OVERALL RESULTS FOR THE EFFECT OF THE PRESENCE OF AN OBSERVER ON CATCHES MADE BY THE PELAGIC FLEET

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INTRODUCTION

The analysis of the observer data for the pelagic fishery is taken further for the complete data base from 1999 to 2004. Previously the analysis had been based on steel vessels (Somhlaba *et al.*, 2005); those findings showed that there were statistically significant positive effects on catches given the presence of an observer on the steel vessels. The results below include the analysis of the combined data for all three categories of vessels: bait, ordinary and steel vessels. Sardine and anchovy data were analysed in detail using one model but with two different error structures: one lognormal (henceforth termed *LogCPUE*) and the other Poisson (henceforth termed *catch*).

METHOD

The data were analysed using General Linear Models (GLMs) with all the main factors fitted first. The interactions between the observer and month factors were investigated. The aim is to ascertain whether the effect of the presence of an observer still remains significant after these interactions have been taken into account, and also to discover how this effect varies over a twelve month period. This evaluation of these interactions gave a clear indication of a trend in the effect of the observer on catch rates and catch for each month for both models used. Using the pattern that emerged from the interactions, the observer factor was aggregated to indicate the effect of the observer presence from February to June and from July to January for sardine, and for anchovy from May to October and from November to January.

The basic equation upon which the *LogCPUE* analysis is based is given by:

$$\log\left(\frac{catch}{hours}\right) = \mu + \beta_{Observer} + \varphi_{Month} + \phi_{Year} + \gamma_{Vessels} + \theta_{Category} + \rho H + \lambda_{Observer*Month} + \varepsilon \quad (1)$$

where:

μ is the intercept,

$\beta_{Observer}$ is the observer factor with 2 levels,

φ_{Month} is the month factor with 12 levels,

ϕ_{Year} is the year factor with 6 levels,

$\gamma_{Vessels}$ is the vessel factor with 15 levels,

$\theta_{Category}$ is the factor indicating a direct or by-catch
H is the total number of hauls per trip with ρ the associated estimable parameter,
λ is an interaction term between the observer and month factors,
ε is the error term assumed to be normally distributed with mean zero and variance σ^2.

For the catch analysis (Poisson model), this equation is modified to:

$$\log(catch) = \mu + \log(hours) + \beta_{Observer} + \varphi_{Month} + \phi_{Year} + \gamma_{Vessels} + \theta_{Category} + \rho H + \varepsilon \quad (2)$$

where:
log(*hours*) is an offset,
ε is the error term now assumed to be Poisson distributed.

The observer factor was redefined in order to clearly show the effect of the observer over different month aggregation for *LogCPUE* and *catch* models. Equation 3 gives the *LogCPUE* model for the aggregated observer factor.

$$\log\left(\frac{catch}{hours}\right) = \mu + \beta_{Observer^*} + \varphi_{Month} + \phi_{Year} + \gamma_{Vessels} + \theta_{Category} + \rho H + \varepsilon \quad (3)$$

where:
$\beta_{Observer^*}$ is the observer factor with 3 levels.

RESULTS

Table 1 gives consolidated results for three scenarios. First the main factors only are fitted for *LogCPUE* and *catch*. Both models show clearly that the observer effect is statistically significant at 5% level with positive impacts of 22% and 19%.
The second scenario involves the interactions of the month and the observer factors. For sardine and the *LogCPUE* model, the observer effect seems to be positive and “strong” from January to June, and for the *catch* the positive “strong” effect seems to be from February to June. The effect over these months was aggregated for both models and both were refitted (for comparability both models were aggregated similarly). The results from the aggregated model show that the observer effect is positive and significant at 5 % level with an impact of 45 % for *LogCPUE* and 50 % for *catch* between January and June, whereas the presence of an observer between July and December makes a negligible contribution of 1% for *LogCPUE* and 2 % for *catch*, with neither statistically significant.

