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Changes in the dynamics of the Norwegian mackerel purse seine fishery – does it influence the representativeness of the reference fleet data?

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ABSTRACT

The last three years, the peak period and the fishing area of the Norwegian mackerel purse seine fishery has changed considerably due to market situations. The Norwegian reference fleet was established to get better and continuous sampling from all the Norwegian fisheries. A total of 34 vessels are contracted and the crew trained to conduct sampling of the catches. The fleet includes both offshore and coastal vessels and since 2003 the number of purse seine vessels has increased from one to five.

In order to investigate if the changes in the mackerel fishery will affect the representativeness of the data from the reference fleet we use data from the vessel monitoring system, landing statistics and sampled data from the reference fleet. We compare the landings per trip of the total fleet with the reference fleet, and look at the spatial and temporal overlap for the time period 2006– 2007.

Keywords: fisheries dynamics; mackerel; purse seine fishery; reference fleet; representativeness

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INTRODUCTION

The Norwegian Reference fleet is a small group of Norwegian fishing vessels that are contracted to provide IMR with detailed information on catches and bycatches in their commercial fishery. From 2000 the first vessels in the cooperation included trawlers, longliners and gillnetters, but in 2003 also a pelagic purse seiner/Danish seiner was contracted, and in 2006 one purse seiner and two combined purse seiner/trawlers were included. In 2007 another purse seiner/Danish seiner was included (Table 1). All vessels are contracted to record logbooks with catches and bycatches (discards included) with a detailed biological sampling of the catch each week.

The Norwegian mackerel (*Scomber scombrus*) fishery is often carried out by the same purse seiners that catch herring (*Clupea harengus*), so timing of the different fisheries are thus also influenced by the quota situation, market and weather conditions of the herring fishery. Per September 2008, the offshore part of the purse seine fleet consists of 80 vessels > 90 ft and 18 vessels from 70-90 ft, but also the 46 coastal purse seiners (13-21.35 m) are allowed to fish mackerel outside the 12 nm limit. A typical purse seine used in the North Sea when fishing for mackerel has an approximately 775 m long float line, a lead line being 11-12 % shorter and a depth of 225 m. Fishing with purse seine is a dynamic operation where the actual measurements of the gear are less important than the way the gear is set and retrieved. The skipper will decide what school[1] to target, how to encircle the school or shoal[2], and if and how much of the fish that should be released, and at what time of the operation this will take place.

A sale embargo for mackerel was held by the fishermen's sales organisation from the end of August until 20 of September 2006, which led to an abnormal late start of the season. Also in 2007, the season started late; this time due to the market situation and a buyer embargo held by all but one or two buyers (Fig 1). The postponed start of the season introduces changes in the fishery, since it changes from being mostly a daytime fishery for schools to a night time fishery targeting larger shoals. The probability of getting large catches increases due to the larger shoals available during night hours. The behaviour of the fish also changes during night time, giving increased probability of bursting nets and unaccounted mortality of escaping fish (Cui et al. 1991).

The aim of this study is investigating the representativeness of the reference fleet for timing of fishing season, size of catches and number of trips used. The question is if a shortening of the fishing season due to the market situations may reveal changes in fishing strategies between vessels.

MATERIAL AND METHODS

The study is based on Norwegian sale slips data and satellite data from the vessel monitoring system (vms). The sale slips data give information about each landing: vessel (fishing ID), date, gear, species, weight landed (round weight, kg), weight landed over quota (when the catch exceeds the yearly quota (round weight, kg)) and fishing ground (cell in the strata system of the Norwegian Directorate of Fisheries[3]). The sale slips are reported after each offload. Each sale can consist of one or more

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[1] School: synchronized and polarized swimming groups (Pitcher and Parrish 1993)

[2] Shoal: groups of fish that remain together for social reasons (Pitcher and Parrish 1993)

[3] http://www.fiskeridir.no/fiskeridir/fiskeri/statistikk/kart/kart_lokasjon_og_omraade

hauls, but are sold as one landing. Vms data are available for active fishing vessels with an overall length above 24 m, the time resolution is one hour and these data give information about: vessel (radio call signal), time (UTC), date, and geographical position. These data sources are combined per vessel by means of the vessel register, which includes both fishing ID and radio call signal.

