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GREENLAND INSTITUTE OF NATURAL RESOURCES
GRØNLANDS NATURINSTITUT GREENLAND

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Note on the project:

Bycatch in the lumpfish (*Cyclopterus lumpus*) fishery in the Nuuk area, West Greenland, during the 2019 fishing season




Participants

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Introduction

The lumpfish fishery in Greenland was MSC certified in 2015. Part of the certification process was an evaluation of the bycatch in the fishery. Lumpfish are caught in large meshed gill nets (260 mm), which reduces bycatch by having an extremely low selectivity for other fish species. Therefore, the main concern regarding bycatch is birds, in particular common eider (*Somateria mollissima*), and marine mammals.

Official reporting systems are in place, and fishermen are obligated to report all catch. However, the system is new and with little control effort, the actual level of bycatch is uncertain. Additionally, the current assessment of lumpfish relies on landing-per-unit-effort (LPUE) data, but this approach should be strengthened by having accurate catch-per-unit-effort (CPUE) data for comparison.

In this project the catch and bycatch in the lumpfish fishery is documented in the Nuuk area. Results are compared to previous estimates. This provides novel CPUE data during the season and an estimate of bycatch in terms of composition and amount.

The project is a collaboration between Greenland Institute of Natural Resources (GINR), Sustainable Fisheries Greenland (SFG) and Lumpfish fishermen. GINR was responsible for the scientific planning of the project and participated in all field trips. SFG was responsible for planning of the project and contact to and coordination with the fishermen. The project was co-financed by GINR and SFG. The fishermen was open to provide information on their fishery and let us registrar the whole catch per fieldtrip.

Methods

Sampling

The 2019 lumpfish fishing season in NAFO 1D started April 10. Using a separate boat (7.5 m, 300 hp) we followed five different fishermen to their nets on nine occasions, starting 12/4. Several fishermen volunteered to be part of the project. From these volunteers, we randomly selected a single fishermen to follow on a full day. The fishermen have very well defined fishing areas, where nets are set at the start of the season and maintained through the season. Hence, the fishermen did not change behavior to accommodate the study, or set nets differently.

Upon reaching the fishing area, the location (decimal degrees), depth (m), fishing period (h) and number of nets (single nets are typically combined with 2-5 nets per station) were registered. We collected all bycatch from the fishermen upon net retrieval. Each bycatch specimen was determined to species, sexed (except fishes), measured and photographed. Random subsamples of female lumpfish were measured (total length, nearest cm below). Male lumpfish were released immediately upon capture as they are normally alive and actively swim away. Therefore, male lumpfish were counted, but not measured.

For birds, the sex and age (young/adult) was registered, while fish were also measured to the nearest cm below.

During sampling, the fishermen were asked questions about bycatch composition in general. This included questions marine mammals and birds, and they were specifically asked about harbor porpoise (*Phocoena phocoena*), king eider (*Somateria spectabilis*) and common murre (*Uria aalge*).

Analysis

The CPUE was estimated for both males and females by dividing the number caught on a given day, by the fishing period and the number of nets. This was standardized to the catch in a net during 100h (no caught*net^{-1}*100h^{-1}). The standard error was calculated for each sampling day.

A normal distribution was fitted to the combined length distribution for all dates. Similarly, distributions were fitted to each specific date.

To estimate the bycatch through extrapolation, we did the following:

- For each sampling date, we obtained the amount of roe sold from the fishermen on the given day. These data are available through the official reporting system (GFLK).
- We assumed that the given sampling date was representative for a certain period (see table 3).
- This allowed us to calculate how many fishing hours was needed to catch the period specific catch.
- We used the sampling date specific bycatch rate to estimate how many of the given species was caught in the period.

The sampling area only covers a limited proportion of the entire West Greenland area lumpfish fishery (field codes JA26 to JF24). Because of differences in distribution of bycatch species, we make no attempt to extrapolate the bycatch to all of West Greenland. The fishery in the selected area constituted 25% of total West Greenland landings.

