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A “SNOWCRAB-BAG” ATTACHED TO THE FISHING LINE OF CAMPELEN 1800 RESEARCH TRAWL

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A "snowcrab-bag" attached to the fishing line of Campelen 1800 research trawl

Undertittel:

Does it affect the catch rates and species composition in the cod end?

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I Introduction

For monitoring abundance and distribution of snow crab in the Barents Sea, data from the bottom trawl surveys in winter (February) and in autumn (August-September) are used. The data collected in the autumn survey is especially important, since provide the basis for quota advice on the fishery for snow crab in the Svalbard Fishery Protection Zone (SFPZ). For these surveys the standard rigging of the bottom trawl (Campelen 1800 shrimp trawl) is specified for catching demersal fish, and is not well designed for catching crabs. Among others it specifies a “rock-hopper” rubber gear of 40cm diameter.

To optimize the catch of snow crab, both in number and size ranges, an additional bag attached to the fishing line of the Campelen trawl has been tried (Sundet et al., 2016). This additional bag is of nearly similar design as those used for investigating escapement of fish beneath the Campelen and a commercial trawl (Engås and Godø, 1989; Ingolfsson and Jørgensen, 2006).

Some preliminary tests with this crab bag were done during the Joint Russian-Norwegian Ecosystem survey in September 2016, and further testing were made during the 2017 Ecosystem survey (Prozorkevich et al. 2018).

2 2017-experimental setup

The experiment was set up for pair-wise testing for differences in cod end catch when the separate crab bag was attached (“WITH”) and when it was not (“WITHOUT”). Starting position, towing direction, towing duration (15 minutes) and towed distance (0.75 n-miles) were equal for both hauls within each pair. The first 5 pairs were performed by repeating 5 of the stations predetermined for the survey (Table 1), pairs 6-12 was done at Sentralbanken North, and pairs 13-18 at Sentralbanken South, and pairs 19-22 at Tor Iversen bank. One additional pair at Sentralbanken North was rejected, since the crab bag got twisted around the bobbins of the Campelen trawl.

The vessel was equipped with two Campelen trawls (trawl ID 1617 and 1623) ready for operation. The two trawls should by construction be identical. At some of the initial tows a camera rig was attached to the trawl to observe the shape and behavior of the crab bag (see attached file produced by Alexander Pavlenkov). Within pairs 1,2, 5 and 6 the crab bag and camera rig were, for practical reasons, attached to one of the trawls, while the “WITHOUT” haul was done by the other trawl.

3 Benthos, stones and clay

Table 1 shows total weight of benthos for those hauls that were weighed. The table also shows weights of stone and clay.

Too few skilled benthos experts were available to make complete species identification of benthos at all stations. For pairs 1-5 total weight of benthos was recorded, but due to some miss-communication, only benthos caught in the crab bag was weighed for the remaining pairs. Among those 5 pairs of weighed cod end catch, 4 showed more benthos in the hauls without crab bag than those with (Table 1). The mean weight over those 5 pairs do not indicate any significant difference, but the number of tows is too low for drawing a conclusion.

Benthos caught in the crab bag was weighed in all the 22 cases. The mean crab bag catch of benthos over pairs 1-5 is similar to the mean catches of benthos observed in the cod end. The largest benthos catches in the crab bag were dominated by starfish and “medusae-heads”.

Stone and clay occurred in the main bag only at the first two pairs, while in the crab bag it occurred in 9 of the 22 cases.

Table 1.

