

Eel, cod and sea trout harvest in Danish recreational fishing during 2012



DTU Aqua report no. 293-2015
By Hans J. Olesen and Marie Storr-Paulsen

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Table of Contents

Resumé (Danish abstract)	4
Abstract	5
1 Introduction.....	6
1.1 Monitoring of recreational fishing.....	6
1.2 Recreational fishing in Denmark.....	6
1.2.1 Passive gear fishing.....	7
1.2.2 Angling	7
1.3 Method approach.....	7
2 Methods.....	8
2.1 Omnibus interview	8
2.2 License interview	9
2.3 Analytical methods.....	9
3 Results.....	11
3.1 Omnibus interview	11
3.1.1 Fishing without license.....	11
3.1.2 Effort	12
3.2 License interview	13
3.2.1 Passive gear fishers	13
3.2.2 Anglers.....	13
3.3 Harvest.....	13
3.3.1 Cod harvest.....	14
3.3.2 Eel harvest	15
3.3.3 Seatrout harvest.....	15
4 Discussion and conclusion.....	16
4.1 Discussion.....	16
4.1.1 Eel.....	16
4.1.2 Cod	17
4.1.3 Seatrout	17
4.1.4 Sources of error	18
4.1.5 Fishing without license.....	18
4.2 Conclusion	19
5 References	20
Appendix A-F	

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 2012, gennemførte DTU Aqua og Danmarks Statistik interviewundersøgelser i juli 2012 og januar 2013.

I undersøgelsen blev de rekreative fiskere, på baggrund af hvilken fisketegnslicens de havde indløst, opdelt i henholdsvis amatør/fritidsfiskere og 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 2012 indløste i alt næsten 150.000 lystfiskere og 33.500 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 18 % og 27 % for henholdsvis fritidsfiskere og lystfiskere.

I alt vurderer DTU Aqua, at der blev fanget og hjemtaget ca. 52 tons ål hvilket er et mærkbart fald på 34 % fra 2011, ca. 1300 t torsk og 400 t havørred, hvor ål- og havørredfangsterne inkluderer den andel der fiskes i ferskvand. Både for havørred og torsk er værdierne meget ens med de 2 forgående år

Ål fanges næsten udelukkende i rusefiskeriet, og den totale rekreative fangst udgjorde i 2012 omkring 14 % af de samlede kommercielle og rekreative landinger. Den rekreative torskefangst udgjorde 4.4 % af den samlede torskefangst. 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 49 % og 33 %). Omkring 93 % af de rekreativt fangede torsk blev taget med stang og hjul, hvilket er et stabilt niveau sammenlignet med tidligere år.

Af samtlige havørreder, der blev fanget og landet, var 85 % fanget med stang og hjul, mens garn og ruse kun fangede 15 %. I alt blev 6 % fanget i ferskvand og her var mere end 96 % fanget 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 2012 cod, eel and seatrout harvest (fish caught and kept) in the Danish angling and passive gear fishing, two interview surveys were conducted in July 2012 and January 2013. Recreational fishing was separated into anglers (with rod and reel) and passive gear fishing (fyke- and gillnets). In 2012 a total of close to 150,000 anglers and 33,500 passive gear fishers had issued the annual license, which is compulsory if saltwater fishing is practiced. In total, it was estimated that 52 t eel were caught in the recreational fishery a 34% reduction compared to the year before. Furthermore, close to 1,300 t cod and 400 t seatrout (including freshwater catches) was harvested in the recreational fishery, these values were very similar to the years before. Eel is almost exclusively taken in the passive gear fykenet fishery and seatrout was mainly caught by anglers which accounted for 85 % of the total harvest. Present interview survey indicates that approximately 4.4 % 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 fishery had a large share of the total yield accounting for 49 % and 33 %, respectively. Approximately 13 % 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.

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.

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). In 2012 the first recreational catches were included in an ICES assessment and it was conducted for the German recreational catches in western Baltic cod stock. Although seldom included, 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 2012 harvest and releases of the three species in the Danish recreational fishery. Similar data from 2009, 2010 and 2011 can be found in Sparrevohn and Storr-Paulsen (2010, 2011a, 2012).

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 fished 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.

year	1999	2000	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012
Anglers	150526	151529	156769	150925	152534	160942	156474	160664	160186	157939	152723	157762	149581
Passive gear	33575	31709	33715	33888	33516	33430	34277	33787	35221	34565	33734	33911	33473

Anglers - domestic as well as tourists - between 18 and 65 years of age have to purchase a mandatory 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 a few legal reasons for anglers not to hold a license e.g. persons younger than 18 years or being 65 years or older or when fishing in privately owned bodies of water including put & take fishing.

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 33,754 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 fishing is 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 155,273 (Table 1). The number of weekly licenses issued in 2012 was 17,334 and for daily license a total of 27,802 licenses were issued (Table 2). 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. Angling for cod from 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 kept at around 2 months as a shorter timeframe could result in mixing of effort and catches and longer timeframes tends to bias the estimates towards overestimation (e.g. Tarrant et al., 1993; NRC 2006). 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.