The bycatch is estimated only for the most common bycatch species: common eider (*Somateria mollissima*), spotted wolfish (*Anarhichas minor*), Atlantic cod (*Gadus morhua*) and Greenland cod (*Gadus ogac*). Other species were caught, but in insignificant low numbers (table 2). For birds, the total bycatch was estimated in numbers.

To estimate the bycatch of fish in weight, all lengths were converted to weight using length-weight relationships as defined on Fishbase.org.

Table 1: Sampling dates and details

Sampling date	No. nets	Fishing time (h)	Females	Males	Females measured
12/4	30	72	198	157	62
29/4	31	144	338	182	105
2/5	18	24	173	25	63
7/5	11	48	351	38	38
9/5	27	48 (4 nets 72)	330	25	80
14/5	26	48	261	11	259
16/5	25	72	324	22	-
21/5	8	96	30	2	30
23/5	6	48	127	3	119
Total	**182**	**-**	**2132**	**465**	**758**

Results

The lumpfish catch and other species bycatch was registered in 182 nets (10.92 km) during nine days of sampling (Table 1). Sampling took place in the primary fishing areas around Nuuk, from 63.11N to 64.30N (Fig. 1). Nets were typically combined in rows of 3-5 nets. All nets were in shallow areas (4-20 m), and only a few were attached to the coast. Most nets stood parallel to the nearest coastline, being anchored in both ends.

