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Probability-based surveying using self-sampling to estimate catch and effort in Norway's coastal tourist fishery

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Recreational fishing as a tourist activity has become an increasingly important part of the Norwegian travel industry, and may contribute significantly to the fishing mortality on Norwegian coastal cod (*Gadus morhua*). Quantifying catches in the tourist fishery is made difficult by Norway's intricate and long coastline, and the lack of a fishing licence system, a registry of businesses catering for fishing tourists, and a registry of charter boats. A probability-based survey was used to estimate annual catch and effort by boat for anglers associated with 445 tourist-fishing businesses during 2009. From a stratified random sample of businesses, fishing tourists were recruited systematically over time to record their daily catch and effort in diaries. Cod dominated the reported landed catch (harvest) north of 62°N, and saithe and mackerel dominated south of 62°N. The estimated total landed catch of all species taken by tourist fishers in the business sector during 2009 was 3335 t (relative standard error, RSE = 17%), of which 1613 t (RSE = 22%) were cod. It is concluded that surveys based on self-sampling can yield accurate estimates of catch and effort accounted for by the business sector of the Norwegian tourist fishery, and that the tourist catch of coastal cod is insignificant compared with the commercial and recreational catch by local residents.

Keywords: catch diary, cluster sampling, fishing tourism, Norwegian coastal cod, probability-based survey, recreational fisheries, self-sampling, sustainable fishing.

Introduction

The contribution of recreational fishing (see Pawson *et al*., 2008) to the fishing mortality of coastal fish resources in Europe is largely unknown, and is an issue raised in the reformulation of the EU Common Fisheries Policy (Council Regulation (EC) 1224/2009 Article 55; EC 1967/2006). Marine recreational fishing is a rapidly growing part of the nature-based tourism industry in Norway (Borch, 2004) and might account for a significant portion of the fishing mortality for some coastal fish stocks. Fishing tourism is currently a high-profile and contentious issue in Norway that has been debated extensively on radio and television, in newspapers, and within political circles (Borch, 2009). The debate centres on the optimum use of coastal fish resources, which sets local inhabitants and professional fishers against fishing tourists and the related businesses (Figure 1). In particular, the commercial fishing industry is concerned that any expansion of fishing tourism will result in local declines in the abundance of coastal cod and other valued stocks, and ultimately to

more-restrictive regulations. Marine recreational fishing in Norway is currently subject to few regulations. No fishing licence is required, no bag-limits are in effect, and legal minimum-length limits were only introduced in 2010, for selected species. Foreign tourists may only export 15 kg of fillet and can only use hand-held tackle, whereas residents of Norway may in addition use pots, nets, longlines, and one machine-driven handline each, and may even, within limits, sell their catch.

The Norwegian Government wants to make fishing tourism a significant component of the tourist industry in Norway (Fiskeri- og kystdepartementet, 2005). To achieve this, several new laws and regulations were recently introduced (for example the Marine Resources Act) to ensure the sustainable utilization of coastal resources, and to prevent conflicts between stakeholders. The drastic decline of the coastal cod (*Gadus morhua*) stock in recent years (ICES, 2010a) is of particular concern, because overfishing is likely taking place. This stock is found in fjords and along the coast of Norway (Stransky *et al.*, 2007), and is targeted by commercial and recreational fishers.

Since 2004, ICES has recommended that there should be no commercial catch of Norwegian coastal cod north of 62°N (ICES, 2010a), but for socio-economic reasons, limited quotas are still given. The total reported catches of coastal cod in the commercial fishery north of 62°N from 2004 to 2008 ranged from 22 434 to 25 777 t. In 2010, the Ministry of Fisheries and Coastal Affairs allocated a combined quota of 10 000 t of coastal cod and 800 t of saithe north of 62°N to the recreational fishery (Figure 1) and to the catches of young aspiring commercial fishers, as part of a programme to recruit youth to the fishing profession.

At present there are no precise and unbiased annual statistics available for total recreational fishing effort along the coast of Norway, or on how much and which species are caught. Hence, it is not possible to assess accurately whether the catches of coastal cod by resident recreational fishers and fishing tourists are covered adequately by the allocated quota. Hence, there is a need for more and better information on the coastal zone, to mitigate conflicts among stakeholders and to ensure sustainable fisheries.

