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Eel, cod and sea trout harvest in Danish recreational fishing during 2011



DTU Aqua report no. 253-2012

By Claus R. Sparrevohn
and Marie Storr-Paulsen

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Resumé (Danish abstract)

Rekreativt fiskeri i Danmark er en yndet hobby, som praktiseres i både fersk- og saltvand, med garn, ruse og med stang/hjul. Ikke desto mindre er omfanget af dette fiskeri som oftest ukendt. For at estimere hvor meget torsk, havørred og ål, der blev fanget og hjemtaget i det rekreative fiskeri i 2011, gennemførte DTU Aqua og Danmarks Statistik interviewundersøgelser i juli 2011 og januar 2012.

I undersøgelsen blev de rekreative fiskere, på baggrund af hvilken fisketegnslicens de havde indløst, opdelt i henholdsvis amatør/fritidsfiskere og i lystfiskere. Amatør- og fritidsfiskere bruger primært garn og ruse, mens lystfiskere fisker med stang og hjul. Da det ligeledes er lovligt at fiske med stang og hjul, når man har indløst en fritidsfiskerlicens, blev en tredje gruppe defineret, nemlig lystfiskere der fisker på fritidsfiskerlicens.

I 2011 indløste i alt 157.762 lystfiskere og 33.911 fritidsfiskere årstegn. I estimeringen af den totale fangst har DTU Aqua desuden taget højde for dem, der fisker på dags- eller ugelicens, samt dem der fisker uden den krævede licens. Sidstnævnte gruppe øgede fangsterne i det rekreative fiskeri med 17 % og 24 % for henholdsvis fritidsfiskere og lystfiskere.

I alt vurderer DTU Aqua, at der blev fanget og hjemtaget ca. 80 tons ål [Relative standard fejl (RSE)=6 %], ca. 1300 t torsk (RSE=5 %) og 400 t havørred (RSE=5 %), hvor havørredfangsterne inkluderer den andel der fiskes i ferskvand.

Ål fanges næsten udelukkende i rusefiskeriet, og den totale rekreative fangst udgjorde i 2011 omkring 18 % af de samlede kommercielle og rekreative landinger. Den rekreative torskefangst udgjorde 4.5 % af den samlede fangst. Der var dog en stor variation fra område til område, og i specielt Kattegat og Øresund udgjorde den rekreative torskefangst en stor andel af den samlede landing (henholdsvis 51 % og 34 %). Omkring 93 % af de rekreativt fangede torsk blev taget med stang og hjul.

Af samtlige havørreder, der blev fanget og landet, var 88 % fanget med stang og hjul, mens garn og ruse kun fangede 12 %. I alt blev 15 % fanget i ferskvand og her var det udelukkende med stang og hjul.

Abstract

Marine recreational fishing is a popular outdoor leisure activity, yet the impact on the targeted stocks is often unidentified. In order to estimate 2011 cod, eel and seatrout harvest (fish caught and kept) in the Danish angling and passive gear fishing, two interview surveys were conducted in July 2011 and January 2012. Recreational fishing was separated into anglers (with rod and reel) and passive gear fishing (fyke and gillnets). In 2011 a total of 157,762 anglers and 33,911 passive gear fishers had issued the annual license, which is compulsory if saltwater fishing is practiced. In total, it was estimated that 80 t [Relative standard error (RSE)=6%] eel, close to 1,300 t (RSE=5 %) cod and 400 t (RSE=5 %) seatrout (including freshwater catches) was harvested in the recreational fishery. Eel is almost exclusively taken in the passive gear fykenet fishery and seatrout was mainly caught by anglers which accounted for 88 % of the total harvest. Present interview survey indicates that approximately 4.5 % of the total Danish cod yield (commercial landings plus recreational harvest) was taken in the recreational fishery. There were, however, large differences between areas and especially in Kattegat and the Sound the recreational had a large share of the total yield accounting for 51 % and 34 %, respectively. Approximately 18 % of the total eel yield was taken by the recreational fishing. In the estimation, harvest taken by fishers without a legal license was also included. This inclusion increased the estimated harvest with 17 % and 24 %, respectively for passive gear and angling.

Glossary

Passive gear fisher: A person fishing with gillnet and/or fykenets. There is also some other fishing carried out by this group, such as hook-fishing for eel, which is not included in this rapport.

Angler: A person fishing with rod and reel and with an angling license. In this rapport there is an additional group of anglers which is those that angle on a passive gear license. The harvest from these two groups are estimated separately, but added when referring to the total angling harvest.

Fishing without a license: Fishery carried out without a license even though mandatory. This group should not be confused with those that carry out illegal fishing, e.g. by fishing in protected areas or during closed seasons.

RSE: Relative Standard Error. Is a percentage that tells how precise the estimated value is. In order to meet the precision level requested from the EU commission RSE should be less than 20.4%. IF an estimate has a low RSE this means that it has a high precision. However, this does not necessarily mean that the estimate is accurate, i.e. are close to the "true" value.

Harvest: Those fish (in tons) that are caught and kept in recreational fishing.

Releases: Those fish (in numbers) that are caught and released again in the recreational fishing.

Recreational catch: All fish caught in the recreational fishing, i.e. harvest plus releases.

Commercial landing: Total Danish commercial landings in tons.

Total yield: Commercial landings plus the recreational harvest in tons.

1 Introduction

1.1 Monitoring of recreational fishing

Within Europe the management of recreational fishing has so far mainly been conducted on a national level without including catches in neither stock assessment nor ecosystem based management (Lewin et al., 2006; Pawson et al., 2008). However, estimated fishing mortality has in some areas been found comparable to - or even in excess of – the mortality caused by the commercial fishery (e.g. Coleman et al., 2004; Morales-Nin et al., 2005). Therefore there is within fisheries management an increasing awareness about the impact from this type of fishing (Lewin et al., 2006). As a consequence the EU Council has since 2008, as a part of the Common Fisheries Policy, obliged member states to estimate harvest (those fish caught and retained) taken by recreational fishing (EU Council regulation No. 199/2008). Due to this obligation, Denmark did in 2009 initiate a recall survey to estimate quarterly harvest of cod (*Gadus morhua*), eel (*Anguilla Anguilla*) and in 2010 sea trout (*Salmo trutta*) was included. This report presents the 2011 harvest and releases of the three species in the Danish recreational fishery. Similar data from 2009 and 2010 can be found in Sparrevohn Storr-Paulsen (2010, 2011a).

1.2 Recreational fishing in Denmark

Approximately 5.5 million people reside in Denmark; 2.5 million on the mainland and the rest on islands (source: Statistic Denmark, www.dst.dk). Denmark has a very extensive coastline being 7,013 km long and no citizen lives more than 50 km from the nearest coast (Agerskov and Bisgaard, 2011). Recreational fishing in marine waters is therefore an important national outdoor leisure activity. In 1997, 16.5 % of the Danish public considered themselves anglers and 12.5 % claimed to have been fishing within the last year (Bohn and Roth, 1997). Further, it was found that out of those that fished, 25 % fished in streams, 30 % in lakes, 27 % in put & take ponds, but the majority, 73 %, answered that they angled in marine waters. An economic validation of the recreational fishery underlines its importance in Denmark, as it was found that Danish willingness to pay for fishing is among the highest in Nordic countries (Roth et al., 2001; Toivonen et al., 2004).

Recreational fishing in Danish coastal waters differs from what is observed in many other countries, especially outside of Europe, in the sense that two major and very different categories of fishers can be identified. The first one is referred to as passive gear fishing throughout this rapport. Passive gear fishing is carried out using stationary gear such as gillnets and fykenets. The second category of leisure fishing in saltwater, is angling.