For anchovy the results are also given in Table 1, and the observer factor has a positive effect of 10 % for *LogCPUE* and 19% for *catch,* with both being statistically significant at 5% level. When interactions are introduced the trend seems to be positive and “strong” from May to October for the *catch* approach and between May and August for *LogCPUE* model. For both models the observer effect was aggregated from May to October and from November to April. The results for the aggregated model are a 10 % positive impact between May and October for *LogCPUE,* and a 20 %

for *catch.* However the effect of an observer between November and April has a negligible contribution of -1% for *LogCPUE* and -13% for *catch,* with neither statistically significant at the 5 % level.

Diagnostics were investigated for the model with an aggregated interaction effect (Figs 1-4) for both sardine and anchovy. In Fig. 1 the mean of standardised residuals (for *LogCPUE*) or deviance residuals (for *catch*), henceforth termed residuals means, are plotted against both month and effort (measured in hauls) for sardine. The residual means do not seem to have any appreciable trend in relation to months that might suggest a misfit. Residuals means against hauls seem to have somewhat similar behaviour, with haul numbers exceeding 5 generally having negative residuals.

Fig 2 shows plots of the standard deviations of the residuals described above, (henceforth termed residual standard deviations) against month and hauls for both models for sardine. The residual standard deviations seem to be reasonably constant for both models, but slightly steadier for the *catch* model for both the month and the haul factors.

Fig. 3 shows the plots of residuals means for any *LogCPUE* and *catch* models for anchovy. Again neither model seems to show any appreciable trend that could suggest serious misfit. In Fig. 4 residual standard deviations are plotted against month and hauls. In this case the *catch* model seemed to show a more constant variance than *LogCPUE* model.

CONCLUSION

Clearly, based on these models the presence of an observer has an impact on the catches made, but only for some months. For the sardine the impact is around 45 % based on the *LogCPUE* model and around 50 % based on the *catch* model. For the anchovy the impact is around 10 % based on the *LogCPUE* and around 20 % based on the *catch* model. Diagnostics indicate a marginal preference for the *catch* model. These results are consistent with dumping taking place if observers are not on board vessels.

REFERENCE

Somhlaba, S., Brandão, A. and Butterworth, D.S. 2005. Further results when interactions between the presence of an observer and month are taken into account for steel vessels. MCM document SWG/AUG2005/PEL/07.

Table 1: Consolidated results for LogCPUE model (with lognormal errors) and the catch model (with Poisson errors). For each model three scenarios are considered: i) only the main factors are fitted; ii) An observer effect for each month is included (i.e. there is an interaction between the observer and month factors); and iii) the observer-month interaction is aggregated over two periods, January to June and July to December for sardine, and May to October and November to April for anchovy. The values shown are the estimates for the observer factor as defined on equations (1) and (2) (the values show the effect of the presence of the observer), followed by its standard error in parentheses. Values shown in bold are statistically significant at the 5% level.

Sardine			
		logCPUE(lognormal)	Catch (Poisson)
	Month	Observer	Observer
no interactions		**0.22** (0.050)	**0.19** (0.035)
interaction	Jan	0.51 (0.52)	-0.009(0.19)
	Feb	**0.81** (0.26)	**0.77**(0.12)
	Mar	0.23 (0.18)	**0.46**(0.12)
	Apr	**0.89** (0.20)	**0.44**(0.16)
	May	**0.60** (0.14)	**0.47**(0.12)
	Jun	0.20 (0.12)	**0.42**(0.17)
	Jul	**-0.60** (0.17)	-0.27(0.21)
	Aug	-0.33 (0.20)	0.26(0.19)
	Sep	**0.24** (0.11)	-0.16(0.095)
	Oct	0.21 (0.14)	0.070(0.082)
	Nov	0.039 (0.21)	0.095(0.087)
	Dec	0.30 (0.33)	0.14(0.12)
aggregation	Jan-Jun	**0.45**(0.071)	**0.50**(0.055)
	July-Dec	0.010(0.070)	0.020(0.044)
Anchovy			
		logCPUE(lognormal)	Catch (Poisson)
	Month	Observer	Observer
no interactions		**0.10** (0.019)	**0.19**(0.027)
interaction	Jan	**-0.61**(0.29)	-2.11(3.88)
	Feb	**0.54**(0.25)	0.19(1.77)
	Mar	0.048(0.16)	-0.92(0.69)
	Apr	-0.068(0.079)	-0.064(0.14)
	May	**0.20**(0.060)	**0.41**(0.095)
	Jun	0.038(0.050)	**0.18**(0.071)
	Jul	**0.16**(0.062)	**0.39**(0.076)
	Aug	**0.22**(0.055)	**0.44**(0.071)
	Sep	0.042(0.032)	0.061(0.044)
	Oct	0.096(0.057)	**0.15**(0.076)
	Nov	0.32(0.22)	-0.83(1.60)
	Dec	0.042(0.033)	0.061(0.044)
aggregation	May-Oct	**0.10(0.020)**	**0.20**(0.027)
	Nov-Apr	-0.010(0.063)	-0.13(0.14)