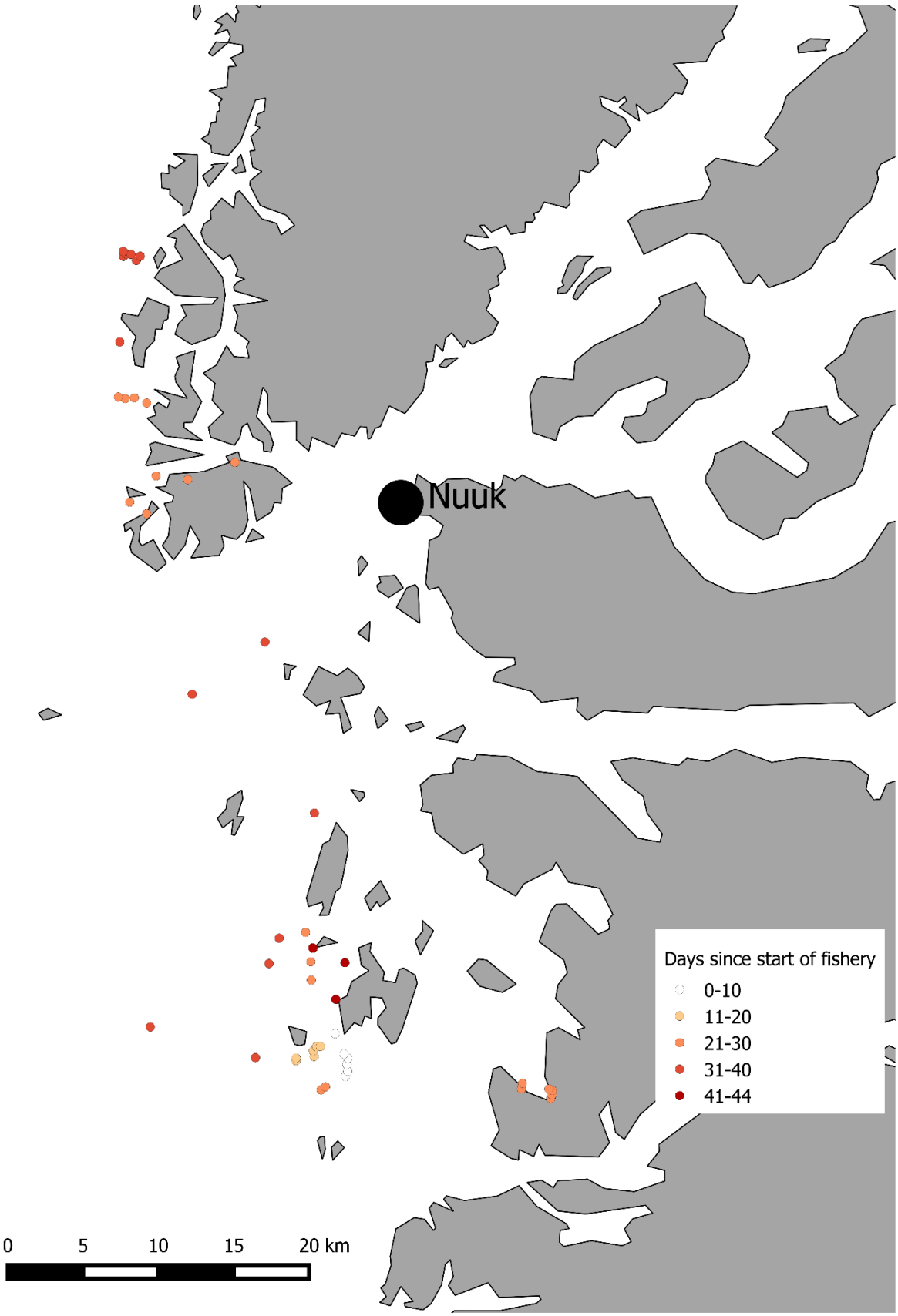

Figure 1: Sampling area. Sampling points are grouped according to the number of days since the start of the fishing season (April 10).

Lumpfish

Lumpfish catch rates (CPUE) changed markedly throughout the season (Fig. 2). During the early part of the season, female and male CPUE were similar. From May 2, female CPUE increased greatly, peaking at 68 on May 5. Female CPUE remained above 20 for the remainder of the fishing season, except on May 21, when the lowest value during the study was observed. Male CPUE has two distinct periods, before and after May 7, with CPUE going from high to low stability.

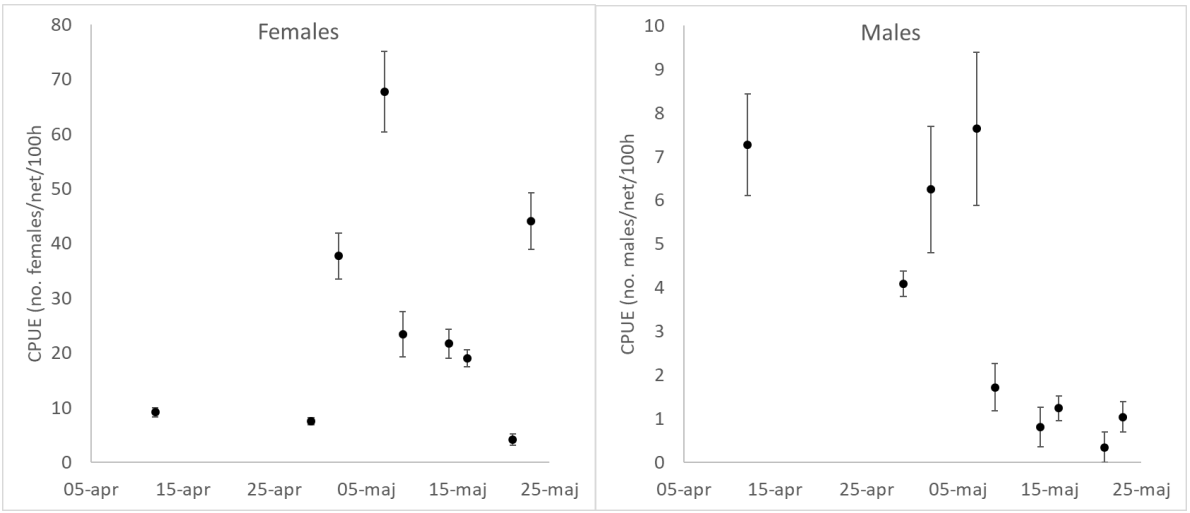

Figure 2: Catch rates (CPUE, no. caught*net^{-1}*100h^{-1}) for female lumpfish (left) and male lumpfish (right). Error bars are standard error. Notice difference in y-axis scale.

