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Sea trials report

Results from sea trials made using biodegradable gillnets on saithe and cod, October – December 2018

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ABSTRACT

Gillnets made of a new biodegradable resin (polybutylene succinate co-adipate-co-terephthalate (PBSAT) were tested under commercial fishing conditions to compare their fishing performance with that of conventional nylon (PA) nets. The relative catch efficiency between the two gillnet types was evaluated over the 2018's fall fishing season for saithe and cod in northern Norway.

For cod both biodegradable gillnets (0.55 and 0.60mm) had a significantly lower catch efficiency compared to the traditional nylon net (0.55mm) with estimated efficiencies at respectively 62.38% (CI: 50.55-74.04) and 54.96% (CI: 35.42-73.52) of with the nylon net.

For saithe, there were 15 sets for analysis of the 0.55 mm setup and 11 for the 0.60 mm setup (table 1 and table 4). Also for saithe results showed a lower catch efficiency for the biodegradable gillnets had a significantly lower catch efficiency compared to the traditional nylon net with estimated efficiencies at respectively 83.40% (71.34-94.86) and 83.87% (66.36-104.92) of with the nylon net.

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1 Experimental setup

Sea trials were conducted on board the coastal gillnet boat "MS Karoline" (10.9 m LOA) throughout October and December in 2018 with the aim to further investigate the relative catch efficiency between gillnets made using biodegradable and nylon twine. The fishing grounds chosen for the tests were located off the coast of Troms (Northern Norway) between 70°21'–70°22'N and 19°39'–19°42'E, which is a common fishing area for coastal vessels from Troms.

Gillnets with a 130 mm nominal mesh opening was used for both types of gillnets, with monofilament twine thickness of 0.55 and 0.60 mm in the biodegradable gillnets and 0.55 mm in the nylon gillnets. Since the biodegradable monofilament is considered to be approximately 10% weaker than nylon monofilament (at equal monofilament thickness), we increased the monofilament thickness from 0.55mm to 0.60 mm to compensate for the difference in tensile strength.

We used two sets of gillnets in the experiments. Each set consisted of 16 gillnets, with eight bio gillnets (B) and eight nylon gillnets (N). The gillnets were arranged in such a way that they provided the best information for paired comparison, nylon versus bio net, accounting for spatial and temporal variation in the availability of cod. With individual sets being the basic unit for the subsequently paired analysis (described in section 2.4), it was important that within each gillnet set averaged over nets that the bio and nylon nets were approximately exposed to the same spatial variability in cod availability. This could in principle be achieved by alternating between the two types of nets after each net sheet as B-N-B-N-B-N-B-N-B-N-B-N-B-N-B-N. However, for easing of registration of fish on board in relation to the type of net in which it was caught, the alternation in net types were only applied after each second net sheet. Therefore, to make conditions as equal between net types a possible set 1 was arranged as N-BB-NN-BB-NN-BB-NN-BB-N and set 2 as B-NN-BB-NN-BB-NN-BB-NN-B. Actual measurements of the mesh openings (four rows of 20 meshes each) were taken with a Vernier calliper without applying tension to the meshes and showed that the mean mesh openings of 0.55mm nylon gillnets and 0.55mm and 0.60mm bio gillnets were 131.6 ± 0.72mm, 131.5 ± 1.0mm and 132.5 ± 0.8mm respectively.

2 Data analysis

We used the statistical analysis software SELNET (Herrmann et al., 2012, 2016) to analyze the catch data and conduct length-dependent catch comparison and catch ratio analyses. Using the catch information (numbers and sizes of cod in each gillnet set deployment), we wanted to determine whether there was a significant difference in the catch efficiency averaged over deployments between the nylon gillnet and the bio gillnet. We also wanted to determine if a potential difference between the gillnet types could be related to the size of the cod. Specifically, to assess the relative length-dependent catch efficiency effect of changing from nylon gillnet to bio gillnet, we used the method described in Herrmann et al. (2017) and compared the catch data for the two net types. This method models the length-dependent catch comparison rate (CCl) summed over gillnet set deployments (for the full deployment period):

$$CC_l = \frac{\sum_{j=1}^{m}\{nt_{lj}\}}{\sum_{j=1}^{m}\{nt_{lj}+nc_{lj}\}} \qquad (1)$$

where nclj and ntlj are the numbers of cod caught in each length class l for the nylon gillnet (control) and the bio gillnet (treatment) in deployment j of a gillnet set (first or second set). m is the number of deployments carried out with one of the two sets. The functional form for the catch comparison rate CC(l,v) (the experimental being expressed by equation 1) was obtained using maximum likelihood estimation by minimizing the following expression:

$$-\sum_l\left\{\sum_{j=1}^{m}\left\{nt_{lj}\times ln\big(CC(l,v)\big)+nc_{lj}\times ln\big(1.0-CC(l,v)\big)\right\}\right\} \qquad (2)$$

where v represents the parameters describing the catch comparison curve defined by CC(l,v). The outer summation in the equation is the summation over length classes l. When the catch efficiency of the bio gillnet and nylon gillnet is similar, the expected value for the summed catch comparison rate would be 0.5. Therefore, this baseline can be applied to judge whether or not there is a difference in catch efficiency between the two gillnet types. The experimental CCl was modelled by the function CC(l,v) using the following equation:

$$CC(l,v) = \frac{exp(f(l,v_0,\ldots,v_k))}{1+exp(f(l,v_0,\ldots,v_k))} \qquad (3)$$

where f is a polynomial of order k with coefficients v0 to vk. The values of the parameters v describing CC(l,v) were estimated by minimizing equation (2), which was equivalent to maximizing the likelihood of the observed catch data. We considered f of up to an order of 4 with parameters v0, v1, v2, v3, and v4. Leaving out one or more of the parameters v0…v4 led to 31 additional models that were also considered as potential models for the catch comparison CC(l,v). Among these models, estimations of the catch comparison rate were made using multi-model inference to obtain a combined model (Burnham and Anderson 2002; Herrmann et al., 2017).