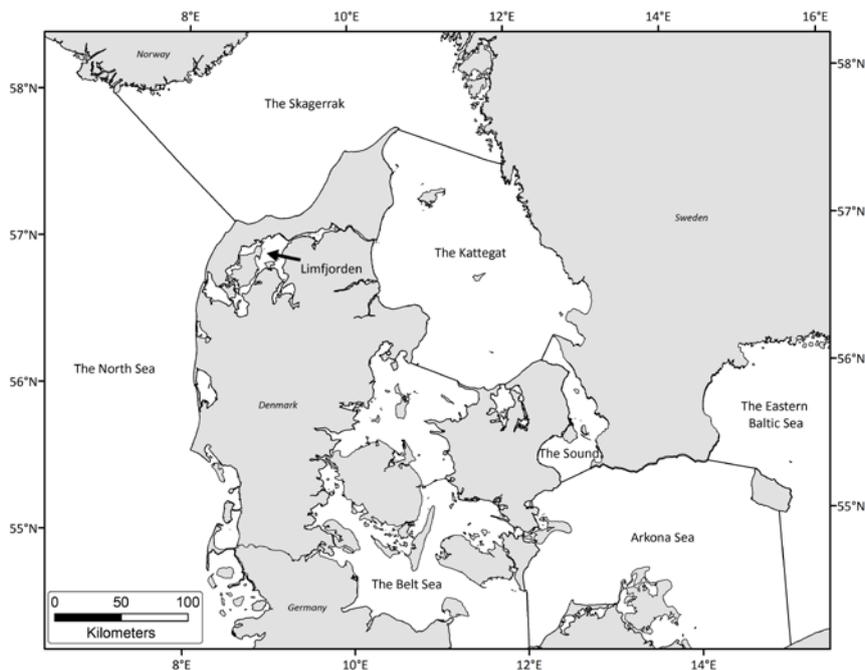


Figure 1. Area definition used in the interview survey.

Fishers not holding a license were asked for their reasons. There are a few 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 their fishing effort. Respondents were also asked about their fishing effort in other countries.

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 two interview rounds that were conducted in July 2012 and in January 2013. Since two different license lists are available, one for anglers and one for passive gear fishers, there were 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 2013 was 3,412500 persons (Danmarks statistik). 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.

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 Sparrevojn 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 (Sparrevojn et al., 2009) and 1,700 g when caught and kept either in fykenets or while angling.

Table 2. Values used in eq. 1 & 2 for estimating harvest and catch and release (C & R) 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	Week	Day	Without	Year	Week	Day	Without
		(a)	(w)	(d)	(m)	(a)	(w)	(d)	(m)
Passive gear	1649/1626	33,473	-	-	16,378	30.8	-	-	10.8
Angling	1622/1607	149581	17,334	27802	91621	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 65 (N), which 1 Jan. 2013 was 3.412.500 (Danmarks Statistik).

A			Do you fish?	Do you have a license?				
	(n)		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			Do you fish?	Do you have a license?				
	(n)		Yes	Yes	No	No- legal	No-illegal	% illegal
Dec	3412500	Angling	408939	204470	204470	105760	98709	24.1
		Passive gear	31728	24677	7051	0	7051	22.2
Nov	3412500	Angling	470693	246044	224649	117673	106976	22.7
		Passive gear	60620	28527	32093	7132	24961	41.2
Oct	3412500	Angling	423894	210166	213728	121113	92616	21.8
		Passive gear	49870	28497	21373	10686	10686	21.4
Jan	3412500	Angling	464242	308340	155902	79683	76219	16.4
		Passive gear	72754	38109	34645	10393	24251	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 the effort between fishers with or without a valid license 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 effort (average days fished) for anglers and passive gear fishers with or without a valid license.

	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 1.9 % and 2.2 % for the anglers and passive gear fishers refused to answer (Table 5). The very high level of responses in the surveys qualifies the investigation.

Table 5. Distribution and motive of non-respondents.

Anglers				
Table of interview results by method				
	phone	web	no answer	Total
Answer	1557	1672	0	3229
Not encountered			266	266
Refusal			78	78
Other reasons			39	39
Language difficulties			15	15
No contact on phone number			106	106
No phone number			267	267
Not relevant			2	2
Total	1557	1672	773	4002
Passive gear				
Table of interview results by method				
	phone	web	no answer	Total
Answer	1494	1781	0	3275
Not encountered			350	350
Refusal			89	89
Other reasons			31	31
Language difficulties			4	4
No contact on phone number			65	65
No phone number			143	143
Not relevant			3	3
Total	1494	1781	685	3960

3.2.1 Passive gear fishers

A total of 3,960 persons were tried contacted and 3,275 participated in an interview. 1,781 answered via the internet and 1,494 via the telephone survey (Table 5). Less than half (39%) of the passive gear fishers answered that they had been fishing within the first 6 months and 56% had been fishing within the last 6 month of 2012. 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 3,229 anglers that participated in the survey 56 and 51 % had actually been fishing within the first and last 6 months of 2012 respectively.

3.3 Harvest

The total harvest estimate was upscaled with 27 % for the angling fishing and 18 % for the passive gear fishing due to the inclusion of the illegal fishing without a license.

