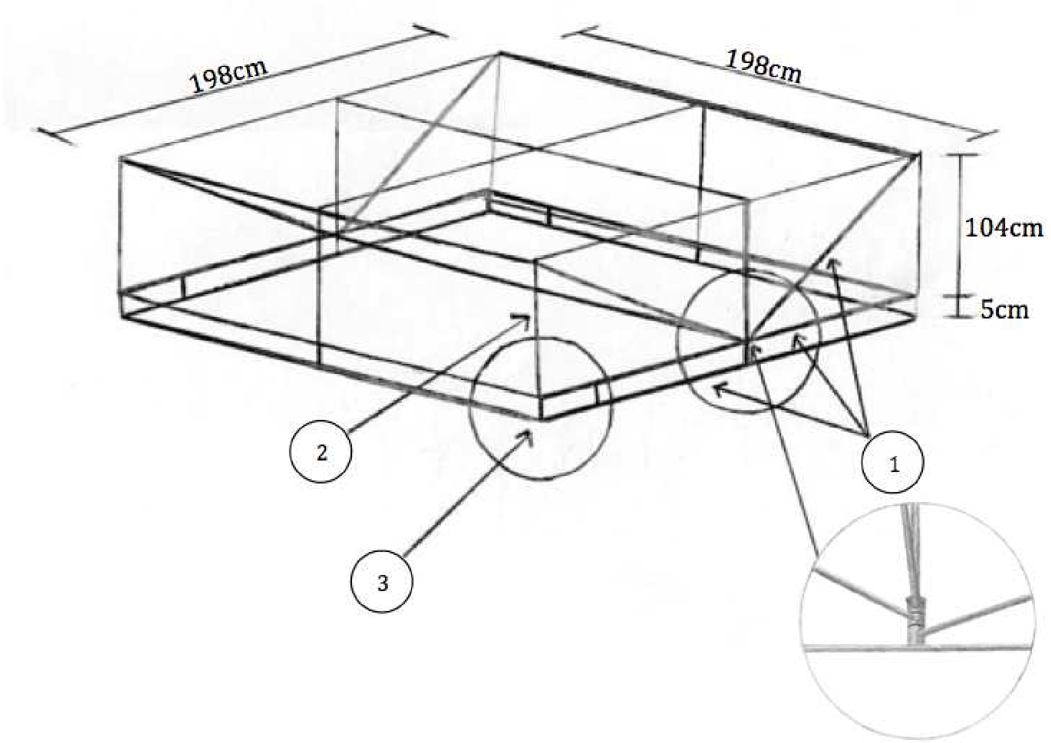


Figure 4. Measurements for NL-pot Numbers corresponds to Table 3.

Table 3. Specifications for NL-pot

Gear components	Specifications
1	1.58cm round stock steel
2	9mm polyethylene rope
3	Rounded corners (no joints in corners)
4	Nokalon trawl float 200mm in diameter 2.9kg buoyancy
Additional float in cod-end	Euro Products, INC. Gillnet oval floats 101mm in diameter 0.79kg buoyancy
5	Attachment line, 14mm polyethylene rope
6	Main net: Yellow polyethylene, 3mm in diameter Mesh length: 120mm
7	50mm mesh size knotless white braided PA

2.3.4 Behaviour study of cod in relation to the NL-pot

Highly favourable conditions for the NL-pot were observed in the Tromsø sound, in April of 2011 at the outlet of an industrial pelagic producer. Behaviour of fish was recorded on film and studied, in the hope that behaviour analysis could give us a better understanding of fish behaviour in relation to the NL- pot and especially the entrances. One pot of the Newfoundland type was placed at 25m depth, in an area with high abundance of cod. The aggregation of cod in the specific area was due to high concentration of chemical stimuli as a result of release of wastewater from a pelagic producer, processing capelin at the time.

Both entrances in the pot were of standard Newfoundland type, with triggers in front of opening. Two GoPro cameras were rigged in the opposite side of both entrances, filming straight towards triggers and funnel. This type of rigging gave the opportunity to study behaviour of fish entering the pot, behaviour of caught fish within the vicinity of the pot in addition to behaviour and amount of fish outside the pot.

Soak duration (from time of deployment until pot was on board) was only three hours. The pot was baited with a mix of mackerel and herring divided in two bait bags placed in front of each entrance, with 4 kg of bait in total. Natural light at the time gave sufficient light condition for the GoPro camera and the system provided good quality documentation of all three hours of fishing. Amount of fish caught and size of fish were estimated, and not measured. This was due to limitations on board the vessel used.

Fish behaviour when entering the pot was categorized and standardized. This was an attempt to assess the function of triggers and entrance. The categorization was a way of trying to quantify the degree of function of the entrance and triggers. The categorization is shown and used in the Results for the behaviour study, section 3.7.

2.3.5 Additional modifications to entrance design in NL-pot

Behaviour studies of cod interacting with the NL-pot (described in section 2.3.4 and 3.7) have given indications towards the fact that the NL-pot type entrance and trigger system is a design that is affecting the catch efficiency of the pot negatively. Film recordings from the behaviour study were shared with Fishing Gear Technologist Philip J. Walsh and Fisheries Technician Rennie Sullivan at the Centre for Sustainable Aquatic Resources at Marine Institute, Memorial University of Newfoundland. According to these experts, an entrance without the trigger system in the NL-pot with resemblance to the Nor-pot entrance system may have a positive effect on catch rates and thus the efficiency of the NL-pot.

Monofilament netting are considered to be less visible (He 2011), especially at low and poor light conditions (Jester 1973). For this reason it is very interesting to use this material, considering the fact that it might be harder for the fish to register the presence of the monofilament by its vision, and thus be more susceptible to enter the pot.

As an additional experiment to the trial of 2014, two additional NL-pots was rebuilt, both with new type entrance as the only new feature (technical drawings in appendix III. Figure 40). Entrances were designed in monofilament with clear resemblance to the entrances in the Nor-pot and without any triggers or steel ring. The new type of entrance was made of monofilament 0.4 twine with 78mm mesh size. The rebuilt NL-pots were placed at the end of each of the Nor-pot fleets.

2.4 Rigging of gear, experimental design and standardizing of variation factors

The two types of pots and the twelve gillnets were all rigged into fleets (Figure 27, Figure 28, Figure 29 and Figure 30 in Appendix I). Both of the pot fleets consisted of 3 pots per fleet, whilst gillnets were rigged with 6 gillnets in each fleet. This gave us 6 different fleets: two fleets with NL-pots, two fleets with Nor-pots and two fleets with 6 gillnets (Figure 31 and Figure 32 in Appendix I). The length of a single gillnet is 30.25m (hanging ratio of 0.55), resulting in 181.5m of gillnets in each fleet. The pot fleets were rigged with 60m between each pot and thus the length of the pot fleets was 120m. The fleets were placed in parallel to each other (Figure 18 in Appendix I). This would ensure that one fleet of gillnets would fish in the same population of fish as the two pot links.

With this choice of trial design we could use gillnets as an indicator of abundance of fish in the area (as explained in section 2.3.1). The placement of the three links were interchanged to maximize the randomizing of samples and to minimize bias data. Distance between the fleets varied between 150-550m and placement of fleets had to be adjusted in reference to bathymetry and depth. The distance between the gear types were never less than 150m. This was consciously done for to ensure that there was sufficient distance between fleets, knowing that if the gear is set too close this might affect results. The soak time varied around 24 hours (+/-6 hours) except for one replication in 2014 (Table 44 in Appendix IV) where moving of gear from an offshore area to a fjord system resulted in a reduction of soak time. The length of fishing time was chosen to avoid saturation (Hamley 1975) in the gear in addition to getting as many replications as needed.

The bait type used was the same for all trials, and was a mix of mackerel (*Scomber scombrus* Linnaeus., 1758), squid (*Odarodes sagittatus* Lamarck., 1798), and herring (*Clupea harengus* Linnaeus., 1758). The amount of bait was standardized to 1.100 grams per bait bag and the mix consisted of equal amounts of the three different bait types. The NL-pot is constructed with two bait bags, one in front of each entrance. The Nor-pot has entrances which face each other, therefore there is only one bait bag in the Nor-pot, and it is placed in between the two entrances. Consequently, the amount of bait is not the same for the two types of pots. Length measurements of all fish caught were done simultaneously with hauling of the gear. Fish was separated for each pot and registrations were done per pot and per fleet. The design of trial in addition to rigging of fleets and pots, were attempts to standardize as many gear-related variables as possible.

2.5 Statistical methods

A one-way analysis of variance (ANOVA) (Quinn and Keough 2002) was used for accounting for significant differences in catch rates and size of cod per gear type. The ANOVA was used for testing variance of means in comparisons where our only independent variable (factor) was gear type. A two-way ANOVA was used for testing variance of means in a situation of including two types of factors (independent variables). The two-way ANOVA provided p-values for each individual main, in addition to information about the degree of between-factors interaction.
For situations where the ANOVA provided a significant p-value, we performed post hoc tests. The chosen post hoc test was Tukey's Honest Significant Difference (TukeyHSD) which is commonly used in conjunction with ANOVA (Quinn and Keough 2002). TukeyHSD provided analyses of every possible mean included in the analysis. The TukeyHSD was indispensible for being able to identify the different performance of the different gear types. The statistical tests are exclusively reported with a α-level of 0.05 (5%). The P-value for all ANOVA- and TukeyHDS tests, are given in direct numeric value in appendix. The appendix also have full tables for all test with corresponding degree of freedom (Df), sum of squares, mean squares and F-value. For easy comparisons of means, the 95% family- wise confidence intervals (CI) for TukeyHSD, are plotted in addition to being given in table form. The p-values are interpreted and presented in three intervals of significance: <0.05, <0.01 and <0.001. Note that in TukeyHSD, the p-value is adjusted.

Choice of visual presentation of statistic results in histograms and boxplots are done for best being able to represent distribution of data. The boxplot is chosen due to its conjunction with the TukeyHSD and it's visual of median in reference to spread of data. The calculations of mean in addition to the medians in boxplots, is for better being able to understand the spread of data.

For the periods of February and May of 2013, 24 replications for every gear type were done and recorded (8 fleets×3 pots or gillnets). The trial in February of 2014 gave 16 fleets of each gear and thus resulted in 48 replications for each of the gear. All statistics and figures produced and presented here, is a result of this database.

When reviewing histograms it is important to remember that, as earlier explained in the method, the registration of catch is done per fleet, per pot and per two gillnets. A frequency of one, on the y-axis, therefore represents one fleet (haul of gear) with the associated catch of this one pot or two gillnets.

Table 4. Number of cod per gear and per period forming the basis for the statistical analysis in this work (all replications).

Gear Type	Period		
	February 2013	May 2013	February 2014
G	211	97	301
NL	15	20	39
Nor	22	90	114

3.0 Results

3.1 Catch rates

3.1.1 February 2013

Figure 5 shows the frequency distribution of number of cod individuals for the three gear types for the whole trial of February 2013 (Table 7 in Appendix II).

Figure 5 clearly shows a between gear difference in catch rates.

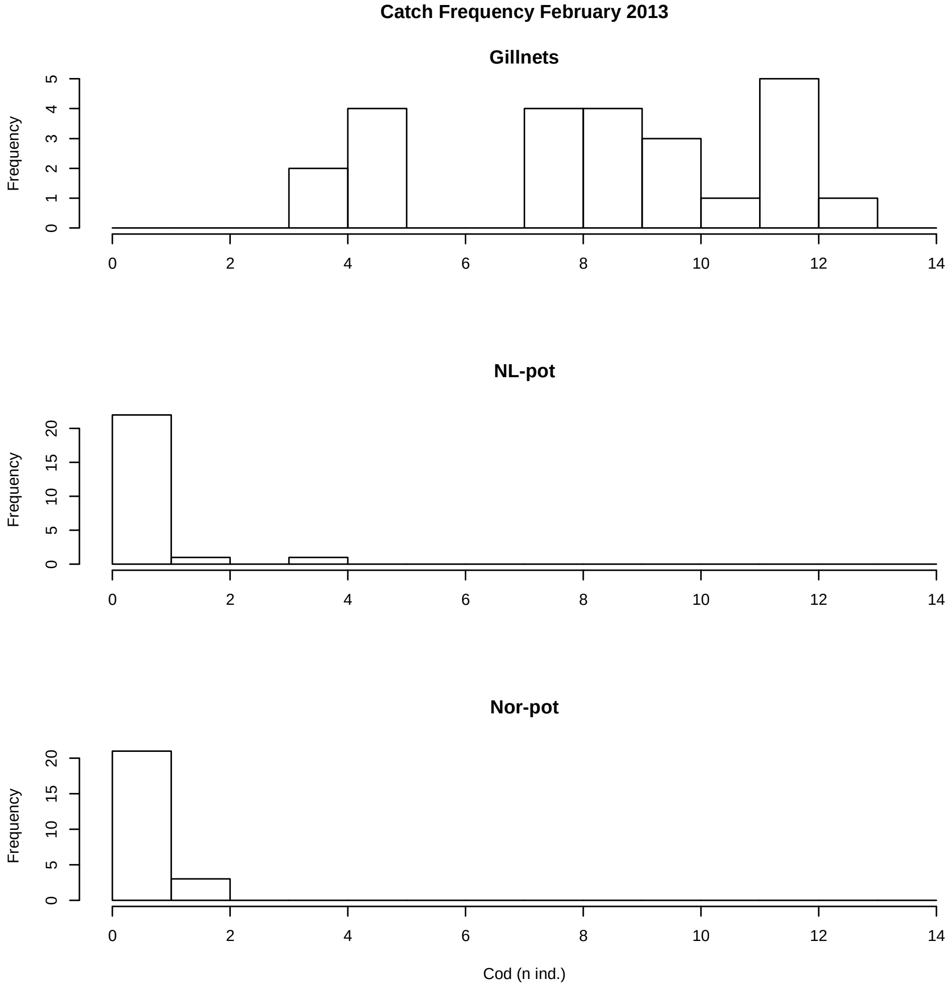


Figure 5. Catch frequency for February 2013, for all three types of gear. Numeric values are given in Table 7 in Appendix II. Y-axis is not to scale between figures.

The frequency for gillnets has a wide distribution with the highest frequencies around eight to eleven fish. The non-existing registrations for the interval of 0, 1 and 2 in gillnet stands in contrast to the high frequency for the same interval in the two types of pots. For the NL-pot there is only two registration of catch higher that the 0-interval and both of these registrations is below the 4-cod interval. For the Nor-pot, no registration above the 1-cod interval is registered.

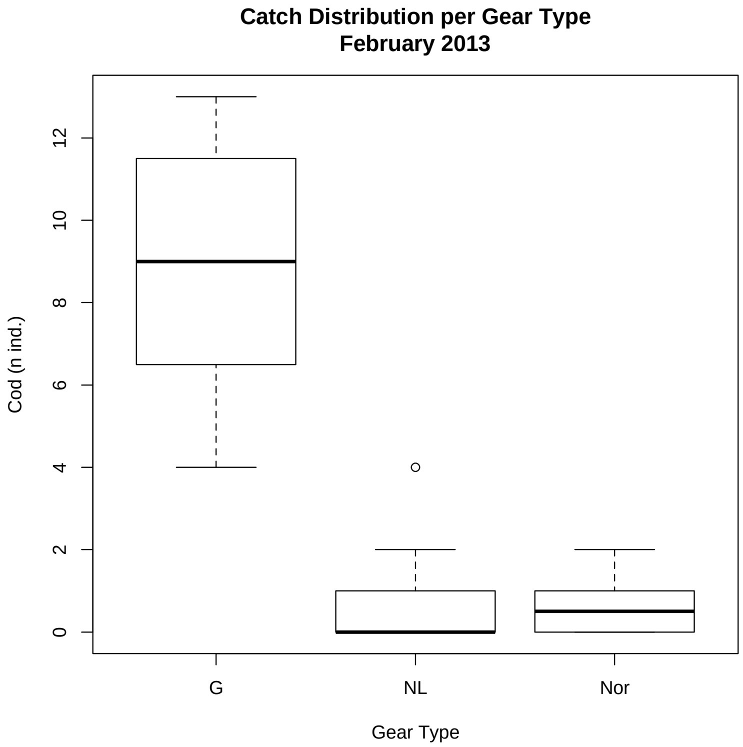


Figure 6. Catch distribution for all gear types. Output values, value of mean, ANOVA and TukeyHSD is given in Table 8, Table 9, Table 10, Table 11 and Figure 33 in Appendix II.

An ANOVA test was performed to recognize whether there was a between- gear difference in the caught number of cod for the trial of February 2013 (Figure 6). The ANOVA test showed that catch rates differed significantly across gear types, $p<0.001$. A post hoc test (TukeyHSD) was performed to identify which of the gear medians that significantly differed from each other. TukeyHSD showed a highly significant difference between gillnets and the Nor-pot and gillnets and the NL-pot, $p<0.001$. There were no significant difference between Nor-pot and the NL-pot, $p>0.05$.

The boxplot in Figure 6 above, shows a median for gillnets (Table 8 in Appendix II) of 9 cod individuals (from now on referred to as cod). The lower quartile for gillnets is 6.5 cod and the whisker is showing a minimum measurement of 4 cod. Registration of the upper quartile is 11.5 cod and a maximum of 13 cod. The spread of data points for gillnets, within the inter quartile range (from now on referred to as IQR) is close to equal on both sides of the median, suggesting a somewhat normal distribution of data. This distribution of data for gillnets is not supported by the histogram in Figure 5 and shows the importance of reviewing both. The calculated mean for gillnets in Figure 6 is 8.75

cod, with a corresponding 95% confidence interval of 2.27 cod (Table 9 in Appendix II). A lower value of mean compared to the median is suggesting a negative skew of data for gillnets. The confidence level of the mean of gillnets is not insignificant, and is a result of deviation from normal distribution of data.

3.1.2 May 2013

Figure 7 below, shows a unimodal distribution of data for gillnets. The data shows that sizes of catches are roughly divided into two aggregations within the intervals of 0-2 and 5-8. Distribution of data in the NL-pot is close to the same as for February of 2013, with a preponderance of catch sizes consisting of 0-1 cod. The Nor-pot has a wide spread of catch sizes, ranging from 0-11 cod. Despite of this the highest frequency of catch for the Nor-pot is zero.

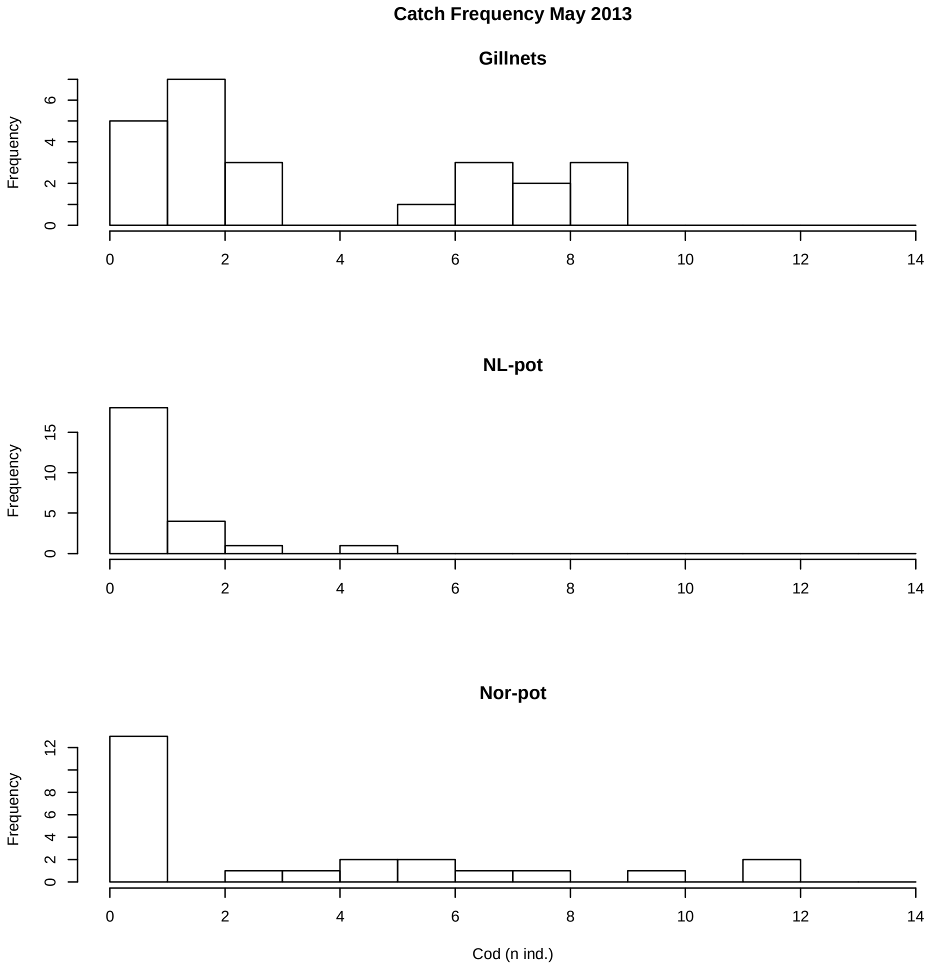


Figure 7. Catch frequency for May 2013, for all three types of gear. Numeric values are given in Table 12 in Appendix II. Y-axis are not to scale between figures.

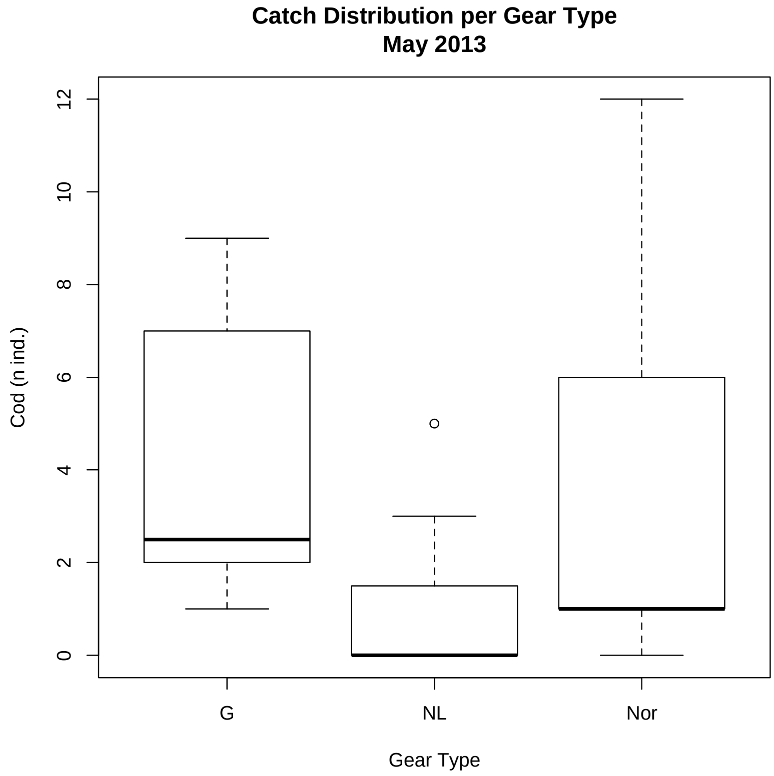


Figure 8. Catch distribution for all gear types in May 2013. Output values, value of mean, ANOVA and TukeyHSD are given in Table 13, Table 14, Table 15, Table 16 and Figure 34 in Appendix II.

An ANOVA test for the caught number of cod per gear type for the trial of May 2013 (Figure 8) showed a significant difference between gears, p<0.001. The TukeyHSD provided less power to these p-values, compared to the results for February 2013. There was a highly significant difference between the NL-pot and gillnets of p<0.001. The Nor-pot and the NL-pot showed a lower significant level at, p<0.01, whiles the TukeyHSD for the Nor-pot and the gillnets gave no significant difference, p>0.05. Figure 34 in Appendix II shows the plotted values of 95% Confidence level (CI) for the TukeyHSD test. The plot clearly shows that the CI for the Nor-pot and gillnets crosses zero, and therefore their means are not necessarily different. The plot also shows that the NL- pot and gillnets and NL-pot and Nor-pot, have significantly difference in means, but they are both close to zero which indicates a lower power of significance. The IQR of gillnets and the Nor-pot is large above the median in Figure 8. This suggests positively skewed data and is confirmed by the histogram plot in Figure 7.

The median for gillnets is 2.5 cod with a lower quartile that lies close to the median. This essentially means that 25% of the data below 2.5 cod still lies quite close to the median, which again strengthens the notion of skewed data. The Nor-pot has an even bigger IQR in addition to a wide spread of the last 25% of data above the upper quartile within the whisker. These data are not registered as outliers, which indicates that the whole data set is skewed to the right. This is again confirmed by the histogram in Figure 7. The small IQR of the NL-pot indicates no skew and little dispersion of data. With the corresponding low median of these data and one outlier, this essentially means that the NL-pot have stable but low catches.