It is assumed that the vessels land their catch each time they leave the fishing ground and return to land. In this study, the mackerel purse seine fleet is defined as all vessels landing mackerel by purse seine throughout a year, with the following exceptions (with explanations):

- *Vessels with a length below 24 m are excluded.* In this study, the spatial distribution of the fleet is studied by vms data. In Norway, only vessels larger than 24 m are monitored by vms.
- *Single landings below 10 tonnes are excluded*. Only the trips targeting mackerel should be included.
- *The vessels with the smallest annual mackerel purse seine landings (5%) were excluded.* In 2006, these had total mackerel landings ranging from 12 661 to 37 294 kg. In 2007 the lowest total catch (after the two first steps) was 71 600 kg, and all vessels were therefore included. Only the vessels seriously participating in the mackerel purse seine fishery should be included.

After this filtering 155 vessels were included in our mackerel fleet in both 2006 and 2007.

The sale slips were used to define the start and end date of the mackerel season for each vessel, and the vms data from these specific periods were extracted. It was assumed that the fleet only targeted mackerel during this period. The mean vessel speed was calculated from the changes in geographical position of the vessels. In the figures showing the distribution of the mackerel fleet in the peak month of the mackerel fishery, only vms data with a calculated speed less than 5 knots were used. This was done to exclude the transportation stages between the mackerel grounds and the landing sites. The positions from the vessels in port are thus still included, but are easy to distinguish from the mackerel fishery as the mackerel grounds are at some distance from the shore.

Table 1. The vessels in the Norwegian reference fleet (RF) belonging to the purse seine fleet and targeting mackerel. RF period = the period each vessel has been a member of the RF. The gears: PS = purse seine, DS = Danish seine, T = trawler.

Vessel name	Radio call signal	Fishing ID	Built	Length, m	Gear	RF period
Utflesa	LLQX	N-505-SG	2001	21.3	PS, DS	2003-
Nybo	LJBD	M-56-MD	1998	69.5	PS	2006-
Hargun	LJVB	H-1-O	1999	68.1	PS, T	2006-2008
Libas	LMQI	H-5-F	2004	94.0	PS, T	2006-2008
Skagøysund	LMUR	T-23-T	2004	27.5	PS, DS	2007-

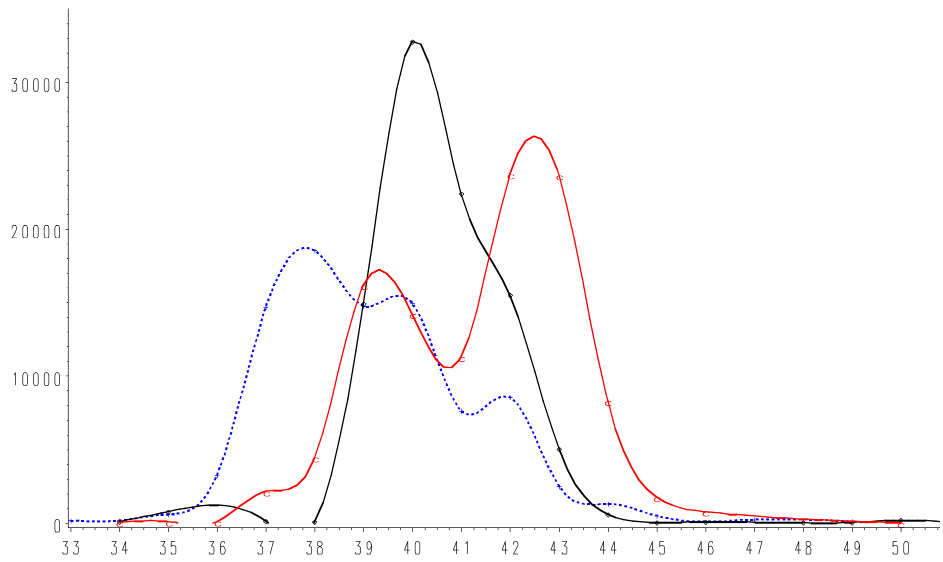

Figure 1. Total mackerel catches (tons) during the autumn of 2005 (blue), 2006 (black) and 2007 (red). Horizontal axis shows week number.