The competition for resources between commercial fishing and tourism has caused conflicts in some coastal areas, with much attention in the media. The present study, in conjunction with complementary investigations of socio-economic effects in the tourist fishery, conducted by the Northern Research Institute (NORUT), provides data critical for resolving such conflicts. In addition to having a sustainable management regime, it is important to distribute the quotas among coastal stakeholders in a way that is equitable, cost efficient, and optimizes the benefits derived from the resource. To this end, the goal here was to estimate the number and weight of the landed catch by species for boat-anglers in the business segment of the tourist fishery.

Material and methods

Defining the target and study population of fishing tourists

Investigating Norway's marine recreational fisheries is difficult because of the intricate coastline that extends more than 25 000 km (not including islands), the diverse assortment of fishing activities, and the fact that no fishing licence is required for recreational fishers. Further, there is no complete registry of businesses catering to fishing tourists, and non-resident fishing tourists are not in the Norwegian telephone directory. To develop a sampling frame that would allow access to fishing tourists, we first grouped the Norwegian marine recreational fishery into sectors based on the fishers' residential status and their choice of accommodation (Figure 1), which determined how they could be contacted. The target population (Cochran, 1977; ICES, 2009, 2010b) of the study was all recreational fishers that rent lodging from tourist-fishing businesses and fish from (mainly charter) boats. Fishing tourists rarely bring their own boats because of the long distances and costs involved. A tourist-fishing business was defined as an enterprise renting out rooms and boats for recreational fishing at sea, and with facilities for gutting and freezing catches. This included private cottages offering the same facilities for tourist fishers renting through booking agencies and web-portals (Figure 1). The tourist-fishing businesses mainly attract foreign anglers, but also some Norwegian citizens or legal residents who, when fishing from a charter boat, primarily use hand-held tackle.

The study population was defined (Jessen, 1978; ICES, 2009, 2010b) based on a list of tourist-fishing businesses identified in collaboration with Norway's Northern Research Institute (NORUT), the Norwegian Hospitality Association (NHO Reiseliv), Innovation Norway, the nature travel operator Din Tur (http://www.dintur.no), and through an Internet search. Our sampling frame was defined by the resulting list of 445 tourist-fishing businesses, which had an estimated 2393 boats available for charter. These businesses form access-points (Pollock *et al*., 1994, 1997) where fishing tourists can be intercepted. However, no registry of charter boats was available.

The study design was developed in several stages, starting in 2007 with the testing of catch diaries (Supplementary Figures S1 and S2) and self-sampling protocols in collaboration with several tourist-fishing businesses near Bergen. In 2008, we developed the sampling frame and conducted a large-scale pilot study to test the viability of self-sampling for a wide range of businesses along the coast. The national survey conducted in 2009 involved two-stage sampling, where (i) a stratified sample of businesses (Primary Sampling Units, PSUs) was selected first, and (ii) a census or random-systematic subsample of reporting weeks (every 6th week, with a random starting point chosen from calendar weeks 1–6) was selected for each PSU selected in (i).

Based on the lessons learned from the pilot study, it was clearly going to be a burden for collaborating businesses to voluntarily administer a self-sampling programme where catch diaries are completed by all fishing tourists during the entire season. We therefore implemented a plan that allowed for systematic sampling of weeks throughout the year, when each business would collect fishing tourists' catch diaries and mail them to IMR. For each selected week, i.e. (ii) above, fishing tourists entered information about their daily landed catches and fishing effort in diaries during their stay. This approach is known as cluster sampling (Cochran, 1977; Levy and Lemeshow, 1991; Lehtonen and Pahkinen, 2004).

All businesses in the sampling frame were stratified by region (north and south of 62°N) and size, based on the number of charter boats offered: group 1 (≤3 boats) and group 2 (>3 boats). There were 231 businesses in group 1 (195 north of 62°N) and 214 in group 2 (163 north of 62°N). In all, 97 businesses were selected initially for the 2009 national survey (Figure 2), including 30 that had been involved in the 2008 pilot study. The target sample size of businesses in each of the four strata was approximately proportional to stratum size (number of businesses). For 44 businesses, the fishing tourists were asked to report the fishing effort and daily total catch of nine focal species by weight and number (Supplementary Figure S1), whereas for 53 businesses, the tourists reported only their fishing effort and the number of fish caught (Supplementary Figure S2). This was done to reduce the workload and to encourage more fishing tourists to report their catches.

Length measurements from the catches of cod, halibut (*Hippoglossus hippoglossus*), and saithe (*Pollachius virens*) were requested from 15 of these businesses. An employee of the business was paid to measure fish during the reporting week. Length data were collected to estimate the catch weight by species using standard length–weight relationships. The diaries also included records of fishing effort, number of boats chartered, and number of fishing tourists. Based on careful examination, data from 51 businesses (605 catch diaries) were deemed sufficiently reliable to be included in the analysis. These were well mixed geographically and by size and were considered representative of the population (445 businesses, in four strata).