3.3.1 Cod harvest

A total of 1311 t cod were harvested in the Danish recreational fishery in 2012 (Appendix A). Cod were harvested with all gears but with the main contribution (93 %) came from the angling fishery. Less than 5 and 3 % of the harvest derived from gillnet and fykenet fishery, respectively.

The angling harvest of cod is quite evenly distributed in quarter 1, 2, and 4 with a bit larger part of the share in the 3rd quarter where 37 % of the harvest was taken. The most important area for cod harvest was the Sound where 28 % of the recreational cod harvest was taken followed by the Belt Sea with 22 % and Skagerrak with 19 %.

In Kattegat, an increase in the recreational fishery has been evident during the last three years investigation. In 2009 a total of 35 t cod was harvested which in 2010 increased to 66 t and in 2011 the amount had increased to 106. However, in 2012 the amount of cod harvest in the recreational fishery in Kattegat was estimated to be close to 57 t. Around 91% of cod harvested was harvested angling and only 9 % from gillnet and fykenet fishery. However, due to the present very low commercial quota (133 t in 2012) and Danish landings (60 t) in this area the recreational harvest are equivalent to 49 % of the total national cod yield in this area. In the Sound recreational fishing is also very important accounting for 33 % of the total Danish Sound cod yield in 2012 and angling alone for 31 %.

In the Western (SD 22-24) and Eastern (SD 25-32) Baltic Danish commercial fishing for cod accounted for 9,100 t and 11,400 t in 2012, respectively (Fig. 2). In this light recreational fishing was relatively important for the western area and minor in the eastern accounted for an equivalent of 8.3 % in west and 0.5 % of the total cod yield in the eastern Baltic, these results are very similar to 2011.

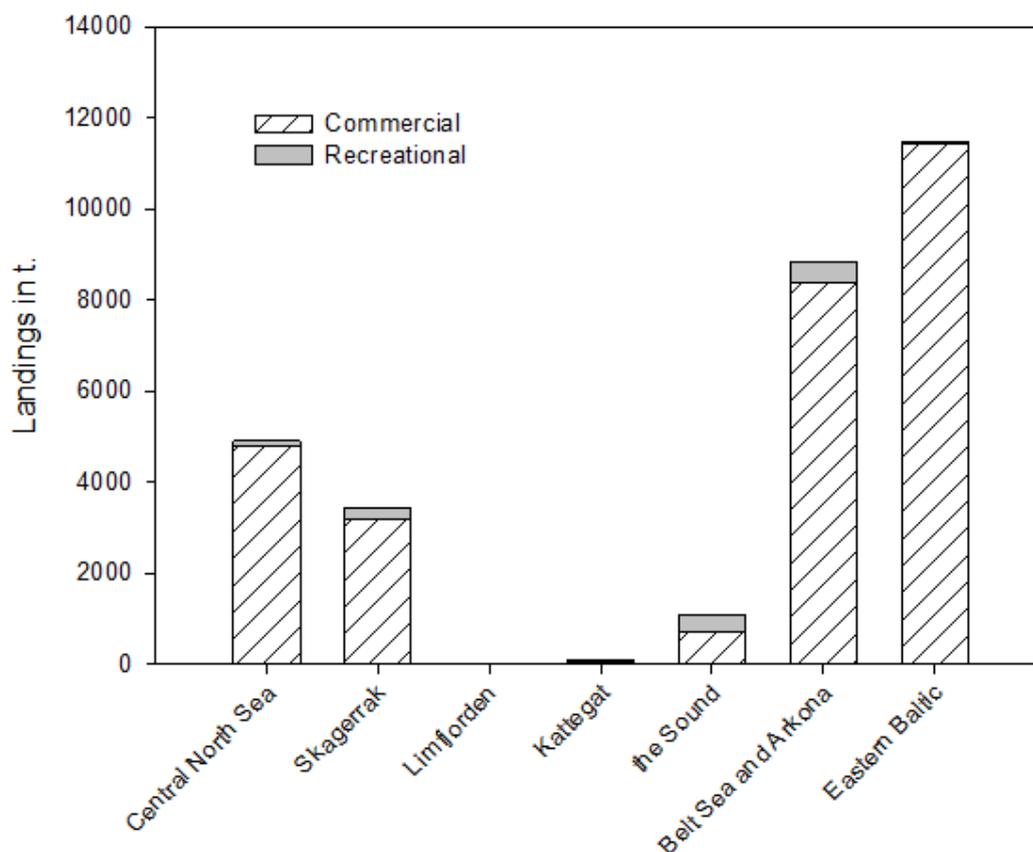


Figure 2. Danish recreational and commercial cod catches by area in 2012.

In the North Sea and Skagerrak the commercial Danish landings in 2012 were by the Danish AgriFish Agency estimated to be 4,803 t and 3,176 t, respectively. The harvest in the recreational fishing from these areas was estimated to be close to 110 t and 250 t respectively corresponding to an equivalent of 2 % and 7 % of the total cod yield.

Overall, the total Danish commercial cod catches amount to 29888 t and our investigations indicate that the total Danish recreational cod harvest in 2012 where 4.4 % of the total yield, which is the same level as was found in 2009 and 2011 (Sparrevohn and Storr-Paulsen, 2011).