The length distributions for female lumpfish changed little during the season (Fig. 3). The average length for the entire period was 36 cm, and the range in average lengths on the individual sampling dates was 36-38 cm, with no time related trend. Similarly, there was no tendency for the large/small individuals being present in a certain period.

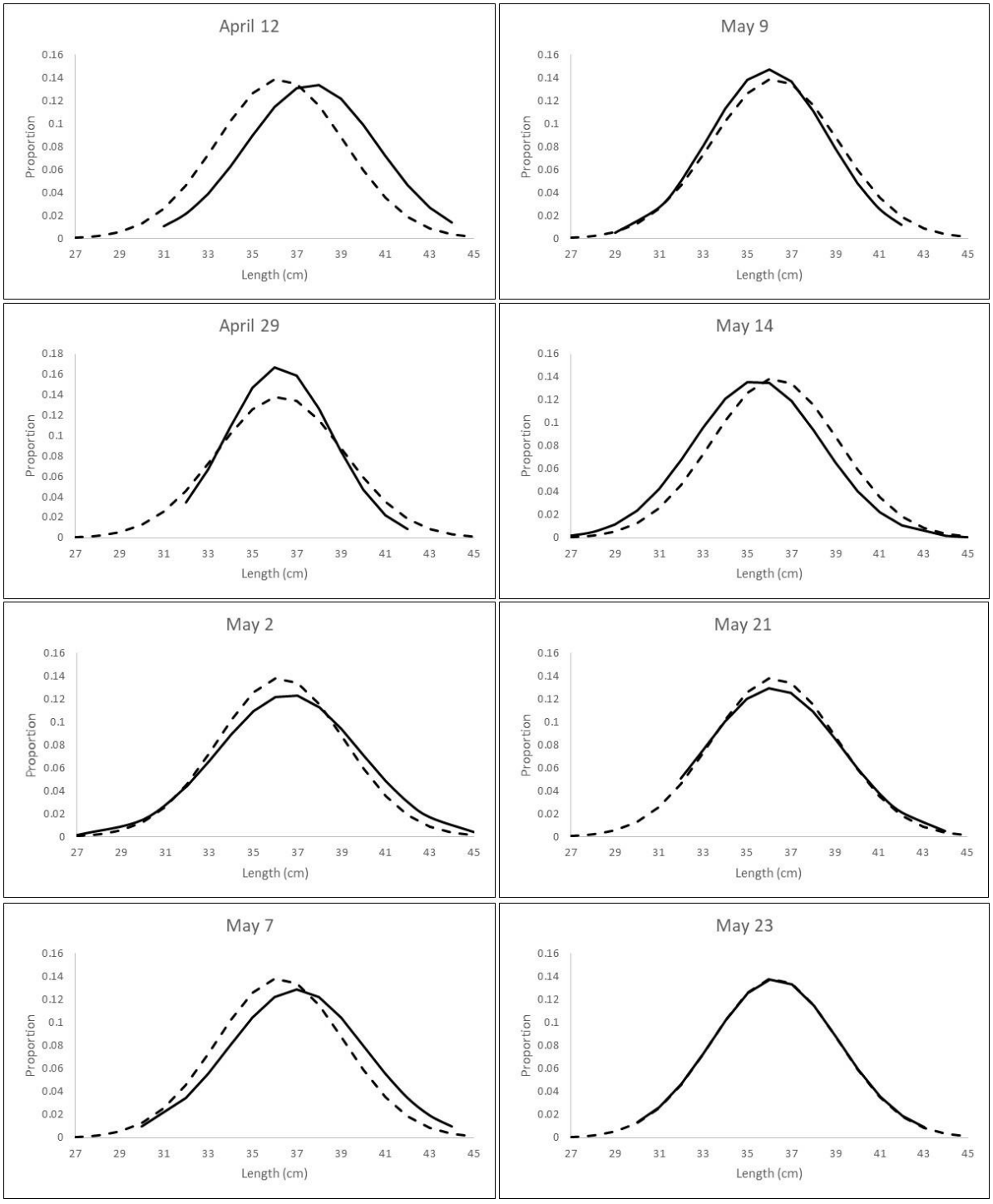

Figure 3: Length distribution from all sampling dates (full line). For comparative purposes the mean length distribution for the entire period is shown on each sampling date (broken line).