RESULTS

Geographical distribution of the fleet during the peak months of the mackerel season in 2006 and 2007 are given in Figure 2 and 3. There is a tendency towards a northerly distribution of the reference fleet compared to the total fleet in the figures.

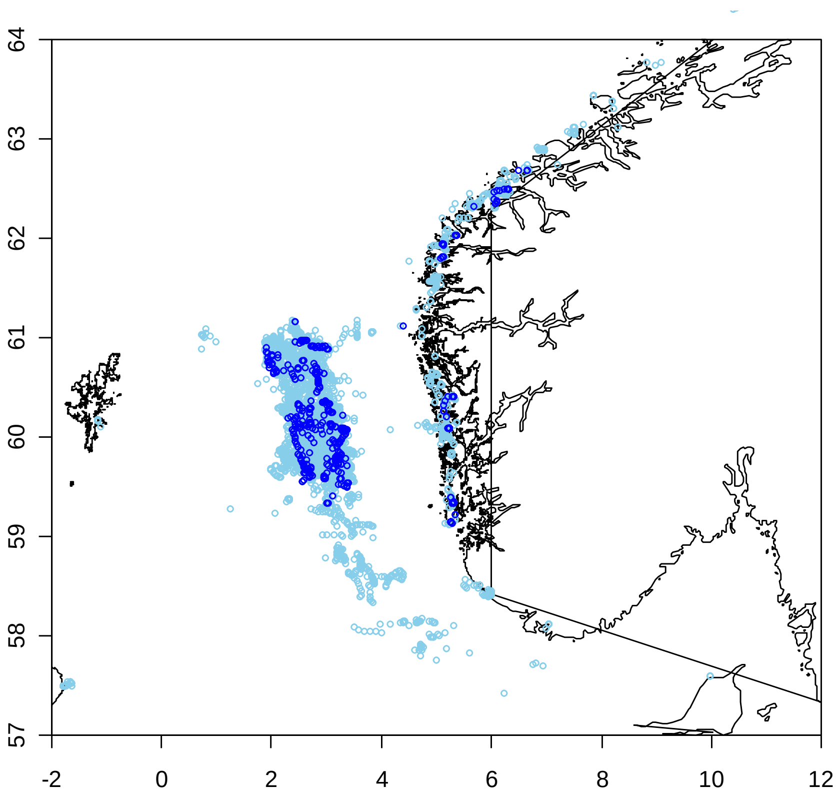

Figure 2. The distribution of the mackerel fleet (light blue) and the reference fleet vessels belonging to the mackerel fleet (dark blue) in October 2006, the peak month of the mackerel season this year.

Only vessel positions with a belonging mean vessel speed < 5 knots included. Positions along / on the shoreline do not represent the mackerel fishery.