Table 1. Number of annual angler- and passive gear licenses issued annually. In 2004 data was unavailable.

	1999	2000	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011
Anglers	150526	151529	156769	150925	152534	160942	156474	160664	160186	157939	152723	157762
Passive gear	33575	31709	33715	33888	33516	33430	34277	33787	35221	34565	33734	33911

Anglers - domestic as well as tourists - between 18 and 65 years of age have to purchase a license costing 19 € for one year, 13 € for one week and 5 € for one day. All passive gear fishers have to pay a license costing 37 € per year and you are not allowed to fish before the age of 12. There are three legal reasons for anglers not to hold a license: 1) persons younger than 18 years or older than 65 years, 2) landowners fishing in their private waters and 3) put & take angling.

1.2.1 Passive gear fishing

Passive gear fishing covers fishing which is carried out using gear such as fykenets and gillnets. For the last 12 years there has on average been 33,575 licenses issued per year (Table 1). The

fishery is leisure based and it is illegal to sell the catch. There are restrictions to the effort, as it is only allowed to fish with a maximum of either 3 gillnets plus 3 fykenets or a total of 6 fykenets. The maximum length of gillnets are 45 m and they are not allowed to be closer than a 100 m from the coastline; a restriction mainly set up to protect seatrout. Further, there are several protected areas such as areas around river mouths, where net are illegal. The gear is typically deployed from a small boat with a limited activity radius, which in practice makes this type of fishing more or less stationary.

The main targeted species are eel caught in fykenets and flounder (*Pleuronectes flesus*) caught in gillnets (Sparrevohn et al., 2009). It is a traditional fishery that has been practiced for centuries in the coastal areas. Earlier, a recreational fishery using eel-trawl and long-lines was also practiced but eel-trawl is now prohibited and long-line fishing is limited. Cod and seatrout are caught both with gillnets and fykenets in the passive gear recreational fishery, but the catches are believed to be restricted to certain areas.

1.2.2 Angling

Angling in saltwater is carried out in waders along the coastline or from structures such as piers, bridges or with boats as a platform. The majority of anglers (73 %) are fishing in marine waters (Bohn and Roth, 1997). During the last 10 years the number of annual licenses issued per year has on average been 155,748 (Table 1). The number of weekly license issued in 2011 was 17,352 and for daily license a total of 26,578 licenses were issued. There are no restrictions, e.g. bag-limit, to angling in saltwater besides those that apply to fishing in general, i.e. closed areas, minimum landing size etc. The only exception is that trolling closer than 100 m from the coastline is prohibited. The main target species in saltwater is seatrout, but garfish (*Belone belone*) and cod are also regularly caught as well as salmon (*Salmo salar*) and various flatfish species (Rasmussen and Geertz-Hansen, 2001). Seatrout is besides being caught in saltwater also caught in freshwaters, during the spawning run.

Platforms used when targeting cod range from beach fishing with rod and reel using casting lures to deepwater jigging onboard chartered boats many miles offshore. There is also a substantial angling on wrecks. Angling for cod on board private boats is in addition very popular and is believed to account for a large fraction of the total harvest, at least locally.

1.3 Method approach

In most European member states information on harvest taken in the recreational fishing is gathered using some kind of interview-based recall survey (ICES 2010a). A recall survey is a type of off-site survey which relies on collecting information through mail, telephone or internet interviews. Respondents are asked to recall e.g. their catches, number of fish caught and released, fishing pattern and/or number of days fished. The specific timeframe respondents are asked to recall within should be as short as possible since the longer the timeframe, the more the estimate tends to be biased towards overestimation (e.g. Tarrant et al., 1993). Also in Denmark an interview-based approach was chosen.

Hence, in September 2009, Statistic Denmark and DTU Aqua developed a concept for a combined telephone and internet recall survey (See Sparrevohn and Storr-Paulsen 2010b for further information). Initially, one license list interview phase was carried out in February 2010 to cover the entire 2009 harvest, i.e. the recall period was set to one year. However, in 2010 this design was improved by conducting two phases thereby limiting the recall period to a maximum of 6 months. Further, the surveys covering the 2010 catches did also include the harvest of seatrout and the number of fish released.

2 Methods

A combined telephone and internet survey based upon two questionnaires, the “Omnibus” and the “License list”, were developed by Statistic Denmark and DTU Aqua. The interviews were conducted by Statistic Denmark as they hold the expertise in this form of surveys. The questionnaire was prior to the 2009 interview tested upon a subgroup of fishers, to optimize the process and reformulating questions that potentially could lead to misunderstandings. DTU Aqua was responsible for the following data processing.

2.1 Omnibus interview

The main objective of this interview was to estimate the size of the population that fished without a license and with what effort. The Omnibus is a monthly survey conducted by Statistic Denmark wherein questions are asked on behalf of e.g. companies, newspapers and research institutes. In 2009, three telephone interview rounds were conducted where questions on recreational fishery were included and in 2010 one additional omnibus survey was conducted in March. The recreational fishery questions were embedded as a minor part of this interview; hence the non-response bias is expected to be ignorable. Respondents were selected by telephoning a random number. The interview was conducted with that person within the household who last had birthday. Only citizens between 16 and 74 were included. A total of 958, 957 and 968 were interviewed and answered in 2009 and in March 2010 a total of 985 were interviewed.

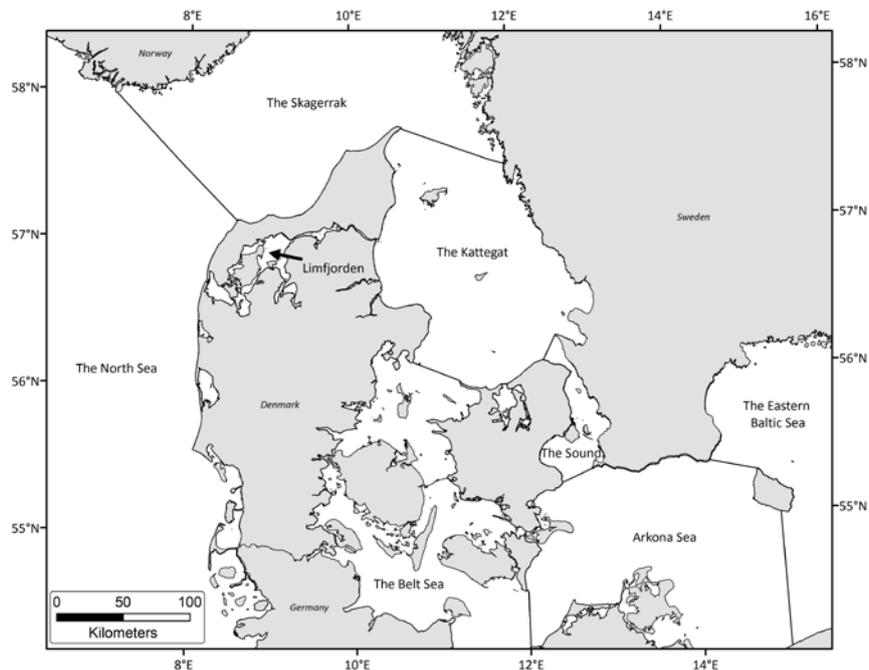


Fig. 1. Area definition used in the interview survey.

Fishers not holding a license were asked for their reasons. There are several legal exemptions from the compensatory license for angling fishing (see section 1.3). Passive gear fishers do not have any legal excuse for not holding a license when fishing in saltwater.

Furthermore, respondents were asked for information on effort in fishing days to be able to estimate whether people fishing without a license are fishing with same effort as people holding a license. These questions provided the needed information for calculating the fraction of illegal

fishers and the effort they fished with. Respondents were also asked about their fishing pattern outside Denmark, such as countries they had visited for fishing.