Bycatch

All bycatch are listed by species in table 2. Nine different species were registered. The most common species by numbers were common eider (N=16), Atlantic cod (N=10), spotted wolffish

(N=7) and Greenland cod (N=5). Common eiders were caught on all days except the last two, and the catch was almost all adult birds (94%) and predominantly females (69%).

Table 2: All registered bycatch.

Sampling date and bycatch	**Count (male/female)**	**N (young/adult)**	**Length (cm)**
April 12			
- Common eider (*Somateria mollissima*)	3 (1/2)	0/3	-
- Atlantic cod (*Gadus morhua*)	1	-	48
April 29			
- Common eider (*Somateria mollissima*)	5 (2/3)	0/5	-
- Black guillemot (*Cepphus grylle*)	1	1/0	-
- Atlantic cod (*Gadus morhua*)	1	-	50
- Greenland cod (*Gadus ogac*)	1	-	55
May 2			
- Common eider (*Somateria mollissima*)	1 (0/1)	0/1	-
- Greenland cod (*Gadus ogac*)	1	-	49
May 7			
- Common eider (*Somateria mollissima*)	2 (1/1)	0/2	-
- Atlantic cod (*Gadus morhua*)	1	-	33
- Greenland cod (*Gadus ogac*)	1	-	35
- Spotted wolffish (*Anarhichas minor*)	2	-	108, 115
May 9			
- Common eider (*Somateria mollissima*)	1 (0/1)	0/1	-
- Atlantic cod (*Gadus morhua*)	2	-	43, 52
- Greenland cod (*Gadus ogac*)	2	-	51, 56
- Shorthorn sculpin *(Myoxocephalus scorpius)*	1	-	36
- American plaice *(Hippoglossoides platessoides)*	1	-	40
May 14			
- Common eider (*Somateria mollissima*)	2 (1/1)	1/1	-
- Long-tailed duck (*Clangula hyemalis*)	1 (1/0)	0/1	-
- Atlantic cod (*Gadus morhua*)	1	-	42
- Spotted wolffish (*Anarhichas minor*)	1	-	110
May 16			
- Common eider (*Somateria mollissima*)	2 (0/2)	0/2	-
- Long-tailed duck (*Clangula hyemalis*)	1 (0/1)	0/1	-
- Atlantic cod (*Gadus morhua*)	3	-	48, 68, 73
- Spotted wolffish (*Anarhichas minor*)	2	-	100, 108
May 21			
- Atlantic cod (*Gadus morhua*)	1	-	45
May 23			
- Spotted wolfish (*Anarhichas minor*)	1	-	96
- Atlantic halibut (*Hippoglossus hippoglossus)*	1	-	63

CPUE for common eider changed through the season, with large peaks in early May (0.46 net*100h^{-1}, Fig. 4), and zero values by the end of the fishery. The highest value on May 2 was observed in the northern part of the sampling area, but the similar value on May 7 (0.43 net*100h^{-1}) was from the southern area. The northern area was sampled again on May 16, where the CPUE had decreased to 0.1.