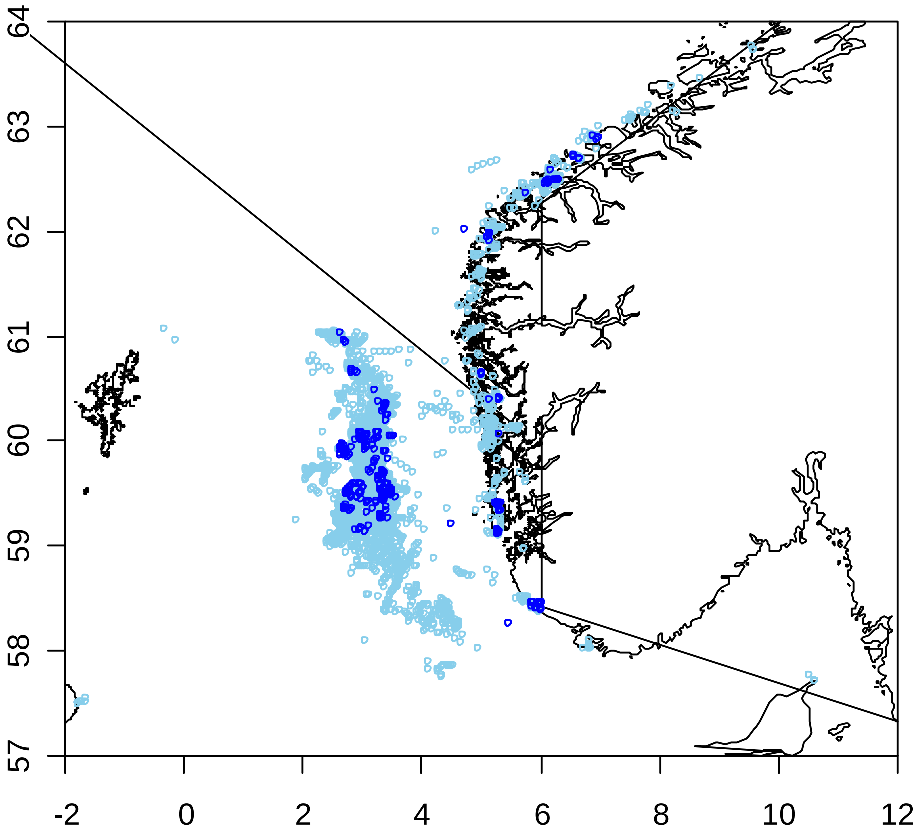

Figure 3. The distribution of the mackerel fleet (light blue) and the reference fleet vessels belonging to the mackerel fleet (dark blue) in October 2007, the peak month of the mackerel season this year. Only vessel positions with a belonging mean vessel speed < 5 knots included. Positions along / on the shoreline do not represent the mackerel fishery.

Landings (Figs 4 and 5) from the total fleet and the reference fleet show the effect of the embargos in 2006 and 2007. A significant difference (GLM, $p<0.05$) between the landing dates for the reference fleet compared to the total fleet is found in 2006, but in 2007 there is no significant difference. The landings per trip are not different between the groups for any of the years tested.

The landings that exceed the yearly vessel quota (Figs 6 and 7) are not significantly different between reference fleet vessels and total fleet for any of the two years. The date for the last landing of the total fleet is not significantly different from the reference fleet for any of the two years analysed. However, the number of trips done during the season is higher for the reference fleet vessels, but the difference in only significant in 2006 (GLM, $p<0.05$).