2.2 License interview

This recall survey targeted fishers with a valid annual license at the time of the interview. The data in this report are based upon interview rounds that were conducted in July 2011 and in January 2012. Since two different license lists are available, one for anglers and one for passive gear fishers, there was conducted two surveys with quite identical questionnaires. Independent of list, the respondent was randomly selected and initially contacted by letter wherein they were encouraged to answer the questions via the internet. If no respond was noticed after a period, the respondent was contacted by telephone and - if reached - encouraged to answer via the internet or via telephone. This questionnaire contained detailed questions on species harvested, numbers released and fishing effort within the last 6 months. The respondent was explicitly told to distinguish between the part of the catch kept (i.e. the harvest) and the part released (discarded). To estimate harvest by ICES managing areas (Fig. 1) and quarter the respondents were asked to provide the information per area and quarter.

During the design stage the problem of which unit (weight or numbers) respondents should be requested to recall their harvest in, was discussed. No conclusion could be drawn since: (1) Both anglers and passive gear fishers are interviewed and they may not have identical recollection of their catches and; (2) respondents are requested to recall the harvest of three different species, where some might be recalled as single harvest whereas others might be recall as total weight. Hence, it was decided to set up the questionnaire in such a way that the respondents had the opportunity to report their harvest in the unit of their own choice. Hence, if catch was reported in numbers they had to be transformed to weight estimates multiplied with an average fish weight (See Sparrevohn 2012 for further information).

In the Danish license system it is also possible to issue a license valid for one day or one week. However, the number issued of these licenses is relatively small compared to the number of annual licenses. Therefore, no separate interview was conducted for these two groups. However they were accounted for in the total harvest estimations, taking the different effort into account. Furthermore, the purchasing a license for passive gear fishing automatically gives license to angle with rod and reel as well. To include this group in the estimates, all passive gear fishers were asked whether he/she also angled, a group referred to as "angling with a passive gear license". An additional interview was therefore conducted on this group in order to estimate their harvest when angling.

2.3 Analytical methods

Estimating the total harvest or numbers released of cod, seatrout and eel in the Danish recreational fishing was done by estimating the harvest on basis of the reported catches from the license list recall survey. These values were then extrapolated to the entire population of fishers (all license holders and fishers without a license) using the effort information collected during the omnibus survey. Different effort levels for those fishing without a license, on a weekly or on a daily license were accounted for in the calculation. To compute the total harvest or released numbers \hat{Y}_{ij} of either cod, seatrout or eel per quarter (i) and area (j) the following equation was used,

$$\hat{Y}_{ij} = \frac{\sum_{k=1}^{n_{ij}} y_{ijk}}{n} N \quad (1)$$

where n is the number of respondents and y the reported harvest per respondent (k). The total population N is computed as:

$$N = \left(\rho_a + \rho_w \cdot \frac{\varepsilon_w}{\varepsilon_a} + \rho_d \cdot \frac{\varepsilon_d}{\varepsilon_a} + \rho_m \cdot \frac{\varepsilon_m}{\varepsilon_a} \right) \quad (2)$$

where ρ is the number licenses issued being valid for a year (a), week (w) or day (d). The number fishing without a license (m) was computed using the estimated percentage that fished without a license even though obliged to have one (Table 3), multiplied with the actual number of Danish citizens between age 18 and 65, which 1 January 2012 was 3,410,000 persons (Agerskov and Bisgaard, 2011). The values were weighted with the fishing effort ε which for those holding an annual license was derived from the omnibus survey and assumed to be 1 day for those holding a daily license and 3 days for those holding a weekly license. All values used can be found in Table 2. The standard error of (1) was computed according to Cochran (1977, page 37) as:

$$s(\hat{Y}_{ij}) = \frac{Ns'}{\sqrt{n}} \sqrt{1 - \left(\frac{n}{N}\right)} \quad (3)$$

Where s'^2 is calculated as:

$$s'^2 = \frac{1}{N-1} \left(\sum_{ij=1}^n y_{ij} - \frac{Y'^2_{ij}}{N} \right) \quad (4)$$

For (4) applies that $Y'_{ij} = Y_{ij}$ if the unit is in the ij^{th} domain and 0 if not. The relative standard error (RSE) was computed as the standard error divided by the estimate. In the license list survey the respondent had the opportunity to report harvest in either kilo or counts. Therefore, it was necessary to find an average weight of a harvested fish in order to adjust from counts to kilo. The average size of eel and cod above minimum landing size caught in the passive fishery was found from Sparrevohn et al. (2009). Eel larger than the minimum landing size caught in fykenets was set to 47 cm corresponding to a weight of 188 g. Cod caught in fykenets above the minimum size was set to 39 cm corresponding to a weight of 540 g. Cod caught in gillnets was set to 47.5 cm, which corresponds to 975 g. Since no estimate on the average weight for cod caught and kept angling was available a value of 1,500 g per fish was chosen. For seatrout the average weight was set to 2,300 g when caught and kept in gillnets (Sparrevohn et al., 2009) and 1,700 g when caught and kept either in fykenets or while angling.

Table 2. Values used in eq. 1-4 for estimating harvest and RSE in passive gear fishing and angling. Effort is in days per year. The respondent number (n) given left to the slash is for the interview covering 1st and 2nd quarter and the value right is the interview covering the 3rd and 4th quarter.

	Respondents (n)	License (ρ)				Effort (ε)			
		Year (a)	Week (w)	Day (d)	Without (m)	Year (a)	Week (w)	Day (d)	Without (m)
Passive gear	2025/2016	33,911	-	-	16,717	30.8	-	-	10.8
Angling	2006/1931	157,762	17,352	23,578	93,417	9.7	3	1	4.4

3 Results

3.1 Omnibus interview

During the four interview rounds in October, November, December 2009 and January 2010 a total of 3,868 persons were interviewed. When asked whether they had fished within the last twelve months, between 13 and 16 % confirmed. Approximately 10 % of these were fishing with passive gear, 90 % were anglers and 0.1 % fishing commercially.

Table 3. Table 3A shows the numbers of respondents (*n*) in the Omnibus in October-December 2009 and January 2010. In table 3B the numbers were scaled up to actual population size of person between 18 and 74 (N), which 1 Jan. 2010 was 3.408.000 (Agerskov and Bisgaard, 2010).

A	(n)		Do you fish?		Do you have a license?			
			Yes	Yes	No	No- legal	No-illegal	% illegal
Dec	968	Angling	116	58	58	30	28	24.1
		Passive gear	9	7	2	0	2	22.2
Nov	957	Angling	132	69	63	33	30	22.7
		Passive gear	17	8	9	2	7	41.2
Oct	958	Angling	119	59	60	34	26	21.8
		Passive gear	14	8	6	3	3	21.4
Jan	985	Angling	134	89	45	23	22	16.4
		Passive gear	21	11	10	3	7	33.3

B	(N)		Do you fish?		Do you have a license?			
			Yes	Yes	No	No- legal	No-illegal	% illegal
Dec	3,408,000	Angling	408,397	204,198	204,198	105,620	98,579	24.1
		Passive gear	31,686	24,645	7,041	0	7,041	22.2
Nov	3,408,000	Angling	470,069	245,718	224,351	117,517	106,834	22.7
		Passive gear	60,539	28,489	32,050	7,122	24,928	41.2
Oct	3,408,000	Angling	423,332	209,887	213,445	120,952	92,493	21.8
		Passive gear	49,804	28,459	21,344	10,672	10,672	21.4
Jan	3,408,000	Angling	463,626	307,931	155,695	79,578	76,118	16.4
		Passive gear	72,658	38,059	34,599	10,380	24,219	33.3

3.1.1 Fishing without license

For both groups of recreational fishers a significant part was found not to have a license. However some did not hold a license due to a valid reason. Excluding the group that did not hold a license for valid reasons, 21 % of all that claimed to have had angled within the last 12 months were doing so without a license, even though carrying out a fishery where license is necessary (Table 3). For

the passive gear fishers, the number of people not holding a license is larger and on average for the four Omnibus surveys 30 % fished without a license. The level fluctuated for passive gear fishers between surveys properly due to fewer persons available in the latter group. Therefore the interpretation of these data should be done with some caution. Further there appeared to be a bias in separating between anglers and passive gear fishery in the first two omnibus surveys since some of the passive gear fishers gave meaningless answers to why they did not hold a license. For example, several passive gear respondents answered that they only fished in put & take, an answer that does not make any sense, since a fishery with gillnets or fykenets in put & take lakes does not exist. The problem was recognized and it was emphasized that respondents should have a clear understanding of the difference between anglers and passive gear fishery. In this investigation we have used the average for the four omnibus surveys to up-scale the illegal fishery.