Pair #	Location	Bottom depth	cod end catch (kg), standard tow			cod end catch (kg), when crab bag attached			Additional catch in crab bag		
			Serial #	benthos	stone, clay	Serial #	benthos	stone, clay	Serial #	benthos	stone, clay
1	East of Hopen	243	2571	7.0	5.0	2572	4.3	10.2	2652	8.1	0
2	North of Sentralbk	214	2576	1.2	19.7	2577	0.7	2.9	2653	5.8	0
3	Svalbardbanken	72	2589	14.0	0	2590	8.0	0	2654	0.5	0
4	Svalbardbanken	86	2594	3.3	0	2595	9.3	0	2655	7.5	0
5	Svalbardbanken	34	2597	3.2	0	2596	1.2	0	2656	6.8	0
6	Sentralbanken N	163	2617	3.9	0	2618	na	0	2657	1.0	0.1
7	Sentralbanken N	163	2620	na	0	2619	na	0	2658	1.8	0
8	Sentralbanken N	162	2621	na	0	2622	na	0	2659	0.6	0
9	Sentralbanken N	163	2624	na	0	2623	na	0	2660	0.2	0
10	Sentralbanken N	163	2625	na	0	2627	na	0	2662	2.0	200.0
11	Sentralbanken N	163	2628	na	0	2630	na	0	2663	2.3	3.4
12	Sentralbanken N	162	2629	na	0	2631	na	0	2664	1.6	0
13	Sentralbanken S	249	2632	na	0	2633	na	0	2665	1.5	0.2
14	Sentralbanken S	251	2635	na	0	2634	na	0	2666	3.4	4.0
15	Sentralbanken S	254	2636	na	0	2637	na	0	2667	1.6	12.0
16	Sentralbanken S	253	2639	na	0	2638	na	0	2668	1.9	15.0
17	Sentralbanken S	248	2640	na	0	2641	na	0	2669	6.6	5.0
18	Sentralbanken S	252	2643	na	0	2642	na	0	2670	7.8	5.0
19	Tor Iversen bk	209	2644	na	0	2645	na	0	2671	1.8	0
20	Tor Iversen bk	210	2647	na	0	2646	na	0	2672	1.6	0
21	Tor Iversen bk	210	2648	na	0	2649	na	0	2673	0	0
22	Tor Iversen bk	210	2651	na	0	2650	na	0	2674	2.1	0
		average 1-5		5.75	4.94		4.70	2.62		5.74	0.02
		CV(%) 1-5		36	65		37	64		24	0
		average 1-22		na	1.12		na	0.60		3.02	11.12
		CV(%) 1-22		na	81		na	80		19	81

4 Comparing fish and Pandalus catches in the cod end, with and without crab bag attached

Table 2. Summary statistics for paired comparisons of catch weight of fish (and Pandalus) by species for the 22 pairs “WITH” and “WITHOUT” crab bag. Diff-Mean is the mean values of “WITH” minus “WITHOUT”, and Diff_Med is the median values of “WITH” minus “WITHOUT”. t-test is the result of a t-test and wrs-test is the result of a Wilcoxon rank sum test

