

Bycatch of seabirds in Norwegian coastal fisheries – comparison of estimation methods with regards to bias

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Summary

Decline in sea-bird populations in the North-East Atlantic increases the need to understand and reduce anthropogenic mortality factors that can be controlled. One such factor is unintentional bycatch in marine fisheries. The aim of this study was to improve knowledge about bycatch of seabirds in Norwegian coastal gillnet and longline fisheries. A key objective was to try out different methods for collecting and analyzing data on seabird bycatch. We assess two methods for collecting data; 1) An *in situ* survey with personal interviews with 133 fishermen (2009 – 2010) from vessels less than 15 m; and 2) analyzing data on seabird bycatch from 2006 to 2009 from 21 vessels in the coastal reference fleet program managed by the Norwegian Institute of Marine Research (IMR). We used several statistical approaches to estimate and compare bycatch from five different fisheries. Northern fulmars (*Fulmarus glacialis*), cormorants (*Phalacrocorax* spp.), black guillemots (*Cephus grille*), Atlantic puffins (*Fratercula arctica*) and razorbills (*Alca torda*) are the species most often killed in long-lines and gill-nets used in the coastal fishery in Norway. The methods and findings are discussed with regards to future sampling design and estimation procedures.

Introduction

Sea-bird populations in the Northeastern Atlantic Ocean are in decline, and several important populations in the Norwegian Sea have been strongly reduced, most severe for pelagic species breeding in nesting cliffs on mainland Norway (Barrett et al. 2006). The decline increases the need to reduce anthropogenic mortality factors that can be controlled. One such factor is unintentional bycatch in marine fisheries, and the main aim of this study was to improve our knowledge of the potential impact of bycatch in Norway. There is limited research on seabird by-catch, especially in the Northeast Atlantic, and a need to develop efficient methods and monitoring systems to better assess this mortality factor especially in gill-net fisheries (Zydulis et al. 2009). Coastal vessels catch land and sell their catches on the same day. The number of sales notes may therefore be a proxy for number of fishing trips and fishing effort. We hence compare two estimation methods: (A) The use of ratio-estimates where bycatch per ton of landed catch is scaled up to total landings, versus (B) a direct estimate where mean by-catch per trip (per sales note) is scaled up to total number of trips (using total number of sales notes as proxy).

Materials and methods

We assessed two methods for collecting data; 1) An *in situ* survey with personal interviews of fishers; and 2) analyzing data on seabird bycatch from the coastal reference fleet program that is managed by the Norwegian Institute of Marine Research. Our study-area covers fishing-areas along the coast from the Russian border south to 68°N. We conducted 118 interviews (2009-2010) with fishermen from boats <15 m. The data from the reference fleet consist of reports from 20 vessels < 15 m, primarily targeting demersal fish using gill-nets, sampling monitoring data on every fishing-trip, during 2006-2009. For each fishery, we calculated bycatch coefficient (seabird bycatch per metric ton landed target fish or seabirds bycatch per fishing trip regarded equal as number of landing notes) based on the two data-sets using the R statistics software (R Development team

2008). This coefficient was used to estimate the total bycatch of seabirds within the fishery, based on publicly available statistics (Directorate of Fisheries) for total catch of target fish (tons landed) in 2009 for the fishery in question.

Results and Discussion

Our preliminary estimates from the data suggest that between 1400 and 2500 seabirds died in Atlantic cod (*Gadus morhua*) gillnet fishery (Cod_GN), between 1000 and 3000 birds in longline cod/haddock fishery (CodHaddock_LL), and appr 500 birds in the Greenland halibut (*Reinhardtius hippoglossoides*) gillnet (Halibut_GN). For Greenland halibut longline (Halibut_LL) and Lumpfish (*Cyclopterus lumpus* -Lumpfish_GN) fisheries in 2009, data from the on-site survey suggests that appr. 1000 and 4500 died in these fisheries, respectively (table 1). Generally, the estimates based on the reference fleet are somewhat lower than those from the on-site survey. Northern fulmars, cormorants, black guillemots, Atlantic puffins and razorbills are the species most often killed in long-lines and gill-nets used in the coastal fishery in Norway. The feasibility of the different data gathering and estimation procedures are discussed with regards to future sampling of bycatch.

Table 1. Estimated bycatch ratios and estimated number of seabirds incidentally killed as bycatch along the Norwegian coast from 68°N and northwards, with datasets from survey (cod gill-net, cod/haddock longline, Greenland halibut and lumpfish gill-net fisheries) and reference fleet (cod gill-net), analyses by different methods; 1: Bycatch/1000kg catch/trip; 2: Stratified one-stage cluster sampling design (PSU=trip), fpc= total catch in each strata; 3: Stratified one-stage cluster sampling design (PSU=trip), fpc= no.trips in each strata; 4: Mean bycatch/trip.

Data-set	Analysis	Fishery	Bycatch ratio	SE	RSE	n	Total landed catch (1000 kg) as scaling factor	Estimated no. of seabirds taken as bycatch 2009	SE
Survey	1	Cod-GN	0.0643	0.3040	0.53	58	38629	2484	1316
	1	CodHaddock_LL	0.1489	0.1032	0.69	19	19959	2972	2051
	1	Halibut_GN	0.0719	0.0407	0.57	8	494	35	20
	1	Halibut_LL	0.7317	0.4786	0.65	14	1398	1023	665
	1	Lumpfish_GN	1.6688	0.3705	0.22	19	2666	4450	979
Ref.fleet	2	Cod_GN	0.0354	0.0068	0.19	1568	38629	1367	260
Ref.fleet	3	Cod_GN	0.0396	0.0071	0.18	1568	38629	1530	275
			Mean bycatch/trip				Total no.of trips as scaling factor		
Ref.fleet	4	Cod_GN	0.0791	0.0150	0.19	1568	31329	2478	471

References

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- Zydelis R, Bellebaum J, Österblom H, Vetemaa M and others (2009) Bycatch in gillnet fisheries – an overlooked threat to waterbird populations. *Biol Conserv* 142:1269–1281.