Quality assurance and control (QA/QC)

During the study, IMR biologists and field technicians visited selected businesses to assess and ensure the quality of self-reported data provided by fishing tourists, and to inform fishers and business owners about the project. Such information was also provided on a website (www.imr.no/turistfiske), through other popular media (e.g. TV2 News), and by distributing brochures in German, English, Russian, Polish, Czech, and Spanish. Posters were provided to all collaborating businesses explaining in detail the procedures for completing catch diaries, and describing commonly caught species to help fishing tourists with species identification.

A comprehensive evaluation of the reliability of species identification by fishing tourists was conducted throughout the study. In addition to IMR staff regularly visiting businesses and interviewing fishing tourists, eight fishing resorts in Hordaland County were repeatedly visited by an expert taxonomist over the course of 10 weeks in summer 2009. During these visits, the ability

of fishing tourists to identify species was evaluated by asking them to identify their own catch and another 17 species from photographs. The choice of these species was based on observations of the recreational fishery in Hordaland County during the 2008 pilot study. Fishers from 42 boat-trips were interviewed by a taxonomist who inspected their catch and checked their species identification. From 30 additional boat-trips, a further 42 fishers were tested on species identification from photographs.

All catch-diary information was entered into the database and checked for outliers. Only data deemed to be reliable were included in the analysis. Returns from businesses that had not properly followed the sampling schedule were also excluded.

Analytical methods

It was assumed that the 51 businesses in our sample satisfying the QA/QC criteria had provided reliable catch-and-effort data that were representative of all businesses, even though the non-response rate for those contacted was nearly 50%. Further, it was assumed that the fishing tourists staying at a selected business during the reporting weeks had provided accurate catch diaries. Estimates of annual total catch by species and fishing effort (number of boat-days) in each stratum (i) were based on standard estimators for cluster sampling (Hansen *et al*., 1953; Cochran, 1977; Wolter, 1985; Särndal *et al*., 1992; Vølstad *et al*., 2006):

$$\hat{Y}_i = \frac{N_i}{n_i} \sum_{j=1}^{n_i} 52 \times \bar{y}_{ij}, \qquad (1)$$

where $\bar{y}_{ij}$ denotes either the mean total weekly effort or catch by species for business j in stratum i, n_i and N_i are, respectively, the number of businesses in the sample and those in the sampling frame for stratum i. The variance of estimator (1) was determined from the PSUs, i.e. the variation in estimated total effort or catch by species by all fishing tourists for each tourist-fishing business in the sample (Williams, 2000):

$$V(\hat{Y}_i) = \frac{N_i^2}{n_i} \sum_{j=1}^{n_i} \frac{(\hat{Y}_{ij} - \bar{Y}_i)^2}{n_i - 1} \qquad . \qquad (2)$$

Because the sampling fraction at the primary level is small ($\frac{n_i}{N_i}$ ~10%), the bias in the estimated variance is likely to be insignificant, though slightly positive (Wolter, 1985, p. 34), so the results will be conservative. Estimates of annual total effort and catch by species, along with their associated standard errors across strata, were based on standard statistical methods (Cochran, 1977). The relative standard error (RSE, the standard error divided by the estimate) of catch (or effort) provides a measure of precision (Jessen, 1978). A generalized linear model (GLM), with region and month as factors to estimate the mean weight per fish by species for each stratum, was used. For catch diaries where only the number of fish by species was recorded, we imputed the missing weights by multiplying the reported number by the mean weight estimated from the GLM.

Results

For 2009, catch and effort data were received from 605 completed diaries, representing more than 4000 boat-days of fishing. The total fishing effort was estimated at 14.3×10^4 boat-days (RSE = 17%). Mean daily catches per boat-day for each month in the season ranged from 7 to 27 kg. Catch per unit effort (cpue) was largest in spring and summer (Table 1). Median daily catches per boat ranged from 6 to 19 kg, and were consistently lower than the mean in every month.

The estimated catch by number and weight for the nine focal species (Table 2) show that the dominant catch north of 62°N was cod and saithe, whereas south of 62°N they were saithe, mackerel (*Scomber scombrus*), and ling (*Molva molva*). The mean number of fishing tourists per boat was fairly stable, typically 2–3 over the 2009 season. The total catches of the nine focal

species were estimated to be 3.3×10^3 t, with 95% confidence limits (CLs) of 2.2×10^3 and 4.5×10^3 t. The estimated total catch of cod was 1.6×10^3 t (95% CLs 1.0×10^3 – 2.3×10^3 t; Table 2). All these estimates refer to landed catch, i.e. excluding fish caught but released at sea. The mean annual total catch per business and per charter boat was estimated to be 7.5 t and 1.4 t, respectively.