Norwegian name	English name	Diff_Mean	sd	Diff_Med	t-test	wrs-test
blåkveite	Greenland halibut	0.151	2.127	-0.422	0.846	1.000
blåsteinbit	Northern wolffish	-13.079	26.095	-11.230	0.096	0.127
dypvannsreke	Pandalus	3.125	6.930	0.040	0.052	0.096
flekksteinbit	Spotted wolffish	24.152	55.239	5.990	0.141	0.048
gapeflyndre	Dab	6.764	24.222	2.688	0.204	0.156
hyse	Haddock	-3.831	13.644	0.011	0.213	0.946
kloskate	Starry ray	-0.655	2.101	-0.235	0.283	0.455
krokulke	Atlantic hookear sculpin	0.008	0.043	0.000	0.396	0.679
langhalet langebarn	snakeblenny	-0.007	0.054	-0.006	0.545	0.430
lodde	capelin	0.234	1.023	0.036	0.308	0.320
nettålebrosmesme	arctic eelpout	-0.064	#N/A	-0.064	#N/A	#N/A
nordlig ålebrosmesme	threespot eelpout	-0.016	0.071	-0.009	0.570	0.813
paddeulke	polar sculpin	-0.003	0.006	-0.003	0.490	0.500
polartorsk	polar cod	0.003	0.040	-0.008	0.814	0.765
rognkjeks	lumpsucker	-0.786	#N/A	-0.786	#N/A	#N/A
skate-egg	Ray eggs	-0.004	0.030	0.000	0.795	0.875
snabeluer	beaked redfish	0.072	0.197	0.070	0.178	0.208
spitsbergenålebrosmesme	Gymnelus sp	-0.002	0.013	-0.002	0.861	1.000
tiskjegg	Atlantic poacher	-0.230	0.862	-0.033	0.336	0.542
torsk	cod	-6.132	35.016	-4.380	0.421	0.588
tverrhalet langebarn	daubed shanny	0.091	0.185	0.010	0.045	0.123
uerslekten	juvenile redfish	0.016	0.103	0.014	0.489	0.349
gråsteinbit	Atlantic wolffish	-1.926	6.030	-0.037	0.431	0.813
vanlig uer	golden redfish	-3.748	5.084	-1.490	0.330	0.250
nordlig knurrulke	moustache sculpin	-0.096	0.142	-0.104	0.077	0.098
pukkelringbuk	Liparis	-0.010	0.027	-0.010	0.692	1.000
tornulke	twohorn sculpin	0.000	0.008	0.000	1.000	0.945
vanlig ulke	shorthorn sculpin	0.001	#N/A	0.001	#N/A	#N/A
vortekjeks	Atl. spiny lumpsucker	0.003	#N/A	0.003	#N/A	#N/A
øyepål	norway pout	0.062	0.436	-0.004	0.766	1.000
havsil	sandeel	-0.332	0.471	-0.332	0.501	1.000
vanlig ringbuk	striped seasnail	-0.002	#N/A	-0.002	#N/A	#N/A
sildG03	herring	-0.010	0.034	-0.004	0.369	0.320
isskate	Arctic skate	1.038	3.580	2.316	0.552	0.813
båndålebrosmesme	doubleline eelpout	0.014	#N/A	0.014	#N/A	#N/A

snottfisk	snailfish	-0.008	0.049	0.004	0.773	1.000
sei	saithe	0.006	#N/A	0.006	#N/A	#N/A
vanlig ålebrosme	Lycodes gracilis	0.096	0.132	0.047	0.243	0.125
firetrådet tangbrosme	fourbeared rockling	0.018	#N/A	0.018	#N/A	#N/A
Number of cases with negative difference		20 of 39		21 of 39		

For the paired comparisons in the Wilcoxon test, the zero observations were assigned a very small random value before ranking (to avoid “ties”)

There are no cases where both the t-test and the Wilcoxon-test indicate significance at 5% level.

For the Wilcoxon test the spotted wolffish is the only case close to significance at a 5% level. For the t-test both the daubed shanny and pandalus are close to 5%.

Across all species tested; Both Diff_Mean and Diff_Med are marginally more often negative than positive.

The conclusion is that the data do not give any clear evidence of change in cod end catchability caused by attaching a crab bag to the Campelen trawl.

5 Results of using the crab bag attached to the trawl

Background:

When we initiated this test trial, we knew that an extra bag attached to Alfredo Trawl and Campelen trawl with Tromsø – rigging collected higher numbers and wider size distribution of snow crab in the extra crab bag compared with the cod end of the two trawl riggings (Sundet et al. 2015 & 2016). That increased our chances to catch snow crab in low density areas and we got more knowledge on both size and sex distribution in the areas examined.

Our task given by the government, is to fulfill national management goals, which is to procure a sustainable long term fishery, maximize the catch in long term and minimize the risk of ecosystem effect. The use of an extra crab bag attached to the Campelen trawl, was meant to increase our knowledge on the size distribution, including estimates of the legal male stock, and to provide better knowledge on the snow crab distribution in the Barents Sea.

Since there is no exclusive snow crab cruise covering the Barents Sea we need to take advantages of the existing cruises in the Barents Sea, both during winter and autumn. Important input data to our yearly quota advice to the management, is based on the ecosystem survey data from the autumn, fishery data and input data on productivity from eastern Canada.

The experiment design and areas trawled is described earlier in the report (2017-experimental set up).



Figure 1. Map showing the beforehand set trawl stations for the cruise and the four areas where the crab bag was attached to the Campelen trawl (black and red squares).

Catches:

In total, 263 crabs were caught in the Campelen trawl without the crab bag, and 308 crabs when the crab bag was attached to the fishing line of the Campelen trawl (Table 3). So, by adding the crab bag, we increased the catches of snow crab by 17 % over 22 paired trawl hauls.