3.1.3 February 2014

Figure 9, shows data for the whole trial of February 2014. This trial was conducted both out west on the offshore fishing banks for NEA cod but also inside a fjord system, targeting CC. Figure 11 shows the isolated distribution for the two different fishing areas. When reviewing Figure 9 and Figure 11, it is important to note that as earlier discussed in limitations section, the data for gillnets are stipulated for

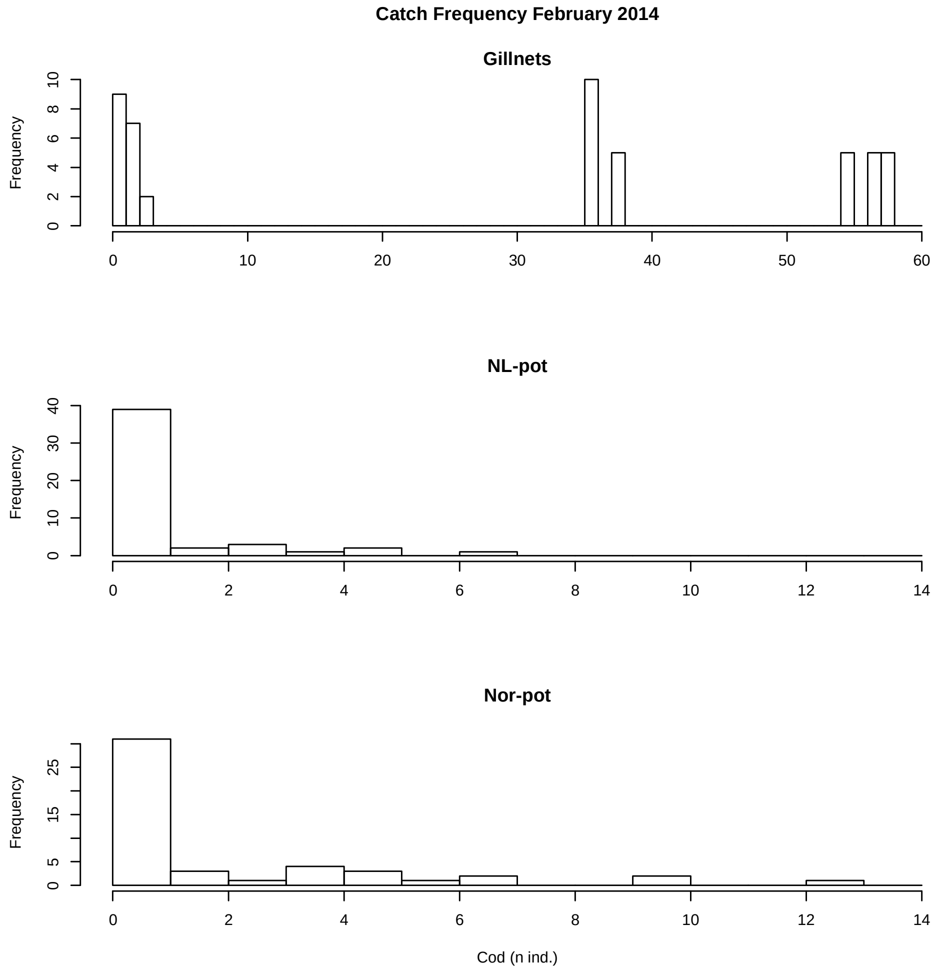


Figure 9. Catch frequency for the whole trial of February 2014, for all gear types. Numeric values are given in Table 17 in Appendix II. Y-axis and X-axis are not to scale between figures.

part of the trial (detailed information on dates where gillnets was not used, see Appendix II, Table 44).

As expected the distribution of data for Gillnets are aggregated into high frequencies and low frequencies (Figure 9 and Figure 10). We had expected an overall lower abundance of cod in the fjord system, although the catches were lower than expected for gillnets inside the fjord system. For the NL-pot there is an increased frequency of catches above the 0-1 intervals (Figure 9 and Figure 10). The distribution for the Nor-pot is increasingly dispersed compared to the previous trials (Figure 9 and Figure 10).

Figure 11 a) and b) shows the data for the two individual areas in the trial for February 2014. It is clear that the expected difference in numbers of caught cod in gillnets was a correct assumption; we can see that catch is dependent upon the area of fishing and gillnets were catching less cod in the fjord system. For both of the pot types the dispersion of data is at its largest inside the fjord system. The Nor-pot is showing higher frequencies and higher catch rates than the NL-pot in addition to a wider spread of data. The NL-pot has less spread of data and a higher frequency at 0-1 intervals compared to the Nor-pot. Gillnets in the offshore area in February of 2014 are the only catch rates that is commercially interesting.

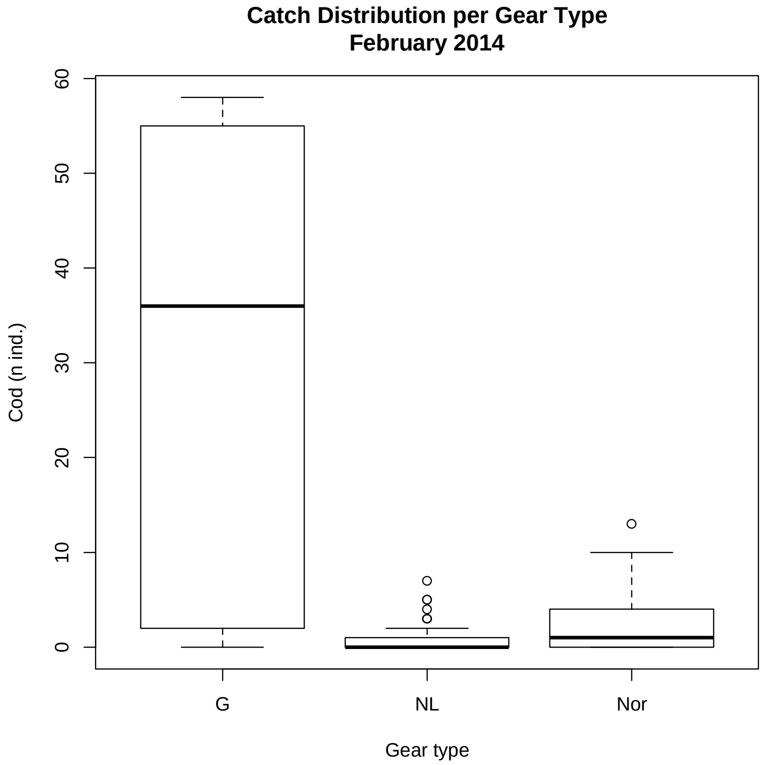


Figure 10. Catch distribution for all gear types for the whole trial of February 2014. Output values, value of mean, ANOVA and TukeyHSD are given in Table 18, Table 19, Table 20, Table 21 and Figure 35. Plot of the 95% family-wise confidence level for TukeyHSD for figure 10 in Appendix II.

The median for gillnets for the whole trial of February 2014 (Figure 10) is 36 cod, with a corresponding IQR of 53 cod. For the NL-pot the median is 0 cod and for the Nor-pot median is 1 cod. For both of the pot types, the spread of data is low and the IQR's are very close to the median. The outliers for the NL-pot can be identified in Figure 9. The histogram for the fjord system shows that there were some increased frequencies for catches with a higher number of cod for the NL-pot. The ANOVA showed highly significant difference between the gear types, p<0.001. The corresponding TukeyHSD test showed strong significant difference between gillnets and both of the pot types, p<0.001. There was not a significant correlation between means for the NL-pot and the Nor-pot, p>0.5.

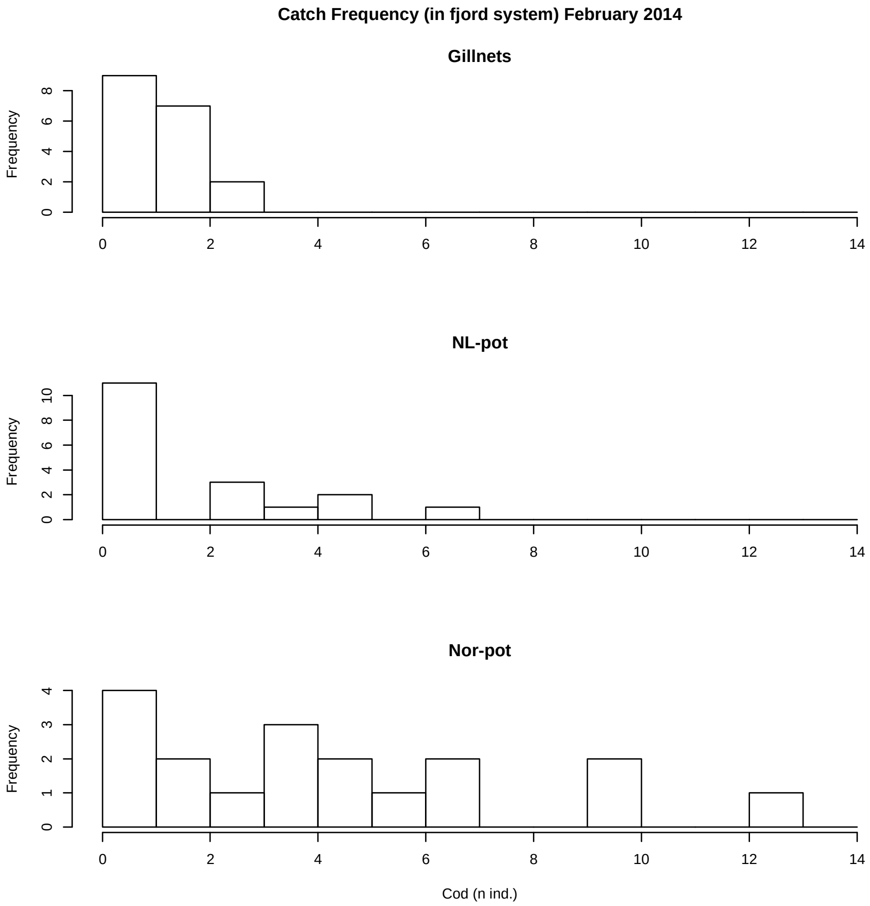


Figure 11. a) Catch distribution for all gear types for the fjord system for February 2014. Y-axis and X-axis are not to scale within and between figures. Numeric values are given in Table 22 in Appendix II

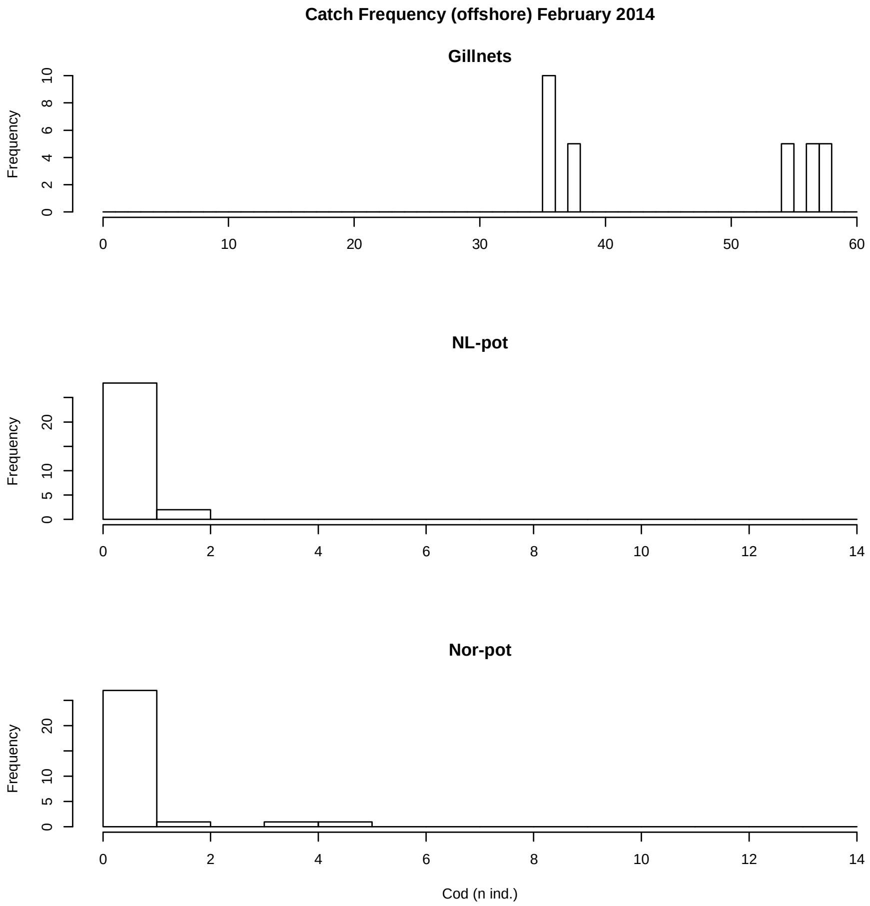


Figure 11. b) Catch distribution for all gear types for the offshore area in February 2014. Y-axis and X-axis not to scale within and between figures. Numeric values are given in Table 27 in Appendix II

Figure 12 a) & b) gives an isolated view of catch rates for the two different areas, in February 2014. When comparing the box plots, it is evident that there is a difference in performance for gillnets and pots between the two areas. Median for gillnets in the offshore area is 46.5 cod, whiles the median for gillnets in the fjord system is 1.5 cod. Catch rates for both types of pots are very low in the offshore area and the median for the Nor-pot is 1 cod and the NL-pot is 0 cod. For the fjord system in February 2014, the catch rates for the Nor- pot has a median of 4 cod, which is higher that gillnets, and the NL-pot has increased its median to 1 cod. Dispersion of data for the Nor-pot is very large with maximum catches of 13 cod and a low at 0 cod. There is some dispersion of data in the NL-pot for the same area but the IQR of the NL-pot is at 3 cod whiles the IQR for the Nor-pot is at 5 cod. The ANOVA for between- gear variation in the fjord system shows a highly significant difference of means, $p<0.001$. The corresponding TukeyHSD shows a significant difference between the Nor-pot and gillnets, $p<0.001$ and Nor-pot and NL-pot, $p<0.01$. There is no significant difference between the NL-pot and gillnets in the fjord system in February 2014, $p>0.05$. The ANOVA for between- gear variation for the offshore area gives a significant p-value at, $p<0.001$. The corresponding TukeyHSD gives a significant difference for both NL-pot and gillnets and Nor-pots and gillnets, both with the highly significant p-value of $p<0.001$. There is no correlation between means for Nor-pot and the NL-pot, $p>0.05$.

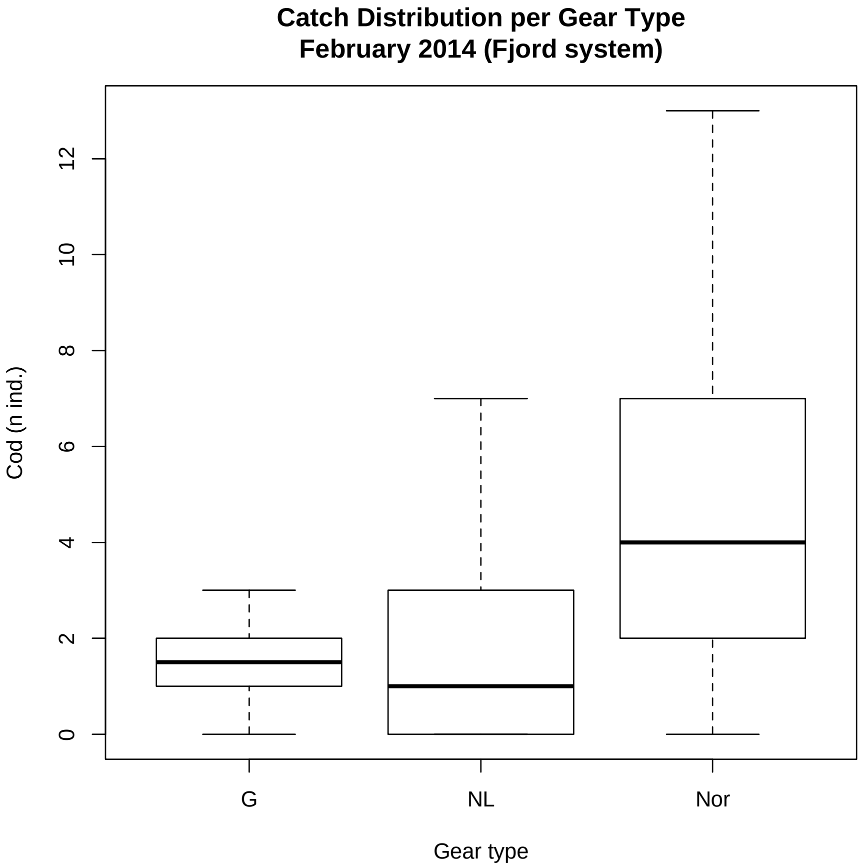


Figure 12. a) Catch distribution for all gear types for the fjord system in February 2014. Y-axis not to scale between figures. Output values, value of mean, ANOVA and TukeyHSD are given in Table 23, Table 24, Table 25, Table 26 and Figure 36 in Appendix II.

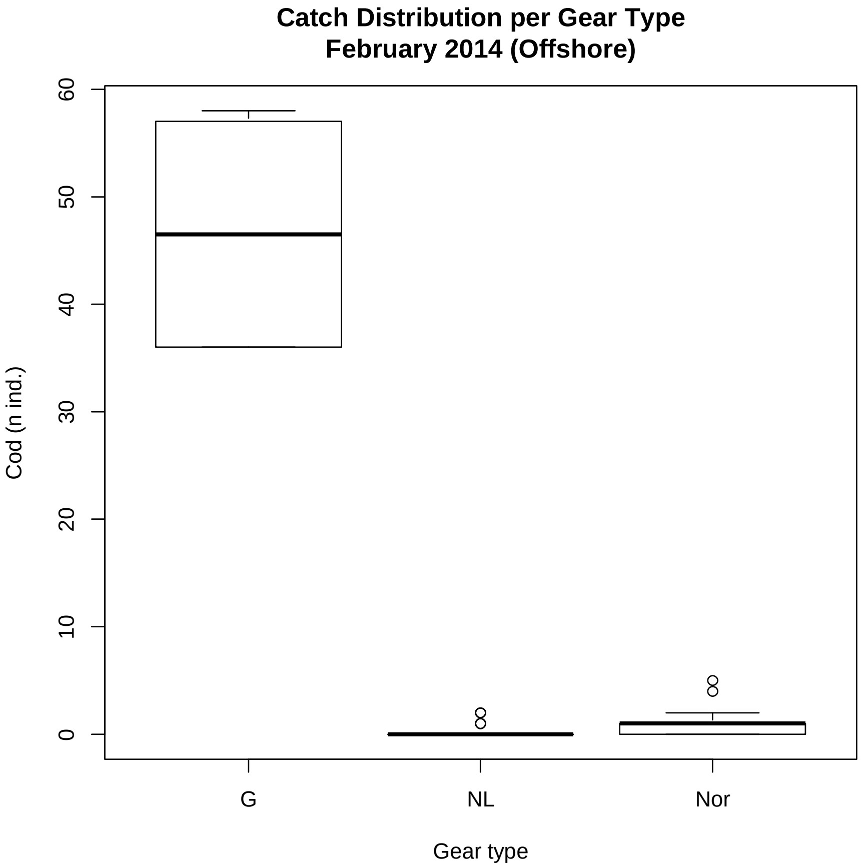


Figure 12. b) Catch distribution for all gear types for the offshore area in February 2014. Y-axis not to scale between figures. Output values, values of mean, ANOVA and TukeyHSD are given in Table 28, Table 29, Table 30, Table 31 and Figure 37.

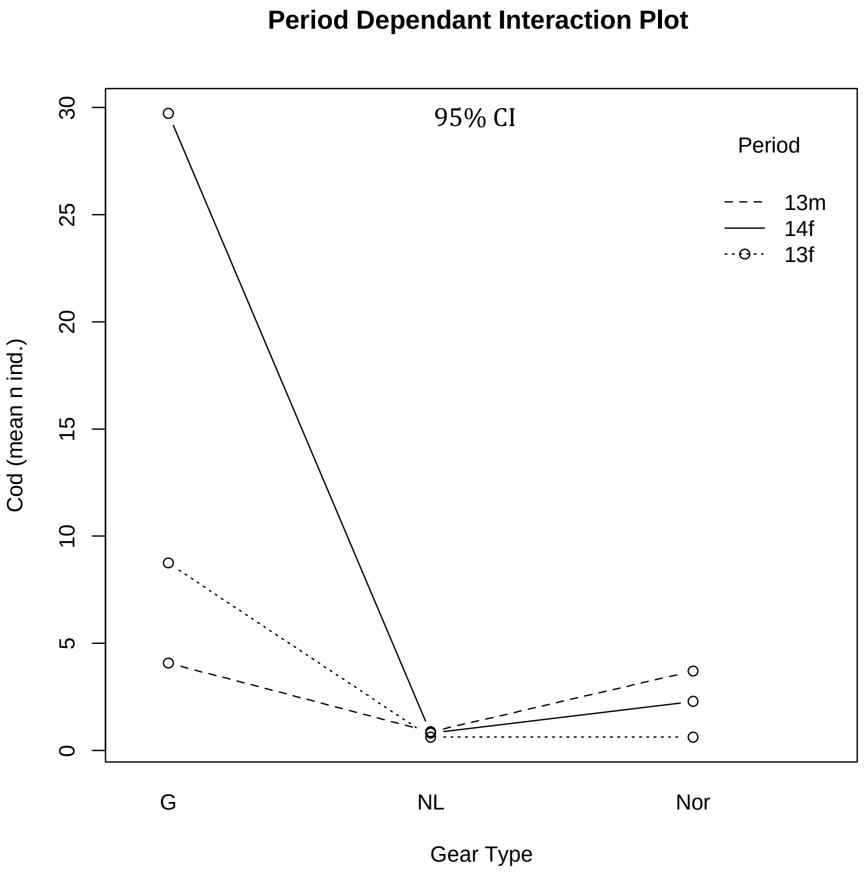


Figure 13. a) Period dependant interaction plot for all gear types. Measurements are in mean number of cod individuals with a 95% CI.

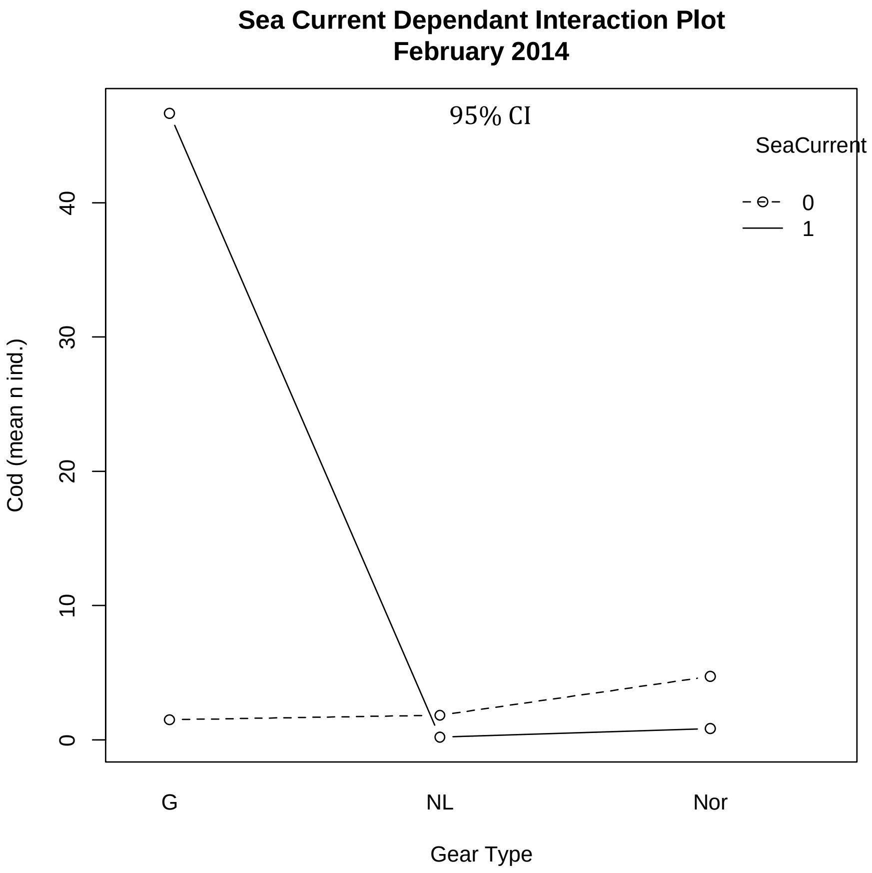


Figure 13. b) Sea current dependant interaction plot for all gear types. (0= no current, 1=current) Measurements are in mean number of cod individuals with a 95% CI.

The interaction plot in Figure 13 a), gives an overview of mean catches per gear per period. The figure confirms an interaction between the three gear types that is dependant of the period. The interaction is especially clear for the trial of February 2014, where the performance of gillnets is very good, but for both types of pots, the catches are very low. Overall, the NL-pot is the gear that provides the lowest catch rates, and holds the lowest performances for all three periods. The interaction plot does not explain why there is an interaction, only that there is one. Figure 13 b) is showing a possible reason as to why the gear performance varies between the different periods. In Figure 13 a) we compared the offshore catches to the inshore catches in the fjord system. In the figure the catches are made dependant on sea current in the area. The sea current is simplified into two categories (0=no current, 1=current), as explained in limitations (section 2.2). The most obvious interaction is of gillnets, which shows a large difference in mean catches between the two conditions. Both types of pots show an increase of mean catches in no current condition.

The outcome of Figure 14 is somewhat expected after reviewing figures for the three trial periods; the CPUE for pots are overall low. Only gillnets in the specific period of February 2014 show a CPUE that is of commercial interest. The IQR for gillnets in February of 2014 (Figure 14) expands from approximately 3.05 CPUE to 0.1 CPUE. This is an IQR value of 2.95 and shows a large variation of CPUE values for this period. The variation is thought to be a result of pooling the data from both the fjord- and offshore area. The pooling of data in the trial of February 2014 is also resulting in some outliers for the Nor-pot in Figure 14.