Year	2009	2010	2011	2012
Estimated caught in the recreational fishery	1230t	1670t	1300t	1311t

The recreational value calculated for 2012 is very similar to last years' value.

3.3.2 Eel harvest

A total of 52.3 t eel was harvested with fykenets in Danish recreational fishing (Appendix B). The majority (69 %) was taken during the third quarter. The most important area was the Limfjord accounting for 30% of the total eel harvest followed by the Belt Sea which accounted for 26 % of the total eel harvest. There has been a very pronounced decrease in eel harvest compared to 2011 where nearly 80 t eel was estimated caught, and the main part of the decrease is in the Belt Sea. The commercial and recreational catches of eel have both declined during the last years (Fig. 3).

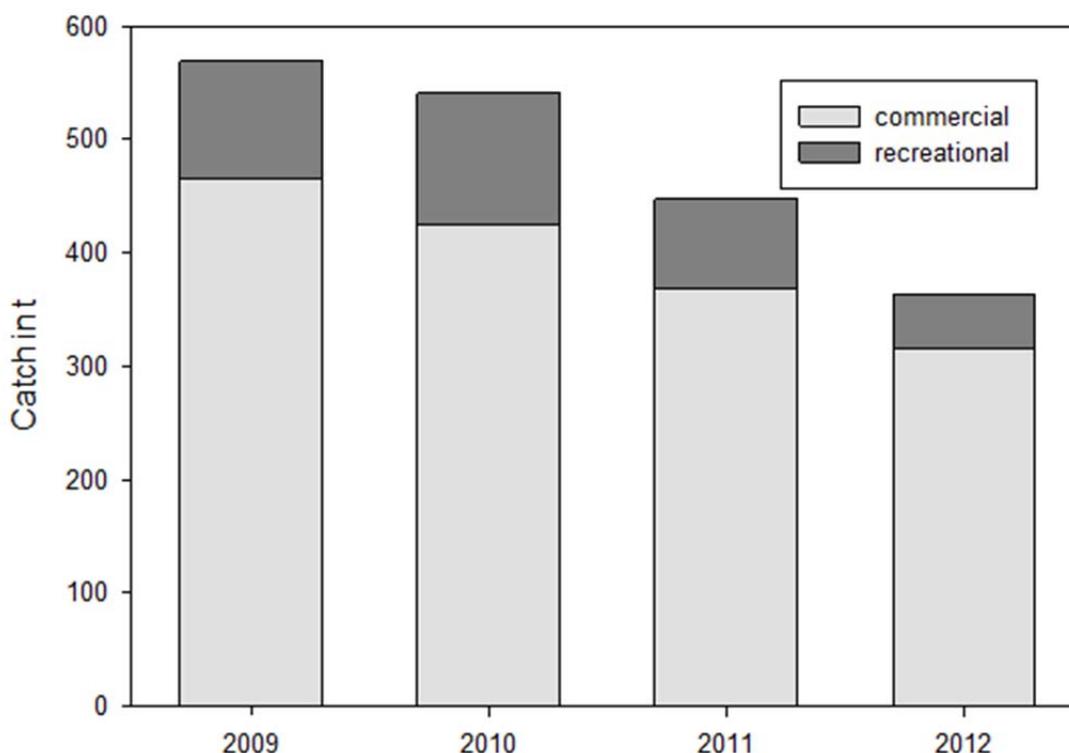


Figure 3. Commercial and recreational landings/catches of eel in Denmark 2009 - 2012.

3.3.3 Seatrout harvest

Sea trout was predominately harvested angling (85 %) (Appendix C). In total 400 t was caught and kept annually and out of these 339 t was harvested angling. For angling, the three most important marine areas identified was the Belt Sea 177t, Kattegat with 79t and the Arkona area with close to 40t. The total harvest in freshwater accounted for 6% of the recreational harvest.

4 Discussion and conclusion

4.1 Discussion

The importance of recreational fishing has grown worldwide over the last decades and recreational harvest has in some cases become comparable with or even exceeds that of commercial fisheries. In Europe, marine recreational fisheries are also gaining importance, and regular collection of catch data from this sector for selected species in European Community waters was initiated in 2001. The western Baltic cod is one of the first fish stocks in Europe that, since 2013, includes recreational catches in stock assessment and fisheries management advice (Eero et al. 2014). One of the reasons for not including the recreational catches in stock assessment is that different from commercial fisheries, obligations for catch reporting and official catch recording systems are usually not in place for recreational fisheries and therefore the estimates can be rather unsure if at all obtainable. It is therefore of large importance to improve data collection for recreational fisheries in the stocks where a substantial part of the total catches comes from this fishery.

In the present study the total Danish recreational harvest and release of sea trout, eel and cod was found by; 1) estimating the harvest and release from a subsample of persons who had issued a license within the last 12 months and 2) using a survey from 2009 to give a general estimate of the amount of fishing carried out without a valid license. This corresponds to 12 - 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 2012 the number of annual angler license issued were 149,581; weekly license was 17,334 and daily 27,802, summing to a total of 194,717 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 2012 only 2 - 3 % was from lakes (www.fd.dk). Total catch of eels by angling is assumed to be negligible and therefore this is not included in the report.