3.1.2 Effort

Since it was expected that that effort between fishers holding a license and fishers without was different, the effort was estimated in order to account this in the total catch estimation (see eq. 2). Results indicate that for anglers fishing without a license, the effort was approximately one third compared to anglers fishing with license. For passive gear fishers the effort for people without a license was a little lower than half, compared to fishers with a license (Table 4).

Table 4. The average days fished for anglers and passive gear fishers with either a license or illegally.

	Angling		Passive gear	
	With license	Illegally	With license	Illegally
November 09	8.5	2.2	24.0	10.7
December 09	9.9	4.2	25.4	16.5
January 10	9.7	4.4	30.8	10.8

3.2 License interview

The refusal rates were very low in the investigation as only 1.7 % and 2.4 % for the anglers and passive gear fishers refused to answer (, Table 6). The very high level of responses in the surveys qualifies the investigation.

Table 6. Distribution and motive of non-respondents.

Anglers

	Metode			Total
	1. Tlf	2. Web	9. No answer	
1. Answer	1.852	2.085	0	3.937
2. Not meet	0	0	323	323
3. Refuse	0	0	67	67
4. Other reasons	0	0	66	66
5. Language problems	0	0	5	5
6. not relevant	0	0	1	1
7. No contact on phone number	0	0	100	100
8. No phone.number found	0	0	306	306
Total	1852	2085	868	4805

Passive gear

Table of interview results by method

	Metode			Total
	1. Tlf	2. Web	9. No answer	
1. Answer	1.927	2.114	0	4.041
2. Not meet	0	0	341	341
3. Refuse	0	0	99	99
4. Other reasons	0	0	58	58
5. language problems	0	0	6	6
6. not relevant	0	0	3	3
7. No kontakt on tlf.number	0	0	55	55
8. No tlf.number found	0	0	221	221
Total	1927	2114	783	4824

3.2.1 Passive gear fishers

A total of 4,824 persons were tried contacted and 4,041 participated in an interview. 2,114 answered via the internet and 1,927 via the telephone survey (Table 6). Less than half (39%) of the passive gear fishers answered that they had been fishing within the first 6 months and 50% had been fishing within the last 6 month of 2011. In 2009 61 % answered that they had been fishing within the last 12 months. The respondents were asked to give their harvest, release and fishing pattern on a three month interval.

3.2.2 Anglers

Of the 2,006 anglers that participated in the first half-year survey 53 % had actually been fishing within the last 6 months, although they had a valid license. For the second half annual survey 1931 anglers answered the questionnaire and there a total of 54 % had not fished within the last 6 months.

3.3 Harvest

The total harvest estimate was upscaled with 24 % for the angling fishing and 17 % for the passive gear fishing due to the inclusion of the illegal fishing without a license.

3.3.1 Cod harvest

A total of 1303 t (RSE=5 %) cod were harvested in the Danish recreational fishery in 2011 (Appendix A). Cod were harvested with all gears but with the main contribution (93 %) came from the angling fishery. Only 6 % of the harvest derived from the gillnet fishery and 1.5 % came from fykenets.

The angling harvest of cod is quiet evenly distributed in the first three quarters of the year but in the last quarter only 18 % of the harvest was taken.

The most important area for cod harvest were the Sound were 30 % of the recreational cod harvest were taken followed by the Belt Sea with 22 % and Skagerrak with 20 %.

3.3.2 Eel harvest

A total of 79.5 t (RSE=6 %) eel was harvested with fykenet in Danish recreational fishing (Appendix B). The majority (60 %) was taken during the third quarter. The most important area was the Belt Sea which alone accounted for 36 % of the total eel harvest followed by Kattegat 21% of the total harvest.

3.3.3 Seatrout harvest

Seatrout was predominately harvested angling (88 %) (Appendix C). In total 401 t (RSE=5 %) was caught and kept annually and out of these 351.5 (RSE=6 %) was harvested angling. For angling, the three most important marine areas identified was the Belt Sea [141 t (RSE=8%)], Kattegat [90 (RSE=15 %)]. The total harvest in freshwater accounted for 15 % of the recreational harvest.

4 Discussion and conclusion

4.1 Discussion

In the present study the total Danish recreational seatrout, eel and cod harvest and release was found by; 1) estimating the harvest and release from a subsample of persons that has issued a license within the last 12 month and 2) estimating the amount of fishing carried out without a valid license. The latter was done using an interview survey targeting the entire Danish population between the age of 16 and 74, i.e. the omnibus survey. In the four omnibus surveys conducted, the number of anglers between 16 and 74 years which had practiced their hobby within the last 12 month was between 400,000 and 460,000. This corresponds to between 12 and 14 % of the Danish population which is very close to 12.5 % which was found in 1997 (Bohn and Roth, 1997). In another survey, relying on an interview panel, the number of anglers in Denmark was estimated to be 616,000 (COWI, 2010). The number of anglers that claimed to have issued a license was between 308,000 and 201,000 whereas the actual number of license issued - including weekly and daily licenses - is around 196,000. According to the omnibus interview survey between 24,000 and 38,000 claimed they had a license for passive gear fishing which is close to the actual number of licenses sold, which is around 34,000. The margin between respondents that claimed to have a valid license and the actual number of license issued is relatively small. In 2011 the number of annual angler license issued were 157,762; weekly license was 17,305 and daily 23,716, summing to a total of 193,744, which is 20 % lower than the persons that claimed to have had a valid license (an average value for the four omnibus survey).

4.1.1 Eel

In recreational fishing eels are mainly harvested in fykenets in saltwater, even though some freshwater fishing for eel exists. The intensity of the freshwater fishing is unknown since it can be carried out legally for all landowners along lakes and rivers. In the commercial fishery the landings from lakes are very low compared to those in saltwater. Of the total landings reported from 2005 to 2009 only between 2 and 3 % was from lakes (www.fd.dk).

Since fykenets set in saltwater are rather sensitive to wave and current action this fishing is mainly carried out in the inner Danish waters where wind and wave protected Fjords, Belts and Sounds are located. This is reflected in the very low harvest of eel in the North Sea, Skagerrak and Eastern Baltic. The same pattern as the two last year was observed in 2011 where the Belts Sea was the area with the highest harvest followed by Kattegat and the Limfjord. Similar eel were not harvested equally throughout the season in 2011. In 2010 the highest harvest were reported from July to September. In 2009 the fishery with fykenets for eels was closed in the period from 10th of May to the 31st of July (Anon 2008). This is reflected in our survey as low harvest during the period from May to July in 2009 and April to June in 2010. Periods which traditionally have been months with a high catch per unit of effort (CPUE) of eel (Pedersen et al., 2005). The total harvest, including fishery without license was in our investigation estimated to be 79.5 (RSE=6 %) t which is a decrease compared to the 116 (RSE=10 %) t estimated in 2010 and 104 t estimated in 2009. In 1997 the total catch of eel in the legal recreational fishery was estimated to be 138 t, which at that time corresponded to 20 % of the total eel yield (recreational harvest plus commercial landings) (Anon, 2008). The commercial landings were in 2011 on 370 t hence the recreational fishing harvested an equivalent of 18 % of the total Danish eel yield. In 2010 the figure was slightly higher at 22 %.