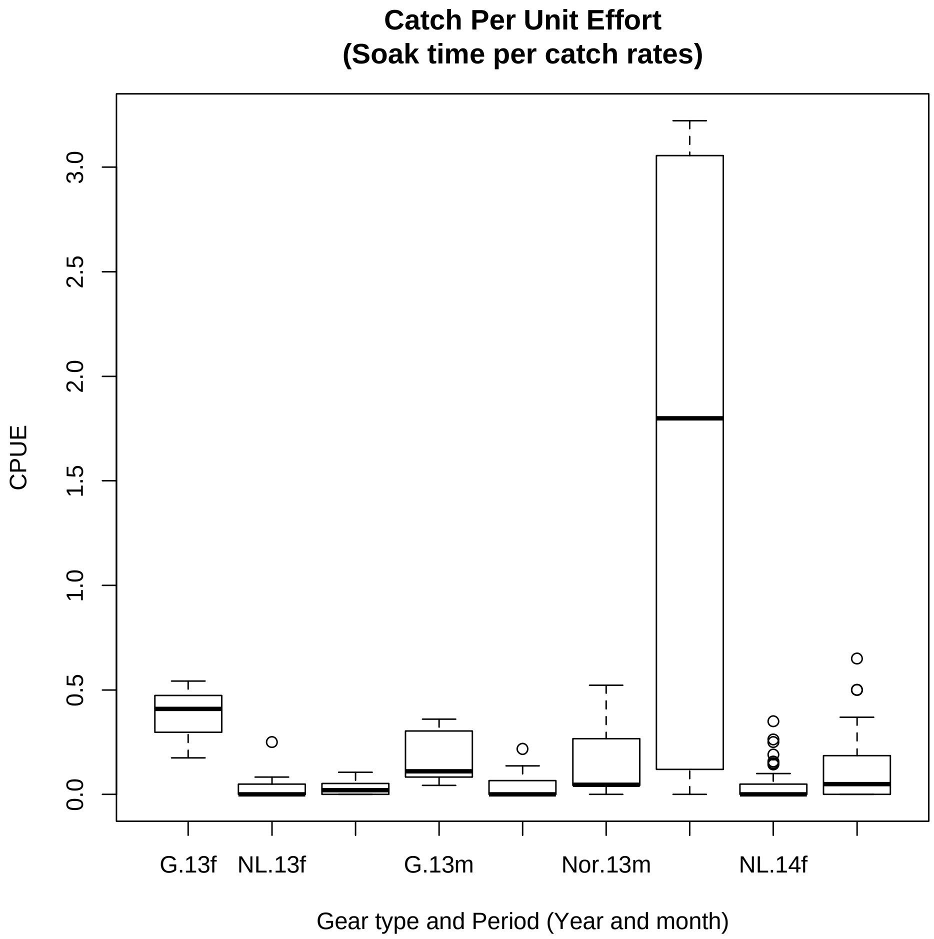
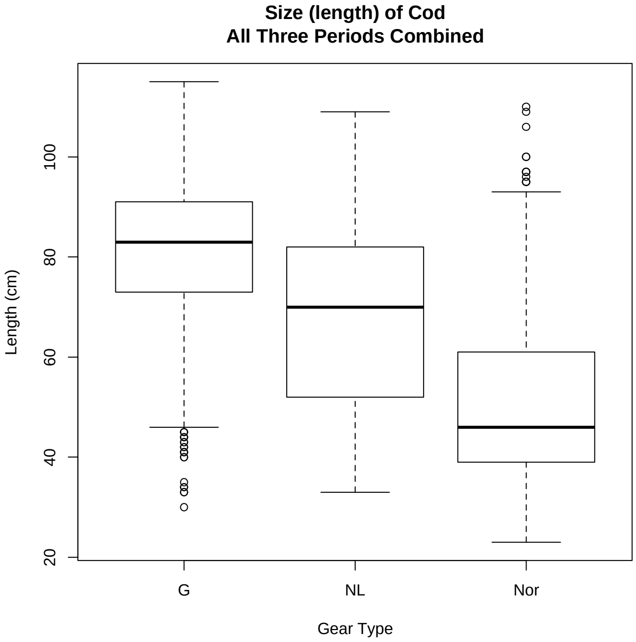


Figure 14. Box plot of Catch per unit effort (CPUE) calculated for all gear types and all periods. CPUE is calculated by soak time in relation to catch rates. Output values are given in Table 32.

3.2 Size distribution

below, show a clear difference in median sizes (length in cm) for cod, in all the different gear types and an ANOVA test for significant difference between the gear types gave a p-value of, p<0.001. The TukeyHSD shows a highly significant difference between all three types of gear, p<0.001. Median for gillnets is 83cm with an IQR range of 18cm. Mean for gillnets is 80cm (Table 34) and lower than the median, which suggests a negative skew of the distribution of data (length sizes). This is confirmed by histogram in Figure 16. The pooling of data gives a relatively large spread towards smaller sizes of cod for gillnets. The long stretch of the lower whisker and a very small minimum value (46cm) in addition to several low outliers for gillnets, would most likely not be the case if data from the fjord area was excluded from the pool of data. Median for the NL-pot is 70cm with a max value at 109cm and a minimum value of 33cm. The IQR of the NL-pot ranges from 52cm-82cm with an corresponding value of 30cm. The Nor-pot shows the lowest performance, in terms of cod sizes, and has a median of 46cm with a minimum value of 23cm. The maximum value for the Nor-pot is 93cm but the data within the upper whisker is very dispersed.



. Size (Length in cm) of cod for all three periods Output values, value of mean, ANOVA and TukeyHSD is given in Table 33, Table 34, Table 35, Table 36 and Figure 38 in Appendix II.

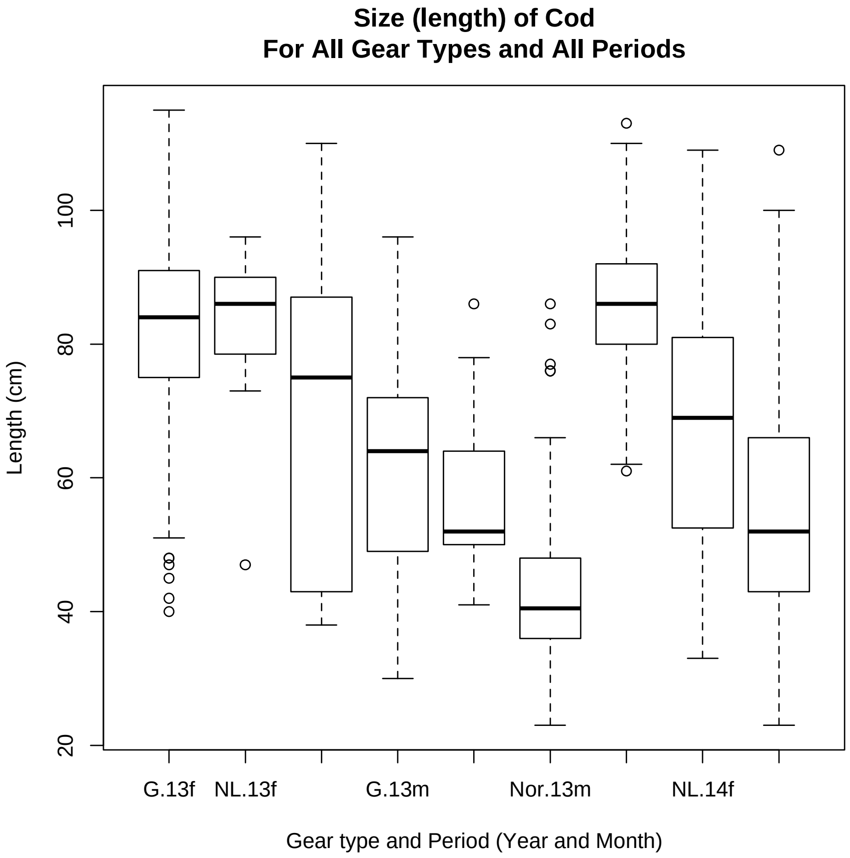


Figure 15. Size (length in cm) for all types of gear and for all periods (year and month). Output values, value of mean, ANOVA and TukeyHSD is given in Table 37, Table 38, Table 39, Table 40 and Figure 39 in Appendix II.

Figure 15 shows length in cm for cod, for all types of gear, dependant of all trial periods. ANOVA and TukeyHSD tests were performed for all these comparisons.

A two way ANOVA was conducted to see if there were significant differences of size of cod individuals between gear types, dependent on period. The ANOVA showed a significant difference of the size of cod individuals with a value of $p<0.001$ for both between gear types and between periods. The ANOVA also provided a significant p-value and confirmed an interaction of cod size between gear types, dependant of period, $p<0.001$. TukeyHSD test was performed for the two variables individually in addition to all possible comparisons of means between every type of gear for every period. For all three gear types, TukeyHSD calculated significant difference in means, $p<0.001$ (Table 39). TukeyHSD also provides a significant difference of cod size between the periods of May 2013 –February 2013 and February 2014-May 2013, $p<0.001$ (Table 40). TukeyHSD shows no significant difference between the periods of February 2013-February2014, $p>0.05$.

In figure 17, the trend of cod size in relation to gear type is the same for the periods of May 2013 and February of 2014 as is also the case in figure 16- here we can see that gillnets provide the largest median sizes whiles the NL-pot comes second and the Nor-pot catches the smallest fish and holds the lowest median. In Figure 15 for the period of February 2013, this is not the case. In this particular period it is the NL-pot that is providing the largest sizes of fish. In this period, the median for the NL-pot is 86cm and in gillnets 84cm. The period of February 2013 is also the period where the Nor-pot has its highest median at 75cm. TukeyHSD for the period of February 2013 shows no significant difference in means between gillnets and the NL-pot and Nor-pot and NL-pot, $p>0.05$. There is on the other hand a significant difference in means between the Nor-pot and gillnets for the period of February 2013, $p<0.01$. Overall, Figure 15 provides an overview of size of cod in relation to fishing area. For the trial of February 2013 the fishing area was offshore. Within the same year but in the month of May, the fishing area was a fjord system. In February of 2014 we fished both offshore and inside the fjord area. The sizes of cod are lowest in the month of May 2013, when we were fishing inshore inside a fjord system.

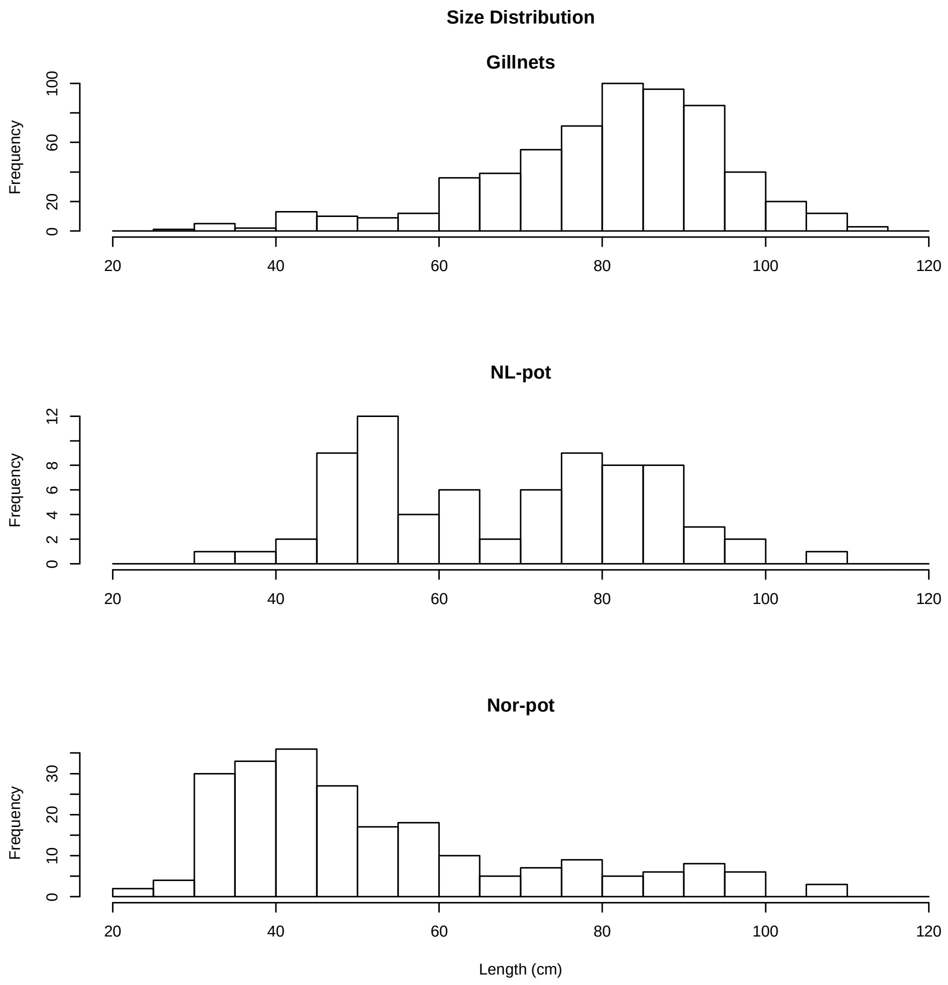


Figure 16. Size (length in cm) distribution for all gear types. Data is pooled from all three sea trials. Y-axis is not to scale between figures. Output values in Table 41 in Appendix II.

Figure 16 confirms the skewed data distribution that was anticipated from the results in boxplot in . The size distribution for gillnets shows a close to normal distribution, which is not the case for the two types of pots. For the NL-pot the distribution is unimodal. The NL-pot has its highest frequency at 50-55cm and 80-85cm. Figure 15 shows that the NL-pot has, for the periods of May 2013 and February of 2013, the median of 52cm and 86cm respectively. This correlates with the unimodal size distribution of Figure 16. Size distribution for Nor-pot is skewed right and the highest frequencies are within the size range of 30cm-45cm.

3.3 By-catch

The by- catch profile for the different gear types varies in species. The gillnets caught haddock and pollock exclusively whiles the Nor-pot caught all four species registered. The NL-pot also caught the whole range of species except for Pollock.

Table 5. By-catch profile per gear type, given in number of individuals

	n of indiv.			
Gear Type	Haddock	Wolf Fish	Tusk	Pollock
G	46	0	0	5
NL	6	4	1	0
Nor	15	3	17	3

3.4 Quality of catch

Quality of catch, regardless of species, varied substantially between the pots and the gillnets. There were no difference in quality of catch between the Nor-pot and the NL-pot. When handling the fish caught in pots, it was clear that this gear provided only one type of quality, which was superior (no gear marks and seemingly in perfect physiological condition) (Picture 1a). As a result of the fish being in good condition, the individuals bled out very fast (Picture 2a). Gillnets provided a range of four main types of quality categories of cod (Picture 1b).

The lowest quality of cod had been fed on by scavengers and amphipods and was not acceptable for human consume or fit for the industry.
The third category of cod was cod with damages from scavengers and amphipods but not to such a degree that it would not be accepted for delivery to industry.
The second best category was cod with marks from gear that had resulted in bleedings in skin. Scavengers or amphipods had not fed on these individuals
Top quality cod caught in gillnets still were marked by the gear but not to a great extent. Most of this fish were dead and many had reached rigor mortis.

In all categories of cod caught in gillnets most the fish was dead, and therefore resulted in a poorer bleeding. In addition, much of the fish was already was within the rigor mortis process which added to the poor bleeding as well as a shorter shelf life and durability of the cod. Also the best quality of cod caught in gillnets, (Picture 2b) were always marked by the gear and often had bleedings in the skin. The bleedings was on occasion seen also in the filet.

Picture 1. a) The quality of cod caught by the NL-pot.

Picture 1. b) All quality types (four categories) of cod caught by gillnets. Lowest quality of fish is shown at bottom of picture.

Picture 2. a) Gills of bled cod from the NL-pot.

Picture 2. b) Cod from the two best quality categories of the gillnets. Second best quality is shown at bottom of picture.

3.5 Handling of gear

The handling of the different gear types varied in time use, convenience and safety. Gillnets were as expected easy to handle. The high degree of convenience connected to the handling of gillnets were due to crew experience and proper rigging of the vessel for the task.

The handling of pots were more time consuming due to little experience with the gear in addition to a rigging that was not ideal for the task. This being said, there was also a clear difference between the handling of the two types of pots. The light structure of the Nor-pot provided an easy and secure handling. The handling of this pot was somewhat time-consuming due to the placement of the zippers- the emptying of the pot took time, especially if king crab (*Paralithodes camtschaticus* Tilenau, 1815) was a part of the catch.

The emptying of the NL-pot was easier and less time consuming but the total handling time (from the point where we got the pot out of the water until the bait was replaced and the pot was ready to go out again) was more than doubled when handling this pot. If one made sure that the catch was collected in the cod-end of the NL-pot before placing the pot on the deck, it was easy to empty the sac of fish. King Crabs was also easy to remove if we made sure that they were inside the cod-end of the NL-pot.

Despite the ease of emptying the NL-pot it was, as mentioned, the most time consuming gear. This was mostly because of the size of the gear, which meant that we had to use a crane for lifting it on board in addition to the need of organizing the pots in such a manner that we were able to open them and replace the bait whiles they were stacked on deck. The triggers in the opening of the NL-pot were cumbersome under hauling, rigging of pot and changing of bait bags. During hauling, the triggers that were situated counter current left the entrance open. We observed one fish that were lost due to this problem. Triggers moved and got stuck during lifting operations, causing extra work when folding the pots on deck. Triggers getting stuck when changing the bait also contributed to additional work and close to doubled the time spent on this operation, compared to the Nor-pots.

The need of lifting the NL-pots resulted in the lowest safety of all the three handlings of gear. No particular risk was involved when handling gillnets or the Nor-pot but when lifting the heavy and large structures of the NL-pots a degree of risk was involved. This risk increased with waves and wind.

3.6 Modification of entrance design

The new entrance designs were installed in two NL-pots to investigate whether Nor-pot style entrances would increase catch rates of the NL-pots.
The results from the new design of entrances were negative and we caught no fish in the pots. We believe that the choice of twine in the entrances was to thin (to soft) which caused entangling of fish (Picture 7 in Appendix III). Due to the results being completely negative, they are therefore not included in any further analyses in the results.

3.7 Behaviour study of cod in relation to the NL-pot

Results from the behaviour analysis are based on video footage, and with time the amount of fish in the pot increases. This created a challenge when trying to do observations due to fish constantly blocking the view of the camera. Therefore the count of fish observed in relation to entrances is much lower than the estimated number of fish caught in the pot. Despite of this, we believe the observations registered to be representable numbers for the population caught in the pot.

The film observations show that within two minutes after the pot lands at bottom, haddock is the first fish on site. After only five minutes of fishing there is a considerable amount of fish, this being mostly cod, surrounding the pot. After ten minutes of fishing, the first cod enters the pot through the counter- current entrance.

The quantitative results from this behaviour study are listed in Table 6. The findings first and foremost show that there is a definite difference in amount of individuals entering the pot against the current, as opposed to entering the pot through the entrance orientated with the current.

The fish entering the pot was explained by three categories:
1. Does not enter the pot as a response to contact with triggers.

2. Fish swims into the entrance and is searching for possible penetration opportunities but does not encounter or find the triggers for whatever reason. Fish turns around and swim back out again

3. Fish search within the entrance funnel for penetration opportunities but in the end swims directly towards bait bag through entrance and through triggers without any problems.

Table 6. Count of cod individuals entering the NL- pot with categorized behaviour 1-3.

	Against current			With current		
Category	1	2	3	1	2	3
Number of fish	14	17	8	4	0	2
Percentage of total	31 %	38 %	18 %	9 %	0 %	4 %

Of the 45 registered and observed cod in the study, 18% has no problem with entering the pot. 69% is lost to the pot, as the fish did not want to go through the trigger system or that the fish did not find the entrance. The last scenario is the most pronounced, as many fish did not try to push through the triggers. It seems as if the fish does not understand that this is the way in. Despite resilience towards contact with the triggers, in every case of category two, fish push towards the netting i.e. the walls of the entrance funnel (Picture 6 in Appendix III). The fish seems quite undisturbed by it's contact with the netting twine, as opposed to its behaviour in category one- were the fish touched the triggers with part of its head (trying to push through) and is disturbed by this and swims away (Picture 4 in Appendix III). In category one the fish also often search towards the netting twine in entrance funnel without being disturbed by this. Most fish that enters the pot (category three) search into netting walls of the entrance before succeeding in entering the pot through triggers. There is on the other hand, some fish that swims directly through the triggers heading straight towards the bait bag. These fish are in most cases, large individuals i.e. of such a size that the relative difference between the cod and the triggers is large enough so that the cod is not intimidated. In the other end of the scale, very small fish (estimated to be smaller than 44cm) fits between the triggers (Picture 5 in Appendix III). These also show a behaviour towards the triggers that differs from most of the fish, meaning they head straight towards the bait bag, fitting between triggers and are not intimidated by them. Due to this, the study indicates that the relative size difference between the cod and the triggers is a factor that can affect catch efficiency of the pot. In reference to further development of pots and entrance systems, it is very interesting to see that the fish has no problem contact with twine netting.

Fish surrounding the pot circulated around the structure although when comparing recordings from the two different camera angels, it seems like the aggregation of fish is larger on the down stream side of the pot. The first cod individuals that enters the pot pots does show some sign of stress by looking for a way out. As the number of cod in the vicinity of the pot increases, the stress is reduced and some individuals can even be seen resting inside the pot (Picture 3 in Appendix III). The pot caught one Pollock, which was stressed and searched for a way out whiles being completely uninterested in the bait (Picture 3 in Appendix III). Most cod seem to be orientated around the bait bags and not many fish swim up into the cod-end of the pot. The short soak time is reason for a high amount of chemical stimuli from the bait and some individuals are quite aggressive toward the bait bags while most fish seem uninterested.

Fish seem to circle around the whole pot, but when studying the activity outside the pot from both angles (both cameras), it looks like there is a higher concentration of fish on the counter-current side of the pot. The placing of the pot and the entrances was very fortunate, i.e. one of the entrances was placed counter-current.

4.0 Discussion

The results of our research shows that catch rates of both types of pots are not commercially interesting and for all trials (except the trial of 2014 inside the fjord area) substantially lower than catch rates caught by gillnets. Previous testing of catch rates of the Nor-pot has been done with a high degree of variation in results and catch rates have varied between mean catches of 3.6 fish to 1.5 fish and lower, per pot (Furevik and Løkkeborg 1994; Furevik and Skeide 2003; Løkkeborg et al. 2013a; Løkkeborg and Humborstad 2012; Løkkeborg et al. 2013b). Our results correlates with the previous trials of the Nor-pot, as our results have a high degree of variation and low catch rates on average. In Newfoundland Canada, the results for catch rates have been higher and more stable for the NL-pot (Walsh 2013; Walsh and Sullivan 2007). The higher catch rates caught in Canada with the NL-pot, we have not been able to produce in any of our trials. Our results also show that the Nor-pot has higher catch rates than the NL-pot in addition to a wider spread in catch rates.

4.1 Catch rates

The results clearly shows that catch rates varies between gears, within and between trial periods (Figure 6, Figure 8, Figure 10, Figure 12 a) and b) and Figure 13 a). The high degree of dispersion in catch rates within the different gear types is at its largest for the fjord areas (Figure 7, Figure 8, Figure 11 a) and Figure 12 a) with only one exception: catch rates for gillnets, in the fjord area in the period of February 2014. The catch rates for pots in the offshore area show less variation and are stable and low. (Figure 6 and Figure 12 b). The highest catch rates for pots are inside the fjord systems, but overall, the catch rates of the pots are far lower than commercial catch rates that were caught in gillnets for large parts of the trials.

The variation in catch rates for pots between inshore and offshore area, might be subject to change due to behavioural differences in the two different cod populations. The target species of the offshore area was the spawning and migratory NEA cod, whiles the CC was the target species in the fjord systems. Løkkeborg and Johannessen (1992) suggested that chemical attraction of spawning cod in mid-water is not as crucial and that vision stimuli might be a more relevant technique for attracting migrating cod to pelagic long lining. Pol et al. (2010) summed up that an essential prerequisite common to all stationary fishing gear is the availability of fish, and additionally that feeding fish is a prerequisite for all baited types of fishing gear. Availability of NEA cod in the offshore areas in February 2014 was high, but the pelagic distribution of the NEA cod might make the aggregations unavailable to specific gear types, in this case pots. Spawning NEA cod is known for forming schools and swimming close to the shelf edge (Sakshaug et al. 2009). This distribution of the target species is a poor match for pot fishing. Pot fishing demands a topography that is relatively flat for best possible placing of the pot. Targeting cod along the shelf edge is difficult when fishing with pots. The NL-pot is especially vulnerable to a non- horizontal displacement, due to the triggers being affected by the gravitational force and thus failing to retain fish.

The feeding activity of spawning cod is generally low, although Fordham and Trippel (1999) reported that after a suppression of feeding by both sexes in the first three-quarters of the females spawning period, an abrupt increase in feeding occurred for cod during the last quarter of the spawning or shortly after release of last egg batch in females. The authors also suggest that baited longlines will be ineffective in capturing spawning adult cod, if the cod cease to feed. The results from the authors suggests that there should be potential for pots and baited gear, as the feeding activity in cod substantially increases within the last quarter of the spawning period.

Simultaneously to our trial in February 2014, there was vessels fishing in the area with baited semi-pelagic long line. These vessels caught 500kg per 300 hooks (Longliner February 2014), which are considered to be high catch rates in the Norwegian fishery for NEA cod at this time and in this area. These catch rates for semi-pelagic longlines is a strong indication that the fish in the area was in fact feeding and responding to baited gear. The semi- pelagic placing of the longlines in the water column, might suggest why the longlines were catching cod and the pots were not. A different spread of plume and the role of vision stimuli that semi-pelagic long lines can provide might also be contributors to the high catch rates of the semi-pelagic longlines. The lack of these plume and vision stimuli might be the reason for the pots failing. A further complication of this discussion is the registration done by gillnets at the same depths and in the same area as the pots. The large amount of cod caught by gillnets proves that fish availability in the area of the pots, in terms of abundance, was high. The cod caught in gillnets, is caught by a completely different fishing method based on fish availability and fish moving (He 2011). They do on the other hand give the indication that in terms of abundance of cod, there is a potential for pot fishing, but the willingness of the fish to attack bait is not explained by the catch from gillnets.