Analysis of the self-reported data indicates that the distribution of daily catches per boat was highly skewed (Figure 3), ranging from 0 to 20 kg; 10 kg was the most frequent result in 2009. As fishing tourists typically stayed for a week, the most common weekly catch would be at least 70 kg per boat, or 23–35 kg per fisher, with a few boats reporting much larger catches.

Infrequently caught species (Supplementary Table S1) that were registered under the heading other species in the catch diaries (Supplementary Figures S1 and S2) were not included in the catch estimates because the relevant statistics were not standardized across catch diaries and business units.

Some 98% of all fish in the catches inspected by the taxonomist were identified correctly (Supplementary Table S2). Only two saithe and pollack (*Pollachius pollachius*) were confused with each other in the fishing trips observed. Good knowledge was also demonstrated when the fishers identified a range of species based on photographs.

Discussion

General comments and comparison with prior studies

Options for regulating the business sector of fishing tourism, such as the implementation of a charter-boat registry, are currently being considered by the Ministry of Fisheries and Coastal Affairs. Reliable data on the catches of cod and other species by this sector are important for this purpose. The data collected from a sample of ~50 business units provided reasonably precise estimates of the total catches in the tourist-fishery sector. However, greater sampling intensity would be needed to reliably quantify the effect of the tourist fishery within counties, or on local stocks, such as the genetically distinct coastal cod stocks found in some fjord systems.

The study was restricted to fishing from boats, whether chartered or privately owned. Extensive field visits and interviews with fishing tourists, many discussions with tourist-business owners, and information obtained from internet portals have confirmed that non-boat fishing by anglers on the shore accounts for just a minor part of the overall catch taken by fishing tourists in Norway, and this activity was ignored for reasons of cost.

The estimated catch of cod suggests that the business sector of the tourist fishery contributes little to the total fishing mortality of cod in comparison with commercial fisheries. Commercial landings of cod by Norwegian vessels in 2009 was reported to be 243 659 t (http://www.fiskeridir.no), of which an estimated 24 800 t were landings of Norwegian coastal cod (ICES, 2010a). This inference would hold even if the list of businesses (the sampling frame) only covered half the fishing tourists in this sector. However, the catches by resident recreational fishers (as defined in Figure 1) may be much larger than those accounted for by tourists, and could exceed the quota of 10 000 t allocated to coastal cod north of 62°N. The estimated landed catch of saithe in the business sector of the tourist fishery alone exceeded the quota of 800 t allocated to the recreational fishery and the extra allowance aimed at recruiting young commercial fishers. The latter have reported annual landings of 100–200 t of cod and ~50 t of saithe north of 62°N recently.

The total catch of the tourist fishery has been estimated before to be 6000–15 000 t (Hallenstvedt, 2001; Hallenstvedt and Wulff, 2001, 2004), fuelling the debate on the management of coastal fish resources in Norway. These estimates were likely biased upwards because they were primarily obtained by combining the daily catch rates observed in regional sport-fishing competitions with estimates of total effort for different segments of the tourist fishery. We could not verify the effort estimates in earlier studies owing to there being insufficient documentation. Also, fishing competitions would often include targeted fishing by highly skilled anglers, so may result in highly biased cpue estimates for particular species. When comparing estimates of total catch taken by fishing tourists in the business segment during 2009 with those obtained earlier, several factors other than bias need to be taken into account. These include the decline in abundance of Norwegian coastal cod, and the reduction in fishing effort during 2009 as a

consequence of the global financial crisis. Many of the collaborating businesses reported fewer tourists renting rooms and chartering boats after the onset of this crisis.

Our study was based on catch diaries where only the harvest (fish kept) was recorded. Marine fishing tourists in Norway are of many nationalities, and many only understand their native language. Hence, catch diaries would likely become too complicated if numbers both kept and released were to be recorded, so increasing non-response rates. Many discussions with fishing tourists during this study revealed that catch-and-release is becoming more common in Norway. Studies conducted by IMR in 2010 indicated that saithe dominate total catches (fish kept + fish released) in the north, but that a significant portion of the saithe catch is released (Keno Ferter, pers. comm.). Because of the introduction of minimum length rules for some species harvested in the recreational fishery, and the 15 kg export limit, more discarding and catch-and-release practices are likely in future.