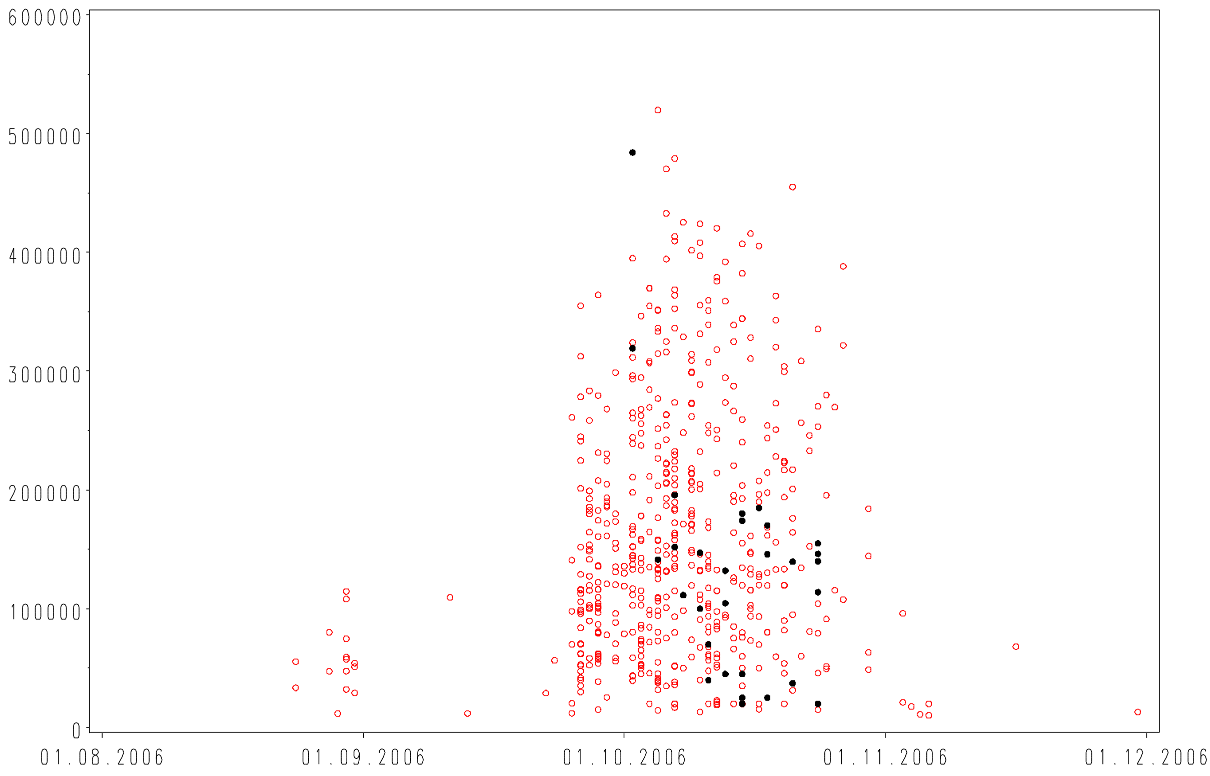

Figure 4. Landings (kg) shown for the period 1 Aug to 1 Dec 2006. Reference fleet vessels are marked with black dots, other vessels with open red circles.

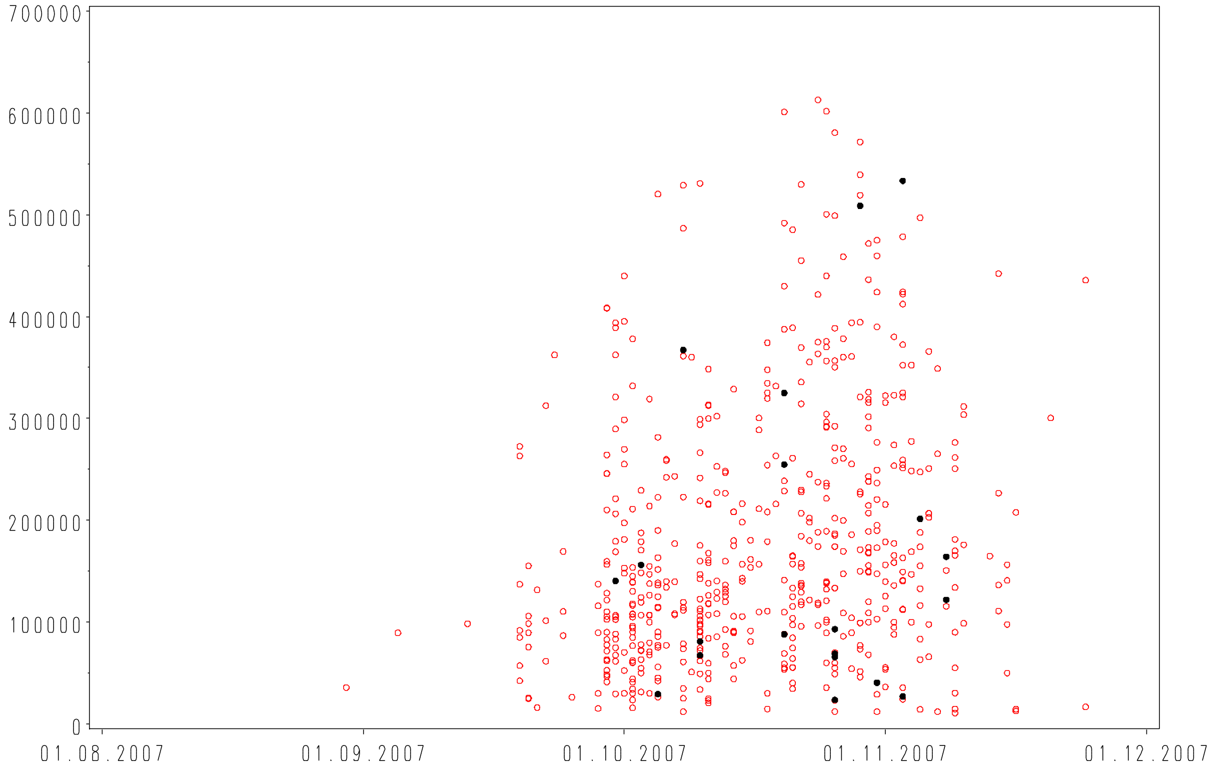

Figure 5. Landings (kg) shown for the period 1 Aug to 1 Dec 2007. Reference fleet vessels are marked with black dots, other vessels with open red circles.