The ability of the combined model to describe the experimental data was evaluated based on the p-value. The p-value, which was calculated based on the model deviance and the degrees of freedom, should not be < 0.05 for the combined model to describe the experimental data sufficiently well, except for cases for which the data are subject to over-dispersion (Wileman et al., 1996; Herrmann et al., 2017). Based on the estimated catch comparison function CC(l,v) we obtained the relative catch efficiency (also named catch ratio) CR(l,v) between the two gillnet types using the following relationship:

$$CR(l,v) = \frac{CC(l,v)}{(1-CC(l,v))} \qquad (4)$$

The catch ratio is a value that represents the relationship between catch efficiency of the bio gillnet and that of the nylon gillnet. Thus, if the catch efficiency of both gillnets is equal, CR(l,v) should always be 1.0. CR(l,v) = 1.5 would mean that the bio gillnet is catching 50% more cod with length l than the nylon gillnet. In contrast, CR(l,v) = 0.8 would mean that the bio gillnet is only catching 80% of the cod with length l that the nylon gillnet is catching.

The confidence limits for the catch comparison curve and catch ratio curve were estimated using a double bootstrapping method (Herrmann et al., 2017). This bootstrapping method accounts for between-set variability (the uncertainty in the estimation resulting from set deployment variation of catch efficiency in the gillnets and in the availability of cod) as well as within-set variability (uncertainty about the size structure of the catch for the individual deployments). However, contrary to the double bootstrapping method (Herrmann et al., 2017), the outer bootstrapping loop in the current study accounting for the between deployment variation was performed paired for the bio gillnet and nylon gillnet, taking full advantage of the experimental design with the bio gillnet and nylon gillnet being deployed simultaneously (see Fig. 1). By multi-model inference in each bootstrap iteration, the method also accounted for the uncertainty due to uncertainty in model selection. We performed 1000 bootstrap repetitions and calculated the Efron 95% (Efron, 1982) confidence limits. To identify sizes of cod with significant differences in catch efficiency, we checked for length classes in which the 95% confidence limits for the catch ratio curve did not contain 1.0.

Finally, a length-integrated average value for the catch ratio was estimated directly from the experimental catch data using the following equation:

$$CR_{average} = \frac{\sum_l \sum_{j=1}^{m} \{nt_{lj}\}}{\sum_l \sum_{j=1}^{m} \{nc_{lj}\}} \qquad (5)$$

where the outer summation covers the length classes in the catch during the experimental fishing period.

2.5. Modelling the effect of number of times deployed on the length-integrated catch ratio

To investigate the effect of the number of times the gillnets were the deployed on the length-integrated catch ratio, the equation (5) was calculated for individual deployment sets such without the summation over gillnet sets. This led to a dataset consisting of pair values for number of times the gillnets were deployed and corresponding values for CRaverage. Based on this dataset, we tested if the value for CRaverage changed linearly with number of deployment times (DNO) using the following equation:

$$CR_{average}(DNO) = \alpha \times DNO + \beta_l \qquad (6)$$

The last part of the analysis using model (6) was conducted using the linear model function (lm) in statistical package R (version 2.15.2; www.r-project.org).

3 Tensile strength tests

Tensile strength tests were carried out on samples of the bio and nylon gillnets used in before and after fishing experiments using a H10KT universal tensile testing machine (Tinius Olsen TMC, PA, USA). Samples of gillnets measuring approx. 20 x 20 meshes were cut from the centre of the new and used gillnets. The tests were performed in wet conditions (at least 40 replicates for each case) according to ISO 1806. Tensile strength, defined as the stress needed to break the sample, is given in kg, and elongation at break, defined as the length of the sample after it had stretched right when it breaks (L) is given relative to the initial mesh size in percentage.

4 Results

Sufficient data was collected for two species throughout the trial period, cod and saithe. A total of 1200 cod were caught, 780 using the nylon gillnet and 420 in the biodegradable gillnet. 1328 saithe individuals were collected, of these, 736 were caught in the nylon gillnets and the remaining 592 were caught in the biodegradable gillnet. Data was collected for 21 catches for both cod and saithe, but the analysis was conducted based on catches that were greater than 10 in each set (Table 1). This was done in order to not add additional uncertainty to the results and has been a method used successfully in previous catch comparison studies. For cod this resulted in a total of 15 sets for analysis of the 0.55 mm setup and 12 for the 0.60 mm setup. For cod both biodegradable gillnets (0.55 and 0.60mm) had a significantly lower catch efficiency compared to the traditional nylon net (0.55mm) with estimated efficiencies at respectively 62.38% (CI: 50.55-74.04) and 54.96% (CI: 35.42-73.52) of with the nylon net (Tables 2-3 and figures 1-6).