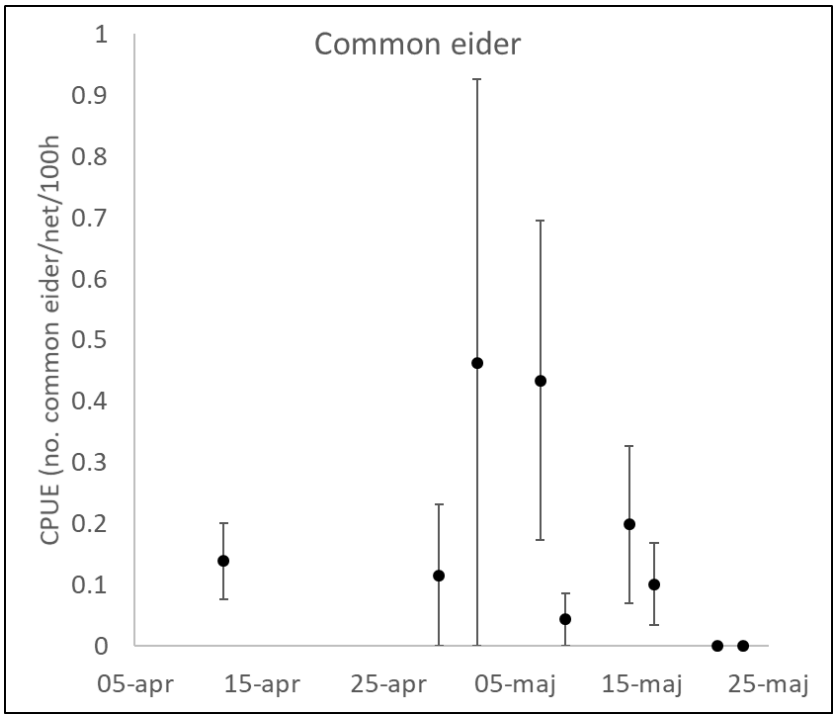

Figure 4: Catch rates (CPUE, no. caught*net^{-1}*100h^{-1}) for common eider. Error bars are standard error.

Using the CPUEs from the single dates to estimate the total bycatch in the sampling area, we estimate at a total bycatch of common eider of 2186 individuals (Table 3). Except for the two last day of the fishery, common eiders were caught on all sampling trips. To estimate the uncertainty of the bycatch estimate for common eider we repeated the calculations with 20% reduced and 20% increased bycatch rates on each sampling day. This resulted in a total bycatch estimate of 1749-2623 birds for the whole fishing season.

Tabel 3: Data on lumpfish fishery and estimates of common eider bycatch. Note that numbers are rounded and may not result in exact values as presented.

Sampling date	**Period covered by date (both days included)**	**CPUE (kg roe*h^{-1}) on sampling date**	**Amount of roe caught in whole area (kg)**	**Total effort in whole period (net*100h^{-1})**	**Bycatch rate (no.*net^{-1}*100h^{-1})**	**Total no. of bycatch (common eider)**
12/4	10/4-18/4	0.04	14425	3501	0.14	490
29/4	19/4-29/4	0.16	22130	1419	0.12	170
2/5	30/4-3/5	0.24	35020	1441	0.46	663
7/5	4/5-8/5	1.15	45965	401	0.43	172
9/5	9/5-12/5	0.13	43217	3342	0.04	134
14/5	13/5-15/5	0.12	21939	1825	0.20	365
16/5	16/5-19/5	0.10	18822	1915	0.10	191
21/5	20/5-22/5	0.10	7829	801	0.00	0
23/5	23/5-24/5	0.82	6086	74	0.00	0
Total	**10/4-24/5**		**215434**			**2186**

The CPUE of Atlantic cod was low in the first part of the season, followed by higher values in most of May. The bycatch was estimated to be 1386 kg in the sampled area.