As explained in the limitation section in the method, for the offshore trial of February 2013, there was a high abundance of capelin out west from the fishing ground. The mix of bait that we used during all of the trials did not contain capelin. The fact that NEA cod in the area was feeding on capelin might have contributed to lowering the performance of the pots. The NEA cod would be feeding higher in the pelagic, and the chemical attractants from the pots could have been covered up by the chemical odour from capelin.

As mentioned in the beginning of the discussion, the performance of pots is better inside the fjord system, with a high degree of variation. The target species inside the fjord system were CC. CC can perform migration into the pelagics during feeding on pelagic resources or during the spawning period, but in general, CC has a relatively stationary feeding behaviour and a demersal lifestyle (Aglen et al. 2012). Løkkeborg (1998) tagged cod and used a stationary positioning system for studying feeding behaviour of cod in relation to a baited longline. This study was conducted in Ramfjorden, where our trial for May 2013 and parts of the February 2014 trial also were conducted. Løkkeborgs results showed that a higher proportion of cod that encountered the bait plume conducted a successful search which resulting in location of bait, than cod that did not encounter the chemical plume. The demersal and stationary lifestyle of the CC in addition to different current condition in the fjord system, could be a possible explanation as to why the performance of the pot improves inside the fjord system.

Figure 13 b) shows an increase in mean catch for both types of pots with lower current condition inside the fjord systems. The interaction plot shows a clear correlation between the two different current conditions for the different gear types. The increase for the NL-pot is very low but still positive. The Nor-pot has a clear positive response to the change in current conditions. The interpretation of the substantial difference in catch rates for gillnets for the two different conditions should be done carefully. It is more likely that the lower abundance of CC in the fjord is the direct reason for gillnets having lower catch rates in the fjord system than on the offshore banks. The reason why the assumption is different for the pots is because both types of pots is showing the opposite effect; they have a lower catch rate in the area with high abundance of cod, and perform better in the low-current area, despite of lower abundance of cod.

Vabø et al. (2004) reported that cod searching for odour plume, pre-olafctory stimuli in the continuous landscape of Ramfjord, was swimming at a relatively large angle towards the current. This type of search behaviour for locating odour plume gave the best results. Vabø concluded that the reason for the good performance of this strategy was the ability of recording both dimensions of the landscape. During post- olfactory stimuli, Vabø recorded that "upstream" search was the best strategy and most fish using this strategy managed to locate the odour source. This type of feeding strategy and the demersal lifestyle and of CC in fjord systems like Ramfjord and Ballsfjord, looks to be favourable for the pot technology. The counter current behaviour of CC when searching for the bait shows the importance of orientating the pot entrance downstream.

4.2 Size distribution

We expected the two different types of mesh size in gillnets to provide a bimodal size distribution. This is not the case in Figure 16, which shows a close a unimodal distribution. The reason for this we assume is that large parts of the cod in this area are above a certain size. This seems like a reasonable assumption since the abundance of cod in the area was spawning cod, and therefore over a certain length. The size distribution for NL-pot is unimodal and median size for cod caught in the NL-pot is 70cm, which is 13cm lower than gillnets and well within a commercial size range (). The Nor-pot on the other hand shows a unimodal distribution, with a right skew of catch size data in Figure 16. The median catch of the Nor-pot is 46cm, which is only 2cm above the minimum legal size limit for cod North of the 62°N. Due to the small size rage of the fish caught in Nor-pot, we believe a commercial fishery with this type of small mesh size is highly debatable.

Figure 15 shows that for all three trials, the Nor-pot catches the smallest fish. This is an expected outcome, since the Nor-pot has the smallest mesh size of all the gear. Outliers in , shows that although the Nor-pot is catching most fish at around 46cm, the Nor-pot is also capable of catching large individuals of cod. All gear types catch smaller fish in May 2013 (Figure 15) compared to the two other trials in February 2013 and 2014. This was an expected result due to the large abundance of adult spawning NEA cod in the offshore area whiles the fjord area has a larger range of CC cohorts available to the gear.

4.3 Behaviour of cod in relation to the catch principle of pots

As previously discussed, the demersal lifestyle and the well-developed sensory modalities of cod is a good fit for pot fishing. This type of fish behaviour is obviously what the principle of pot fishing is built upon. Despite of this theoretically good fit between cod behaviour and the principle of pot fishing, we have proved through our findings that the pots do not work as well as expected. From the behavioural study of the NL-pot, done by film recording of fish behaviour, it seems quite obvious that the fish is sensitive to the design of the pot structure. Fish in the behavioural study had all the prerequisites for being available to baited gear (we base this statement on the high catch rate of the pot). Despite of this, we recorded massive loss of fish that, what we perceive as mainly due to the design of the entrance and trigger system, did not enter the pot and turned around after contact with parts of the entrance. We believe that in the case of the NL-pot, there might be a lack of correct visual stimuli, resulting in confusion under location of the entrance. When the fish is approaching the pot structure, the fish is post-olfactory stimuli and is effectively executing search behaviour. We believe that the entrance of the NL-pot might increase its function if there is a better visual stimulus at near approach. The visual stimulus should be a guide into the pot, towards the bait, and it should be obvious and easy for the fish to understand at what angle to approach the structure and where to penetrate. Newman and Williams (1995) stated that trap silhouettes presented by different mesh sizes, was of prime importance for a strong visual stimulation in target fish. The study further showed that smaller mesh sizes provided a distinct visual image, whiles larger mesh resulted in fish failing to perceive the entrance of the pot and further, a low ingress of fish. The mesh size in the NL-pot is large in reference to the Nor-pot (120mm in mesh length to 57mm in mesh size). The entrance of the Nor-pot is exclusively of monofilament, whiles the entrance in the NL-pot is of white and braided Polyamide. From the combination of and contrast between small mesh and the close to invisible monofilament entrance in the Nor- pot, we believe a strong silhouette is produced, providing a good visual guide for the fish. The monofilament entrance give the fish a good and constant visual of the bait bag whiles the small meshed netting frames the entrance, making the way in and the way to the bait clear for the fish. The visual contrast between the main netting and the entrance is not as distinct in the NL-pot and produce opportunity for confusion on location of entrance and how to penetrate the entrance. The penetration is further complicated by the trigger system in the NL-pot, which was identified as an obvious bottleneck by the film footage studied.

4.4 Quality of catch

The quality of cod caught in gillnets, stood in clear contrast to the pot caught cod. Both the NL-pot and the Nor-pot gave superior quality of fish. It is unsure whether the top quality catch from the pots would give better prices, but there is no doubt that the price for the quality of cod caught in gillnets would give reduction in price to the fisherman. In every category of the gillnet catch, there is a quality reduction that is going to limit the possibility of utilization for the land industry, which initially results in reduction of product value. Whiles the superior quality from the cod caught in pots would ensure that the buyer of the fish could utilize the whole catch in whatever production desirable. A prerequisite for profitability in all production stages for seafood is quality. These quality demands can be guaranteed with cod caught by pots, assuming correct handling of catch on board and under production of the industry. The physiological state of the fish caught in pots we asses to be very interesting in relation to further use of cod in aquaculture.

4.5 Handling of gear

The handling of the NL-pot was difficult due to its size and the risk involved in the handling process. The size of the NL-pot and the challenges connected to the trigger system is two technical aspects that needs to be corrected before this type of design can stand a chance of being a commercially interesting design in the Norwegian coastal fleet. The time consuming handling of the NL-pot would not be a match with the constant need for efficiency of handling on board. The lighter and smaller construction of the Nor-pot on the other hand, is better eligible for keeping efficiency high on board, giving a short turnover time for each pot and in this way ensuring that one boat could handle 100-150 pots per day. In situations with bad weather, pots give the fisherman possibility for leaving the gear in the water without compromising the quality of the catch. This is an advantage in safety for the crew on board fishing vessels that gillnets or other stationary fishing gears like for example longlines, can not provide.

4.6 Design of trial

Using gillnets as a species and size indicator, is confirmed to be a good design; the large range of sizes confirms that gillnets could handle the different size ranges in both the offshore and inshore fjord area. However, the catch of gillnets did not give us any information on the degree of willingness of the fish to feed on bait. This would be better provided for by bottom longlines, which would be a very good alternative, but it was impossible to do with the vessel we had at our disposal.

The parallel formation of the three gear types we consider a good design in terms of using the gillnets as an indicator, at the same time as giving enough free area for all of the pot fleets to fish as they would in a commercial setting, without the gillnets. The NL-pot was never constructed for use in fleets (Walsh 2013) but our experience with the NL-pot in fleets was satisfactory. With the type of rigging that we used, we believe the NL-pots work just as well in fleets as if they were placed one by one. The Nor-pots also worked well in fleets, though this was expected due to previous successful trials with this type of rigging. The standardisation of the bait type and amount was helpful in interpreting our results. If bait were a non-standardized factor, it would have been very difficult interpreting the differences in catch rates between the inshore and offshore areas.

4.7 Conclusion and advice for further research

Both type of pots were set on the bottom, making them stationary. When deploying the pots in fleets, we believe that they would orientate them selves with current, orientating one of the entrances of each pot counter current. We believe that the pot tested, with this type of rigging, were in fact orientated correctly relative to the current conditions, but due to their stationary placing on the bottom, we believe them to be vulnerable towards shifts in current conditions. Fewer shifts in current conditions inside the fjord systems as opposed to offshore grounds could be a possible reason for the pots performing better in the fjord areas. The importance of counter current orientation is confirmed by the film observations (Section 3.7), the current plot (Figure 13 b) and also by other fish behaviour studies (Fernö et al. 1986; Furevik and Løkkeborg 1994).

We believe that floating pot structures off the bottom would ensure a constant and correct counter current orientation. A theory as to why the Nor-pot caught the highest catch rates might be that when sea currents shifted, the light construction of the Nor-pot was lifted of bottom and thus was orientated counter current. Under heavy current conditions, we are on the other hand unsure whether the collapsible structure of the Nor-pot in fact collapses due to the sea current forces. We believe that the NL-pot is such a heavy construction that it stays stationary on the bottom despite shifts in current and will not in any way collapse under heavy current conditions. Despite of the stationary positioning of the NL-pot, we are at this stage very unsure of how the cod-end of the NL-pot behaves under strong current conditions. If the cod-end moves around much or even collapses under strong current conditions, this might scare fish away from the NL-pot structure, and contribute to the poor efficiency of the NL-pot during shifting current conditions. Orientation of pots in a counter current direction we believe is of vital importance and could be key in further development of pot technology in reference to increasing catch rates.

We have discussed the role of fish vision post-olfactory stimuli and argued for that there is an underlying potential in guiding fish towards bait and into the pot structure via the use of contrast (Section 1.2, Section 2.3.4 and Section 4.1). Research on the role of fish vision in reference to its behaviour towards baited structures like pots, would be very informative and could improve the function of the pot technology.

The quality of catch caught in the pots in addition to the by-catch profile confirms the large potential in terms of deliverance of a high quality product of both target species and by-catch species. When discussing the potential of pot technology with interested parties in the industry, the potential is evident to fishermen, which confirms that if the catch rates of pots were satisfying, this gear type would be close to an ideal one. Fisherman Mr André Reinholdtsen states that if catch rates per pot were 50kg, he would use 500grams of bait per pot and fish with approximately 50 pots per day. In this scenario 50 pots using 25kg of bait would then give 2500kg of fish. Mr Reinholdtsen compares this calculation with longline fisheries and states that for catching roughly the same amount of fish you would have to catch 200kg of fish per 300 hooks. Using 3600 baited hooks and catching 2400kg of fish, Mr Reinholdtsen states that one would need 100 kg of bait in addition to 250kr per 300 hooks, which is the cost of having someone mending and re-baiting the longline.

Our estimations show that using herring as bait with todays prices per kg (7.85kr); a longline fishery using 3600 hooks would cost $785kr + (250kr \times 12) = 3785kr$. With these mentioned preconditions of catch volume and prices, the production cost per kg fish in the longline fishery would be

$$\frac{3785kr}{2400kg} = 1.57kr$$

The production cost per kg fish caught by pots with the mentioned preconditions of catch volume and bait prices ($7.85kr \times 25kg = 196kr$) would be

$$\frac{196kr}{2500kg} = 0.078kr$$

The estimations done above are excluded labour- and investment costs and the direct variable cost is what we are using for comparison between the two gear types. Following the preconditions of the calculations above, if a fisherman were to invest 1kr in production cost per kilo catch, the corresponding catch needed for one single pot would be 3.9kg and for longline 285kg per 300 hooks. Løkkeborg et al. (2013b) caught 35kg in average in floated Nor-pots outside Vesterålen (Northern Norway) in March/April of 2013. A catch rate in pots of this magnitude would result in a production cost per kg of 0.11kr.

The catch rates of 50kg in average per pot are hypothetical and this type of catch rates has yet to be produced or proven in a commercial-like fishery. The catch rates of longline will vary and for the same period and area for the season of 2014, there have been catches of 700kg per 300 hooks (Larsen 2014) which stands in contrast to the 200kg in these comparisons. Even still, the low direct cost of pot fishing, is interesting and another advantage of this type of fishery.

We believe if one is able to increase the catch rates in baited pots, the technology has a promising potential in the Norwegian coastal fishery for Atlantic cod. If coastal vessels could use pot technology, while fishing satisfying catch rates, this would ensure the possibility of a high value production of cod for the land industry, directing well-paying markets. The low direct cost in pot fishing, in addition to low fuel consumption, we believe would ensure a low cost fishery. Low environmental impacts, good welfare and little stress under capture process compared to other gear types (Løkkeborg et al. 2013a) are product values that we believe can result in marketing advantages for pot caught cod.

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6.0 Appendix

Appendix I

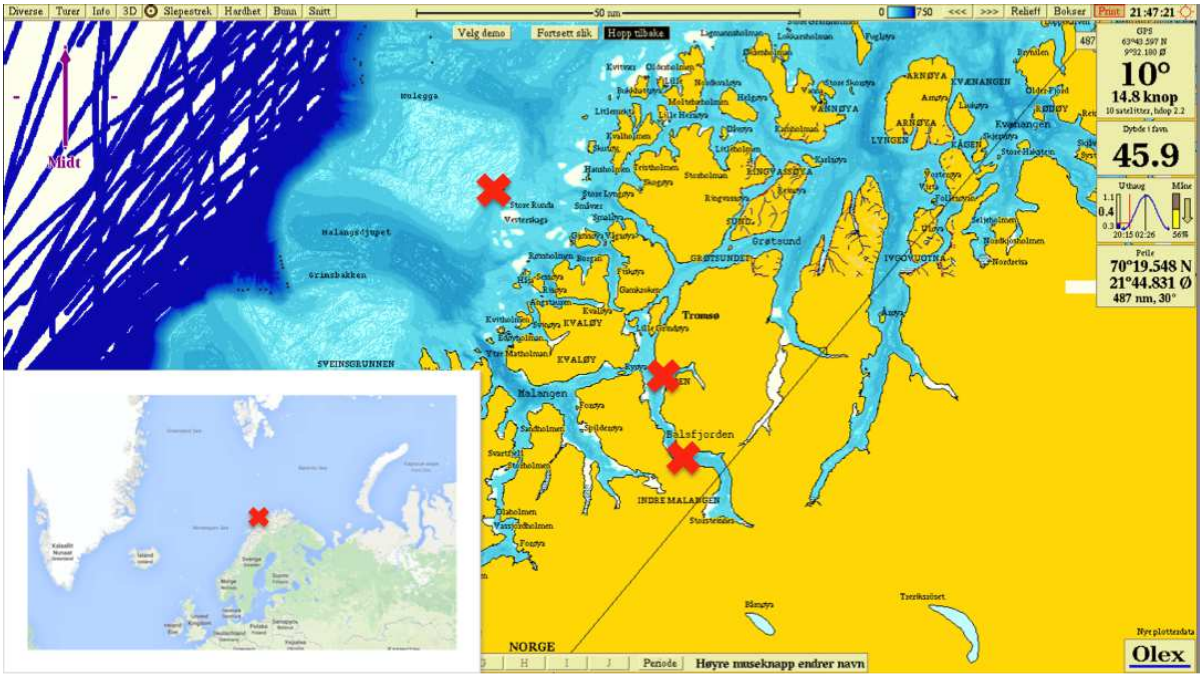


Figure 17. Overview of the three different sea trial areas. Framed picture shows placing of trials, in reference to the Atlantic Ocean.

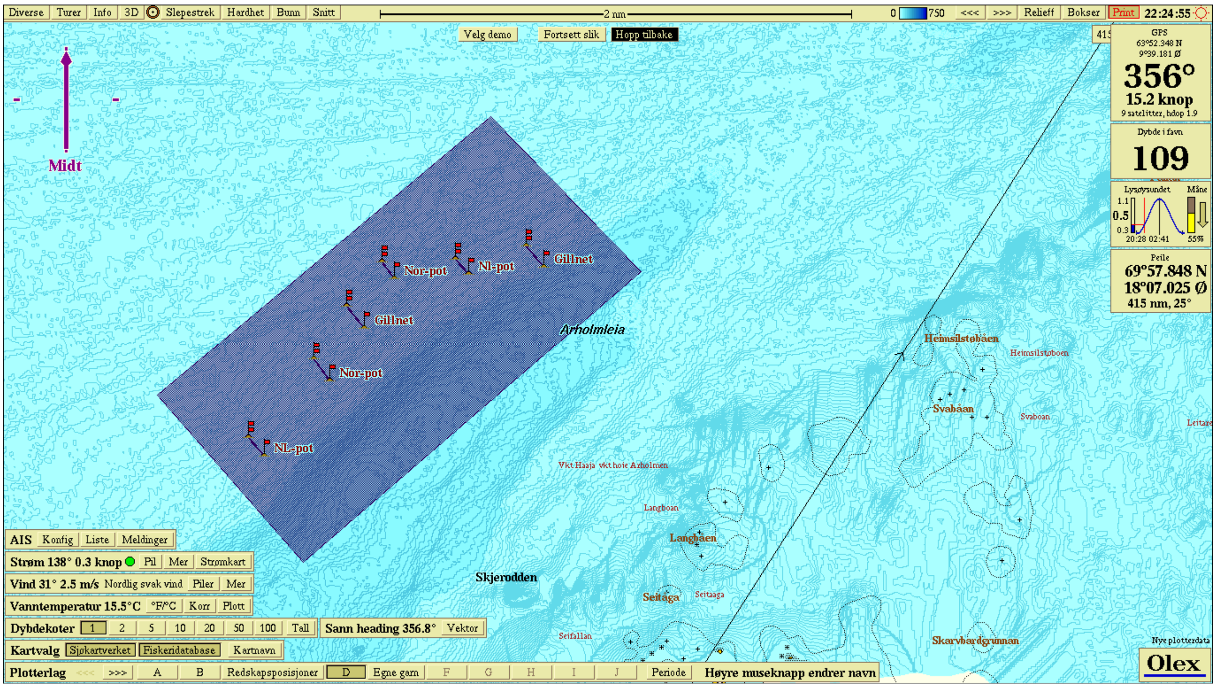


Figure 18. "Offshore" sea trial area for February 2013 and 2014; the continental shelf west of Troms County, Auværhavet

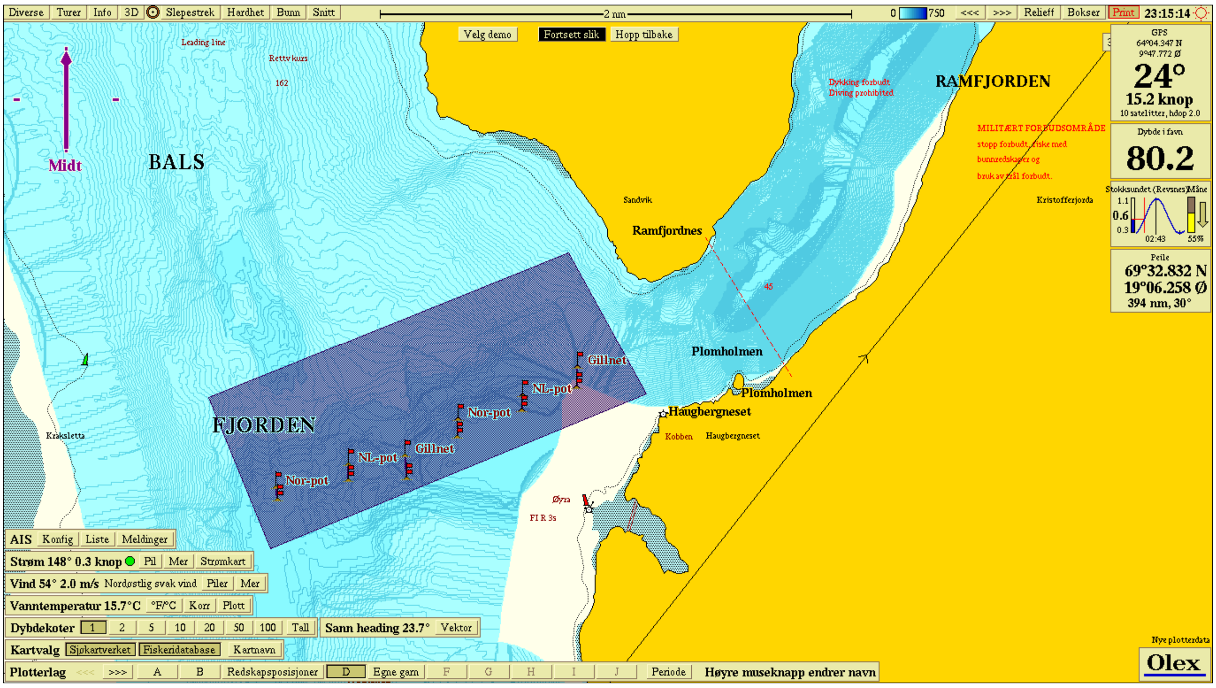


Figure 19. "innshore" sea trial area for May 2013 and February 2014; a fjord system in Troms County, Ramfjordmunningen.