For saithe, there were 15 sets for analysis of the 0.55 mm setup and 11 for the 0.60 mm setup (table 1 and table 4). Also for saithe results showed a lower catch efficiency for the biodegradable gillnets had a significantly lower catch efficiency compared to the traditional nylon net (0.55mm) with estimated efficiencies at respectively 83.40% (71.34-94.86) and 83.87% (66.36-104.92) of with the nylon net (Tables 4-6 and Figures 7-12).

Table 1: Catch data of all deployments for cod, rows highlighted in grey indicate sets used in the analysis (sets containing catches of 10 or more cod).

Set	Setup	Setting date	Fishing time	Fishing depth (m) (min - max)	Acc. no. of deployments	No. of cod in nylon gillnets	No. of cod in bio gillnets	Min cod length in nylon gillnets	Max cod length in nylon gillnets	Min cod length in bio gillnets	Max cod length in bio gillnets
1	55/55	06/09/18	19h 45min	140	1	1	1	87	87	60	60
1	55/60	06/09/18	19h 45min	120	1	0	0	0	0	0	0
2	55/55	10/09/18	21h 45min	110	2	3	1	60	85	64	64
2	55/60	10/09/18	22h 10min	130	2	2	3	66	76	60	101
3	55/55	30/10/18	27h 30min	170-140	3	15	7	51	88	50	73
3	55/60	30/10/18	26h 15min	130-110	3	1	2	80	80	61	63
4	55/55	31/10/18	22h 40min	180-160	4	6	2	59	69	60	64
4	55/60	31/10/18	24h 15min	110-130	4	1	2	65	65	50	67
5	55/55	01/11/18	22h 40min	100-120	5	3	2	63	73	65	68
5	55/60	01/11/18	23h 55min	105-125	5	2	2	63	68	60	64
6	55/55	10/11/18	24h 50min	25-30	6	40	28	60	88	59	84
6	55/60	10/11/18	24h 15min	50-70	6	6	3	61	81	67	73
7	55/55	12/11/18	21h 20min	25-30	7	4	1	56	66	78	78
7	55/60	12/11/18	21h 45min	50-70	7	4	0	60	68	59	91
8	55/55	13/11/18	22h	50-70	8	2	4	59	69	60	90
8	55/60	13/11/18	18h 20min	50-70	8	1	3	74	74	56	83
9	55/55	26/11/18	22h 20min	35-20	9	27	11	52	86	55	92
9	55/60	26/11/18	23h 20min	95-45	9	11	0	55	77	0	0
10	55/55	27/11/18	23h 20min	35-20	10	14	6	53	76	56	75
10	55/60	27/11/18	22h 20min	50-85	10	1	2	66	66	64	69
11	55/55	28/11/18	23h 40min	38-25	11	30	9	53	68	56	75
11	55/60	28/11/18	26h 20min	55-45	11	12	7	50	74	56	71
12	55/55	29/11/18	18h 5min	30-75	12	36	23	52	92	54	87
12	55/60	29/11/18	18h 55min	45-48	12	11	13	57	98	53	84
13	55/55	30/11/18	25h 40min	30-75	13	26	18	56	96	66	96
13	55/60	30/11/18	26h	45-48	13	24	8	51	94	67	95

14	55/55	01/12/18	18h 5min	30-76	14	20	7	50	85	54	67
14	55/60	01/12/18	18h 15min	45-49	14	100	12	50	92	51	95
15	55/55	02/12/18	26h 10min	35-20	15	33	17	50	95	56	78
15	55/60	02/12/18	28h 5min	50-85	15	16	11	51	96	58	87
16	55/55	03/12/18	16h	30-75	16	28	14	50	84	55	66
16	55/60	03/12/18	16h 15min	45-48	16	11	6	52	92	62	96
17	55/55	04/12/18	23h	30-75	17	46	47	52	95	51	76
17	55/60	04/12/18	23h 25min	45-48	17	50	44	55	94	50	94
18	55/55	06/12/18	25h 20min	30-75	18	19	12	54	67	52	72
18	55/60	06/12/18	22h 20min	45-48	18	26	4	52	95	64	85
19	55/55	07/12/18	24h 5min	30-75	19	26	22	50	74	52	67
19	55/60	07/12/18	27h 55min	45-48	19	15	10	56	85	55	86
20	55/55	08/12/18	22h 50min	30-75	20	27	12	52	87	50	89
20	55/60	08/12/18	18h 10 min	45-48	20	32	9	54	92	59	87
21	55/55	09/12/18	16h 30min	30-75	21	26	25	54	71	51	82
21	55/60	09/12/18	16h 5min	45-48	21	22	10	55	96	51	95

Table 2: Catch rate and fit statistics results from the 0.55 mm biodegradable and nylon set based on the valid deployments for cod. Values in parentheses indicate a 95% confidence interval. DOF denotes the degrees of freedom

Length (cm)	Catch ratio (%)
50	74.59 (24.39-269.67)
55	70.97 (46.14-96.63)
60	66.97 (47.25-87.92)
65	62.66 (47.73-84.43)
70	58.17 (40.29-82.65)
75	53.72 (29.74-80.38)
80	48.70 (21.37-70.54)
85	45.71 (13.67-72.52)
90	42.56 (4.97-93.69)
95	40.37 (1.62-320.05)
Average	62.38 (50.55-74.04)
P-value	0.2915
Deviance	45.46
DOF	41

Table 3: Catch rate and fit statistics results from the 0.60 mm biodegradable and 0.55 mm nylon set based on the valid deployments for cod. Values in parentheses indicate a 95% confidence interval. DOF denotes the degrees of freedom. *: In case only best model is used and not the model averaging P-value would be 0.077.