Since fykenets set in saltwater are rather sensitive to wave and current action this fishing is mainly carried out in the inner Danish waters e.g. Fjords, Belts and Sounds sheltered from wind and waves. This is reflected in the very low harvest of eel in the North Sea, Skagerrak and Eastern Baltic. A changed pattern compared to last years was observed in 2012 where the Limfjord had the highest catches followed by the Belt Sea, however this was in contrast to the effort where the Belt Sea accounted for 40% of the total effort and only 26% of the total catches. The commercial eel catches have also decreased in later years but not as much as in the recreational catches. It cannot be ruled out that some of the decrease in recreational eel catches is caused by a larger degree of misreporting as there has been more focus on eel and sustainability in the public later years. In 2009 a new regulation was implemented where 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 surveys from 2009-2012 where the lowest catches are seen in 2. quarter, 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 around 52 t which is a large decrease compared to the 80 t in 2011

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 2012 on 316 t hence the recreational fishing harvested an equivalent of 14 % of the total Danish eel yield. In 2011 the figure was slightly higher at 18 %.

A total of 60,000 eel was estimated to be caught and released which is 10 000 more than observed in 2010 and 2011 (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 fyknets the survival is expected to be high.

4.1.2 Cod

In 2012 recreational cod catches were estimated to be close to 1300t, similar to last year's value (Sparrevohn and Storr-Paulsen, 2012). As in the two former investigations angling contributed with the main part of cod harvested in the recreational fishery.

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 was 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 700 t in average the last years (ICES, 2013). Due to the large decline in commercial catches in later years the recreational fishing in 2012 accounts 1/3 of the total Danish Sound cod yield and the main contribution was from anglers. 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). 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 anglers.

In Kattegat, the recreational catches is also a very large fraction of total catches in later years and an increase in the recreational fishery has been evident during the 2009-2011 investigation. However, in 2012 the amount of cod harvest in the recreational fishery in Kattegat was decreasing again. Due to the present very low commercial quota (133 t in 2012) and Danish landings (60 t) in this area the recreational harvest are equivalent to 49 % of the total national cod yield in this area.

In 2012 the number of released cod was a total of 1,184,048 cod was estimated to be caught and released again. This value was little bit higher than in 2011 where only around 1 mill cod had been caught and released.

4.1.3 Seatrout

In 2012 a total of 400 t of seatrout was being caught mainly by anglers. This estimate was similar to 2011. Like for cod in the sound, there might be a tendency for underestimating the harvest in the Arkona Sea, since this area, according to anecdotal information is 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 550,000 seatrouts was estimated to be caught and released in 2011 and this was nearly doubled in 2012 where 960,000 seatrouts was estimated to be caught and released.

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 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 are 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).

4.1.5 Fishing without license

The inclusion of illegal fishing 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 18 % and 27 % 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 carrying capacity the fishing mortality caused by recreational fishing can be an important factor that should be incorporated into stock assessment, recovery plans and ecosystem based management. The harvest of fishers without a valid license was important as it increased the estimated harvests with 18 % for the passive gear fishing and 27 % for angling. Hence, recall surveys designed to estimate harvest and catches in the recreational fishery should not be based upon fishing license list alone but should also be 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.
- NRC 2006. Review of Recreational Fisheries Survey Methods. National Research Council, 202 pp. <http://www.nap.edu/catalog/11616.html>
- 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. 2013. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 10 -17 April 2013, ICES Headquarters, Copenhagen. ICES CM 2013\ACOM:10. 747 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. Sparrevojn 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.
- Sparrevojn, 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.
- Sparrevojn, 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
- Sparrevojn 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.
- Sparrevojn, 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 in tons (y=yield) per year. The number of respondents that reported a harvest within a given domain is denoted h.