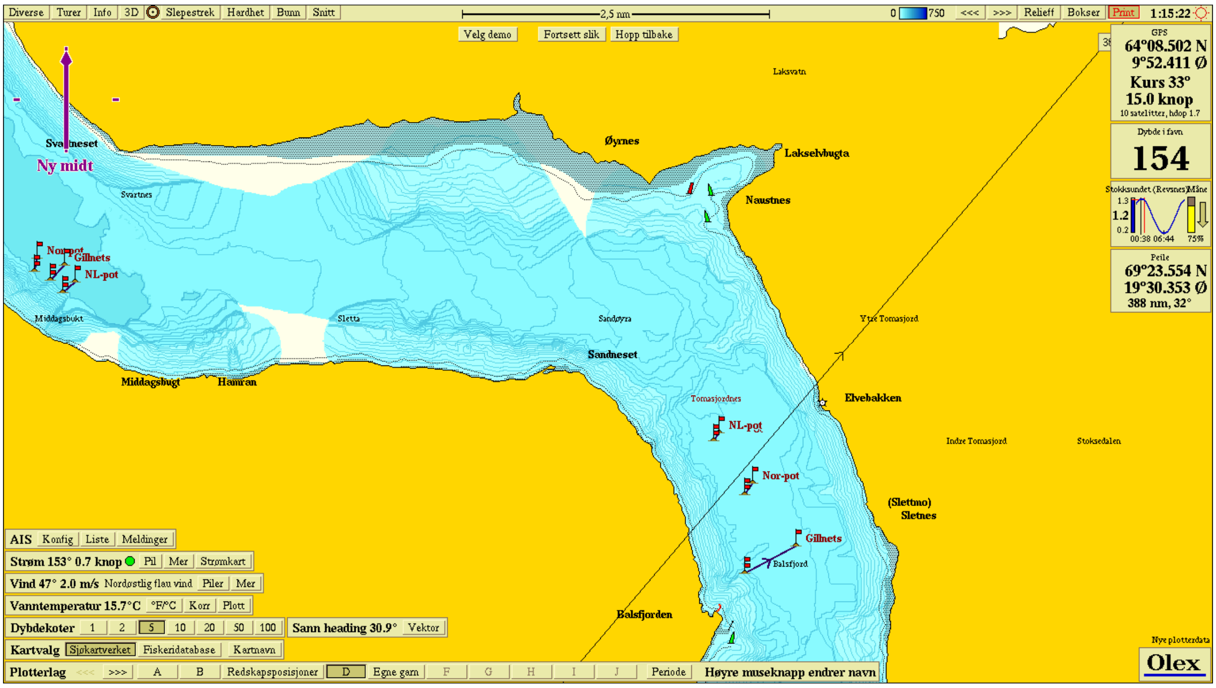


Figure 20. ."Innshore" sea trial area for February 2014; a fjord system in Troms county: Ballsfjorden

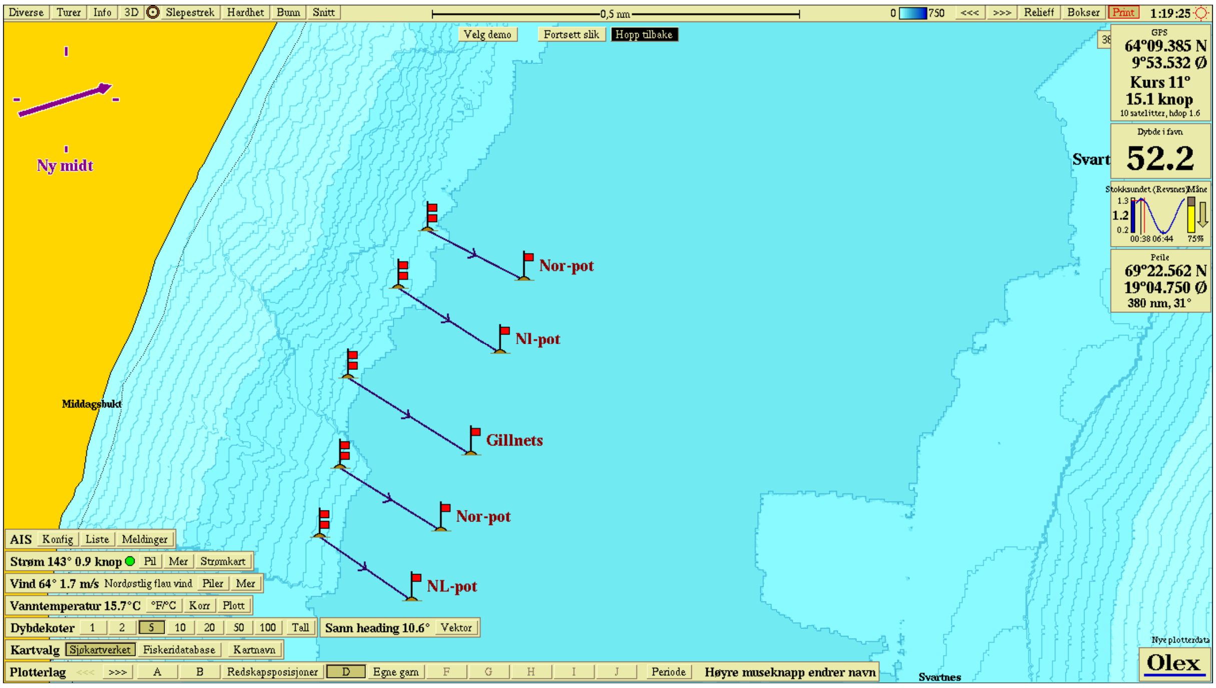


Figure 21. Design of trial in Ballsfjord, February 2014

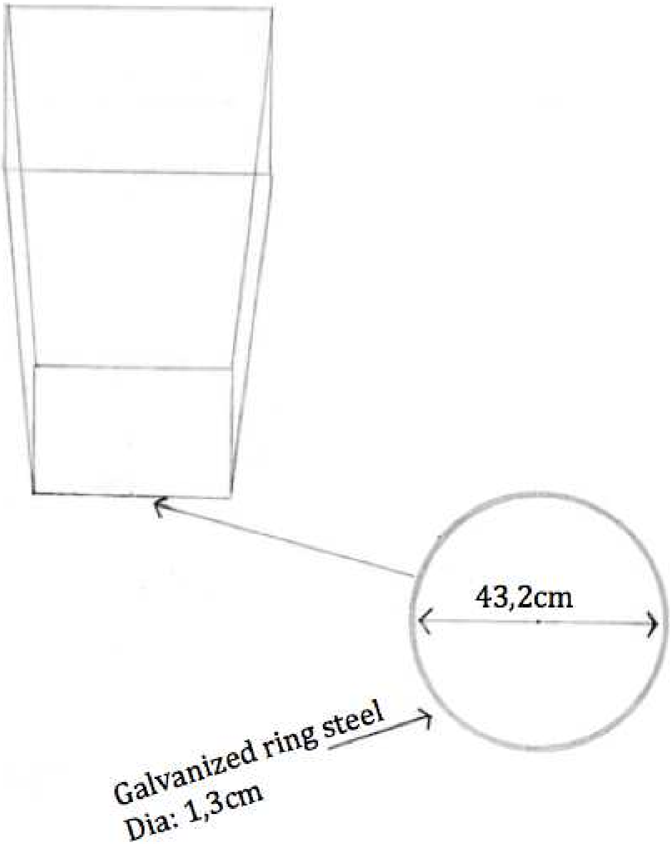


Figure 22. Entrance of the NL-pot. Drawing is not to scale and inspired by (Walsh and Hiscock 2005).

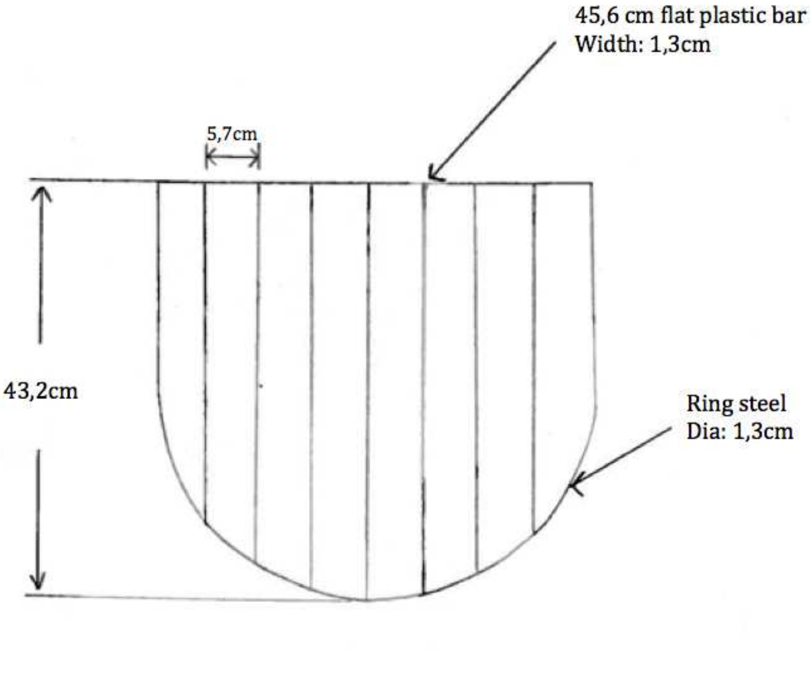


Figure 23. Triggers (mounted on plastic bar) used in NL-entrance. Drawing is not to scale and inspired by (Walsh and Hiscock 2005).

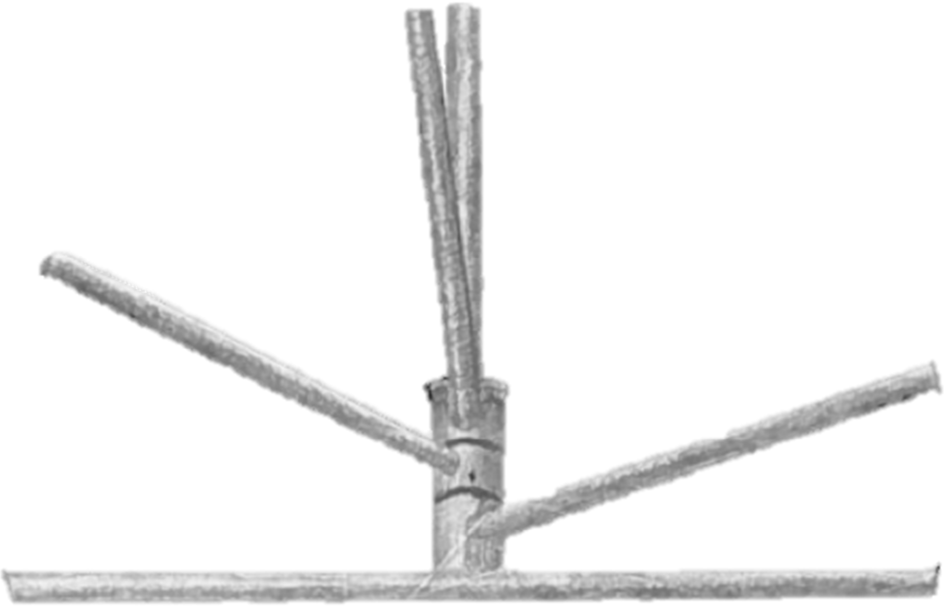


Figure 24. Pivot point in NL-pot (placing of pivot point shown in Figure 3 in method section). Drawing is not to scale and inspired by (Walsh and Hiscock 2005).

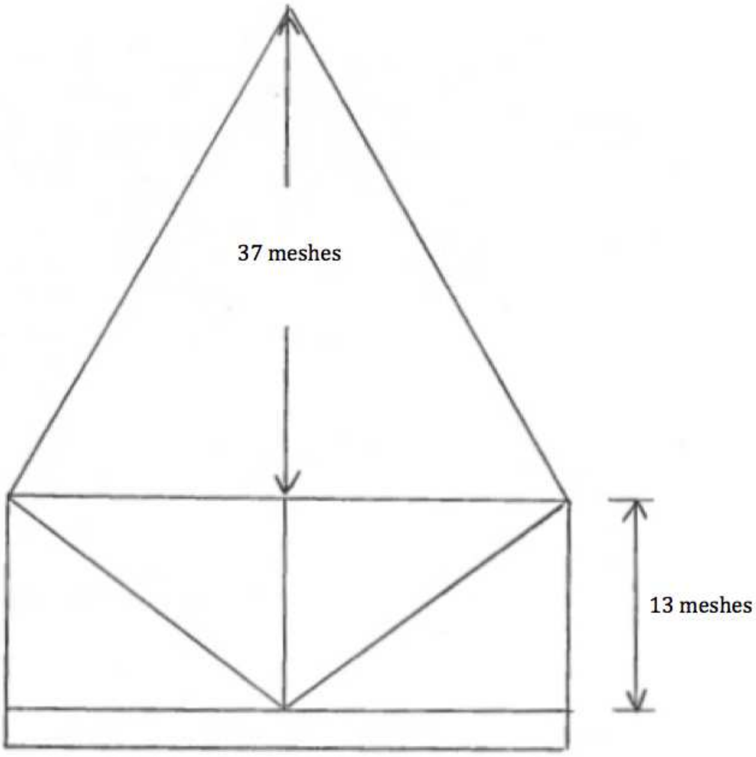


Figure 25. Side view of NL-pot, showing measures for netting in walls and cod-end of pot. Drawing is not to scale and inspired by (Walsh and Hiscock 2005).

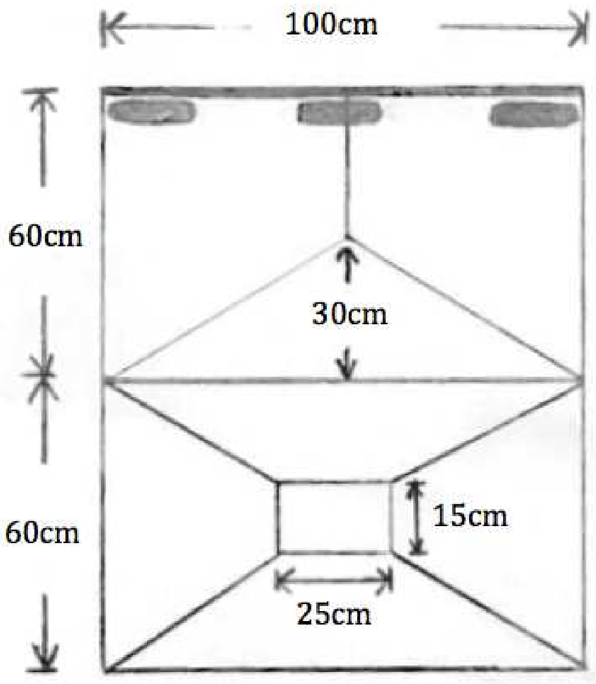


Figure 26. End view of Nor-pot with measures for inner and outer entrance. Sketch is not to scale and inspired by Furevik et al. (2010).

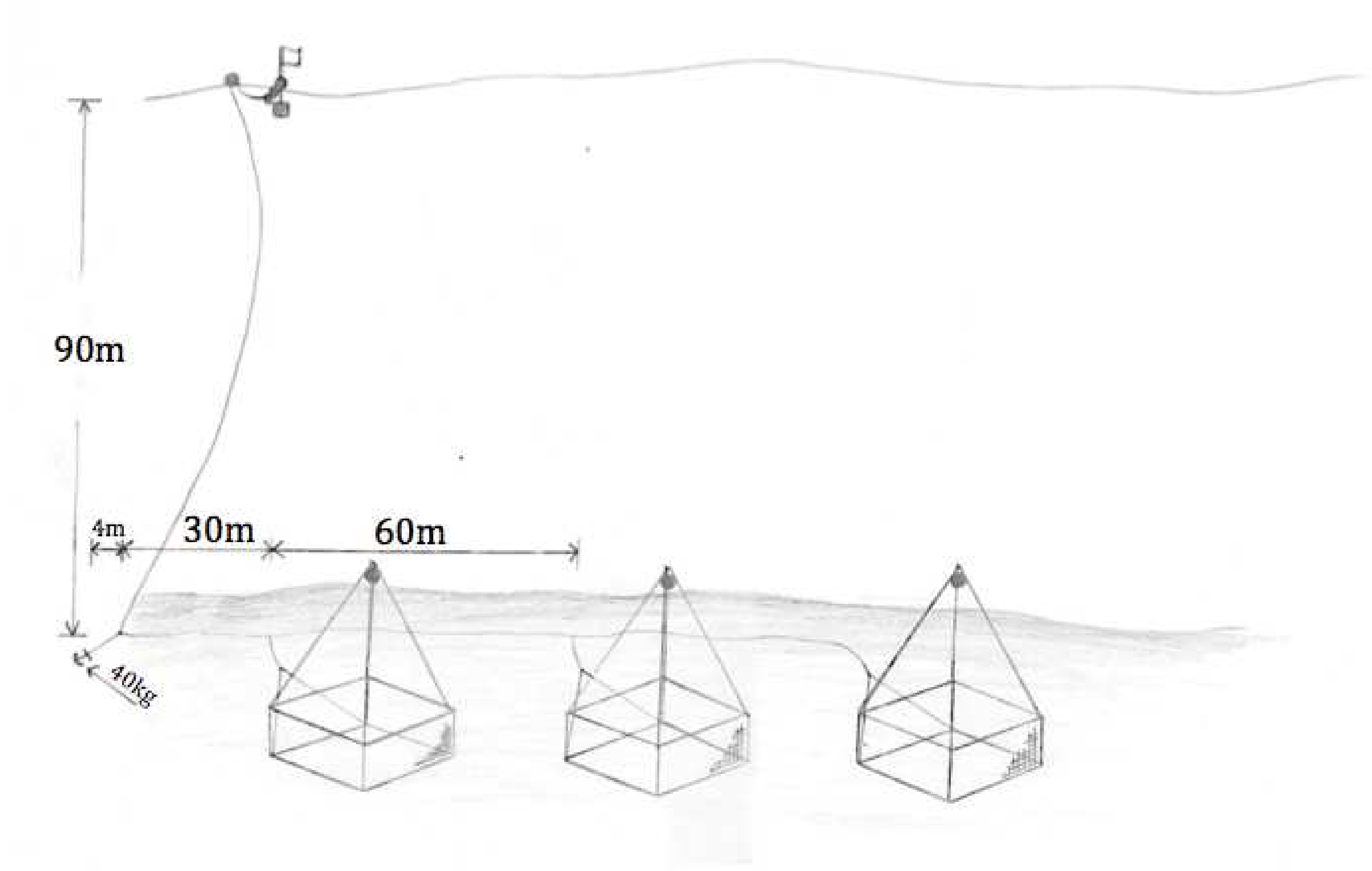


Figure 27. Rigging of NL-pot used in all trials for the offshore areas. The sketch is not to scale.

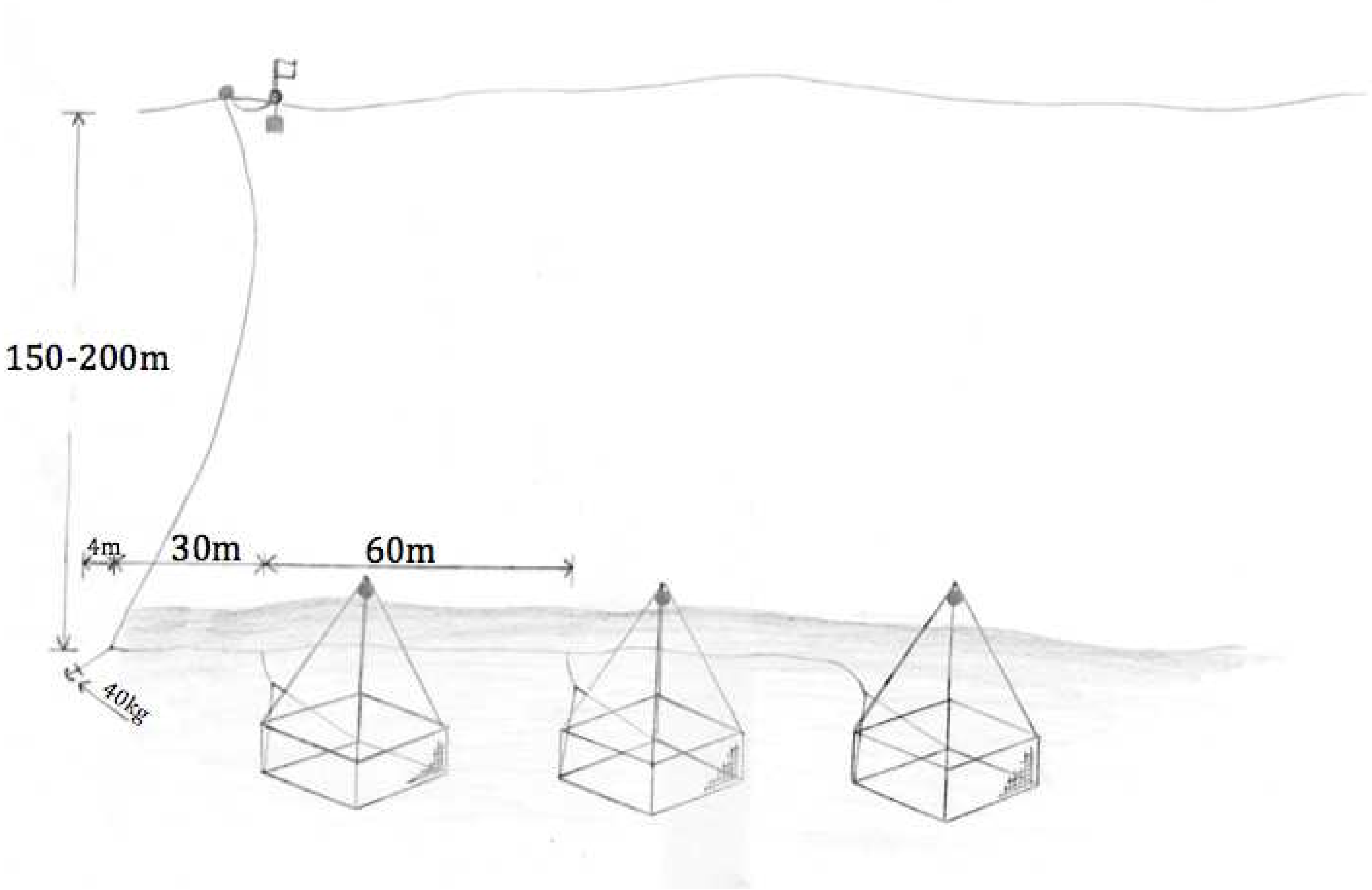


Figure 28. Rigging of NL-pot used in all trials for the innshore areas. The sketch is not to scale.

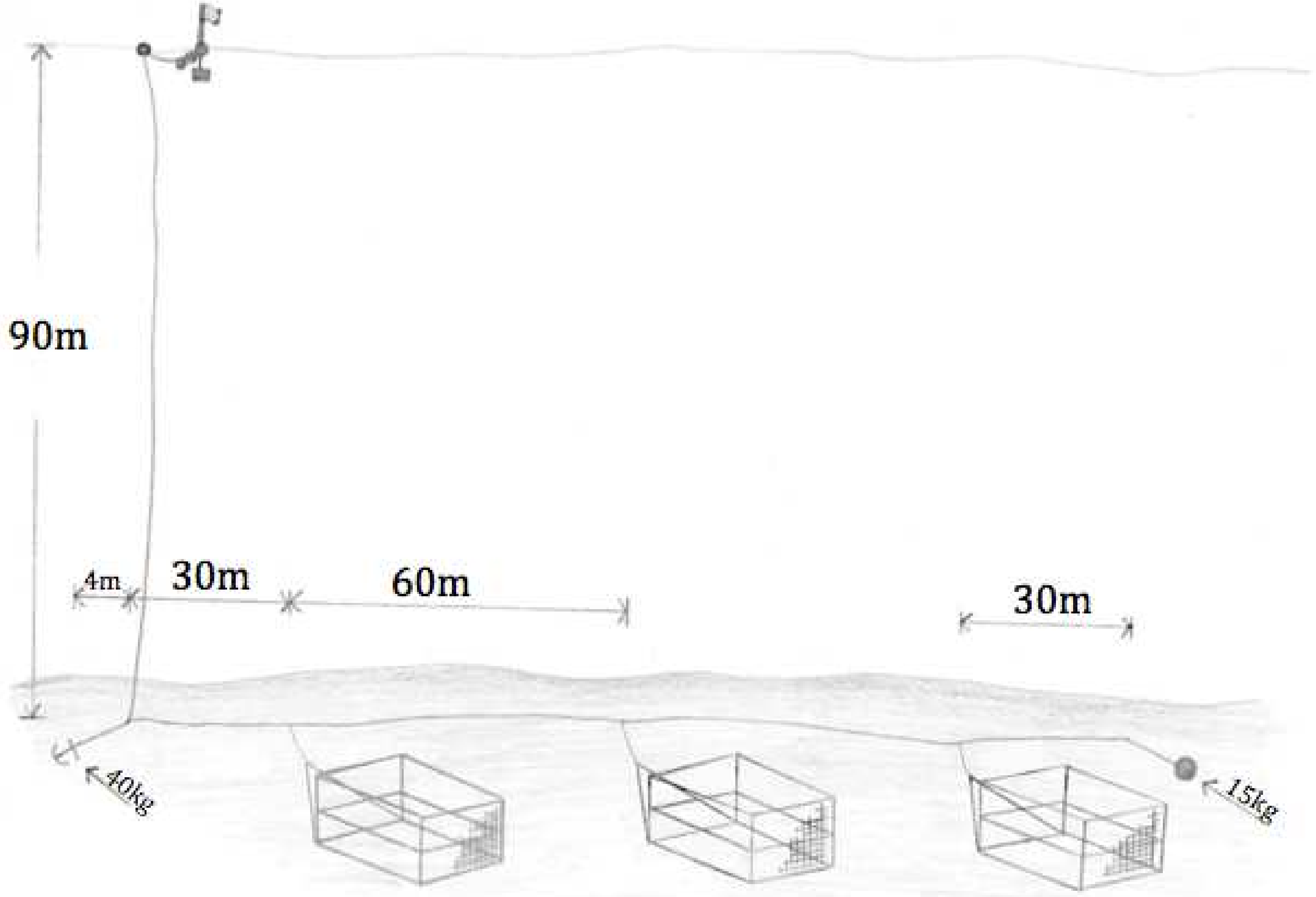


Figure 29. Rigging of Nor-pot used in all trials for the offshore areas. The sketch is not to scale.

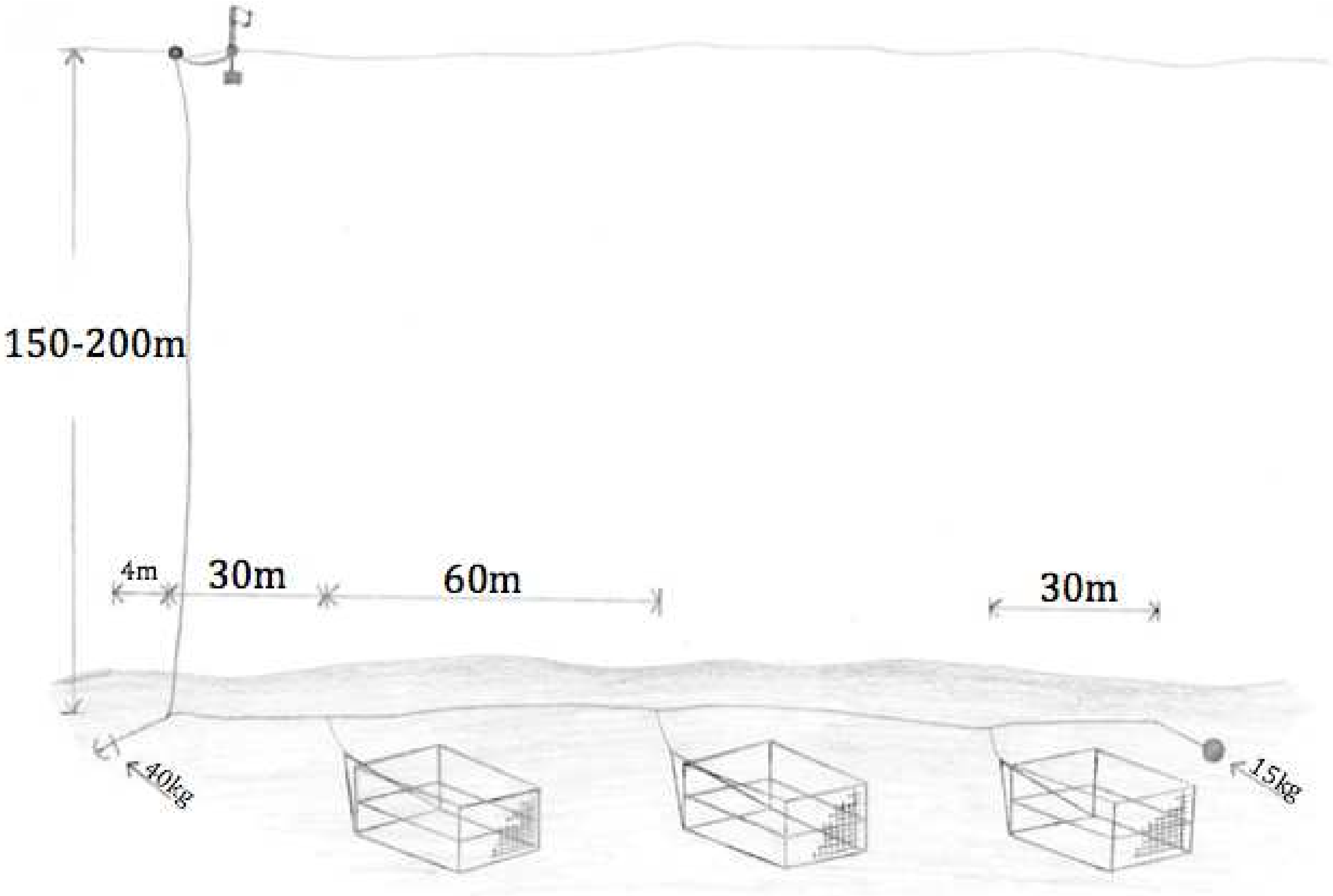


Figure 30. Rigging of Nor-pot used in all trials for the innshore areas. The sketch is not to scale.