Length (cm)	Catch ratio (%)
50	65.93 (24.43-410.77)
55	58.57 (28.60-139.11)
60	54.41 (29.05-94.91)
65	52.63 (29.65-74.56)
70	52.61 (30.64-70.73)
75	53.90 (31.20-83.56)
80	55.90 (33.45-106.62)
85	57.63 (33.27-126.53)
90	57.74 (28.19-116.21)
95	55.26 (9.76-109.90)
100	52.01 (0.68-134.61)
105	51.88 (0.00-185.15)
Average	54.96 (35.42-73.52)
P-value	0.0334*
Deviance	60.29
DOF	42

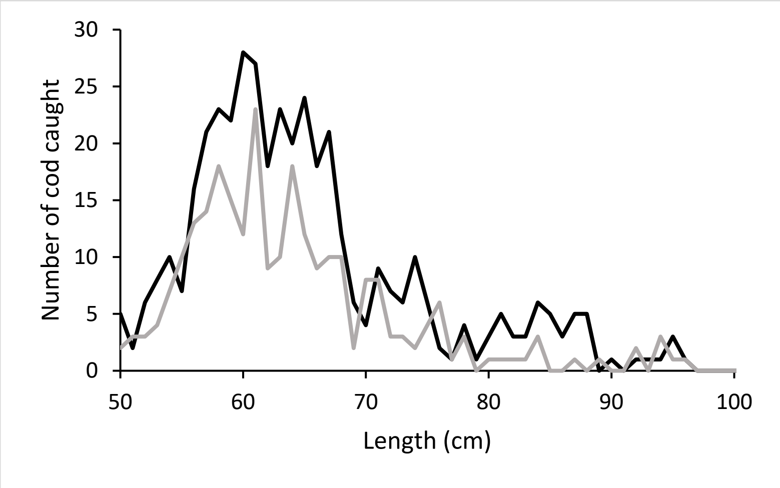

Fig 1: The size distribution of cod caught using 0.55 mm nylon (black) and biodegradable (grey) twine gillnets

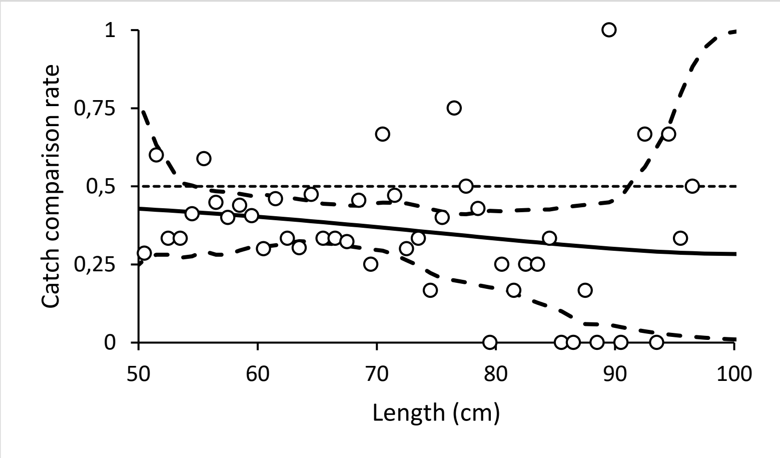

Fig 2: The catch comparison curve for cod with circle marks indicating the experimental rate and the curve indicates the modelled catch comparison rate. The dotted line at 0.5 indicates the baseline where both 0.55 mm gillnets fish the same amount. The stippled curve indicates a 95% confidence interval for the estimated catch comparison curve.

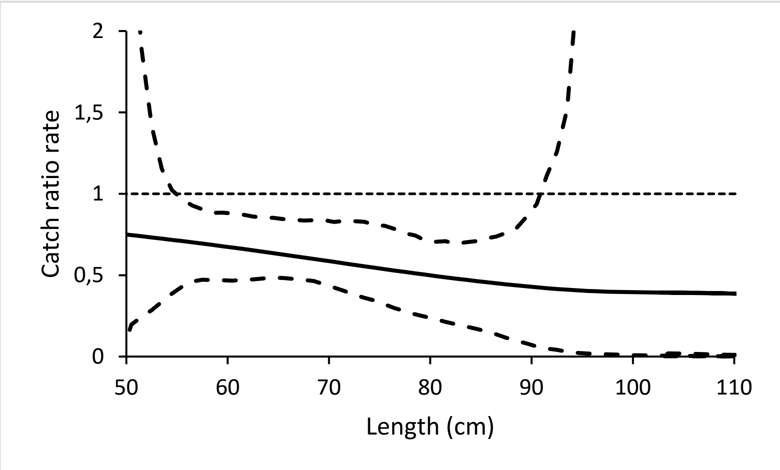

Fig 3: The estimated catch ratio curve for cod (solid line). The dotted line at 1.0 indicates the baseline where fishing efficiency of both 0.55 mm gillnet types is equal. The stippled curves represent a 95% confidence interval of the estimated catch ratio curve.