Further studies is planned to quantify the catches taken by fishing tourists in the informal sector, and those taken by recreational fishers. Ignoring the contribution of recreational fishing to the total fish harvest could have severe consequences for economically and ecologically important fish stocks (Cooke and Cowx, 2004, 2006). Without reliable estimates of total catch, including those of resident recreational fishers and non-resident fishing tourists, it is impossible to manage the fishery to ensure the sustainability of fish stocks important to Norway (see Pollock *et al.*, 1994; Reid and Montgomery, 2005).

Sources of bias

The estimated total catches of the business sector presented here need to be qualified because several unknown factors could have biased the results.

Our total-catch estimate for the business sector of the tourist fishery is probably a lower bound, because the sampling frame (445 businesses) did not cover the entire population of these enterprises. In particular, the sampling coverage of private cottages rented through tour operators was limited. The list primarily included cottages rented through Din Tur, which mainly operates in the north. An important practical problem in conducting surveys is that the lists available for selecting the sampling units are generally incomplete or out of date. This deficiency can seriously bias the estimates of total catch by species. Updating the database of businesses is difficult and expensive. However, some information useful for assessing the coverage of businesses in our study recently became available. At the request of the Ministry of Fisheries and Coastal Affairs, several regional offices of the Directorate of Fisheries conducted a search for tourist-fishing businesses during summer 2009. Door-to-door canvassing in the Counties of Møre and Romsdal, Trøndelag, and Finnmark (Figure 2) revealed 117 tourist-fishing businesses that were not on our list, suggesting that we had covered <80% of the business sector.

The incomplete coverage of tourist-fishing businesses could be addressed by a more comprehensive search in all counties, but this would be labour-intensive and costly. For future surveys, an alternative would be to use multiple sampling frames (see Skinner, 1991; ICES, 2010b) to estimate the total number of tourist businesses. A larger frame could be based on a registry of businesses that provide accommodation to tourists in coastal areas. Contacts with a stratified random sample of these businesses would reveal the proportion that caters to fishing tourists and have boats for charter, and overlaps with our current list of 445 businesses could be determined. If an accurate number of businesses and charter boats could be established through such methods, or by introducing a mandatory registration system, then the bias in the estimated total catch attributable to incomplete sampling frames would be reduced or eliminated (ICES, 2010b).

Another potential source of bias is that some anglers may have misreported their catches or submitted no catch diaries during the reporting weeks. In southern Norway, some large businesses declined to cooperate in the study, again potentially biasing our catch estimates.

In winter 2010, 24 business owners that provided data in 2009 attended a 2 d workshop at the IMR to discuss the project. Sources of bias in catch reporting and issues of non-response were discussed. The general consensus was that the reports in catch diaries were of good quality. The effect of non-reporting was discussed at length with business owners; it was concluded that this was not a major source of bias in the estimated weekly catch.

In general, the accuracy of catch estimates could be improved if reliable independent estimates of effort (number of boats and their activity levels) were available in addition to those provided by the businesses that collaborated with IMR. Catch-and-effort estimates based on the diaries are sensitive to non-response (i.e. some anglers do not submit any diaries or fail to report effort), or to under-reporting because of the 15 kg export limit. However, the reported catches per boat-day (Figure 3) should be a realistic representation of the cpue distribution. As there was no limit on how much a fishing tourist was allowed to catch, they had no reason to under-report catches.

The estimation of catches by informal tourist fishers (those operating privately, not through tourist-fishing enterprises), and the catches taken by recreational fishers, was beyond the scope of this study. However, a pilot study is being conducted in collaboration with the Norwegian Coast Guard to test methods for estimating the relative size of each sector with respect to the total fishing effort. In this study, information on the nationality and accommodations of recreational fishers are recorded during the routine inspections of leisure boats by the Coast Guard. This approach, in conjunction with our estimates of effort and cpue from the business sector, could provide a more-complete estimate of the total catch taken by the tourist fishery.

Supplementary material

The following supplementary material is available at the *ICESJMS* online version of the paper: Table S1 provides a list of species reported in the catch diaries under the heading other species, Table S2 data on species identification skills of anglers from 33 fishing trips, and Figures S1 and S2 show the catch-diary forms distributed and used by fishing tourists.

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Figure legends

Figure 1. Diagram of the marine recreational-fishery sectors in Norway based on the accommodation and resident status of recreational fishers. The study population is shown emboldened.

Figure 2. Map of tourist-fishing businesses collaborating with the Institute of Marine Research in 2009.

