SM2593

REPLY TO REFEREE #1

**General comments**

This study aims to assess and compare two experimental designs modifying a standard bottom trawling survey with the help of advanced geostatistical tools. This applied research is important to improve abundance estimates and to derive continuous resource maps. Before publication minor changes are required to improve the organization of the manuscript and to insert adequate references. The introduction is not very well organized and it lacks of both general references for geostatistical applications in fisheries and references discussing the geostatistical assessment of sampling designs in fisheries (see comments below). The analytical standard is high and results are in general clearly presented. However, the discussion of the results seems incomplete as important issues such as the impact of sample size or species studied are not discussed.

**Introduction**

1) Move description of data collection p2 line 41 – p3 line 52. to methods section.

A new section "Material" was introduced to describe the survey and lines 27 to 52 were moved there. We believe it improves the manuscript organization.

2) Move last sentence of the introduction (p.3 line 69-72) to discussion.

Done.

**Methods**

1. In methods section 2.1 p. 4 line 91 the authors discuss the proposal of sampling designs mixing a set of locations with additional sampling stations at short distances. Here the authors are lacking to discuss this concept, its necessity and its application in a fisheries context see work of Simard et al. (1992); Petitgas, P. (2001) or Doonan et al. (2003). Further, the author's statement p.4 line 93-94: "Such designs were not considered for bottom trawl surveys until now,…." is not correct. In Stelzenmüller et al. (2005) a bottom trawl sampling design is described which aimed to improve geostatistical estimates by adding sampling stations at shorter distances. The whole methods section 2.1 (p.4 lines 79-99) on the description of sampling designs in theory and praxis should be moved to the introduction.

The above mentioned text was moved to the introduction and the issues expanded along the lines suggested by the referee.

2. A table should be inserted stating the number of sampling stations within each design. For example only by counting visually the number of sample positions in Fig. 2 it became clear that the hybrid design contained 17 regular grid stations, while the systematic design contained 19 regular grid stations. Further, this table should also contain a summary statistics with mean, variance, and coefficient of variation for both sampling designs.

The information required by the referee were included in table 1. We considered it is not necessary to include a new table. Regarding the differences in the regular grid it resulted from an error on the plot and is now corrected. Both designs have the same number of regular locations, 19, and the same number of additional locations, 17. This is now explicitely said in section 3.1, previous section 2.1.

**Results**

Figure 1: Replace axis labels with latitude and longitude; give location reference and scale bar, and label the 500 m isobaths.

Done. There is no need for a scale bar once that the gray area is just showing the location of the study area, as clarifyied now. The location of Lisbon in degrees was include to better help on locating the study area. The axis labels were kept in km to be consistent with Figure 2.

Figure 2: Either label axis with lon/lat or X (km)/Y (km) but not with lon (km)/lat (km).

Done.

**Discussion**

1) p.8 lines 212-214. In order to underpin the use of the geostatistical estimator and its variance the authors should discuss their results in relation to the measures of sample average, variance etc. for both designs (see comment 2-methods).

Although we agree on including the design statistics we believe it's not a good reference for discussion once that, in our opinion, the computation of such statistics in situations of spatial dependency canbe misleading, in particular the variance can be underestimated. One important result of our work is the proposal of statistics that can be used to compare abundance estimates and using design statistics as reference will distract the reader.

2) p.8 line 222-Results showed that the hybrid design performed better.

The number of samples is often a crucial point in geostatistical analyses especially for applications in fisheries where expensive ship times often limit the number of hauls. Although both sampling designs comprised 36 sampling stations, the composition between numbers of stations of the regular grid and number of stations of the additional stations differed between the hybrid (17/19)

and the systematic (19/17) designs. Though, I would expect a sensitivity of the analysis to sample size in design composition (see also Rufino et al. 2006). This issue should be included in the discussion of the results.

This comment results from an error in the plot that mislead the referee. See answer to comment 2 in methods.

3) The performance of both sampling designs was assessed on the base of hake abundance data. Do the authors expect different results when testing the designs for different species or even biological groups such as different size classes (see Stelzenmüller et al. 2005)? I would assume before recommending a new survey design that this design performs well for most species.

The paragraph moved from the introduction as suggested by the referee was expanded to include this idea.

**Specific comments**

1) Remove citations from abstract - OK
2) Replace "yield" with "abundance", p1, line 7; p6, line 166; p6, line 168; p14 Figure 2 caption - OK
3) Replace "tools" with "measures", p1 line 8 - OK
4) Check units of abundance throughout the text, kg / $km^2$ not kg / km - OK
5) Check space between numbers and their units throughout the text for e.g. p2 lines29, 43, 47, 48; etc. - OK
6) Correct spelling of reference from Muller 2001 to Müller 2001, p4, lines 83,86, 92; p10 line 287 - OK