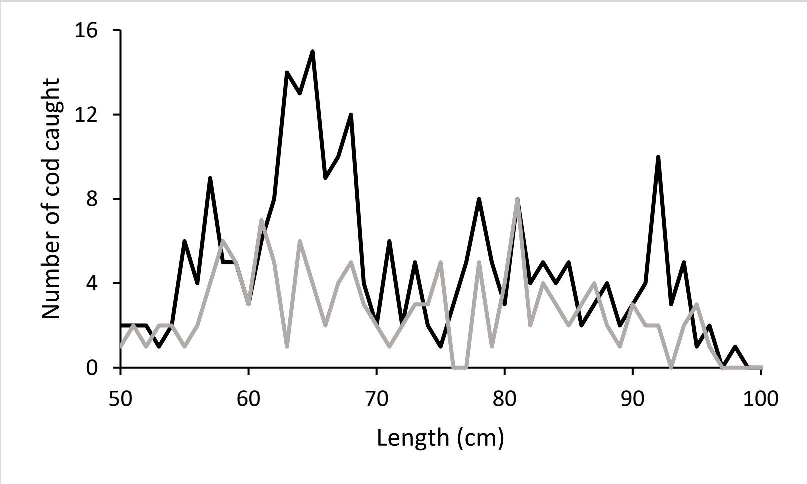

Fig 4: The size distribution of cod caught using 0.60 mm nylon (black) and biodegradable (grey) twine gillnets

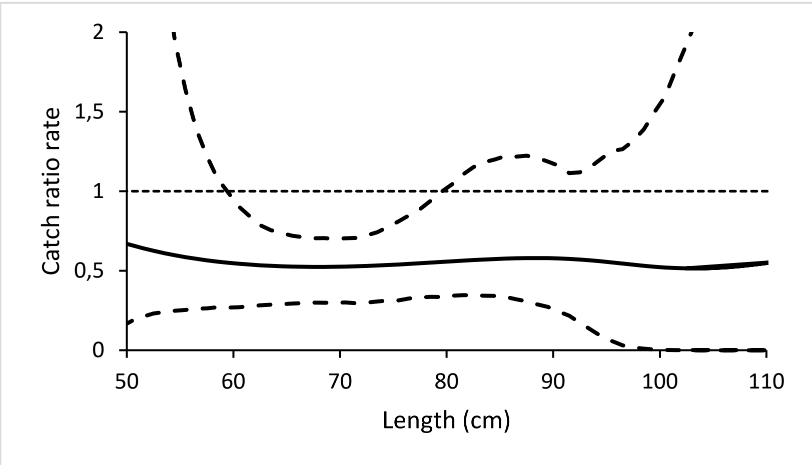

Fig 5: The estimated catch ratio curve for cod (solid line). The dotted line at 1.0 indicates the baseline where fishing efficiency of the 0.55 mm nylon and the 0.60 mm biodegradable gillnet types is equal. The stippled curves represent a 95% confidence interval of the estimated catch ratio curve.

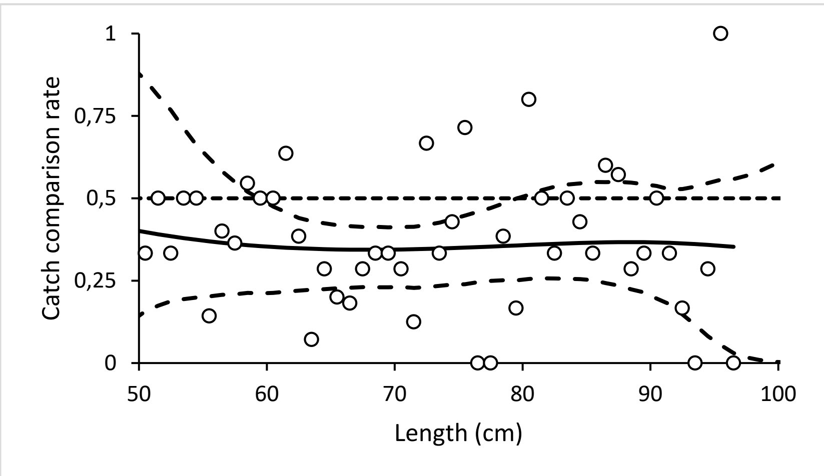

Fig 6: The catch comparison curve for cod with circle marks indicating the experimental rate and the curve indicates the modelled catch comparison rate. The dotted line at 0.5 indicates the baseline where the 0.55 mm nylon and the 0.60 mm biodegradable gillnets fish the same amount. The stippled curve indicates a 95% confidence interval for the estimated catch comparison curve.

Table 4: Catch data of all deployments for saithe, rows highlighted in grey indicates sets used in the analysis (sets containing catches of 10 or more saithe).