Figure 3. Distribution of reported total landed catches (all species) per boat-day in 2009. The *x*-axis is labeled with the midpoint of the weight bin.

Running headings

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Probability-based surveying

Table 1. Summary statistics for estimated total catch (kg) per boat-day by month for the 2009 national survey of tourist recreational fishing in Norway (there were no samples in November or December).

Month	*n*	Mean	s.e.	Median	Minimum	Maximum
January	1	18.5	NA	18.5		
February	8	7.3	1.4	7.3	2.0	12.5
March	119	12.8	1.5	6.9	0	86.0
April	257	21.0	1.6	15.0	0	240.0
May	328	23.4	1.8	13.7	0	262.0
June	381	20.8	1.3	13.0	0	214.8
July	377	25.0	1.8	14.0	0	250.0
August	199	27.2	2.9	16.0	0	254.0
September	157	12.6	1.1	9.0	0	75.0
October	63	16.9	1.9	11.5	1.5	66.5

n = number of boat-days in the sample; s.e. = standard error.

Table 2. Estimated total catch by number and weight (t) with standard errors (s.e.) by region (north and south of 62°N) for the 2009 national survey of tourist recreational fishing in Norway.

Species common and scientific names	Region	Catch (number)	s.e. (number)	Weight (t)	s.e. (t)	RSE (%)	Weight LCL (t)	Weight UCL (t)
Cod	North	529 633	118 440	1 586.0	348.3	22	903.3	2 268.7
Gadus morhua	South	13 129	5 447	27.0	11.2	41	5.1	48.9
Haddock	North	68 018	14 611	115.1	24.1	21	67.9	162.2
Melanogrammus aeglefinus	South	6 393	1 798	9.4	2.6	28	4.2	14.6
Saithe	North	378 929	117 445	825.2	241.3	29	352.2	1 298.2
Pollachius virens	South	186 266	35 479	208.0	49.8	24	110.4	305.6
Pollack	North	31 703	9 213	81.1	25.7	32	30.8	131.4
Pollachius pollachius	South	17 167	3 408	21.4	4.2	19	13.3	29.6
Halibut	North	5 335	1 699	79.7	29.4	37	22.2	137.3
Hippoglossus hippoglossus	South	31	28	0.2	0.2	90	-0.1	0.5
Mackerel	North	26 838	7 100	13.6	3.6	26	6.6	20.6
Scomber scombrus	South	154 211	37 698	54.4	13.9	26	27.2	81.7
Ling	North	21 988	6 949	68.5	26.9	39	15.8	121.2
Molva molva	South	16 321	4 209	40.4	9.4	23	22.0	58.7
Tusk	North	74 150	24 417	173.7	51.7	30	72.4	275.0
Brosme brosme	South	8 796	2 816	15.9	4.1	26	7.8	23.9
Wolffish	North	4 046	1 292	15.3	4.4	29	6.7	23.8
Anarhichas sp.	South	52	45	0.3	0.3	88	-0.2	0.8

Lower (LCL) and upper (UCL) 95% confidence limits are shown for the weight estimates.