Cod harvest	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		TOTAL	
		y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h
Fykenets	Jan - Mar	0.0	0	0.0	0	0.0	0	0.0	2	0.0	1	1.6	14	0.0	0	0.0	0	1.6	17
	Apr - Jun	0.0	0	0.0	0	0.0	0	0.1	4	1.2	1	0.9	13	0.4	1	0.0	0	2.6	19
	Jul - Sep	0.0	0	0.0	0	0.9	8	1.0	13	12.5	12	5.6	43	0.4	5	0.1	1	20.5	82
	Oct - Dec	0.0	0	0.0	0	0.7	5	0.6	9	3.6	4	4.3	31	0.3	2	0.0	0	9.5	51
	Total		0.0	0	0.0	0	1.6	13	1.7	28	17.3	18	12.4	101	1.1	8	0.1	1	34.3
Gillnets	Jan - Mar	0.8	1	1.1	8	0.0	1	0.6	5	1.0	7	5.6	28	0.7	3	0.0	1	9.9	54
	Apr - Jun	0.0	2	2.5	9	0.0	1	0.6	9	1.5	8	4.7	49	0.1	4	0.0	4	9.3	86
	Jul - Sep	1.1	3	0.3	7	0.0	0	1.6	15	2.9	15	6.8	61	3.0	15	1.3	3	17.0	119
	Oct - Dec	0.8	3	0.9	10	0.3	3	0.7	13	3.0	11	13.4	50	6.0	11	0.2	3	25.3	104
	Total		2.8	9	4.8	34	0.3	5	3.5	42	8.4	41	30.5	188	9.8	33	1.5	11	61.6
Angling (passive gear license)	Jan - Mar	3.0	6	8.8	12	0.0	0	1.2	5	8.8	30	18.6	28	2.6	5	1.9	7	44.9	93
	Apr - Jun	7.7	17	19.5	32	0.0	0	1.5	13	6.6	19	12.0	28	2.8	7	2.3	10	52.4	126
	Jul - Sep	11.8	12	13.7	23	0.0	2	5.4	12	6.7	31	15.7	37	5.3	11	4.2	13	62.9	141
	Oct - Dec	5.7	4	3.9	9	0.0	1	1.1	5	7.9	36	10.6	41	3.8	8	0.4	3	33.4	107
	Total		28.2	39	45.9	76	0.0	3	9.2	35	29.9	116	56.9	134	14.6	31	8.9	33	193.7
Angling (angling license)	Jan - Mar	13.6	7	12.2	8	12.3	1	3.6	7	79.5	53	39.6	44	28.1	9	8.9	6	197.9	135
	Apr - Jun	23.6	12	96.5	24	0.0	0	9.8	16	39.0	48	42.5	58	14.9	9	0.4	8	226.7	175
	Jul-Sep	40.2	10	84.9	23	0.0	0	25.4	16	112.2	93	67.5	60	57.4	14	1.2	4	388.7	220
	Oct - Dec	2.4	4	6.8	8	0.0	0	4.0	11	78.3	78	36.8	45	42.9	8	37.2	3	208.4	157
	Total		79.8	33	200.4	63	12.3	1	42.8	50	309.0	272	186.3	207	143.4	40	47.7	21	1021.8
Grand total	Angling	108.1	72	246.3	139	12.3	4	52.0	85	339.0	388	243.3	341	158.0	71	56.6	54	1215.5	1154
	Passive gear	2.8	9	4.8	34	1.9	18	5.3	70	25.7	59	42.9	289	10.9	41	1.7	12	95.9	532
	Total	110.8	81	251.1	173	14.2	22	57.2	155	364.7	447	286.2	630	168.8	112	58.3	66	1311.4	1686

Appendix B. Eel harvest in tons (y=yield) per year. The number of respondents that reported a harvest within a given domain is denoted *h*.

Eel harvest	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		Sweden		Freshwater		TOTAL	
		y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h
Fykenets	Jan - Mar	0.0	0	0.0	0	0.1	2	0.2	5	0.8	4	0.9	18	0.4	3	0.0	0			0.0	0	2.4	32
	Apr - Jun	0.0	0	0.0	0	0.6	11	0.4	12	0.0	3	1.0	27	0.2	8	0.0	0			0.0	2	2.2	63
	Jul - Sep	5.7	11	0.0	2	14.1	50	2.6	44	3.7	24	7.7	89	2.0	21	0.0	3			0.4	12	36.1	256
	Oct - Dec	0.1	1	0.0	0	1.1	14	4.0	23	2.1	13	3.8	53	0.4	7	0.1	2			0.0	4	11.6	117
	Total	5.9	12	0.0	2	15.9	77	7.1	84	6.6	44	13.5	187	2.9	39	0.1	5			0.4	18	52.3	468

Appendix C. Seatrout harvest in tons (y=yield) per year. The number of respondents that reported a release within a given domain is denoted *h*.