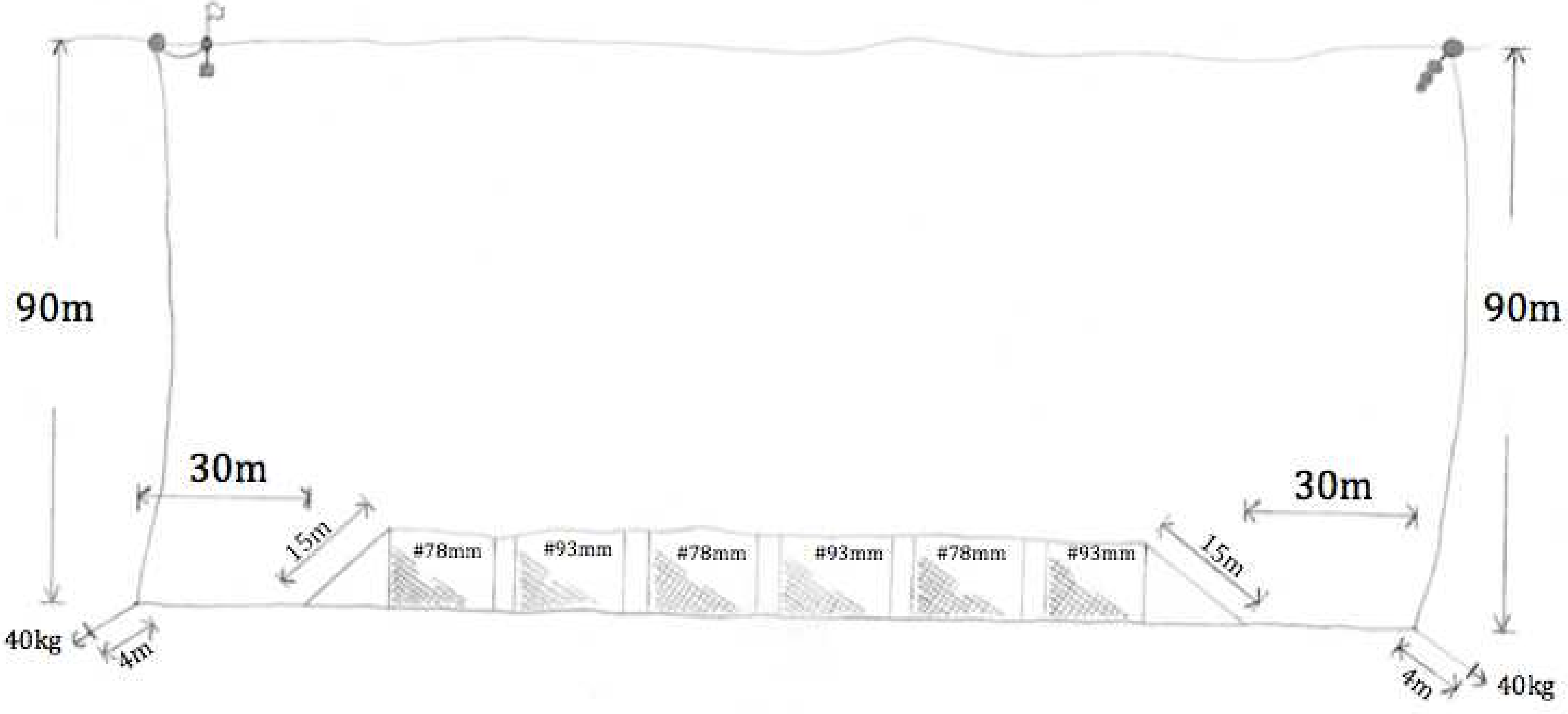


Figure 31. Rigging of gillnets used in all trials for the offshore areas. The sketch is not to scale.

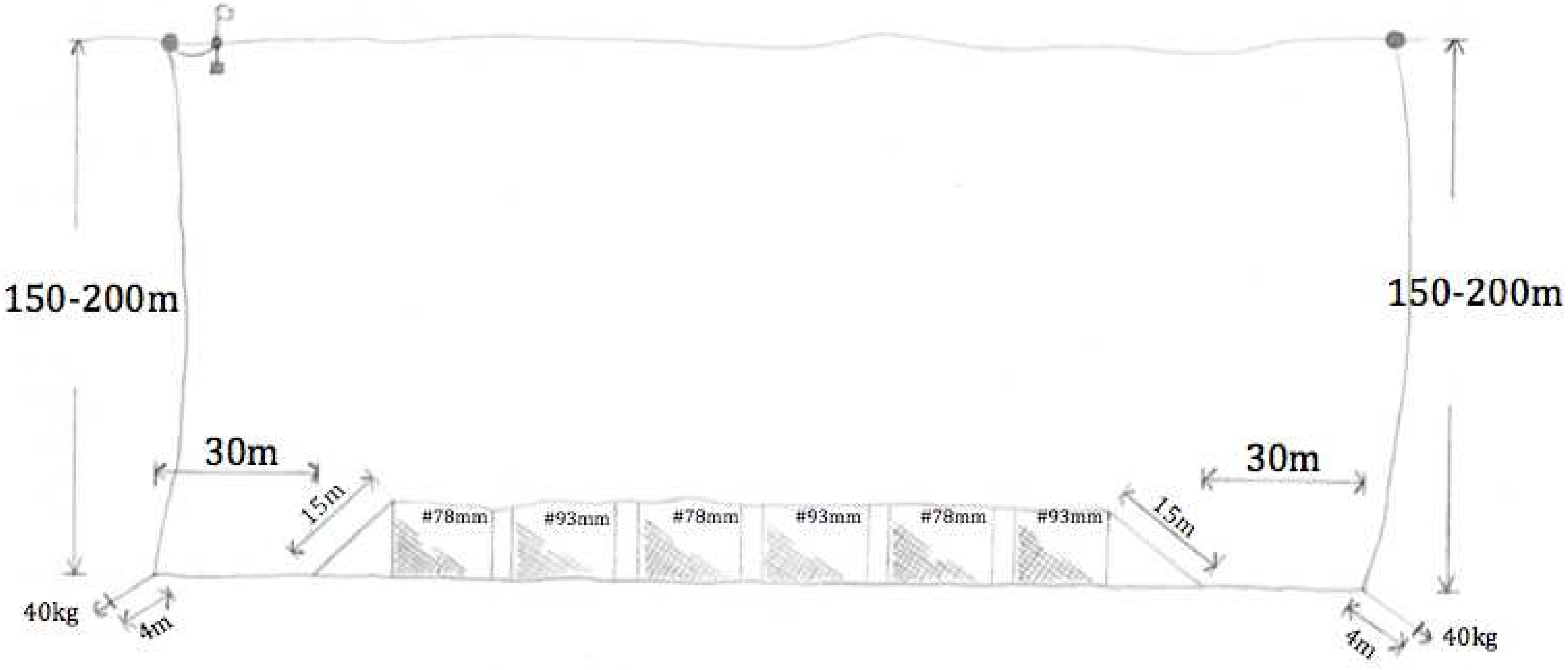


Figure 32. Rigging of gillnets used in all trials for the innshore areas. The sketch is not to scale.

Appendix II

Results for February 2013

Table 7. Output for Catch Frequency histogram in figure 5

Intervals of cod (n indiv.)														
Cod (n indiv.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency														
Gillnets	0	0	0	2	4	0	0	4	4	3	1	5	1	0
NL- pot	22	1	0	1	0	0	0	0	0	0	0	0	0	0
Nor- Pot	21	3	0	0	0	0	0	0	0	0	0	0	0	0

Table 8. Output for boxplot of catch distribution per gear type in figure 6

	G	NL	Nor
Min	4.0	0	0.0
Lower quartile	6.5	0	0.0
Median	9.0	0	0.5
Upper quartile	11.5	1	1.0
Max	13.0	2	2.0

Table 9. Value of mean with 95% confidential interval for boxplot of catch distribution per gear type in figure 6

Gear Type	Mean	CI95.low	CI95.upp
G	8.750	7.6168570	9.8831430
NL-pot	0.625	0.2554345	0.9945655
Nor-pot	0.625	0.3405650	0.9094350

Table 10. ANOVA for boxplot of catch distribution per gear type, in figure 6

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	1056.3	528.1	168.9	<2e-16
Residuals	69	215.8	3.1		

Table 11. TukeyHSD for boxplot of catch distribution per gear type, in figure 6

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-8.125000e+00	-9.347707	-6.902293	0
Nor-G	-8.125000e+00	-9.347707	-6.902293	0
Nor-NL	2.664535e-15	-1.222707	1.222707	1

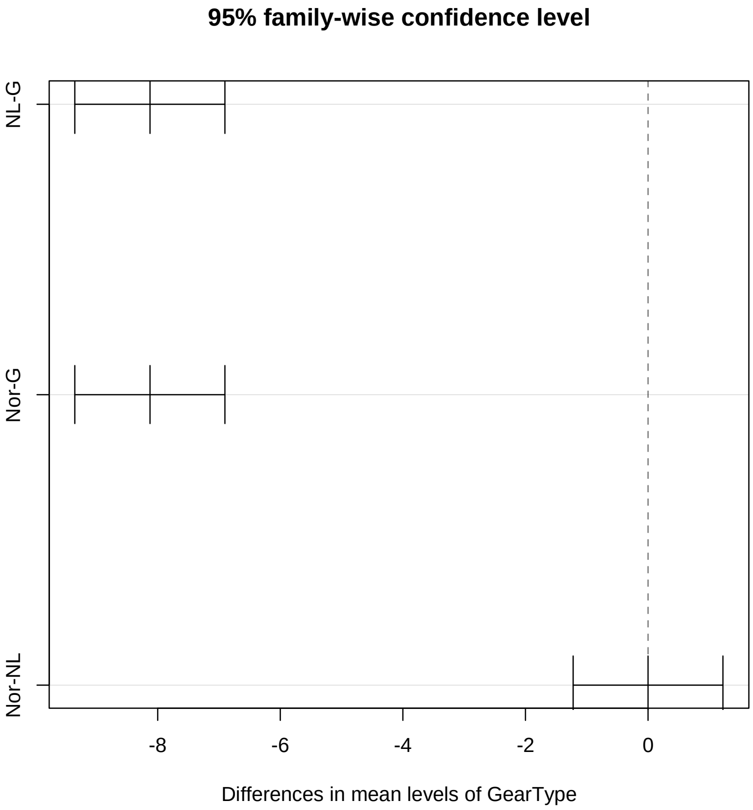


Figure 33. Plot of the 95% family-wise confidence level for TukeyHSD for figure 6

May 2013

Table 12. Output for Catch Frequency histogram in figure 7

Intervals of cod (n indiv.)														
Cod (n indiv.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency														
Gillnets	5	7	3	0	0	1	3	2	3	0	0	0	0	0
NL- pot	18	4	1	0	1	0	0	0	0	0	0	0	0	0
Nor- Pot	13	0	1	1	2	2	1	1	0	1	0	2	0	0

Table 13. Output for boxplot of catch distribution per gear type in figure 8

	G	NL	Nor
Min	1.0	0.0	0
Lower quartile	2.0	0.0	1
Median	2.5	0.0	1
Upper quartile	7.0	1,5	6
Max	9.0	3.0	12

Table 14. Value of mean with 95% confidential interval for boxplot of catch distribution per gear type in figure 8

Gear Type	Mean	CI95.low	CI95.upp
G	4.083333	2.8634333	5.303233
NL-pot	0.875000	0.3701349	1.379865
Nor-pot	3.708333	2.1952704	5.221396

Table 15. ANOVA for boxplot of catch distribution per gear type, in figure 8

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	147.7	73.85	8.794	0.000396
Residuals	69	579.4	8.40		

Table 16. TukeyHSD for boxplot of catch distribution per gear type, in figure 8

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-3.208333	-5.2120781	-1.204589	0.0007925
Nor-G	-0.375000	-2.3787448	1.628745	0.8953258
Nor-NL	2.833333	0.8295886	4.837078	0.0033156

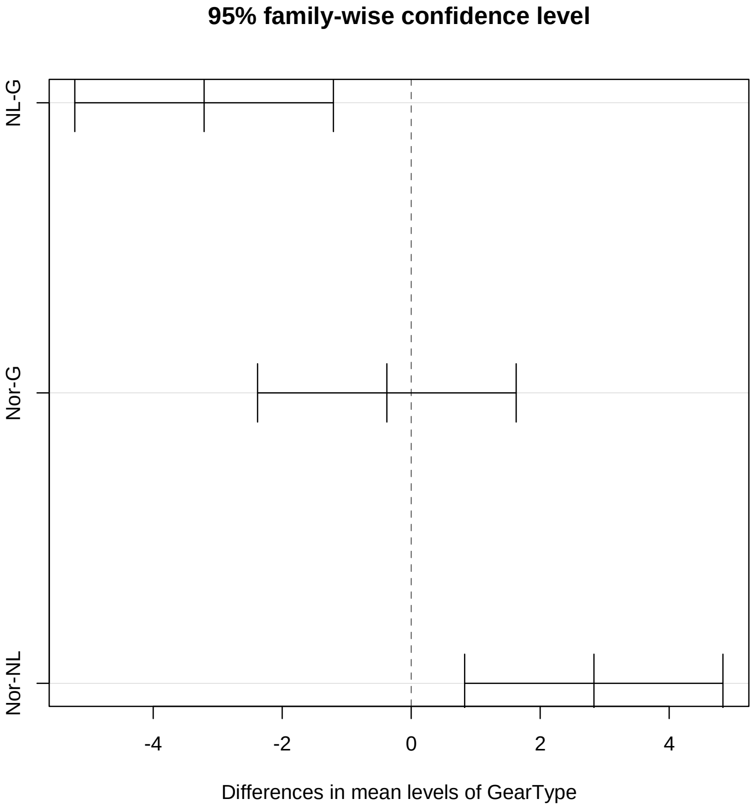


Figure 34. Plot of the 95% family-wise confidence level for TukeyHSD for figure 8

Table 17. Output for Catch Frequency histogram in figure 9

Intervals of cod (n indiv.)															
Cod (n indiv.)	0	1	2	3	4	5	6	23	24	25	26	27	28	29	30
	31	32	33	34	35	36	37	54	55	56	57	58	59	60	
Frequency															
Gillnets	9	7	2	0	0	0	0	0	0	0	0	0	0	0	0
Gillnets	0	0	0	0	10	0	5	5	0	5	5	0	0		

Intervals of cod (n indiv.)														
Cod (n indiv.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency														
NL- pot	39	2	3	1	2	0	1	0	0	0	0	0	0	0
Nor- Pot	31	3	1	4	3	1	2	0	0	2	0	0	1	0

Table 18. Output for boxplot of catch distribution per gear type in figure 10

	G	NL	Nor
Min	0	0	0
Lower quartile	2	0	0
Median	36	0	1
Upper quartile	55	1	4
Max	58	2	10

Table 19. Value of mean with 95% confidential interval for boxplot of catch distribution per gear type in figure 10

Gear Type	Mean	CI95.low	CI95.upp
G	29.729167	23.0753804	36.382953
NL-pot	0.812500	0.3542631	1.270737
Nor-pot	2.291667	1.4380436	3.145290

Table 20. ANOVA for boxplot of catch distribution per gear type, in figure 10

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	147.7	73.85	8.794	0.000396
Residuals	69	579.4	8.40		

Table 21. TukeyHSD for boxplot of catch distribution per gear type, in figure 10

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-28.916667	-35.551610	-22.28172	0.0000000
Nor-G	-27.437500	-34.072444	-20.80256	0.0000000
Nor-NL	1.479167	-5.155777	8.11411	0.8577129

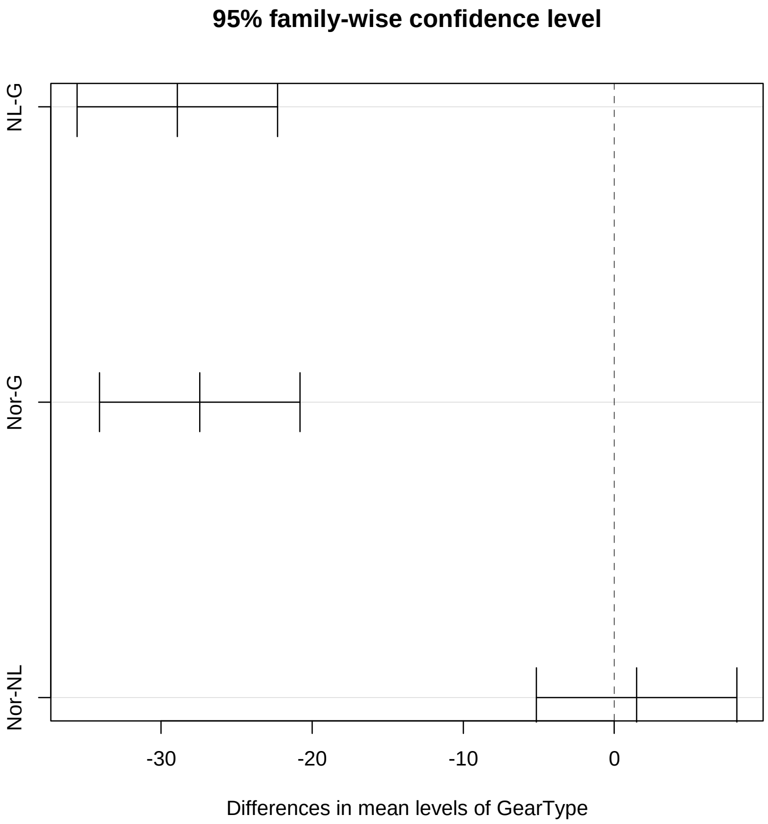


Figure 35. Plot of the 95% family-wise confidence level for TukeyHSD for figure 10

February 2014 (Fjord system)

Table 22. Output for Catch Frequency histogram in figure 11 a)

Intervals of cod (n indiv.)														
Cod (n indiv.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency														
Gillnets	9	7	2	0	0	0	0	0	0	0	0	0	0	0
NL- pot	11	0	3	1	2	0	1	0	0	0	0	0	0	0
Nor- Pot	4	2	1	3	2	1	2	0	0	2	0	0	1	0

Table 23. Output for boxplot of catch distribution per gear type in figure 12 a)

	G	NL	Nor
Min	0.0	0	0
Lower quartile	1.0	0	2
Median	1.5	1	4
Upper quartile	2.0	3	7
Max	3.0	7	13

Table 24. Value of mean with 95% confidential interval for boxplot of catch distribution per gear type in figure 12 a)

Gear Type	Mean	CI95.low	CI95.upp
G	1.500000	1.1038585	1.896142
NL-pot	1.833333	0.8033654	2.863301
Nor-pot	4.722222	3.0617848	6.382660

Table 25. ANOVA for boxplot of catch distribution per gear type, in figure 12 a)

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	113.0	56.52	9.104	0.000416
Residuals	51	316.6	6.21		

Table 26. TukeyHSD for boxplot of catch distribution per gear type, in figure 12 a)

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	0.3333333	-1.671556	2.338222	0.9151904
Nor-G	3.2222222	1.217333	5.227111	0.0008659
Nor-NL	2.8888889	0.884000	4.893778	0.0029430

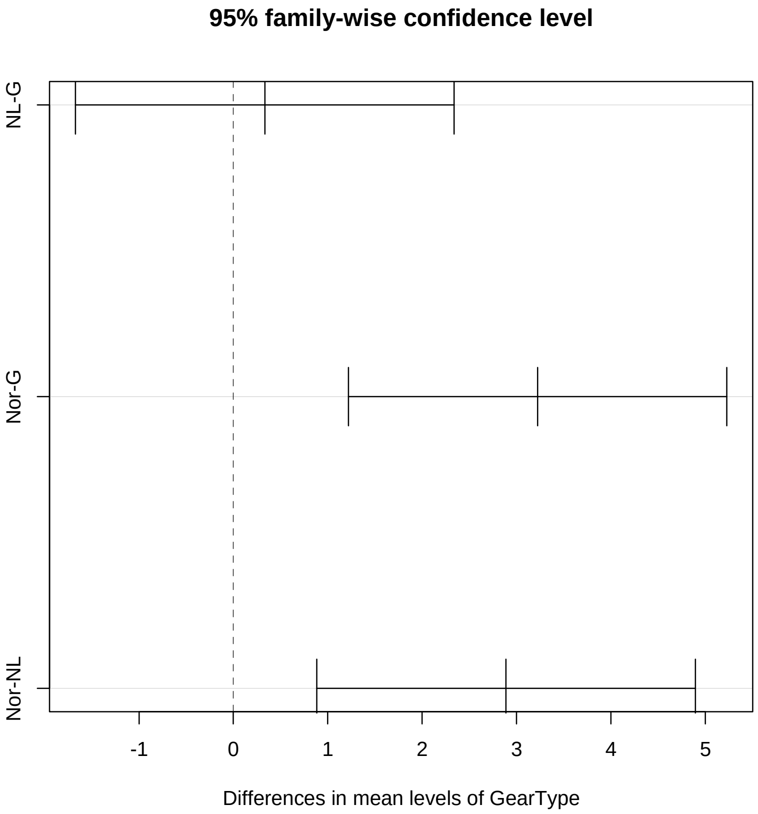


Figure 36. Plot of the 95% family-wise confidence level for TukeyHSD for figure 12 a)

February 2014 (Offshore)

Table 27. Output for Catch Frequency histogram in figure 11 b)

Intervals of cod (n indiv.)															
Cod (n indiv.)	0	1	2	3	4	5	6	23	24	25	26	27	28	29	30
	31	32	33	34	35	36	37	54	55	56	57	58	59	60	
Frequency															
Gillnets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gillnets	0	0	0	0	10	0	5	5	0	5	5	0	0	0	

Intervals of cod (n indiv.)														
Cod (n indiv.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency														
NL- pot	28	2	0	0	0	0	0	0	0	0	0	0	0	0
Nor- Pot	27	1	0	1	1	0	0	0	0	0	0	0	0	0

Table 28. Output for boxplot of catch distribution per gear type in figure 12 b)

	G	NL	Nor
Min	36.0	0	0
Lower quartile	36.0	0	0
Median	46.5	0	1
Upper quartile	57.0	0	1
Max	58.0	0	2

Table 29. Value of mean with 95% confidential interval for boxplot of catch distribution per gear type in figure 12 b)

Gear Type	Mean	CI95.low	CI95.upp
G	46.6666667	43.004863413	50.3284699
NL-pot	0.2000000	0.002876782	0.3971232
Nor-pot	0.8333333	0.422809325	1.2438573

Table 30. ANOVA for boxplot of catch distribution per gear type, in figure 12 b)

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	42602	21301	601	<2e-16
Residuals	87	3084	35		

Table 31. TukeyHSD for boxplot of catch distribution per gear type, in figure 12 b)

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-46.4666667	-50.132053	-42.801281	0.0000000
Nor-G	-45.8333333	-49.498719	-42.167947	0.0000000
Nor-NL	0.6333333	-3.032053	4.298719	0.9107799

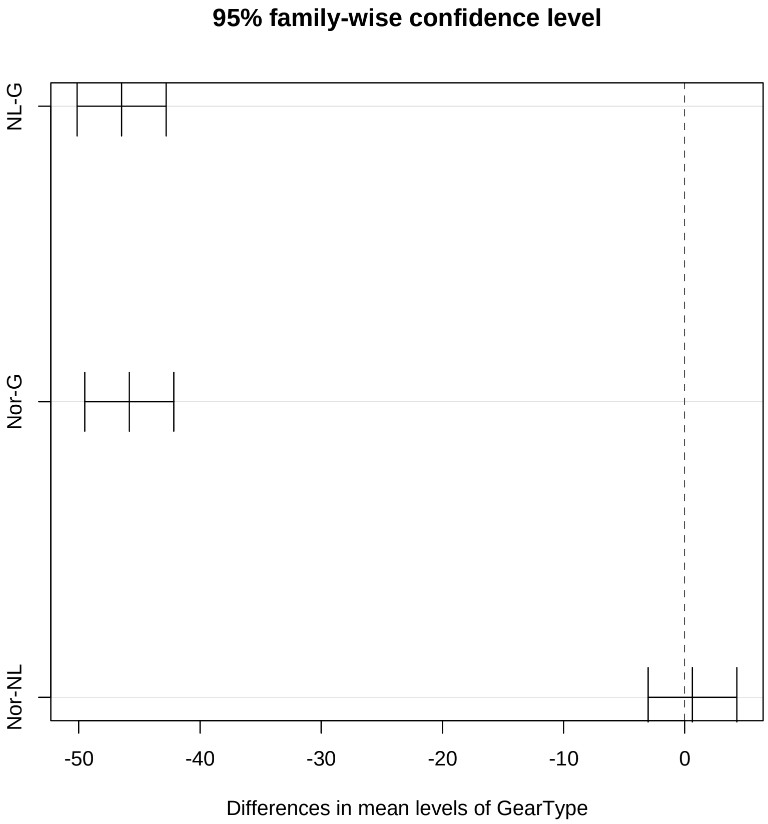


Figure 37. Plot of the 95% family-wise confidence level for TukeyHSD for figure 12 b)