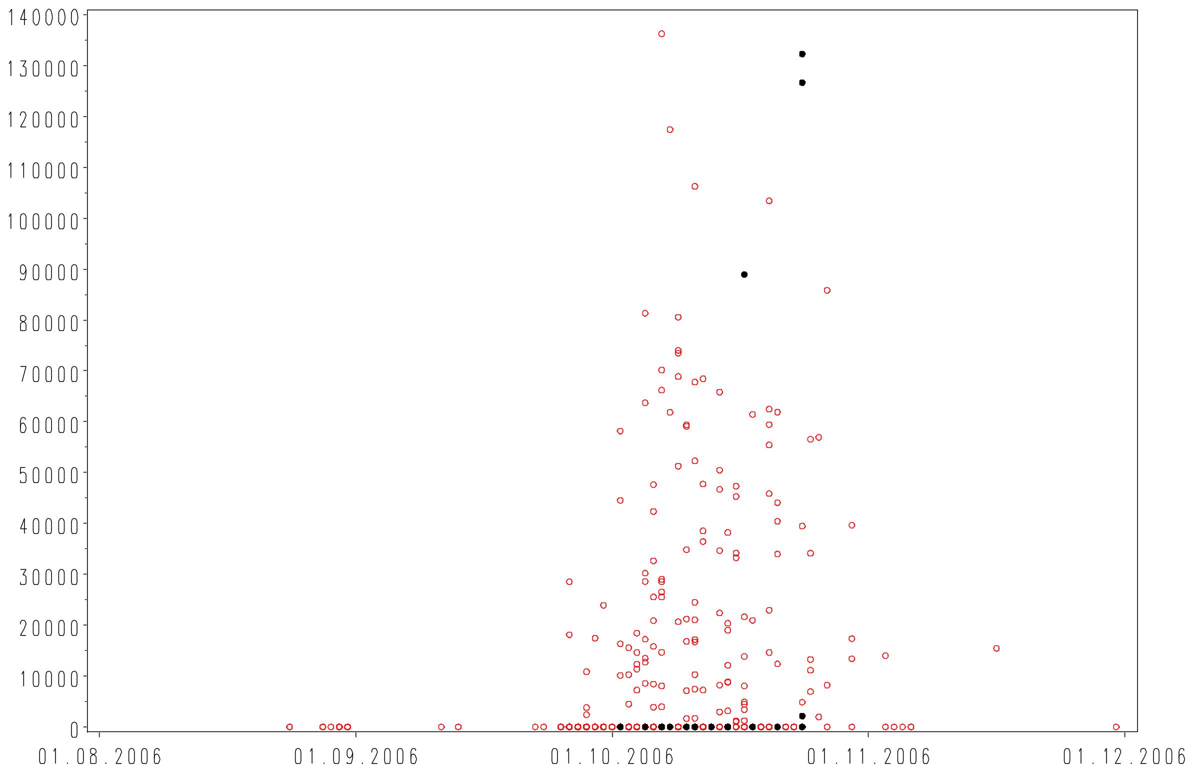

Figure 6. Landings (kg) over quota for the period 1 Aug to 1 Dec 2006. Reference fleet vessels are marked with black dots, other vessels with open red circles.