Set	Setup	Setting date	Fishing time	Fishing depth (m) (min - max)	Acc. no. of deployments	No. of saithe in nylon gillnets	No. of saithe in bio gillnets	Min saithe length in nylon gillnets	Max saithe length in nylon gillnets	Min saithe length in bio gillnets	Max saithe length in bio gillnets
1	55/55	06/09/18	19h 45min	140	1	4	2	64	74	64	67
1	55/60	06/09/18	19h 45min	120	1	0	0	0	0	0	0
2	55/55	10/09/18	21h 45min	110	2	3	0	73	83	0	0
2	55/60	10/09/18	22h 10min	130	2	3	2	67	70	69	73
3	55/55	30/10/18	27h 30min	170-140	3	9	4	54	69	50	75
3	55/60	30/10/18	26h 15min	130-110	3	3	0	50	75	0	0
4	55/55	31/10/18	22h 40min	180-160	4	3	1	65	76	70	70
4	55/60	31/10/18	24h 15min	110-130	4	0	1	0	0	50	50
5	55/55	01/11/18	22h 40min	100-120	5	4	2	62	77	63	70
5	55/60	01/11/18	23h 55min	105-125	5	5	3	61	71	59	68
6	55/55	10/11/18	24h 50min	25-30	6	21	13	59	83	59	86
6	55/60	10/11/18	24h 15min	50-70	6	17	8	52	87	56	77
7	55/55	12/11/18	21h 20min	25-30	7	3	1	67	72	68	68
7	55/60	12/11/18	21h 45min	50-70	7	10	3	64	88	65	81
8	55/55	13/11/18	22h	50-70	8	4	0	65	82	0	0
8	55/60	13/11/18	18h 20min	50-70	8	6	0	65	86	0	0
9	55/55	26/11/18	22h 20min	35-20	9	47	42	50	91	50	86
9	55/60	26/11/18	23h 20min	95-45	9	8	3	62	79	58	76
10	55/55	27/11/18	23h 20min	35-20	10	17	13	51	72	50	63
10	55/60	27/11/18	22h 20min	50-85	10	0	0	0	0	0	0
11	55/55	28/11/18	23h 40min	38-25	11	25	33	50	81	50	85
11	55/60	28/11/18	26h 20min	55-45	11	27	17	53	80	54	77
12	55/55	29/11/18	18h 5min	30-75	12	34	30	50	81	50	88
12	55/60	29/11/18	18h 55min	45-48	12	2	6	70	80	65	77
13	55/55	30/11/18	25h 40min	30-75	13	28	23	50	92	60	85

13	55/60	30/11/18	26h	45-48	13	6	3	61	72	67	80
14	55/55	01/12/18	18h 5min	30-76	14	26	20	50	82	54	77
14	55/60	01/12/18	18h 15min	45-49	14	2	7	75	75	57	79
15	55/55	02/12/18	26h 10min	35-20	15	44	33	50	78	51	80
15	55/60	02/12/18	28h 5min	50-85	15	20	19	61	88	55	81
16	55/55	03/12/18	16h	30-75	16	16	15	50	78	53	73
16	55/60	03/12/18	16h 15min	45-48	16	9	12	54	85	58	84
17	55/55	04/12/18	23h	30-75	17	26	23	51	78	51	76
17	55/60	04/12/18	23h 25min	45-48	17	61	52	59	96	55	87
18	55/55	06/12/18	25h 20min	30-75	18	31	11	50	73	50	70
18	55/60	06/12/18	22h 20min	45-48	18	3	11	62	75	57	77
19	55/55	07/12/18	24h 5min	30-75	19	51	40	50	86	50	84
19	55/60	07/12/18	27h 55min	45-48	19	20	12	53	88	61	81
20	55/55	08/12/18	22h 50min	30-75	20	54	39	50	81	50	82
20	55/60	08/12/18	18h 10 min	45-48	20	15	9	53	77	54	85
21	55/55	09/12/18	16h 30min	30-75	21	47	58	52	76	50	86
21	55/60	09/12/18	16h 5min	45-48	21	22	21	50	82	55	72

Table 5: Catch rate and fit statistics results from the 0.55 mm biodegradable and 0.55 mm nylon set based on the valid deployments for saithe. Values in parentheses indicate a 95% confidence interval. DOF denotes the degrees of freedom.

Length (cm)	Catch ratio (%)
50	103.33 (64.00-199.22)
55	94.42 (73.90-140.63)
60	86.58 (70.16-110.11)
65	80.20 (63.52-92.19)
70	75.54 (53.68-88.66)
75	72.85 (46.76-95.12)
80	72.49 (47.52-119.27)
85	75.14 (43.22-261.02)
90	81.86 (31.08-1550.13)
95	93.83 (19.72-8043.05)
Average	83.40 (71.34-94.86)
P-value	0.6438
Deviance	33.29
DOF	37

Table 6: Catch rate and fit statistics results from the 0.60 mm biodegradable and 0.55 mm nylon set based on the valid deployments for saithe. Values in parentheses indicate a 95% confidence interval. DOF denotes the degrees of freedom.