Table 32. Output for boxplot of CPUE in figure 14

	Min	Lower quartile	Median	Upper quartile	Max
G.13f	0.1739130	0.2980769	0.4096990	0.4744246	0.5416667
NL.13f	0.00000000	0.00000000	0.00000000	0.05000000	0.08333333
Nor.13f	0.00000000	0.00000000	0.02000000	0.05263158	0.10526316
G.13m	0.04347826	0.08333333	0.11011905	0.30434783	0.36000000
NL.13m	0.00000000	0.00000000	0.00000000	0.06620553	0.13636364
Nor.13m	0.00000000	0.04347826	0.04545455	0.26679842	0.52173913
G.14f	0.0000000	0.1190476	1.8000000	3.0555556	3.2222222
NL.14f	0.00	0.00	0.00	0.05	0.10
Nor.14f	0.00000000	0.00000000	0.04880952	0.18614719	0.36842105

Appendix III

Size Distribution

Table 33. Output for boxplot of size (cm) distribution per gear type in figure 15

	G	NL	Nor
Min	46	33	23
Lower quartile	73	52	39
Median	83	70	46
Upper quartile	91	82	61
Max	115	109	93

Table 34. Value of mean with 95% confidential interval for boxplot of size (cm) distribution per gear type in figure 15

Gear Type	Mean	CI95.low	CI95.upp
G	80.84072	79.66450	82.01694
NL-pot	68.05405	64.10587	72.00223
Nor-pot	52.96903	50.44446	55.49359

Table 35. ANOVA for boxplot of size (cm) distribution per gear type, in figure 15

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	129915	64957	245.6	<2e-16
Residuals	906	239630	264		

Table 36. TukeyHSD for boxplot of size (cm) distribution per gear type, in figure 15

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-12.78667	-17.48680	-8.086535	0
Nor-G	-27.87170	-30.84545	-24.897944	0
Nor-NL	-15.08503	-20.19849	-9.971567	0

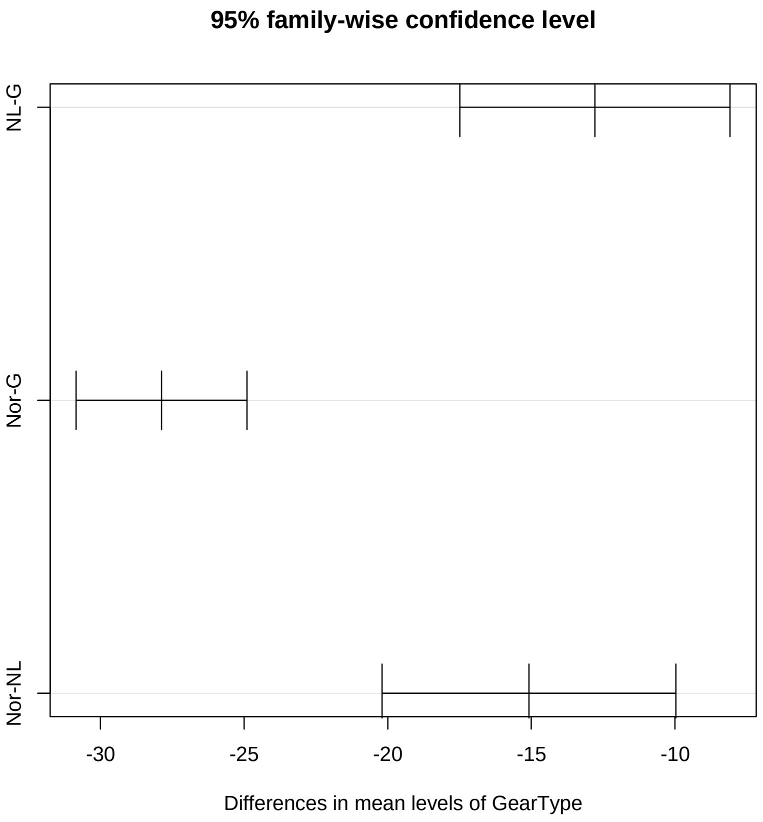


Figure 38. Plot of the 95% family-wise confidence level for TukeyHSD for figure 15

Table 37. Output for boxplot of size (cm) distribution per gear type, period and gear type:period, in figure 16

	Min	Lower quartile	Median	Upper quartile	Max
G.13f	51	75	84	91	115
NL.13f	73.0	78.5	86.0	90.0	96.0
Nor.13f	38	43	75	87	110
G.13m	30	49	64	72	96
NL.13m	41	50	52	64	78
Nor.13m	23.0	36.0	40.5	48.0	66.0
G.14f	62	80	86	92	110
NL.14f	33.0	52.5	69.0	81.0	109.0
Nor.14f	23	43	52	66	100

Table 38. Two- way ANOVA for boxplot of size (cm) distribution per gear type, period and gear type:period, in figure 16

	Df	Sum squares	Mean squares	F value	Pr(>F)
Gear Type	2	129915	64957	328.91	<2e-16
Period	2	51993	25996	131.63	<2e-16
Gear Type: Period	4	9893	2473	12.52	6.42e-10
Residuals	900	177745	197		

Table 39. TukeyHSD for boxplot of size (cm) distribution per gear type and period, in figure 16

Gear Type	Mean difference	Lower bound	Upper bound	P adjusted
NL-G	-12.78667	-16.84816	-8.725179	0
Nor-G	-27.87170	-30.44138	-25.302011	0
Nor-NL	-15.08503	-19.50368	-10.666373	0
Period	Mean difference	Lower bound	Upper bound	P adjusted
13m-13f	-16.737459	-19.843407	-13.63151	0.0000000
14f-13f	1.152671	-1.452368	3.75771	0.5525777
14f-13m	17.890130	15.123270	20.65699	0.0000000

Table 40. TukeyHSD for boxplot of size (cm) distribution per gear type:period, in figure 16

Gear Type:Period	Mean difference	Lower bound	Upper bound	P adjusted
NL:13f-G:13f	0.9993681	-10.6771158	12.6758520	0.9999993
Nor:13f-G:13f	-12.3672986	-22.1570151	-2.5775821	0.0029610
G:13m-G:13f	-19.5786388	-24.9389868	-14.2182908	0.0000000
NL:13m-G:13f	-24.0172986	-34.2406782	-13.7939190	0.0000000
Nor:13m-G:13f	-37.6895208	-43.1908228	-32.1882188	0.0000000
G:14f-G:13f	4.2323692	0.3090357	8.1557027	0.0233668
NL:14f-G:13f	-14.2775550	-21.8938051	-6.6613049	0.0000003
Nor:14f-G:13f	-25.1480003	-30.2271703	-20.0688303	0.0000000
Nor:13f-NL:13f	-13.3666667	-27.9981587	1.2648254	0.1052156
G:13m-NL:13f	-20.5780069	-32.7013455	-8.4546682	0.0000058
NL:13m-NL:13f	-25.0166667	-39.9417965	-10.0915368	0.0000082
Nor:13m-NL:13f	-38.6888889	-50.8752064	-26.5025714	0.0000000
G:14f-NL:13f	3.2330011	-8.3270402	14.7930424	0.9944322
NL:14f-NL:13f	-15.2769231	-28.5528138	-2.0010323	0.0109287
Nor:14f-NL:13f	-26.1473684	-38.1490340	-14.1457028	0.0000000
G:13m-Nor:13f	-7.2113402	-17.5299454	3.1072650	0.4243247
NL:13m-Nor:13f	-11.6500000	-25.1502879	1.8502879	0.1552299
Nor:13m-Nor:13f	-25.3222222	-35.7147487	-14.9296958	0.0000000
G:14f-Nor:13f	16.5996678	6.9491326	26.2502029	0.0000040
NL:14f-Nor:13f	-1.9102564	-13.5613314	9.7408186	0.9998848
Nor:14f-Nor:13f	-12.7807018	-22.9560765	-2.6053270	0.0032343
NL:13m-G:13m	-4.4386598	-15.1695756	6.2922560	0.9353691
Nor:13m-G:13m	-18.1108820	-24.5061449	-11.7156191	0.0000000
G:14f-G:13m	23.8110080	18.7092818	28.9127341	0.0000000
NL:14f-G:13m	5.3010838	-2.9839829	13.5861504	0.5511525
Nor:14f-G:13m	-5.5693615	-11.6053397	0.4666166	0.0977128
Nor:13m-NL:13m	-13.6722222	-24.4742381	-2.8702063	0.0028749
G:14f-NL:13m	28.2496678	18.1594859	38.3398496	0.0000000
NL:14f-NL:13m	9.7397436	-2.2780137	21.7575008	0.2236495
Nor:14f-NL:13m	-1.1307018	-11.7239634	9.4625599	0.9999958
G:14f-Nor:13m	41.9218900	36.6722612	47.1715188	0.0000000
NL:14f-Nor:13m	23.4119658	15.0350139	31.7889177	0.0000000
Nor:14f-Nor:13m	12.5415205	6.3800251	18.7030158	0.0000000
NL:14f-G:14f	-18.5099242	-25.9464250	-11.0734234	0.0000000
Nor:14f-G:14f	-29.3803695	-34.1858089	-24.5749302	0.0000000
Nor:14f-NL:14f	-10.8704453	-18.9764287	-2.7644620	0.0011104

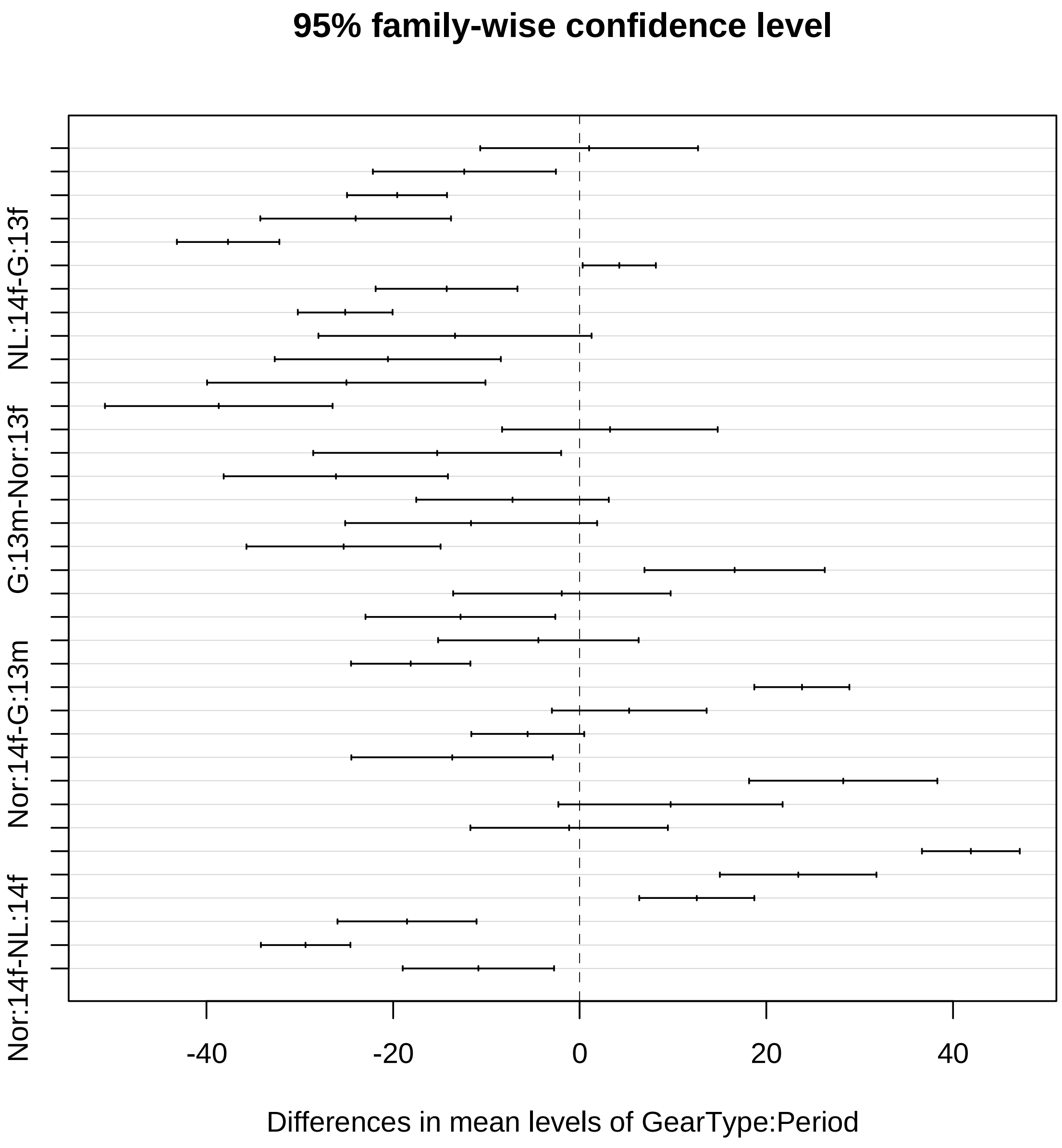
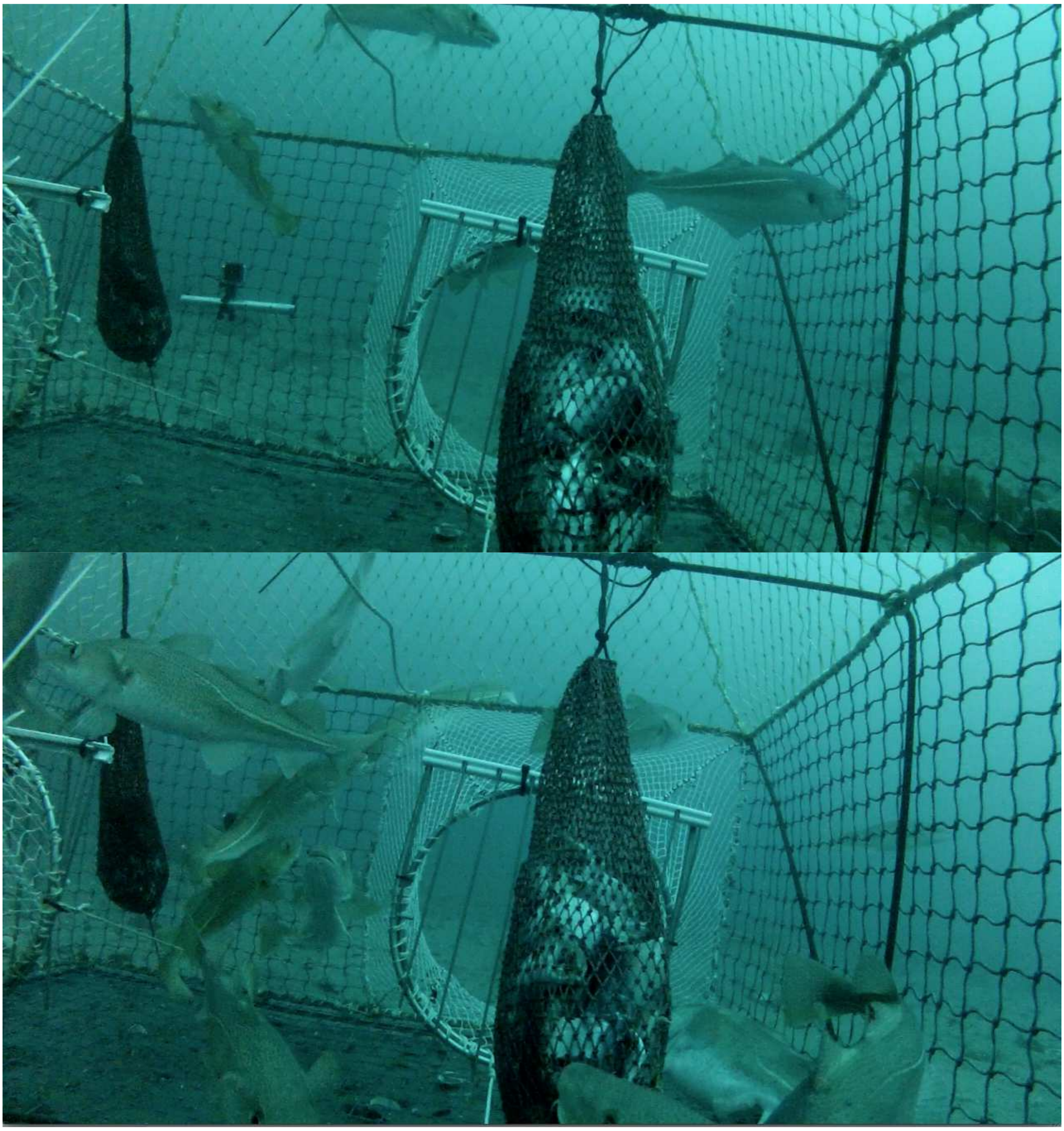


Figure 39. Plot of the 95% family-wise confidence level for TukeyHSD for figure 16

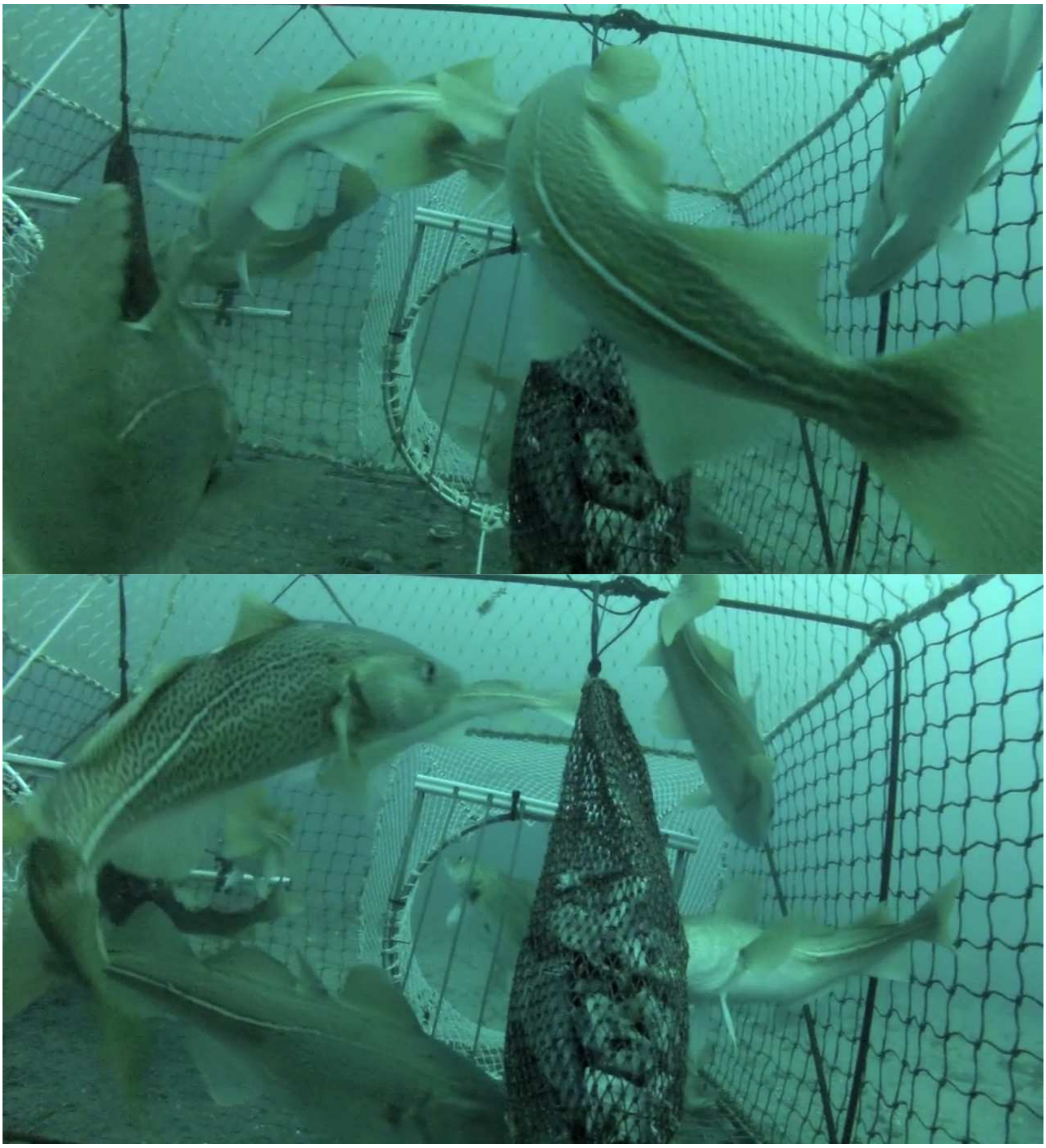
Table 41. Output for size (cm) Frequency histogram in figure 17

	Intervals of cod (cm)														
Cod (n indiv.)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
	95	100	105	110	115	120									
Gillnets	0	1	5	2	13	10	9	12	36	39	55	71	100	96	85
Gillnets	40	20	12	3	0										
NL-pot	0	0	1	1	2	9	12	4	6	2	6	9	8	8	3
NL-pot	2	0	1	0	0										
Nor-pot	2	4	30	33	36	27	17	18	10	5	7	9	5	6	8
Nor-pot	6	0	3	0	0										

Appendix III



**Picture 3. Above: stressed pollock, tries to escape.
Below: cod relaxes on top of entrance netting.**



Picture 4. Above: cod tries to enter pot through triggers.
Below: after contact with steel ring/triggers; fish turns around and swims away

Picture 5. Above: small cod enters the pot between triggers.

Picture 6. Cod search for way in through netting

Picture 7. Tusk stuck in the new design entrance.

Entrances of monofil PA no. 4 and 78mm mesh size

Mounted with hanging ratio of 0,43. 1# from each side is to be included in the laces

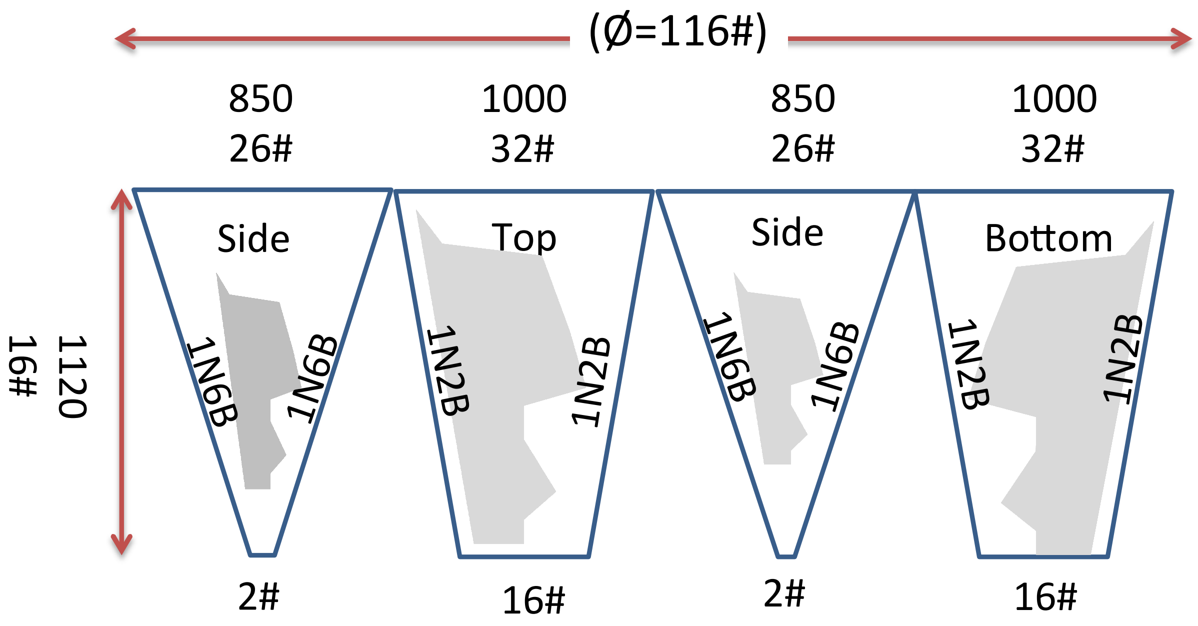


Figure 40. Technical drawing of new design of NL-pot entrance (drawing provided by Roger B. Larsen)

Appendix IV

Table 42. February 2013: Registrations of soak time (time in water) and depth for all fleets

12.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 1	NL-link	18,5	77	80
	Nor-link	18	59	61
	Gillnet-link	17	68	70
12.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 2	NL-link	20	65	66
	Nor-link	20	64	68
	Gillnet-link	23	64	70
13.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 3	NL-link	21	67	72
	Nor-link	22	76	82
	Gillnet-link	23	61	67
13.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 4	NL-link	22	71	95
	Nor-link	22	65	68
	Gillnet-link	26	69	75
14.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 5	NL-link	24	76	81
	Nor-link	23	66	72
	Gillnet-link	26	62	69
14.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 6	NL-link	22	67	71
	Nor-link	25	71	75
	Gillnet-link	24	71	76

15.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 7	NL-link	21	76	80
	Nor-link	19	58	60
	Gillnet-link	20	68	75
15.02.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 8	NL-link	16	70	67
	Nor-link	17	70	75
	Gillnet-link	22	65	69

Table 43. May 2013: Registrations of soak time (time in water) and depth for all fleets

22.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 1	NL-link	22	56	58
	Nor-link	22	61	63
	Gillnet-link	24	58	59
22.05.13		Soak time (hours)	Depth: start	Depth (meters): stop
Fleet 2	NL-link	22	60	58
	Nor-link	22	57	60
	Gillnet-link	24	55	61
23.05.13		Soak time (hours)	Depth: start	Depth (meters): stop
Fleet 3	NL-link	23	63	55
	Nor-link	23	56	57
	Gillnet-link	25	60	61
23.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 4	NL-link	23	53	59
	Nor-link	22	57	60

	Gillnet-link	23	35	60
24.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 5	NL-link	23	63	66
	Nor-link	23	57	56
	Gillnet-link	23	35	32
24.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 6	NL-link	22	66	56
	Nor-link	23	64	58
	Gillnet-link	23	54	60
25.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 7	NL-link	24	60	61
	Nor-link	22	56	62
	Gillnet-link	24	63	55
25.05.13		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 8	NL-link	24	60	60
	Nor-link	22	61	54
	Gillnet-link	21	55	56

Table 44. February 2014: Registrations of soak time (time in water) and depth for all fleets. Restricted use of gillnets in some fleets are shown.