Fig. 1

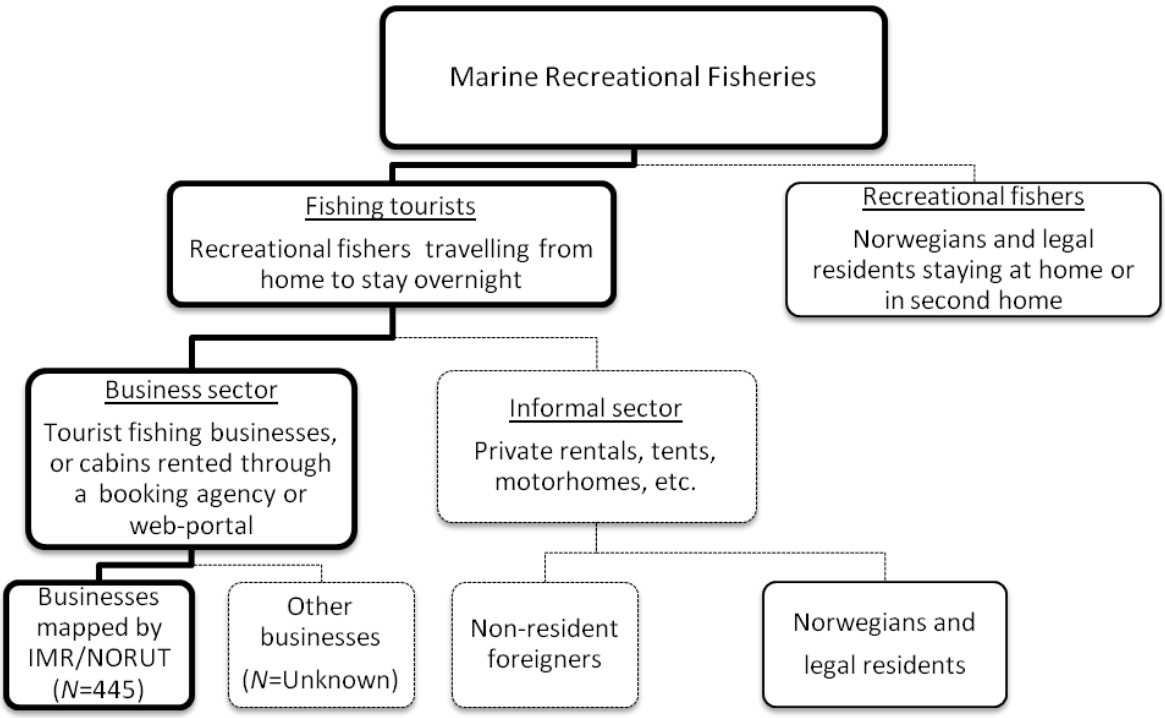

Marine Recreational Fisheries
Fishing tourists
Recreational fishers travelling from home to stay overnight
Recreational fishers
Norwegians and legal residents staying at home or in second home
Business sector
Tourist fishing businesses, or cabins rented through a booking agency or web-portal
Informal sector
Private rentals, tents, motorhomes, etc.
Businesses mapped by IMR/NORUT (N=445)
Other businesses (N=Unknown)
Non-resident foreigners
Norwegians and legal residents