Length (cm)	Catch ratio (%)
50	126.66 (70.30-608.14)
55	124.11 (76.96-319.85)
60	110.00 (70.75-186.24)
65	93.93 (60.67-137.33)
70	79.96 (53.35-110.59)
75	68.32 (46.18-97.93)
80	57.43 (36.45-96.40)
85	45.23 (25.14-79.05)
90	32.05 (8.66-67.15)
95	23.18 (1.29-62.48)
100	17.57 (0.83-64.05)
Average	83.87 (66.36-104.92)
P-value	0.4114
Deviance	35.19
DOF	34

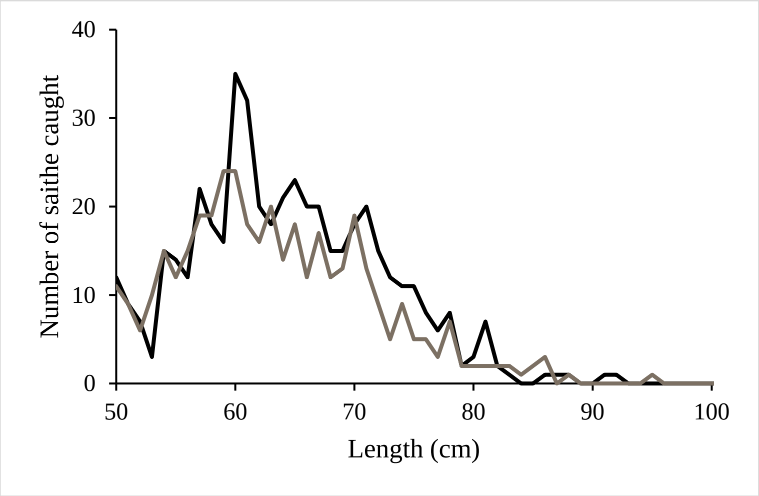

Fig 7: The size distribution of saithe caught using 0.55 mm nylon (black) and biodegradable (grey) twine gillnets

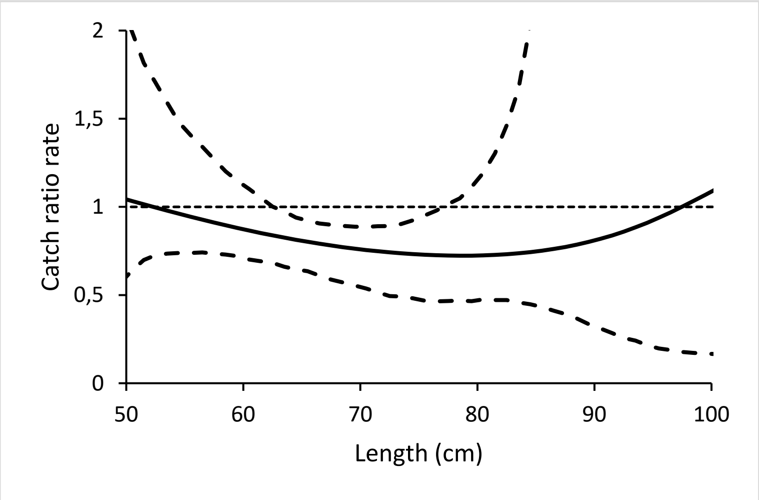

Fig 8: The estimated catch ratio curve for saithe (solid line). The dotted line at 1.0 indicates the baseline where fishing efficiency of both 0.55 mm gillnet types is equal. The stippled curves represent a 95% confidence interval of the estimated catch ratio curve.

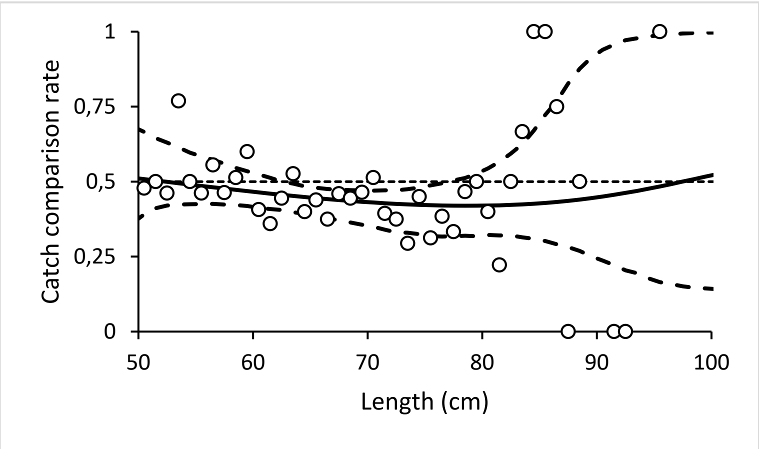

Fig 9: The catch comparison curve for saithe with circle marks indicating the experimental rate and the curve indicates the modelled catch comparison rate. The dotted line at 0.5 indicates the baseline where the 0.55 mm nylon and biodegradable gillnets fish the same amount. The stippled curve indicates a 95% confidence interval for the estimated catch comparison curve.