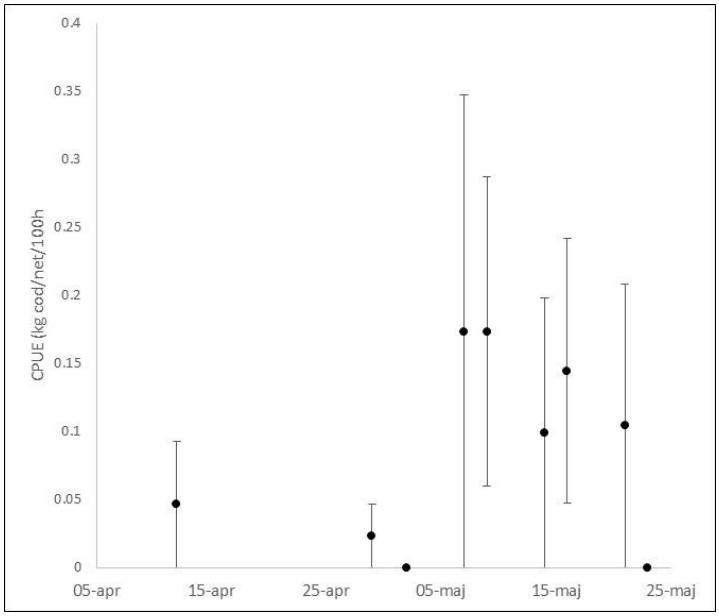

Figure 5: Catch rates (CPUE, kg*net^{-1}*100h^{-1}) for Atlantic cod. Error bars are standard error.

Similar estimations made for spotted wolffish resulted in an estimated bycatch of 726 kg. For Greenland cod, the bycatch was estimated to 900 kg.

Other bycatch species

We report no bycatch of marine mammals but fishermen were asked questions regarding the general bycatch pattern. Of marine mammals, the fishermen mentioned the occasional catch of ringed seal (*Pusa hispida*), but this was not an annual event. None of the questioned fishermen had ever caught other mammals, and they were specifically asked about harbor porpoise (*Phocoena phocoena*). As for birds, the fishermen were asked specifically to the possible bycatch of king eider (*Somateria spectabilis*) and common murre (*Uria aalge*) but none of them had ever encountered these species in the nets.

Conclusions

- Males appear to arrive at the spawning ground before females. Considering the selectivity of the used gear (260 mm gill net), the males will not be caught with the same efficiency as the females, and it is therefore even more noteworthy, that the early season CPUE are similar.

- The abrupt drop in male CPUE suggests that males stop moving actively around, and probably start establishing and attending nests.

- Female CPUE remains relatively high, indicating that females continue to arrive at the spawning grounds, and move around more than males in search of an optimal spawning location.

- In the sampled area, approximately 579,000 female lumpfish were caught. This is equivalent to 2.3 mio. individual females in the entire West Greenland fishery. Less than 5% of the bodies are landed, although the industry is willing to buy them from the fishermen.

- When using the length-weight relationship and gonad weight-total weight relationship provided in Hedeholm *et al.* 2013, the average conversion factor from landed weight following draining in the factory is 3.65.

- The only significant bycatch is common eider. In the most recent MSC surveillance audit for the West Greenland lumpfish fishery, the total bycatch of common eider in the entire fishery is 73 individuals. This study clearly shows this to be an underestimate, even considering the uncertainty associated with catch rates and the relatively low coverage of the fishery in the sampled area (~3‰). Rather than taking the estimated values as absolute estimates of the actual bycatch, they should serve as indications of a flawed reporting system.

- The bycatch estimates of the other species also indicate an underreporting why this appears to be a common problem.

- Considering that the estimated bycatch of 1749-2623 eiders covers only 25% of the total lumpfish landings in West Greenland, the total bycatch will add a significant contribution to the overall

removal of eiders from the population. The impact on the population is worse if the observed large proportion of adult females is representative for the bycatch in West Greenland.

- In comparison, the yearly number of hunted common eiders in Greenland averaged 27345 birds in the period 2010-2015 (APNN, 9. June 2017). The impact of this removal is however smaller than the number indicates, due to a large proportion of juveniles among the hunted birds.

- The observed large proportion of adult females in the bycatch in the fishery is considerably higher than observed in a previous bycatch study (Merkel 2004). In the present study, the sample size is rather small and additional sampling is recommended to verify the observed age and sex distribution.

- The breeding population of common eider has been increasing in Northwest Greenland since around 2001, but so far the magnitude of impact from hunting and bycatch has not been quantified, i.e. the proportional reduction in population growth caused by hunting and bycatch. This is a natural next step to carry out.