A total of 51,000 eel was estimated to be caught and releases which is remarkable similar to what was observed in 2010 (Sparrevohn et al., 2011). The rationale for releasing these individuals, such as if they were under the minimum landing size, was not examined but since they were caught in fynetes the survival is expected to be high.

4.1.2 Cod

During 2009, Sparrevohn and Storr-Paulsen (2012) estimated that nearly 1,231 (RSE=6 %) t cod were harvested in the recreational fishing. In 2010 this was somewhat higher, i.e. 1,666 t (RSE=7 %) and this year investigation indicated a level on 1303 (RSE=5 %) t. Similar to the two former investigations the main part of cod harvested in the recreational fishery was angled.

Anecdotal information has highlighted the Sound as an important recreational cod fishing area but also The Belt Sea and Skagerrak showed in our survey high harvest. Commercial Danish landing in the Sound has between 2004 and 2008 been fluctuated around 1,900 t (ICES 2010). The commercial landings in the Sound are mainly from a small area north of Helsingør called "Kilen" where it has been legal to trawl, opposite to the rest of the Sound where a trawling ban has been in place since 1932. However, a spatial and temporal closure (to protect the cod in the main spawning season) of the Sound commencing early in 2009 for both recreational and commercial fishery and reduced the commercial landings to 680 t in average the last three years (ICES, 2012). Due to the large decline in commercial catches later years the recreational fishing in 2011 accounts for 34 % of the total Danish Sound cod yield and angling alone for 32 %. Angling harvest might be even higher, since cod harvest reported in numbers was converted into weight assuming an average mass of 1500 g. The average weight of cod caught and kept by anglers in the Sound is likely somewhat higher at least during the winter where spawning fish are targeted and fish larger than 10 kg are caught regularly. However, although the Sound was the area with the highest total recreational harvest of cod it is not necessary reflecting an overfishing of the stock. Actually, the Sound cod is considered to be in a relatively healthy condition, with a high CPUE and a wide age distribution compared to the adjacent waters (Svedäng et al., 2004; Svedäng et al., 2010). In the Western (SD 22-24) and Eastern (SD 25-32) Baltic Danish commercial fishing for cod accounted for 8,582 t and 10,842 t in 2011, respectively (ICES 2012). In this light recreational fishing was relatively important for the western area and minor in the eastern accounted for an equivalent of 7.8 % in west and less than 0.1 % of the total cod yield in the eastern Baltic. Anecdotal information has highlighted a large fraction of German anglers fishing in the Danish part of the Western Baltic. However, it has not been possible to quantify the amount fished by foreigners as it is possible in Denmark to purchase a license for a day or a week without providing any personal information. Therefore, it has not been possible to contact this fraction of the fishery.

In Kattegat, an increase in the recreational fishery has been evident during the three years investigation. In 2009 a total of 35 t cod was harvested which in 2010 increased to 66 t (RSE=20%). In this year investigation the amount had increased to 106 (RSE=31%). Around 95% of cod harvested was harvested angling and only 5 % from gillnet and fykenet fishery. However, due to the present very low commercial quota (190 t) and Danish landings (102 t) in this area the recreational harvest are equivalent to 51 % of the total cod yield in this area.

In the North Sea and Skagerrak the commercial Danish landings were by the Danish fiskeridirektoratet estimated to be 4863 t and 3,042 t, respectively in 2011 (ICES 2012b). The harvest in the recreational fishing from these areas was estimated to be 164 t (RSE=19 %) and 262 (RSE=13 %) t respectively corresponding to an equivalent of 3 % and 8 % of the total cod yield. Overall, the total Danish commercial cod catches amount to 27431 t and our investigations indicate that the total Danish recreational cod harvest in 2011 where 4.5 % of the total yield, which is the same level as was found in 2009 (Sparrevohn and Storr-Paulsen, 2011).

In 2010 the number of released cod was a total of 1,619,512 cod was estimated to be caught and released again. This value was considerable lower in 2011 where only around 1 mill cod had been caught and released. However the cod catches was also estimated to be lower.

4.1.3 Seatrout

In 2010 a total of 600 t of seatrout was being caught mainly by anglers. In 2011 we estimates that a total of 400 t was caught again mainly by anglers.

Like for cod in the sound, there might be a tendency for underestimating the harvest in the Arkona Sea, since this area, according to anecdotic information are an area with a high average weight. The same might very well be that case for fresh water where mainly mature individuals are caught.

A total of 734,000 seatrouts was estimated to be caught and released in 2010 and this was fallen to 550,000 in 2011. However this 25% fall corresponds well with the 33% decrease in harvest.

4.1.4 Sources of error

Relying on respondent ability to remember catches or effort within a specific time period are followed by a number of biases such as digit preference, telescoping, non-responding bias and rule-based estimation. Digit preference means that the respondent will have a tendency for rounding figures to 0 or 5, a tendency that will increase with increasing recalling period (Huttenlocher et al., 1990). In this study we did see a tendency for some digit preference especially when reporting the catch in weight but whether this would increase or decrease the total estimated harvest is difficult to decide. Telescoping is the tendency for respondents to report an event, such as the catch of a trophy fish, even though it actually happened outside the time frame asked. This could potential mean an overestimation, especially in the angling harvest of cod, where some trophy fishing takes place. The bias introduced by non-respondents emerges since those fishers with the lowest participation rate will have the highest non-responding rate (Tarrant and Manfredo, 1993), but since the non-respondent rate in present survey was very low this is not likely to have caused any major bias. Another potential source of bias is the risk that a rule is applied by the respondent when trying to remember the catches during the last 6 or 12 month. Typically, an average catch per trip is memorized and then multiplied with the assumed number of trips. This can potentially lead to a severe overestimation of the harvest, because there is a general tendency for exaggerating the participation rates in recreational events, there among fishing (Tarrant et al., 1993). For fishing it has been estimated that the effort was overestimated with 45 % in a 12 month recall period compared to diaries (Connelly and Brown, 1995). This could impose a large overestimation in present study, especially for the passive gear fishing where it seems likely that some applies a rule, such as multiplying on average catch per gillnet or fykenet with the recalled number of days fished. This should be investigated further e.g. as suggested by the ICES Planning Group on Recreational Fisheries (ICES, 2010a) by a dual frame approach where recall surveys are supported by either diaries or on-site surveys, such as access point interception or aerial based counting (Vølstad et al., 2006).

The angler recall survey only targets Danish citizens, even though tourist are also obliged to issue a license in order to fish legal in Denmark. In our study around 3 % of the Danes interviewed had fished as tourist in other countries, especially Sweden which is very close and easy accessible. There is no precise estimation of the number of tourist travelling to Denmark to fish, but the potential number of angling tourist is high. In Germany there is around 3,300,000 anglers (Anon., 2007) and for the Berlin-Brandenburg population around half claimed to have been on an angling holyday within the last year (Arlinghaus et al., 2008).