Table 3 shows the catches of snow crab in the trawl pairs. In the first area, there was only catches in two of the five hauls, and here it was caught crabs in both pairs. The missing catches in trawl pair 3 to 5 can be due to the depth ranging from 34 to 86 m, depths not preferred by the snow crab.

At Sentralbanken N and Sentralbanken S we have catches of snow crab in all the 13 paired trawl hauls. Sentralbanken is also an important fishing area for snow crab. In only two of the hauls the catches were higher in the extra bag compared to the cod end. The catches at Tor Iversen banken was low and insignificant compared with the areas at Sentralbanken.

Of the 22 paired trawl hauls, it was caught more crabs in the crab bag compared with the cod end, at only four stations. Not surprisingly, the trawl hauls with the crab bag attached caught higher number of crabs than those without the crab bag, but the yield was low; only 45 individuals (17 %).

Table 3: Overview over number of trawl hauls with catches of crabs in the “normal trawl haul” and in the trawl haul with attached crab bag.

Area name		Depth (m)	Serialno	Campelen without	Total Catch		Serialno	Campelen with	The Crab bag	Total Catch
East of Hopen	1	243	2571	87	87		2572	26	9	35
N of Sentralbanken	2	214	2576	3	3		2577	7	1	8
Svalbardbanken	3	72	2589	0	0		2590	0	0	0
Svalbardbanken	4	86	2594	0	0		2595	0	0	0
Svalbardbanken	5	34	2597	0	0		2596	0	0	0
Sentralbanken N	6	163	2617	36	36		2618	7	5	12
Sentralbanken N	7	163	2620	9	9		2619	8*	16*	24**
Sentralbanken N	8	162	2621	2	2		2622	6	2	8
Sentralbanken N	9	163	2624	9	9		2623	4	0	4
Sentralbanken N	10	163	2625	10	10		2626	14	0	14
Sentralbanken N	11	163	2628	13	13		2627	63	0	63
Sentralbanken N	12	162	2629	12	12		2630	17	0	17
Sentralbanken S	13	249	2632	4	4		2633	5	11	16**
Sentralbanken S	14	251	2635	20	20		2634	5	4	9
Sentralbanken S	15	254	2636	21	21		2637	19	7	26
Sentralbanken S	16	253	2639	12	12		2638	22	2	24
Sentralbanken S	17	248	2640	17	17		2641	25	5	30
Sentralbanken S	18	252	2643	5	5		2642	10	4	14
Tor Iversen banken	19	209	2644	2	2		2645	0	2	2**
Tor Iversen banken	20	210	2647	0	0		2646	1	0	1
Tor Iversen banken	21	210	2648	1	1		2649	0	0	0
Tor Iversen banken	22	210	2651	0	0		2650	0	1	1**
Total Catch					263			239	69	308

*the length measurements from these 24 crabs are missing. ** trawl hauls with higher catches in the crab bag compared with the cod end.

Size distribution:

Total weight and carapace width (CW) of all crabs caught was measured in addition to other morphological measurements such as claw length in male crabs and abdomen width in females. The measurements done on crabs caught in the extra bag was first written down on paper, and then recorded in a database after end of cruise. During this process, measurements on 16 crabs was lost

(serial no 2619), therefore we only have width measurements from 53 crabs. There is a deviation between the number of crabs in table 3 and table 4, this is due to missing values and miss-measurements in the database.

To visualize the size distribution of small crabs (< 20 mm CW) properly we chose to present that group in a figure separate from the larger (>20 mm CW) crabs (figure 2 and 3). Table 4 shows the distribution of catches in the three different sampling units; the Campelen trawl without the crab bag, Campelen trawl with the crab bag and the crab bag.

Table 4: Showing the number of crabs in the size-frequency distribution figures 2 and 3.