Seatrout harvest	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		Sweden		Freshwater		TOTAL	
		y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h	y	h
Fykenets	Jan - Mar	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0	0	0.0	0			0.0	0	0.0	2
	Apr - Jun	0.0	0	0.0	0	0.0	0	0.2	3	0.0	0	0.1	3	0.0	0	0.0	0			0.0	0	0.3	6
	Jul - Sep	0.0	0	0.0	1	1.3	2	0.1	4	0.0	1	0.0	4	0.0	1	0.0	0			0.0	1	1.6	14
	Oct - Dec	0.0	0	0.2	1	0.0	1	0.2	2	0.0	1	0.1	4	0.0	0	0.0	0			0.0	0	0.7	9
	Total	0.0		0.3		1.3		0.5		0.1		0.2		0.0		0.0				0.0		2.5	0
Gillnets	Jan - Mar	0.2	2	0.1	1	0.3	2	1.4	9	0.2	2	2.9	18	1.1	5	0.0	0			0.1	1	6.1	40
	Apr - Jun	0.4	3	1.3	3	2.2	9	3.0	15	1.1	4	3.6	30	0.0	1	0.0	0			0.0	0	11.5	65
	Jul - Sep	1.2	3	0.7	7	5.3	0	7.5	15	0.5	15	8.6	61	2.8	15	0.1	3			0.7	0	27.4	119
	Oct - Dec	0.1	3	0.2	10	2.2	3	3.8	13	0.7	11	3.3	50	1.7	11	1.2	3			0.0	0	13.3	104
	Total	1.9	11	2.3	21	10.0	14	15.6	52	2.5	32	18.4	159	5.5	32	1.3	6			0.8	1	58.3	328
Angling (passive gear license)	Jan - Mar	0.0	0	0.0	0	0.2	5	2.4	19	0.3	4	4.8	36	0.6	5	0.1	2	0.0	2	3.3	7	11.7	80
	Apr - Jun	0.1	1	0.0	0	0.2	5	1.8	22	1.0	13	9.8	51	0.1	5	0.4	2	0.0	1	3.2	12	16.7	112
	Jul - Sep	0.0	0	0.0	0	1.3	6	5.2	28	0.5	12	3.5	48	1.1	13	0.4	2	0.0	2	1.2	17	13.1	128
	Oct - Dec	0.0	0	0.0	0	1.1	3	0.7	13	0.3	8	2.7	34	1.3	11	0.5	1	0.0	1	0.2	8	6.8	79
	Total	0.1	1	0.0	0	2.8	19	10.0	82	2.1	37	20.9	169	3.1	34	1.4	7	0.0	6	8.1	44	48.3	399
Angling (angling license)	Jan - Mar	0.4	5	0.2	2	2.8	17	17.2	41	7.8	11	19.9	65	3.0	18	1.2	11	0.4	4	1.5	18	54.3	192
	Apr - Jun	0.0	3	0.3	1	2.2	13	10.2	44	4.8	16	59.6	85	3.3	13	0.6	4	0.7	5	3.9	26	85.6	210
	Jul-Sep	1.0	4	0.1	1	6.7	11	21.1	69	8.5	32	39.3	109	18.5	37	4.4	7	0.0	7	8.1	57	107.7	334
	Oct - Dec	0.0	0	0.0	1	4.2	12	4.4	45	4.3	21	18.4	88	6.8	28	4.2	5	0.0	5	0.9	21	43.2	226
	Total	1.4	12	0.7	5	15.9	53	52.8	199	25.4	80	137.1	347	31.6	96	10.4	27	1.1	21	14.4	122	290.8	962
Grand total	Angling	1.5	13	0.7	5	18.7	72	62.8	281	27.5	117	158.0	516	34.7	130	11.8	34	1.1	27	22.4	166	339.1	1361
	Passive gear	1.9	11	2.5	23	11.3	17	16.1	61	2.6	34	18.7	172	5.6	33	1.3	6	0.0	0	0.8	2	60.9	359
	Total	3.4	24	3.2	28	30.0	89	78.9	342	30.1	151	176.6	688	40.3	163	13.1	40	1.1	27	23.2	168	400.0	1720

Appendix D: Cod C&R (C&R) in numbers per year. The number of respondents that reported a harvest within a given domain is denoted h.

Cod catch and release	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		TOTAL	
		C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h
Fykenets	Jan - Mar	0	0	0	0	0	0	0	0	0	0	24431	4	0	0	0	0	24431	4
	Apr - Jun	0	0	0	0	0	0	143	2	95	1	2267	3	1193	1	0	0	3698	7
	Jul - Sep	0	0	0	0	3979	5	603	5	3835	4	12059	20	2171	4	0	0	22647	38
	Oct - Dec	0	0	0	0	2629	3	603	2	4824	1	10612	15	482	1	0	0	19150	22
	Total	0	0	0	0	6608	8	1349	9	8754	6	49368	42	3846	6	0	0	69925	71
Gillnets	Jan - Mar	0	0	549	3	72	1	0	0	382	3	1455	7	48	1	0	0	2505	15
	Apr - Jun	0	0	358	3	0	0	692	4	2720	3	3483	24	24	1	286	1	7563	36
	Jul - Sep	0	0	265	3	0	0	169	4	699	4	10588	24	1013	8	362	1	13096	44
	Oct - Dec	3618	1	0	0	0	1	193	2	941	2	5740	17	892	4	482	1	11866	28
	Total	3618	1	1172	9	72	2	1054	10	4742	12	21267	72	1977	14	1130	3	35030	123
Angling (passive gear license)	Jan - Mar	1503	5	9782	10	0	0	2720	5	5726	29	9686	28	930	5	978	7	31326	89
	Apr - Jun	2267	13	12764	27	0	0	2362	9	4700	17	6537	28	1503	6	2863	9	32996	109
	Jul - Sep	1616	12	12807	23	338	2	1664	12	6319	30	32584	32	2291	11	2894	10	60512	132
	Oct - Dec	579	4	2846	9	193	1	289	5	3618	34	24938	39	1037	7	96	3	33597	102
	Total	5964	34	38199	69	531	3	7035	31	20363	110	73745	127	5762	29	6832	29	158430	432
Angling (angling license)	Jan - Mar	6174	7	7656	8	4939	1	2346	7	59269	52	80136	42	10742	8	4816	6	176078	131
	Apr - Jun	12224	10	25313	20	0	0	6174	15	56923	49	82236	53	4198	8	4198	7	191266	162
	Jul-Sep	27046	10	49873	22	0	0	19850	14	80020	92	128032	56	28534	14	15384	4	348739	212
	Oct - Dec	7072	3	13275	7	0	0	6079	11	47144	78	59302	42	39452	8	32256	3	204579	152
	Total	52515	30	96116	57	4939	1	34449	47	243356	271	349706	193	82927	38	56654	20	920662	657
Grand total	Angling	58480	64	134315	126	5470	4	41484	78	263718	381	423451	320	88689	67	63486	49	1079092	1089
	Passive gear	3618	1	1172	9	6680	10	2403	19	13495	18	70635	114	5823	20	1130	3	104956	194
	Total	62097	65	135486	135	12150	14	43887	97	277214	399	494086	434	94511	87	64616	52	1184048	1283

Appendix E: Eel C&R (C&R) in numbers per year. The number of respondents that reported a harvest within a given domain is denoted h.