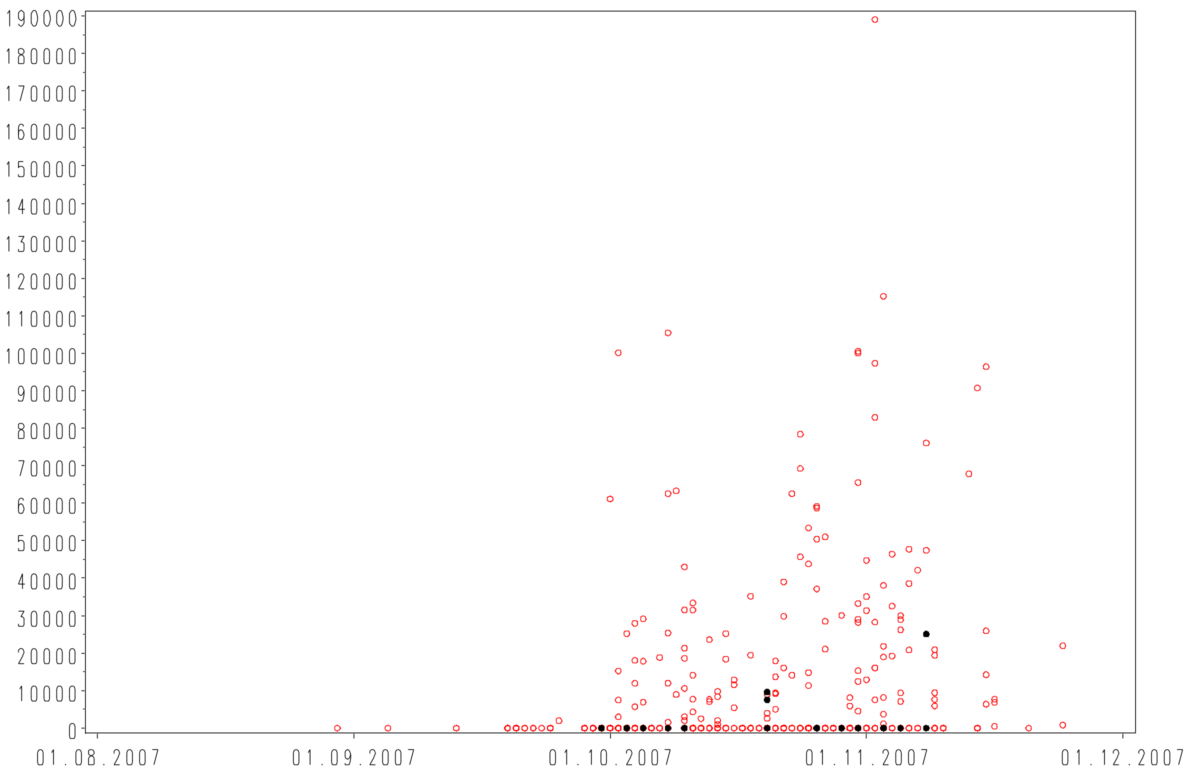

Figure 7. Landings (kg) over quota for the period 1 Aug to 1 Dec 2007. Reference fleet vessels are marked with black dots, other vessels with open red circles.

DISCUSSION

The mackerel season in 2006 and 2007 had postponed starts, and the fisheries thereby changed from being mostly a daytime fishing for schools to a night time fishing at larger shoals. The time that the fish is available to the purse seine is changing due to the change of the behaviour of the fish, and requires a change in fishing strategy by the vessels that target the species.

We found that the spatial coverage by the reference fleet seems somewhat biased in 2006 and 2007. This finding needs further analysis, but it can influence the precision of the biological parameters.

The landings from the reference fleet are not different in quanta compared to the total fleet. Even if the production capacity of the buyers have increased, quality of the fish may be reduced in huge catches, and very large catches are therefore avoided, both by targeting smaller schools and by reducing the catch size by slipping. The findings that there are no significant differences in landing weight suggest that there are no large differences between the reference fleet and the total fleet when it comes to the practise of choosing schools or slipping. However, the results say nothing about the slipping practise, that may be crucial for the survival of the fish slipped (Lockwood et al. 1983, Pawson and Lockwood, 1980).

The temporal difference in landing found in 2006 may suggest differences in fishing strategy. As landing slips only give information on when the fish is landed, not how long the trip has been, fishing might go on as trials: setting and slipping, without any registration in the sale slips. The difference in landing dates might be a result of a delayed start, or a trial fishery. During the first weeks of the 2007 season little fish was landed. Anecdotal information was that the fleet was setting and catching like usual, but slipped almost everything due to the small size of the fish.

The amount of fish over quota is not different between our reference fleet and the total fleet, nor the time for the last landing. But the total number of trips by the reference fleet is significantly larger in 2006, and thus the number of samples of the catches. The precision can then increase, but the accuracy may still be biased because of the temporal and spatial nature of the data.

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