Snow crab <20 mm CW <i>Figure 2</i>			
	Female	Male	Total
Cod end	69	61	130
Cod end with bag	75	69	144
Crab bag	2	5	7
Total	146	135	280
Snow crab >20 mm CW <i>Figure 3</i>			
Cod end	53	96	149
Cod end with bag	23	40	63
Crab bag	9	33	42
Total	85	169	254

Based on the size distribution it seems like that the Campelen trawl catches small crabs very well and even better than the crab bag attached. There is very little difference in the sex ratio in catches.

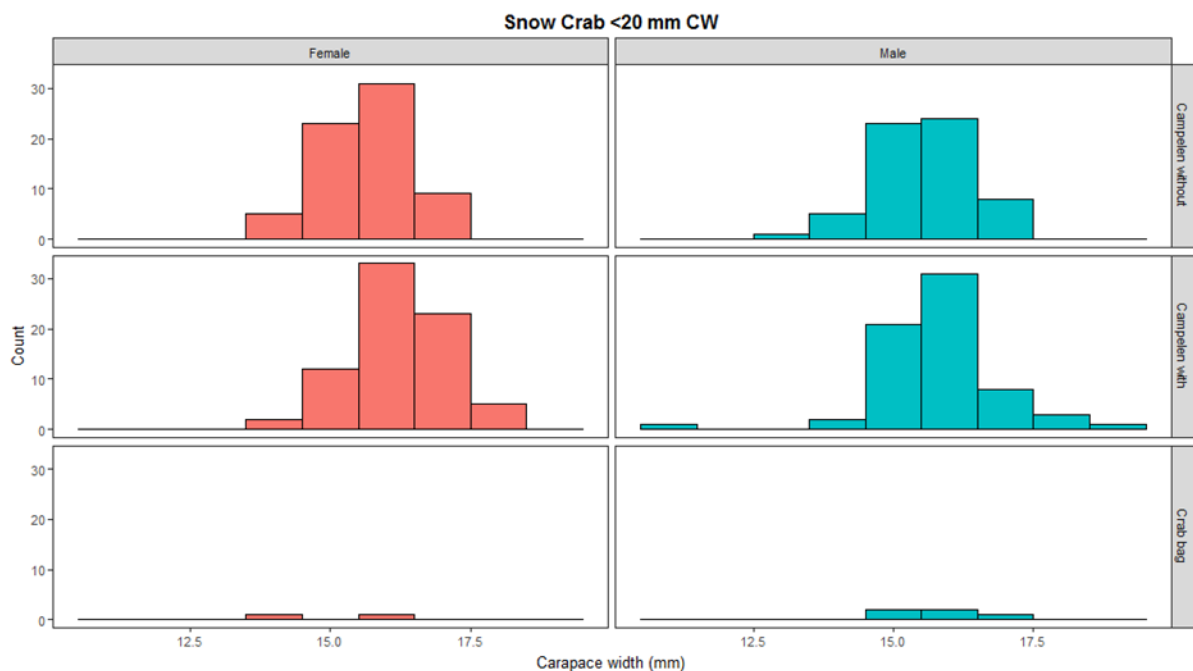


Figure 2: Size distribution of small male and female snow crabs (< 20 mm CW) in 1 mm bins caught in the different sampling compartments. The upper panel show crabs caught in the Campelen trawl without attached crab bag, the middle panel shows crabs caught in the Campelen when the crab bag was attached and the lower panel show the size distribution of the crabs caught in the crab bag. The number of individuals is shown in the table below.

The size distribution of snow crab larger than 20 mm carapace width in figure 3 shows that crab sizes between 40 to 60 mm CW are not present in the samples. This is a typical pattern for several years of sampling of snow crab from the ecosystem survey. For these size groups, there is no significant difference in size distribution from the three different sampling compartments. Only three males above minimum legal size (>100 mm CW) was caught in the survey and these were taken in the Campelen.