Fig. 2

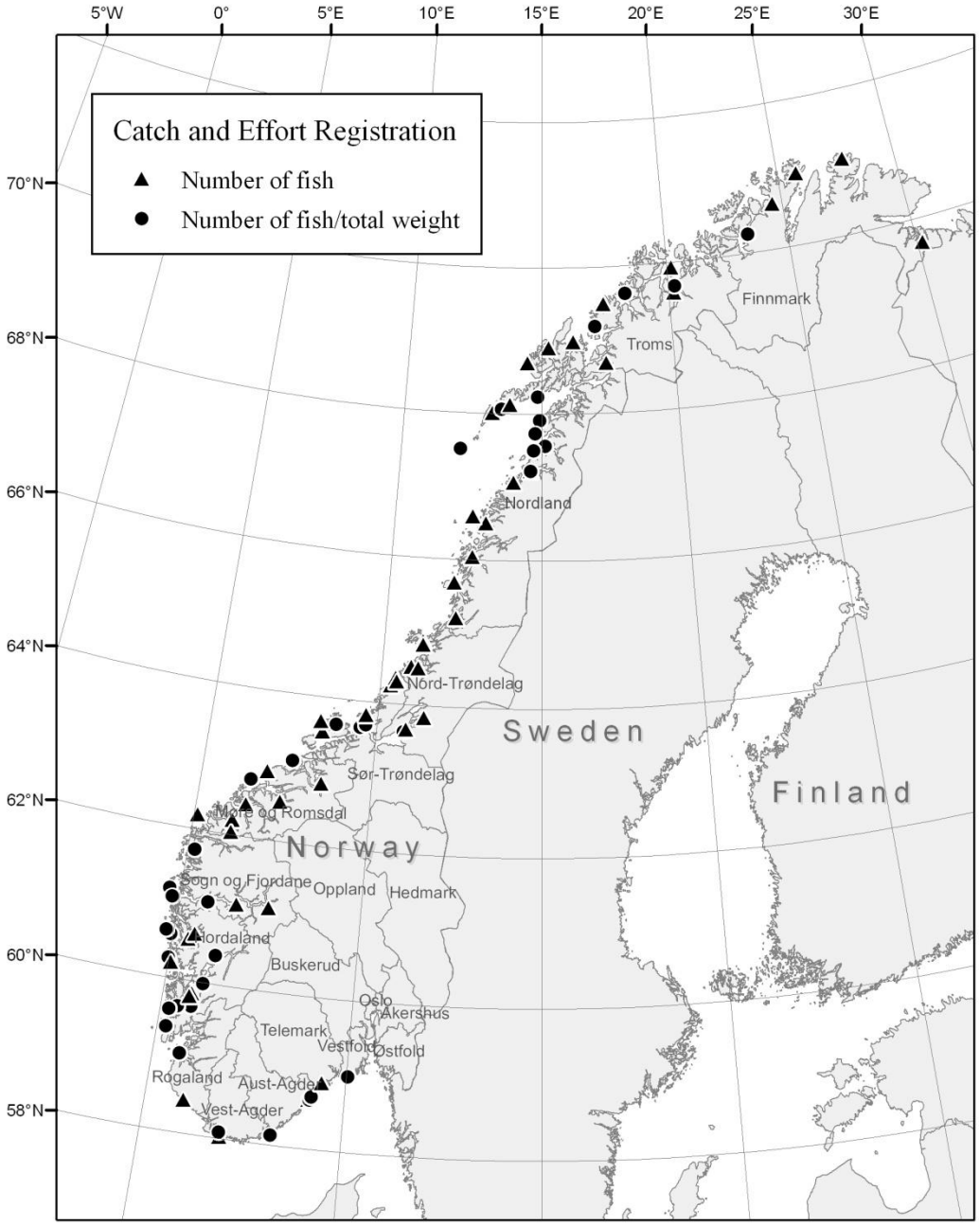
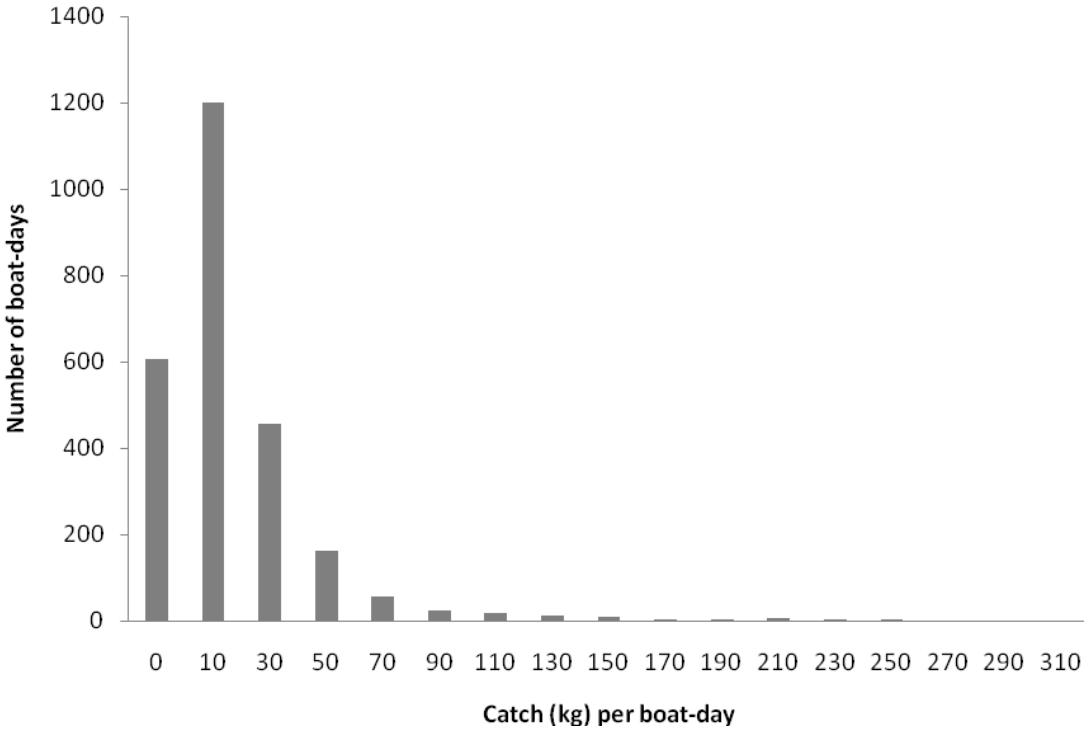

Catch and Effort Registration
Number of fish
Number of fish/total weight
5°W
0°
5°E
10°E
15°E
20°E
25°E
30°E
70°N
68°N
66°N
64°N
62°N
60°N
58°N
Finnmark
Troms
Nordland
Nord-Trøndelag
Sør-Trøndelag
Møre og Romsdal
Sogn og Fjordane
Oppland
Hedmark
Hordaland
Buskerud
Oslo
Akershus
Telemark
Vestfold
Østfold
Rogaland
Aust-Agder
Vest-Agder
Sweden
Finland
Norway

Fig. 3


1400
1200
1000
800
600
400
200
0
Number of boat-days
0
10
30
50
70
90
110
130
150
170
190
210
230
250
270
290
310
Catch (kg) per boat-day