When estimating the harvest, the RSE for the passive gear estimates was in general higher than for angling. When computing the RSE it is assumed that the population sampled is infinite and if this assumption is not meet, then the RSE tends to be overestimated. However, as long as the number of respondent does not exceed 5 % of the population surveyed, the finite population correction can be ignored and the overestimation will be minor (Cochran, 1977, p. 24). In the case of anglers less than 1 % of the total number of anglers was included in the survey but for passive gear fishers 4.6 % of the population was actually sampled. Hence, it could be argued that – at least some of the elevated RSE – is caused by the estimation method. It could also be this group of fishers actually is more heterogeneous than anglers. The heterogeneity of anglers and their behavior patterns are unquestionable important and has been investigated in several papers

(Arlinghaus et al., 2008; Johnston et al., 2010), but whether these results can be applied to passive gear fishers are not known.

4.1.5 Fishing without license

The inclusion of illegal fishing in was significant. Approximately 20-25 % reported that they fished illegally, though with a lower effort which corresponded to an increase in the passive gear catches on 17 % and 24 % for angling. One exception was in the November omnibus survey where 41 % of the passive gear fishers reported they fished without a license. However, there seemed - at least during the first interview round - to be a problem for respondents to differentiate between being fishing with passive gear ("fritidsfisker" in Danish) and angling ("lystfisker" in Danish). Indication of some misunderstanding of the classification during the two first interview rounds in October and November was that respectively 3 and 2 respondents claimed that they did not need a license. As arguments for that they used reasons that do not make sense when fishing with a passive gear. E.g. claiming to only fish in put & take lakes. In December, where the confusion had been resolved none of the respondents claimed not to need a license. Therefore, this single high percentage of illegal fishery (41%) should be treated with caution. Another aspect when asking people whether they have fished illegally is the risk of under estimating the numbers since the respondents might be tempted to claim to hold a license when they actually do not.

4.2 Conclusion

Using a license list recall survey and including those fishers that fished without a license showed that the recreational harvest was in some of the areas comparable to the commercial landings. This is a result of decreasing commercial landings more than it actually illustrates that recreational fishery in general imposes large fishing mortality. Nevertheless, it exemplifies that especially when stocks are overfished and below its caring capacitive the fishing mortality caused by recreational fishing can be an important factor that should be incorporated into stock assessment, recovery plans and ecosystem bases management. The harvest of fishers without a valid license was important as it increased the estimated harvests with 17 % for the passive gear fishing and 24 % for angling. Hence, recall surveys designed to estimate harvest and catches should not be based upon fishing license list alone but should also including those fishing without the mandatory license.

5 References

- Anonymous, 2008. Danish Eel Management Plan. In accordance with COUNCIL REGULATION (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel December 2008. © Ministry of Food, Agriculture and Fisheries, December 2008
- Agerskov, U., and Bisgaard, M.P. 2010. Statistical Yearbook. www.dst.dk/yearbook, 2010.
- Agerskov, U., and Bisgaard, M.P. 2011. Statistical Yearbook. www.dst.dk/yearbook, 2011.
- Arlinghaus, R., Bork, M., and Fladung, E. 2008. Understanding the heterogeneity of recreational anglers across an urban-rural gradient in a metropolitan area (Berlin, Germany), with implications for fisheries management. *Fisheries Research* 92: 53-62.
- Bohn, J., E. Roth. 1997. Survey on angling in Denmark 1997 – Results and Comments. In: A.-L- Toivonen & P. Tuumaimem (eds) *Socio-Economics of Recreational Fishery*. Copenhagen: Nordic Council of Ministers, Temanord 1997, Vol. 604, pp. 79-88.
- Cochran, W.G. 1977. *Sampling Techniques*, 3rd ed. Wiley, New York. 428 pp.
- Connelly, N. A., and Brown, T. L. 1995. Use of Diaries to Examine Biases Associated with 12-Month Recall on Mail Questionnaires. *Transactions of the American Fisheries Society* 124: 314-422.
- COWI 2010. Analyse af adfærd, motive og præferencer blandt danske lystfiskere Udarbejdet som del af projektet Samfundsøkonomisk betydning af lystfiskeri i Danmark. http://www.fvm.dk/Admin/Public/DWSDownload.aspx?File=%2fFiles%2fFiler%2fFiskeri%2fsamf%26oslas h%3bko+lyst+marts+2010%2fSamfundsoekonomisk_betydning_af_lystfiskeri_DK_version_final_12_03_10_samlet.pdf
- Huttenlocher, D., Hedges, L. V., and Bradburn, N. M. 1990. Reports of elapsed time: bounding and rounding processes in estimation. *Journal of Experimental Psychology: Learning, Memory and Cognition* 16: 196-213.
- ICES. 2009. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 22 – 28 April 2009, ICES Headquarters, Copenhagen. ICES CM 2009\ACOM:07. 626 pp.
- ICES. 2010a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES Document CM 2010\ACOM:13. 1048 pp.
- ICES. 2011. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 12 – 19 April 2011, ICES Headquarters, Copenhagen. ICES CM 2011\ACOM:XX. In prep.
- ICES. 2009b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak - Combined Spring and Autumn (WGNSSK), 6 - 12 May 2009, ICES Headquarters, Copenhagen. 1028 pp.
- Johnston, F. D., Arlinghaus, R., and Dieckmann. 2010. Diversity and complexity of angler behavior drive socially optimal input and output regulations in a bioeconomic recreational-fisheries model. *Canadian Journal of Fisheries and Aquatic Science*. 67: 1507-1531.
- Morales-Nin, B., Moranta, J., García, C., Tugores, M. P., Grau, A. M., Riera, F., and Cerdà, M. 2005. The recreational fishery off Majorca Island (western Mediterranean): some implications for coastal resource management. *ICES Journal of Marine Science* 62: 727-739.
- Pawson, M.G., Glenn, H., and Padda, G. 2008. The definition of marine recreational fishing in Europe. *Marine Policy* 32: 339-350.

- Pedersen, S.A., J. Støttrup, C.R. Sparrevohn and H. Nicolajsen, 2005. Registreringer af fangster i indre danske farvande 2002, 2003 og 2004 – Slutrapport. DFU-Rapport nr. 155-05. 149s.
- Rasmussen, G., P. Geertz-Hansen. 2001. Fisheries management in inland and coastal waters in Denmark from 1987 to 1999. *Fisheries Management and Ecology*. 8: 311-322.
- Roth, E., A.L. Toivonen, S. Navrud, B. Bengtsson, G. Gudbergsson, P. Tuunainen, H. Appelblad, G. Weissglas. 2001. Methodological, conceptual and sampling practices in the surveying of recreational fisheries in the Nordic countries – experiences of a validation survey. *Fisheries Management and Ecology*. 8: 355-367.
- Sparrevohn, C.R., H. Nicolajsen, L. Kristensen, J.G. Støttrup 2009. Registrering af fangster i de danske kystområder med standardredskaber fra 2005-2007. Nøglefiskerrapporten 2005-2007. DTU Aqua-rapport nr. 205-2009. Charlottenlund. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet, 72 p.
- Sparrevohn, C. R.; M. Storr-Paulsen 2010. Eel and cod catches in Danish recreational fishing : Survey design and 2009 catches in series: DTU Aqua-report (ISSN: 1395-8216) (ISBN: 978-87-7481-110-7) , pages: 23, 2010, DTU Aqua, Charlottenlund
- Sparrevohn C.R. & Storr-Paulsen M. (2011a) Eel, sea trout and cod catches in Danish recreational fishing, survey design and 2010 catches in Danish waters. *In series: DTU Aqua Report* (ISSN: 1395-8216) (ISBN: 978-87-7481-139-8). DTU Aqua, Charlottenlund. 21 p.
- Sparrevohn, C. R.; M. Storr-Paulsen (2011b) Using interview based recall surveys to estimate cod *Gadus morhua* and eel *Anguilla Anguilla* harvest in Danish recreational fishing. *ICES Journal of Marine Science* 69: 323-330.
- Tarrant, M. A., and Manfredo, M. J. 1993. Digit preference, recall bias and nonresponse bias in self reports of angling participation. *Leisure Sciences* 15: 231-238.
- Tarrant, M. A., Manfredo, M. J., Bayley, P. B., and Hess, R. 1993. Effects of recall bias and nonresponse bias on self-report estimates of angling participation. *North America Journal of Fisheries Management* 13: 217-222.
- Toivonen, A.-L., E. Roth, S. Navrud, G. Gudbergsson, H. Appelblad, B. Bengtsson, P. Tuunainen. 2004. The economic value of recreational fisheries in the Nordic countries. *Fisheries Management and Ecology*. 11: 1-14.
- Vølstad, J.H, Pollock, K. H., and Richus, W. 2006. Comparing and combining effort and catch estimates from aerial-access designs, with applications to a large-scale angler survey in the Delaware River. *North American Journal of Fisheries Management* 26:727–741