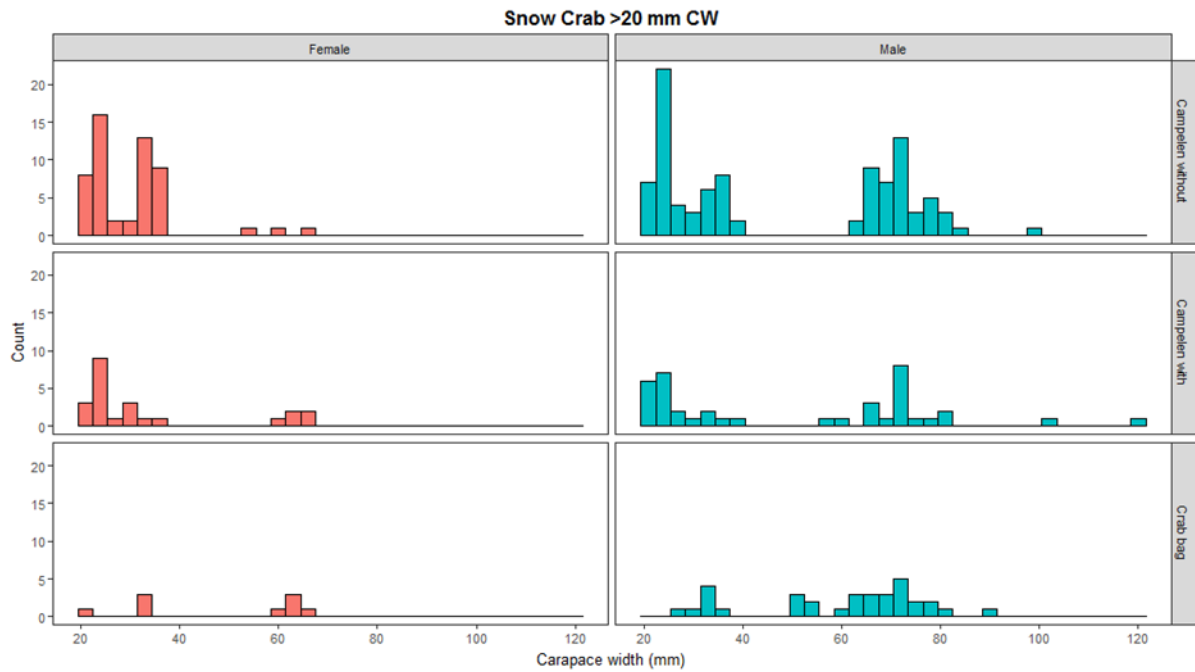


Figure 3. Size distribution of snow crabs (> 20 mm) from different sampling compartments. Bins are 3 mm. Upper panel show crabs caught in Campelen trawl without crab bag, the middle panel crabs caught in Campelen trawl with crab bag attached, and bottom panel crabs caught in the crab bag.

6 Conclusions and recommendations

Initially, we wanted to test whether the crab bag attached to the Campelen trawl could increase our catches of snow crab, especially in areas with low densities. We knew that two earlier cruises (Sundet et al 2015 and 2016) gave much higher catches and wider size distribution, even though this was other trawl types involved.

The Campelen trawl is not designed to catch snowcrab. Therefore, the catch efficiency for snow crabs was expected to be low. The findings in this experiment showed only minor increase in number of crabs caught when a crab bag was attached to the Campelen trawl, and there were no differences in size distribution between the main trawl and the crab bag as we saw in the earlier studies (Sundet et al 2015, 2016). This may be due to the difference in rigging of the Campelen trawl between the two experiments (Tromsø-rigging versus HI-rigging). One with a stiff gear (Tromsø-rigging) and one with a loose gear (HI-rigging).

The number of paired trawl hauls is too low to carry out credible statistical testing of the results.

We also question if the results of this experiment would be different if all hauls were carried out in areas with high snow crab densities. More than one third of the hauls in the current experiment was carried out in areas of probably very low crab densities. In addition, most hauls in this experiment were taken at shallow depths with regards to what we know about the preferred depth of the snow crab in the Barents Sea. The results might be different if more hauls were taken at larger depths.

In conclusion, there are no results from this experiment that indicate that the use of the crab bag attached to the Campelen trawl contribute to any improvement of the snow crab samples from the ecosystem surveys in the Barents Sea. Consequently, if one wants to improve snow crab samples used for stock assessment it must be achieved by other sampling methods than the Campelen trawl.

7 References

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