Eel catch and release	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		Sweden		Freshwater		TOTAL	
		C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h
Fykenets	Jan - Mar	0	0	0	0	72	1	72	1	358	1	1455	7	334	1	0	0			0	0	2290	11
	Apr - Jun	0	0	0	0	1909	6	2362	4	549	2	954	4	119	2	0	0			0	0	5893	18
	Jul - Sep	1230	3	0	0	12493	21	9503	14	4052	11	8297	29	1182	6	169	1			2364	6	39288	91
	Oct - Dec	0	0	0	0	796	5	2147	5	892	3	9213	14	0	0	0	0			0	0	13048	27
	Total	1230	3	0	0	15269	33	14083	24	5851	17	19919	54	1635	9	169	1			2364	6	60520	147

Appendix F: Seatrout C&R (C&R) in numbers per year. The number of respondents that reported a harvest within a given domain is denoted h.

Seatrout catch and release	Period	Central North Sea		Skagerrak		Limfjorden		Kattegat		The Sound		Belt Sea		Arkona Sea		Eastern Baltic		Sweden		Freshwater		TOTAL		
		C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	C&R	h	
Fykenets	Jan - Mar	0	0	0	0	0	0	0	0	0	0	239	2	0	0	0	0	0	0	0	0	239	2	
	Apr - Jun	0	0	0	0	0	0	239	1	0	0	24	1	0	0	0	0	0	0	0	0	262	2	
	Jul - Sep	0	0	0	0	48	1	48	1	0	0	24	1	0	0	0	0	0	0	0	48	1	169	4
	Oct - Dec	0	0	0	0	0	0	0	0	0	0	24	1	0	0	0	0	0	0	0	0	24	1	
	Total	0	0	0	0	48	1	287	2	0	0	311	5	0	0	0	0	0	0	0	48	1	694	9
Gillnets	Jan - Mar	0	0	0	0	167	1	215	3	0	0	382	4	716	1	0	0	0	0	0	0	1479	9	
	Apr - Jun	48	1	0	0	48	1	72	1	0	0	286	5	0	0	0	0	0	0	0	0	453	8	
	Jul - Sep	121	1	121	1	531	5	362	8	0	0	627	9	145	1	72	1	0	0	24	1	2002	27	
	Oct - Dec	0	0	0	0	0	0	0	0	0	0	72	3	24	1	0	0	0	0	0	0	96	4	
	Total	168	2	121	1	745	7	648	12	0	0	1367	21	885	3	72	1	0	0	24	1	4031	48	
Angling (passive gear license)	Jan - Mar	0	0	0	0	143	4	2386	19	262	4	8899	35	2004	5	0	1	1742	2	1431	0	16868	70	
	Apr - Jun	95	1	0	0	95	5	2147	22	620	13	5511	50	596	5	72	1	239	1	573	12	9949	110	
	Jul - Sep	0	0	0	0	1109	6	4293	28	675	12	6632	48	1544	13	169	2	241	1	1519	15	16183	125	
	Oct - Dec	0	0	0	0	1158	3	1857	13	579	8	4414	33	965	11	121	1	0	0	941	7	10033	76	
	Total	95	1	0	0	2506	18	10683	82	2137	37	25456	166	5109	34	361	5	2221	4	4464	34	53033	381	
Angling (angling license)	Jan - Mar	7285	5	0	2	29264	17	63097	40	18892	11	67912	64	11236	18	5433	11	1482	4	10742	0	215344	172	
	Apr - Jun	864	3	247	1	7656	13	21115	43	9755	16	69764	83	8026	13	1235	4	1482	5	14447	25	134590	206	
	Jul-Sep	124	4	248	1	32877	11	88953	69	29279	32	122450	108	42181	37	6699	7	6823	3	26301	55	355935	327	
	Oct - Dec	0	0	372	1	17493	12	54091	45	13151	21	74437	86	19478	28	4218	5	4714	3	7444	21	195398	222	
	Total	8274	12	867	5	87289	53	227255	197	71076	80	334564	341	80921	96	17585	27	14501	15	58934	101	901266	927	
Grand total	Angling	8369	13	867	5	89795	71	237938	279	73213	117	360020	507	86030	130	17946	32	16722	19	63398	135	954299	1308	
	Passive gear	168	2	121	1	794	8	935	14	0	0	1678	26	885	3	72	1	0	0	72	2	4724	57	
	Total	8537	15	988	6	90588	79	238873	293	73213	117	361698	533	86915	133	18019	33	16722	19	63470	137	959023	1365	

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By Hans J. Olesen and Marie Storr-Paulsen

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Cover photo: Angler Rune S. Nielsen with a 3.5 kg seatrout

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