07.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 1	NL-link	21	75	81
	Nor-link	21	83	90
	Gillnet-link	18	75	82
07.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop

Fleet 2	NL-link	22	73	83
	Nor-link	22	77	83
	Gillnet-link	20	70	77
08.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 3	NL-link	20	83	90
	Nor-link	20	75	81
	Gillnet-link	No gillnets		
08.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 4	NL-link	18	77	83
	Nor-link	20	73	83
	Gillnet-link	No gillnets		
09.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 5	NL-link	20	82	80
	Nor-link	21	76	70
	Gillnet-link	No gillnets		
09.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 6	NL-link	21	83	73
	Nor-link	21	80	75
	Gillnet-link	No gillnets		
10.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 7	NL-link	20	75	80
	Nor-link	22	83	73
	Gillnet-link	No gillnets		
10.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 8	NL-link	22	73	83
	Nor-link	21	82	80

	Gillnet-link	No gillnets		
11.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	22	80	81
Fleet 9	Nor-link	24	75	80
	Gillnet-link	No gillnets		
11.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	23	83	74
Fleet 10	Nor-link	24	73	83
	Gillnet-link	No gillnets		
12.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	21	82	80
Fleet 11	Nor-link	22	80	81
	Gillnet-link	23	80	82
12.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	21	83	73
Fleet 12	Nor-link	20	80	76
	Gillnet-link	22	83	79
13.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	15	125	126
Fleet 13	Nor-link	14	124	124
	Gillnet-link	14	122	120
13.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	19	183	182
Fleet 14	Nor-link	19	184	183
		Only one gillnet		
14.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
Fleet 15	NL-link	20	180	177

	Nor-link	20	179	179
	Gillnet-link	21	176	181
14.02.14		Soak time (hours)	Depth (meters): start	Depth (meters): stop
	NL-link	21	184	181
Fleet 16	Nor-link	20	183	181
	Gillnet-link	Only one gillnet		

Table 45. Raw data for catch statistics

Date	Period	Fleet	GearType	Gear	SeaCurrent	CatchCod	CatchHaddock	CatchTusk	CatchPollock	CatchWolf
120213	13f	Fleet1	G	2nets	1	9	1	0	0	0
120213	13f	Fleet1	G	2nets	1	8	2	0	1	0
120213	13f	Fleet1	G	2nets	1	9	2	0	0	0
120213	13f	Fleet1	NL	Potnr1	1	0	1	0	0	0
120213	13f	Fleet1	NL	Potnr2	1	1	0	0	0	0
120213	13f	Fleet1	NL	Potnr3	1	0	0	0	0	0
120213	13f	Fleet1	Nor	Potnr1	1	0	0	0	0	0
120213	13f	Fleet1	Nor	Potnr2	1	0	0	0	0	0
120213	13f	Fleet1	Nor	Potnr3	1	0	0	0	0	0
120213	13f	Fleet2	G	2nets	1	4	1	0	0	0
120213	13f	Fleet2	G	2nets	1	5	1	0	0	0
120213	13f	Fleet2	G	2nets	1	4	1	0	0	0
120213	13f	Fleet2	NL	Potnr1	1	1	0	0	0	0
120213	13f	Fleet2	NL	Potnr2	1	1	0	0	0	0
120213	13f	Fleet2	NL	Potnr3	1	1	1	0	0	0
120213	13f	Fleet2	Nor	Potnr1	1	0	0	7	0	0
120213	13f	Fleet2	Nor	Potnr2	1	0	0	0	0	0
120213	13f	Fleet2	Nor	Potnr3	1	2	0	2	0	0
130213	13f	Fleet3	G	2nets	1	10	1	0	0	0
130213	13f	Fleet3	G	2nets	1	11	1	0	0	0
130213	13f	Fleet3	G	2nets	1	10	0	0	0	0
130213	13f	Fleet3	NL	Potnr1	1	0	0	0	0	0
130213	13f	Fleet3	NL	Potnr2	1	0	0	0	0	0
130213	13f	Fleet3	NL	Potnr3	1	0	0	0	0	0
130213	13f	Fleet3	Nor	Potnr1	1	0	0	0	0	0
130213	13f	Fleet3	Nor	Potnr2	1	0	0	0	0	0
130213	13f	Fleet3	Nor	Potnr3	1	1	1	0	0	0

130213	13f	Fleet4	G	2nets	1	12	0	0	0	0
130213	13f	Fleet4	G	2nets	1	12	0	0	0	0
130213	13f	Fleet4	G	2nets	1	12	0	0	0	0
130213	13f	Fleet4	NL	Potnr1	1	0	0	0	0	0
130213	13f	Fleet4	NL	Potnr2	1	0	0	0	0	0
130213	13f	Fleet4	NL	Potnr3	1	0	0	0	0	0
130213	13f	Fleet4	Nor	Potnr1	1	0	0	0	0	0
130213	13f	Fleet4	Nor	Potnr2	1	1	0	0	0	0
130213	13f	Fleet4	Nor	Potnr3	1	0	0	1	0	0
140213	13f	Fleet5	G	2nets	1	9	1	0	0	0
140213	13f	Fleet5	G	2nets	1	9	2	0	0	0
140213	13f	Fleet5	G	2nets	1	10	2	0	0	0
140213	13f	Fleet5	NL	Potnr1	1	0	0	0	0	0
140213	13f	Fleet5	NL	Potnr2	1	2	0	0	0	1
140213	13f	Fleet5	NL	Potnr3	1	0	0	0	0	0
140213	13f	Fleet5	Nor	Potnr1	1	1	0	0	0	0
140213	13f	Fleet5	Nor	Potnr2	1	0	0	1	1	0
140213	13f	Fleet5	Nor	Potnr3	1	0	0	1	0	0
140213	13f	Fleet6	G	2nets	1	12	1	0	2	0
140213	13f	Fleet6	G	2nets	1	13	0	0	1	0
140213	13f	Fleet6	G	2nets	1	12	0	0	0	0
140213	13f	Fleet6	NL	Potnr1	1	1	0	0	0	0
140213	13f	Fleet6	NL	Potnr2	1	1	0	0	0	0
140213	13f	Fleet6	NL	Potnr3	1	0	2	0	0	0
140213	13f	Fleet6	Nor	Potnr1	1	1	0	0	0	0
140213	13f	Fleet6	Nor	Potnr2	1	2	0	0	0	0
140213	13f	Fleet6	Nor	Potnr3	1	1	0	0	0	0
150213	13f	Fleet7	G	2nets	1	5	3	0	0	0
150213	13f	Fleet7	G	2nets	1	5	2	0	0	0
150213	13f	Fleet7	G	2nets	1	5	2	0	0	0

150213	13f	Fleet7	NL	Potnr1	1	1	0	0	0	0
150213	13f	Fleet7	NL	Potnr2	1	0	0	0	0	0
150213	13f	Fleet7	NL	Potnr3	1	1	1	0	0	0
150213	13f	Fleet7	Nor	Potnr1	1	2	0	0	0	0
150213	13f	Fleet7	Nor	Potnr2	1	1	0	0	0	0
150213	13f	Fleet7	Nor	Potnr3	1	1	0	0	0	0
150213	13f	Fleet8	G	2nets	1	8	1	0	0	0
150213	13f	Fleet8	G	2nets	1	8	0	0	0	0
150213	13f	Fleet8	G	2nets	1	8	0	0	0	0
150213	13f	Fleet8	NL	Potnr1	1	0	1	0	0	0
150213	13f	Fleet8	NL	Potnr2	1	4	0	0	0	0
150213	13f	Fleet8	NL	Potnr3	1	1	0	1	0	0
150213	13f	Fleet8	Nor	Potnr1	1	1	0	2	0	0
150213	13f	Fleet8	Nor	Potnr2	1	0	0	3	0	0
150213	13f	Fleet8	Nor	Potnr3	1	1	0	0	0	0
220513	13m	Fleet1	G	2nets	0	3	0	0	0	0
220513	13m	Fleet1	G	2nets	0	3	0	0	0	0
220513	13m	Fleet1	G	2nets	0	3	0	0	0	0
220513	13m	Fleet1	NL	Potnr1	0	0	0	0	0	1
220513	13m	Fleet1	NL	Potnr2	0	1	0	0	0	0
220513	13m	Fleet1	NL	Potnr3	0	2	0	0	0	0
220513	13m	Fleet1	Nor	Potnr1	0	1	0	0	0	0
220513	13m	Fleet1	Nor	Potnr2	0	0	1	0	0	0
220513	13m	Fleet1	Nor	Potnr3	0	1	0	0	0	0
220513	13m	Fleet2	G	2nets	0	8	0	0	0	0
220513	13m	Fleet2	G	2nets	0	7	0	0	0	0
220513	13m	Fleet2	G	2nets	0	8	0	0	0	0
220513	13m	Fleet2	NL	Potnr1	0	3	0	0	0	0
220513	13m	Fleet2	NL	Potnr2	0	1	0	0	0	0
220513	13m	Fleet2	NL	Potnr3	0	0	0	0	0	0

220513	13m	Fleet2	Nor	Potnr1	0	1	0	0	0	0
220513	13m	Fleet2	Nor	Potnr2	0	5	0	0	0	0
220513	13m	Fleet2	Nor	Potnr3	0	10	0	0	0	1
230513	13m	Fleet3	G	2nets	0	9	0	0	0	0
230513	13m	Fleet3	G	2nets	0	9	0	0	0	0
230513	13m	Fleet3	G	2nets	0	9	0	0	0	0
230513	13m	Fleet3	NL	Potnr1	0	1	0	0	0	0
230513	13m	Fleet3	NL	Potnr2	0	0	0	0	0	0
230513	13m	Fleet3	NL	Potnr3	0	0	0	0	0	1
230513	13m	Fleet3	Nor	Potnr1	0	12	0	0	0	0
230513	13m	Fleet3	Nor	Potnr2	0	7	0	0	0	0
230513	13m	Fleet3	Nor	Potnr3	0	3	0	0	0	0
230513	13m	Fleet4	G	2nets	0	1	0	0	0	0
230513	13m	Fleet4	G	2nets	0	1	0	0	0	0
230513	13m	Fleet4	G	2nets	0	1	0	0	0	0
230513	13m	Fleet4	NL	Potnr1	0	2	0	0	0	0
230513	13m	Fleet4	NL	Potnr2	0	2	0	0	0	0
230513	13m	Fleet4	NL	Potnr3	0	0	0	0	0	0
230513	13m	Fleet4	Nor	Potnr1	0	4	0	0	0	0
230513	13m	Fleet4	Nor	Potnr2	0	5	0	0	0	0
230513	13m	Fleet4	Nor	Potnr3	0	6	0	0	0	0
240513	13m	Fleet5	G	2nets	0	6	0	0	0	0
240513	13m	Fleet5	G	2nets	0	7	0	0	0	0
240513	13m	Fleet5	G	2nets	0	7	0	0	0	0
240513	13m	Fleet5	NL	Potnr1	0	1	0	0	0	0
240513	13m	Fleet5	NL	Potnr2	0	2	0	0	0	0
240513	13m	Fleet5	NL	Potnr3	0	5	0	0	0	0
240513	13m	Fleet5	Nor	Potnr1	0	1	0	0	0	0
240513	13m	Fleet5	Nor	Potnr2	0	1	0	0	0	0
240513	13m	Fleet5	Nor	Potnr3	0	0	0	0	0	1

240513	13m	Fleet6	G	2nets	0	2	0	0	0	0
240513	13m	Fleet6	G	2nets	0	1	1	0	0	0
240513	13m	Fleet6	G	2nets	0	2	0	0	0	0
240513	13m	Fleet6	NL	Potnr1	0	0	0	0	0	0
240513	13m	Fleet6	NL	Potnr2	0	0	0	0	0	0
240513	13m	Fleet6	NL	Potnr3	0	0	0	0	0	0
240513	13m	Fleet6	Nor	Potnr1	0	8	1	0	0	0
240513	13m	Fleet6	Nor	Potnr2	0	12	0	0	0	0
240513	13m	Fleet6	Nor	Potnr3	0	6	1	0	0	0
250513	13m	Fleet7	G	2nets	0	2	1	0	0	0
250513	13m	Fleet7	G	2nets	0	2	0	0	0	0
250513	13m	Fleet7	G	2nets	0	2	0	0	0	0
250513	13m	Fleet7	NL	Potnr1	0	0	0	0	0	0
250513	13m	Fleet7	NL	Potnr2	0	0	0	0	0	0
250513	13m	Fleet7	NL	Potnr3	0	0	0	0	0	0
250513	13m	Fleet7	Nor	Potnr1	0	1	0	0	0	0
250513	13m	Fleet7	Nor	Potnr2	0	1	0	0	0	0
250513	13m	Fleet7	Nor	Potnr3	0	1	0	0	0	0
250513	13m	Fleet8	G	2nets	0	2	0	0	0	0
250513	13m	Fleet8	G	2nets	0	1	1	0	0	0
250513	13m	Fleet8	G	2nets	0	2	0	0	0	0
250513	13m	Fleet8	NL	Potnr1	0	0	0	0	0	0
250513	13m	Fleet8	NL	Potnr2	0	0	0	0	0	0
250513	13m	Fleet8	NL	Potnr3	0	1	0	0	0	0
250513	13m	Fleet8	Nor	Potnr1	0	1	0	0	0	0
250513	13m	Fleet8	Nor	Potnr2	0	1	0	0	0	0
250513	13m	Fleet8	Nor	Potnr3	0	1	0	0	0	0
70214	14f	Fleet1	G	2nets	1	58	1	0	0	0
70214	14f	Fleet1	G	2nets	1	57	1	0	0	0
70214	14f	Fleet1	G	2nets	1	55	1	0	0	0

70214	14f	Fleet1	NL	Potnr1	1	0	0	0	0	0
70214	14f	Fleet1	NL	Potnr2	1	0	0	0	0	0
70214	14f	Fleet1	NL	Potnr3	1	0	0	0	0	0
70214	14f	Fleet1	Nor	Potnr1	1	0	0	0	0	0
70214	14f	Fleet1	Nor	Potnr2	1	1	0	0	0	0
70214	14f	Fleet1	Nor	Potnr3	1	0	1	0	0	0
70214	14f	Fleet2	G	2nets	1	38	0	0	0	0
70214	14f	Fleet2	G	2nets	1	36	0	0	1	0
70214	14f	Fleet2	G	2nets	1	36	0	0	0	0
70214	14f	Fleet2	NL	Potnr1	1	0	0	0	0	0
70214	14f	Fleet2	NL	Potnr2	1	0	0	0	0	0
70214	14f	Fleet2	NL	Potnr3	1	0	0	0	0	0
70214	14f	Fleet2	Nor	Potnr1	1	0	0	0	0	0
70214	14f	Fleet2	Nor	Potnr2	1	0	0	0	0	0
70214	14f	Fleet2	Nor	Potnr3	1	1	0	0	0	0
80214	14f	Fleet3	G	2nets	1	58	1	0	0	0
80214	14f	Fleet3	G	2nets	1	57	1	0	0	0
80214	14f	Fleet3	G	2nets	1	55	1	0	0	0
80214	14f	Fleet3	NL	Potnr1	1	0	0	0	0	0
80214	14f	Fleet3	NL	Potnr2	1	1	0	0	0	0
80214	14f	Fleet3	NL	Potnr3	1	0	0	0	0	0
80214	14f	Fleet3	Nor	Potnr1	1	1	2	0	0	0
80214	14f	Fleet3	Nor	Potnr2	1	1	2	0	0	0
80214	14f	Fleet3	Nor	Potnr3	1	1	2	0	0	0
80214	14f	Fleet4	G	2nets	1	38	0	0	0	0
80214	14f	Fleet4	G	2nets	1	36	0	0	0	0
80214	14f	Fleet4	G	2nets	1	36	0	0	0	0
80214	14f	Fleet4	NL	Potnr1	1	0	0	0	0	0
80214	14f	Fleet4	NL	Potnr2	1	0	0	0	0	0
80214	14f	Fleet4	NL	Potnr3	1	0	0	0	0	0

80214	14f	Fleet4	Nor	Potnr1	1	0	0	0	0	0
80214	14f	Fleet4	Nor	Potnr2	1	1	0	0	1	0
80214	14f	Fleet4	Nor	Potnr3	1	5	0	0	0	0
90214	14f	Fleet5	G	2nets	1	58	1	0	0	0
90214	14f	Fleet5	G	2nets	1	57	1	0	0	0
90214	14f	Fleet5	G	2nets	1	55	1	0	0	0
90214	14f	Fleet5	NL	Potnr1	1	1	0	0	0	0
90214	14f	Fleet5	NL	Potnr2	1	0	0	0	0	0
90214	14f	Fleet5	NL	Potnr3	1	0	0	0	0	0
90214	14f	Fleet5	Nor	Potnr1	1	0	0	0	0	0
90214	14f	Fleet5	Nor	Potnr2	1	1	1	0	0	0
90214	14f	Fleet5	Nor	Potnr3	1	0	0	0	0	0
90214	14f	Fleet6	G	2nets	1	38	0	0	0	0
90214	14f	Fleet6	G	2nets	1	36	0	0	0	0
90214	14f	Fleet6	G	2nets	1	36	0	0	0	0
90214	14f	Fleet6	NL	Potnr1	1	0	0	0	0	0
90214	14f	Fleet6	NL	Potnr2	1	0	0	0	0	0
90214	14f	Fleet6	NL	Potnr3	1	0	0	0	0	0
90214	14f	Fleet6	Nor	Potnr1	1	1	1	0	1	0
90214	14f	Fleet6	Nor	Potnr2	1	0	0	0	0	0
90214	14f	Fleet6	Nor	Potnr3	1	4	0	0	0	0
100214	14f	Fleet7	G	2nets	1	58	1	0	0	0
100214	14f	Fleet7	G	2nets	1	57	1	0	0	0
100214	14f	Fleet7	G	2nets	1	55	1	0	0	0
100214	14f	Fleet7	NL	Potnr1	1	2	0	0	0	0
100214	14f	Fleet7	NL	Potnr2	1	0	0	0	0	0
100214	14f	Fleet7	NL	Potnr3	1	0	0	0	0	0
100214	14f	Fleet7	Nor	Potnr1	1	0	0	0	0	0
100214	14f	Fleet7	Nor	Potnr2	1	0	0	0	0	0
100214	14f	Fleet7	Nor	Potnr3	1	0	2	0	0	0

100214	14f	Fleet8	G	2nets	1	38	0	0	0	0
100214	14f	Fleet8	G	2nets	1	36	0	0	0	0
100214	14f	Fleet8	G	2nets	1	36	0	0	0	0
100214	14f	Fleet8	NL	Potnr1	1	2	0	0	0	1
100214	14f	Fleet8	NL	Potnr2	1	0	0	0	0	0
100214	14f	Fleet8	NL	Potnr3	1	0	0	0	0	0
100214	14f	Fleet8	Nor	Potnr1	1	1	0	0	0	1
100214	14f	Fleet8	Nor	Potnr2	1	1	0	0	0	0
100214	14f	Fleet8	Nor	Potnr3	1	1	0	0	0	0
110214	14f	Fleet9	G	2nets	1	58	1	0	0	0
110214	14f	Fleet9	G	2nets	1	57	1	0	0	0
110214	14f	Fleet9	G	2nets	1	55	1	0	0	0
110214	14f	Fleet9	NL	Potnr1	1	0	0	0	0	0
110214	14f	Fleet9	NL	Potnr2	1	0	0	0	0	0
110214	14f	Fleet9	NL	Potnr3	1	0	0	0	0	0
110214	14f	Fleet9	Nor	Potnr1	1	2	0	0	0	0
110214	14f	Fleet9	Nor	Potnr2	1	1	0	0	0	0
110214	14f	Fleet9	Nor	Potnr3	1	0	0	0	0	0
110214	14f	Fleet10	G	2nets	1	38	0	0	0	0
110214	14f	Fleet10	G	2nets	1	36	0	0	0	0
110214	14f	Fleet10	G	2nets	1	36	0	0	0	0
110214	14f	Fleet10	NL	Potnr1	1	0	0	0	0	0
110214	14f	Fleet10	NL	Potnr2	1	0	0	0	0	0
110214	14f	Fleet10	NL	Potnr3	1	0	0	0	0	0
110214	14f	Fleet10	Nor	Potnr1	1	1	0	0	0	0
110214	14f	Fleet10	Nor	Potnr2	1	1	0	0	0	0
110214	14f	Fleet10	Nor	Potnr3	1	0	0	0	0	0
120214	14f	Fleet11	G	2nets	0	1	2	0	0	0
120214	14f	Fleet11	G	2nets	0	0	0	0	0	0
120214	14f	Fleet11	G	2nets	0	0	0	0	0	0

120214	14f	Fleet11	NL	Potnr1	0	0	0	0	0	0
120214	14f	Fleet11	NL	Potnr2	0	0	0	0	0	0
120214	14f	Fleet11	NL	Potnr3	0	0	0	0	0	0
120214	14f	Fleet11	Nor	Potnr1	0	4	0	0	0	0
120214	14f	Fleet11	Nor	Potnr2	0	6	0	0	0	0
120214	14f	Fleet11	Nor	Potnr3	0	7	0	0	0	0
120214	14f	Fleet12	G	2nets	0	1	0	0	0	0
120214	14f	Fleet12	G	2nets	0	1	0	0	0	0
120214	14f	Fleet12	G	2nets	0	2	0	0	0	0
120214	14f	Fleet12	NL	Potnr1	0	0	0	0	0	0
120214	14f	Fleet12	NL	Potnr2	0	0	0	0	0	0
120214	14f	Fleet12	NL	Potnr3	0	0	0	0	0	0
120214	14f	Fleet12	Nor	Potnr1	0	2	0	0	0	0
120214	14f	Fleet12	Nor	Potnr2	0	0	0	0	0	0
120214	14f	Fleet12	Nor	Potnr3	0	1	0	0	0	0
130214	14f	Fleet13	G	2nets	0	3	0	0	0	0
130214	14f	Fleet13	G	2nets	0	2	0	0	0	0
130214	14f	Fleet13	G	2nets	0	2	0	0	0	0
130214	14f	Fleet13	NL	Potnr1	0	1	0	0	0	0
130214	14f	Fleet13	NL	Potnr2	0	1	0	0	0	0
130214	14f	Fleet13	NL	Potnr3	0	0	0	0	0	0
130214	14f	Fleet13	Nor	Potnr1	0	4	0	0	0	0
130214	14f	Fleet13	Nor	Potnr2	0	1	0	0	0	0
130214	14f	Fleet13	Nor	Potnr3	0	2	0	0	0	0
130214	14f	Fleet14	G	2nets	0	3	0	0	0	0
130214	14f	Fleet14	G	2nets	0	2	0	0	0	0
130214	14f	Fleet14	G	2nets	0	2	0	0	0	0
130214	14f	Fleet14	NL	Potnr1	0	3	0	0	0	0
130214	14f	Fleet14	NL	Potnr2	0	5	0	0	0	0
130214	14f	Fleet14	NL	Potnr3	0	0	0	0	0	0

130214	14f	Fleet14	Nor	Potnr1	0	5	0	0	0	0
130214	14f	Fleet14	Nor	Potnr2	0	7	0	0	0	0
130214	14f	Fleet14	Nor	Potnr3	0	1	0	0	0	0
140214	14f	Fleet15	G	2nets	0	1	1	0	0	0
140214	14f	Fleet15	G	2nets	0	2	0	0	0	0
140214	14f	Fleet15	G	2nets	0	1	0	0	0	0
140214	14f	Fleet15	NL	Potnr1	0	7	0	0	0	0
140214	14f	Fleet15	NL	Potnr2	0	5	0	0	0	0
140214	14f	Fleet15	NL	Potnr3	0	3	0	0	0	0
140214	14f	Fleet15	Nor	Potnr1	0	4	0	0	0	0
140214	14f	Fleet15	Nor	Potnr2	0	5	0	0	0	0
140214	14f	Fleet15	Nor	Potnr3	0	10	0	0	0	0
140214	14f	Fleet16	G	2nets	0	1	1	0	0	0
140214	14f	Fleet16	G	2nets	0	2	0	0	0	0
140214	14f	Fleet16	G	2nets	0	1	0	0	0	0
140214	14f	Fleet16	NL	Potnr1	0	3	0	0	0	0
140214	14f	Fleet16	NL	Potnr2	0	4	0	0	0	0
140214	14f	Fleet16	NL	Potnr3	0	1	0	0	0	0
140214	14f	Fleet16	Nor	Potnr1	0	10	0	0	0	0
140214	14f	Fleet16	Nor	Potnr2	0	3	0	0	0	0
140214	14f	Fleet16	Nor	Potnr3	0	13	0	0	0	0