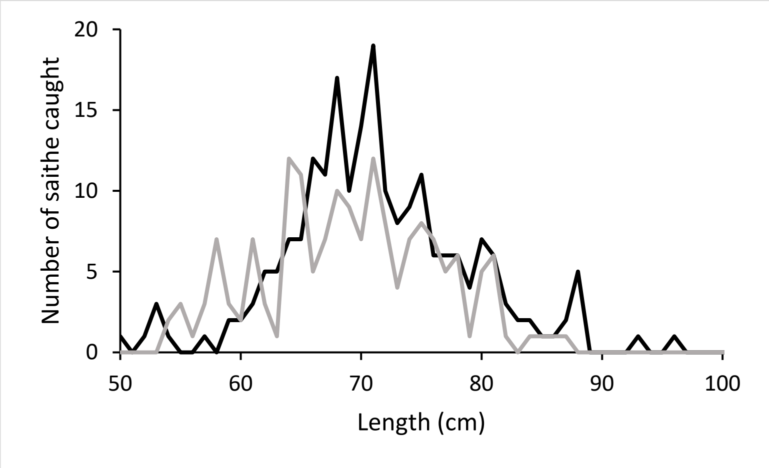

Fig 10: The size distribution of saithe caught using 0.60 mm nylon (black) and biodegradable (grey) twine gillnets

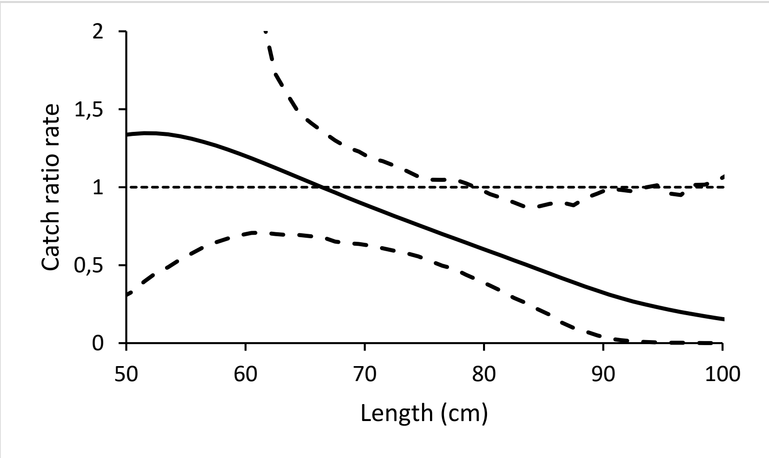

Fig 11: The estimated catch ratio curve for saithe (solid line). The dotted line at 1.0 indicates the baseline where fishing efficiency of both the 0.55 mm nylon and the 0.60 mm biodegradable gillnet types is equal. The stippled curves represent a 95% confidence interval of the estimated catch ratio curve.

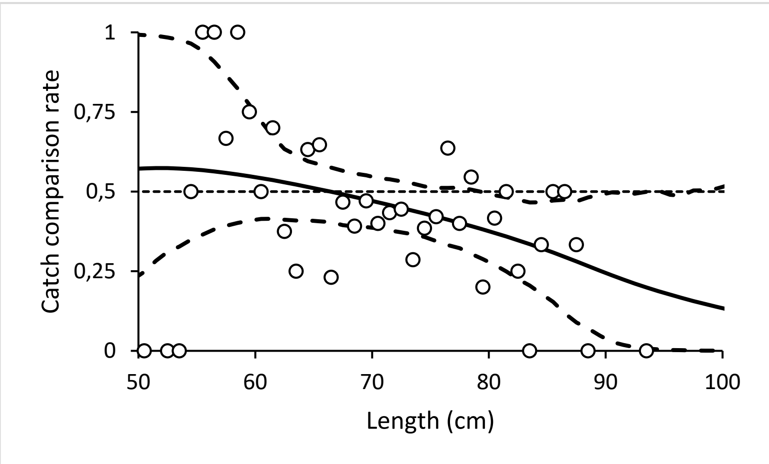

Fig 12: The catch comparison curve for saithe with circle marks indicating the experimental rate and the curve indicates the modelled catch comparison rate. The dotted line at 0.5 indicates the baseline where the 0.55 mm nylon and the 0.60 mm biodegradable gillnets fish the same amount. The stippled curve indicates a 95% confidence interval for the estimated catch comparison curve

When new, nylon gillnets made of 0.55 mm monofilaments were significantly (8.9%) stronger than bionets of 0.55mm monofilaments, and equally stronger than bionets of 0.60 mm monofilament. When used, nylon gillnets were 21.2% and 15.1 % stronger than bionets of 0.55mm and 0.60mm monofilaments. Used nylon nets did not lose strength but lost 14.6% elongation at break. Used bionets lose 13.5% and 16.7% strength and 4 and 8% elongation at break (Table 3).

Table 3: Mean tensile strength (kg) and elongation at break (%) with 95 % confidence intervals (in brackets) for new and used gillnets.

Sea trial	Netting	Tensile strength (kg)			Elongation at break (%)		
		New	Used	%	New	Used	%
Autumn 2018	0.55mm Nylon	14.6 (14.2–15.1)	14.6 (13.9–15.1)	–0.0	32.7 (31.9–33.4)	27.9 (26.9–28.9)	–14.6
	0.55mm Biodegradable	13.3 (13.1–13.5)	11.5 (10.9–12.1)	–13.5	39.4 (38.8–39.9)	37.8 (36.6–39.1)	–4.0
	0.60mm Biodegradable	14.9 (14.5–15.3)	12.4 (11.7–13.0)	–16.7	39.2 (38.5–39.8)	37.9 (36.3–39.4)	–8.1

5 Discussion and conclusion

The nylon gillnets caught significantly more cod and saithe than the biodegradable gillnets throughout the fishing season and generally showed better catch rates for most length classes. Any difference in breaking strength and elongation a break between 0.55mm nylon-nets and 0.60mm bio-nets was detected when nets were new, and therefore it is unclear what caused the catch differences between the nets.

6 References

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