Appendix A: Cod harvest (Y) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Total			
		Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	
Cod harvest in fykenets	Jan-Mar	0.03	97	1				0	97	1	0.1	97	1	0		0	1.2	49	10	0		0					1.3	45	13
	Apr-Jun							0.1	83	2	0.4	76	3	0.2	69	2	1	37	11	0.2	97	1				1.9	112	19	
	Jul-Sep							0.5	43	9	1.1	49	10	2.1	35	12	5.9	23	51	0	70	2				9.6	19	84	
	Oct-Dec							0.5	55	5	0.2	61	3	1	48	8	4.5	35	27	0.4	95	2				6.6	33	45	
	Total							1.1	33	17	1.8	35	17	3.3	27	22	12.6	17	99	0.6	71	5				19.4	13	160	
Cod harvest in gillnets	Jan-Mar	0.5	97	1	2.3	46	8	0		0	0.5	52	5	4.2	38	10	10.2	29	43	2.7	50	5	0.1	97	1	20.5	18	73	
	Apr-Jun	1	63	3	0.9	54	4	0.5	97	1	1.5	34	17	4.1	39	19	4.5	18	52	1.3	42	9	0.1	75	2	13.9	13	107	
	Jul-Sep	0.1	97	1	1.1	89	2	0.1	72	3	0.7	41	11	4.3	45	15	6.3	17	58	6.8	59	8	0.9	67	3	20.3	22	101	
	Oct-Dec	1.2	67	4	5.4	43	6	0.1	97	1	0.7	42	8	3.6	35	12	7.3	19	60	3.8	50	8	0.5	60	3	22.6	16	102	
	Total	2.8	41	9	9.7	29	20	0.7	71	5	3.4	21	41	16.2	20	56	28.3	12	213	14.6	32	30	1.6	43	9	77.3	9	383	
Cod harvest angling with a passive gear license	Jan-Mar	3.3	40	7	10.5	31	16	0.1	97	1	4	43	9	13.7	19	50	7.1	31	26	1.2	65	5	16	31	3	55.9	12	117	
	Apr-Jun	10	35	13	13	22	26				12	54	10	16.2	24	40	12.6	21	44	3.2	42	8	5.3	21	6	72.3	12	147	
	Jul-Sep	6	42	10	25.4	30	23	0.9	97	1	5	60	15	12.8	21	47	26.8	23	66	1.5	44	7	2.3	23	4	80.7	13	173	
	Oct-Dec	3.4	72	3	12.7	36	16	0.5	97	1	0.5	50	6	11.8	27	51	11.4	41	40	4.1	72	7	1.2	41	3	45.6	17	127	
	Total	22.7	23	33	61.6	16	81	1.5	67	3	21.5	34	40	54.5	11	188	57.9	15	176	10.0	34	27	24.8	21	16	254.5	7	564	
Cod harvest angling with a angling license	Jan-Mar	34.9	58	5	19.4	39	8				8.1	70	6	99.7	13	90	34	27	29	10.3	95	2	4.7	89	2	211.1	13	142	
	Apr-Jun	48.3	34	14	73	32	17	1.3	79	2	4.3	42	10	74.7	25	63	43.6	22	35				2.5	100	1	247.7	12	142	
	Jul-Sep	40.5	32	10	76.5	26	23	0.2	100	1	37.8	50	16	100.9	32	65	68.3	27	49	2.2	58	3	3	71	4	329.4	11	171	
	Oct-Dec	15.1	58	3	21.7	48	16	0.3	100	1	29.2	88	4	48.8	24	52	47.7	32	42	0.2	100	1	0.5	100	1	163.5	20	120	
	Total	138.8	22	32	190.6	17	64	1.8	60	4	79.4	41	36	324.1	13	270	193.6	14	155	12.7	78	6	10.7	50	8	951.7	7	575	
Grand total	Angling	161.5	19	65	252.2	14	145	3.3	45	7	100.9	33	76	378.6	11	458	251.5	11	331	22.7	46	33	35.5	21	24	1206.2	5	1139	
	Passive gear	2.8	41	9	9.7	29	20	1.8	34	22	5.2	18	58	19.5	17	78	40.9	10	312	15.2	31	35	1.6	43	9	96.7	7	543	
	Total	164.3	19	74	261.9	13	165	5.1	31	29	106.1	31	134	398.1	10	536	292.4	10	643	37.9	30	68	37.1	20	33	1302.9	5	1682	

Appendix B. Eel harvest (Y) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h .

		Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Fresh water			Total		
		Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h			
Eel harvest in fykenets	Jan-Mar	0.04	97	1				0.2	56	4	0.64	63	5	0.1	97	1	1.6	40	19	0.1	94	2							2.7	112	32
	Apr-Jun	0.06	97	1	0.5	80	2	2.5	36	20	2.23	40	13	0.5	53	5	4.8	21	46	0.5	39	8	0.1	97	1	0.5	49	5	11.2	21	96
	Jul-Sep	1.7	49	7				10.6	21	49	10.1	21	53	8	31	29	15.3	12	125	2.5	27	22	0.1	75	2	2.5	43	13	48.3	8	287
	Oct-Dec	0.04	97	1				2.1	32	20	3.5	31	22	2.4	30	19	6.9	19	64	2.1	31	18	0.3	66	3	1.3	74	3	17.3	14	147
	Total	1.8	45	10	0.5	80	2	15.4	16	93	16.5	16	93	11.0	24	54	28.6	9	254	5.2	19	50	0.5	47	6	4.3	34	21	79.5	6	562

Appendix C. Seatrout harvest (Y) in tons per year with corresponding relative standard error (RSE). The number of respondents that reported a release within a given domain is denoted *h*.

	Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Fresh water			Total			
	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	Y	RSE	h	
Trout harvest in fykenets	Jan-Mar						0	97	1						0.1	69	2									0.1		3			
	Apr-Jun														0.1	73	2									0.1	73	2			
	Jul-Sep									0.1	71	2	0.1	97	1	1	33	13								1.2	244	16			
	Oct-Dec						0	97	1	0.1	69	2	0	97	1	0.2	76	2	0	97	1					0.3	972	7			
	Total						0.0		2	0.2	50	4	0.1	97	2	1.4	27	19	0.0		1					1.7	173	28			
Trout harvest in gillnets	Jan-Mar			0.1	97	1	0.8	45	6	2.2	38	9	0.1	73	2	1.7	35	14	0.7	77	2	0	97	1		5.6	45	35			
	Apr-Jun	0.3	54	4	0.1	97	1	0.9	37	8	3.7	25	25	0.5	51	5	2.2	24	27	1.1	47	6	0.1	69	2		8.9	22	78		
	Jul-Sep	0.2	70	2	0.1	69	2	4.1	29	23	4.8	22	33	1.1	44	7	6.9	21	46	1.8	55	6			0.1	97	1	19.0	14	119	
	Oct-Dec						2.1	35	13	3	31	15	1.8	60	6	3.3	28	23	4.2	69	6			0.3	76	2	14.4	26	63		
	Total	0.5	43	6	0.3	51	4	7.9	19	50	13.7	14	82	3.5	35	20	14.1	13	110	7.8	40	20	0.1	69	3		47.9	9	295		
Trout harvest angling with a passive gear license	Jan-Mar						0.6	52	6	1.7	52	11	1.2	56	7	4	33	23	0.8	53	6	1.8	89	2	0.4	44	7	10.1	28	55	
	Apr-Jun	0	97	1			0.3	50	5	1.5	32	17	0.4	46	6	4.2	27	35	1.4	47	6	0.5	55	5	1	42	12	8.3	24	75	
	Jul-Sep						0.9	38	9	1.8	35	16	1.8	51	9	5	26	34	0.4	42	6	0.1	97	1	1.8	34	17	10.0	22	75	
	Oct-Dec						0.5	85	2	1.4	69	10	1.3	48	7	1.3	29	17	0.4	56	5	0.3	60	3	0.7	37	9	5.2	36	44	
	Total	0.0		1			2.3	28	22	6.4	24	54	4.7	28	29	14.5	15	109	3.0	28	23	2.7	61	11	3.9	21	45	37.5	9	294	
Trout harvest angling with a angling license	Jan-Mar	0.4	100	1	0.1	100	1	4.1	45	7	19	25	26	6	32	15	25.9	21	41	8.2	41	13	1.5	63	3	6.6	34	17	71.8	12	124
	Apr-Jun	0.4	100	1			2	59	5	12.4	26	32	5.4	30	15	33.7	18	60	10.1	43	12	1.5	58	3	8.8	35	17	74.3	12	145	
	Jul-Sep	3.5	3	3			4.5	38	10	30.6	40	33	10.8	27	17	32.9	16	61	4.4	43	7	3.1	94	2	32.8	19	51	122.6	12	184	
	Oct-Dec	0.5	7	2			0.6	74	2	7.2	26	21	7.3	41	11	18.9	27	33	2.3	49	5				8.5	27	18	45.3	14	92	
	Total	4.8	12	7	0.1	100	1	11.2	25	24	69.2	20	112	29.5	17	58	111.4	10	195	25.0	24	37	6.1	52	8	56.7	14	103	314.0	7	545
Grand total	Angling Passive gear	4.8	12	8	0.1	100	1	13.5	21	46	75.6	18	166	34.2	15	87	125.9	9	304	28.0	21	60	8.8	41	19	60.6	13	148	351.5	6	839
	Passive gear	0.5	43	6	0.3	51	4	7.9	19	52	13.9	14	86	3.6	34	22	15.5	12	129	7.8	40	21	0.1	69	3		49.6	11	323		
	Total	5.3	12	14	0.4	46	5	21.4	15	98	89.5	15	252	37.8	14	109	141.4	8	433	35.8	19	81	8.9	40	22	60.6	13	148	401.1	5	1162

Appendix D: Cod catch and release (C&R) in numbers per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

	Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Total			
	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	
Cod C&R in fykenets	Jan-Mar						196	97	1							1467	47	5							1662	43	6	
	Apr-Jun						665	65	4	59	97	1	156	97	1	4673	64	8	978	97	1				6531	49	15	
	Jul-Sep						1453	47	8	3221	62	7	1277	65	3	19061	27	38	29	97	1				25042	22	57	
	Oct-Dec						246	67	3	511	78	2	2200	54	5	16822	60	15	295	97	1				20073	50	26	
	Total						2559	33	16	3790	54	10	3633	40	9	42024	28	66	1302	76	3				53308	22	104	
Cod C&Rt in gillnets	Jan-Mar			489	80	2				0			196	74	2	1955	32	14	39	97	1				2679	28	19	
	Apr-Jun									645	63	6	137	85	2	2210	27	17	176	56	3				3168	23	28	
	Jul-Sep									59	73	2	1316	65	4	5087	42	25	137	97	1				6599	32	32	
	Oct-Dec	344	70	2						39	97	1	236	83	2	1473	70	3	3742	38	15	0			5833	25	23	
	Total	344	70	2	489	80	2	39	97	1	940	48	10	3121	43	11	12993	21	71	353	48	5			18279	15	102	
Cod C&R angling with a passive gear license	Jan-Mar	962	65	5	7208	39	9	275	75	2	3025	65	7	8347	22	34	11156	32	26	452	58	3	2259	53	4	33684	15	90
	Apr-Jun	3005	40	9	6560	36	20	0			10645	73	12	6521	24	33	14554	25	38	1611	44	6	5794	68	6	48690	20	124
	Jul-Sep	2683	44	9	7142	34	20	0			1105	45	8	13790	30	36	31467	26	66	868	51	6	1578	54	4	58634	15	149
	Oct-Dec	99	97	1	3314	39	11	40	97	1	178	62	3	11147	41	30	11009	28	36	1578	58	5	631	63	3	27995	12	90
	Total	6749	27	24	24225	19	60	315	67	3	14953	54	30	39805	17	133	68186	15	166	4509	28	20	10262	41	17	169003	9	453
Cod C&R angling with a angling license	Jan-Mar	9002	64	6	17127	66	8	110	100	1	8563	56	6	59833	19	68	68616	35	34	1098	100	1	3294	70	2	167642	17	126
	Apr-Jun	7356	37	10	28434	45	17	6587	100	1	5928	37	12	50721	18	55	78606	22	50				3294	62	3	180926	13	148
	Jul-Sep	18932	41	12	50980	47	20				59192	61	17	113023	24	53	100363	21	57	2395	60	3	2509	71	4	347394	14	166
	Oct-Dec	9124	55	5	3878	50	8				456	100	1	43453	20	44	48129	20	45	228	100	1				105268	10	104
	Total	44414	25	33	100419	29	53	6697	98	2	74139	49	36	267030	12	220	295714	13	186	3721	49	5	9096	39	9	801230	8	544
Grand total	Angling	51163	22	57	124643	24	113	7011	94	5	89092	42	66	306835	11	353	363900	11	352	8230	27	25	19359	29	26	970233	7	997
	Passive gear	344	70	2	489	80	2	2599	33	17	4730	44	20	6754	29	20	55017	22	137	1654	61	8				71587	17	206
	Total	51507	22	59	125132	24	115	9610	69	22	93822	40	86	313589	10	373	418917	10	489	9884	25	33	19359	29	26	1041820	6	1203

Appendix E: Eel catch and release (C&R) in numbers per year with corresponding relative standard error (RSE). The number of respondents that reported a harvest within a given domain is denoted h.

	Central North Sea			Skagerrak			Limfjorden			Kattegat			The Sound			Belt Sea			Arkona Sea			Eastern Baltic			Fresh water			Total RSE		
	C&R	RSE	h	C&R	RSE	h	C&R	RSE	H	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h	C&R	RSE	h
Eel C&R in fykenets	Jan-Mar						2151	89	2	117	97	1			2562	54	7											4830	49	10
	Apr-Jun				196	97	1	6648	60	2	1603	70	6			2210	38	2	939	65	4				0,6	47	5	11595	37	35
	Jul-Sep	1228	67	3			6442	38	5	5794	34	8	2514	48	7	7974	29	6	845	72	4	98	97	1			24895	16	84	
	Oct-Dec						1591	58	5	1264	36	9	2769	71	6	3915	27	0	137	97	1						9676	15	41	
	Total	1228	67	3	196	97	1	16832	31	4	8778	26	4	5283	44	3	16660	18	5	1921	45	9	98	97	1		50996	13	0	

Colophon

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