Figure 1: The means of standardised residuals or deviance residuals plotted against month and hauls for the *LogCPUE* (left side plots) and *Catch* (right side plots) models respectively for sardine for scenario iii), i.e. aggregated observer-month interactions.

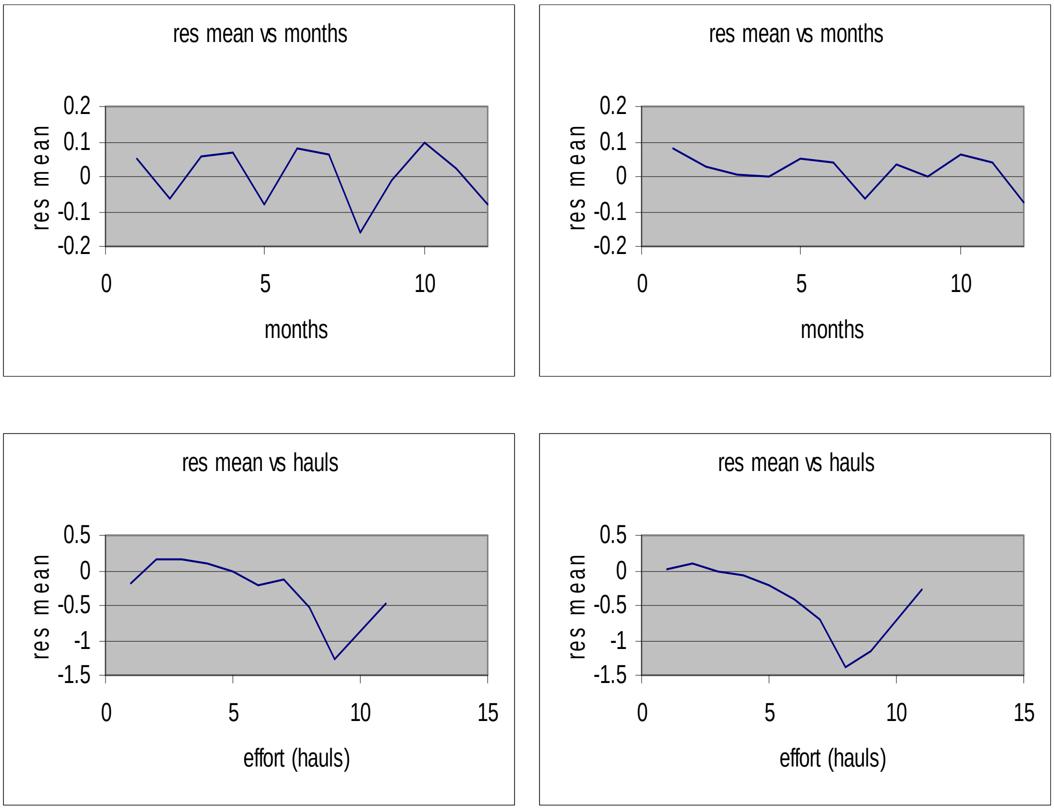
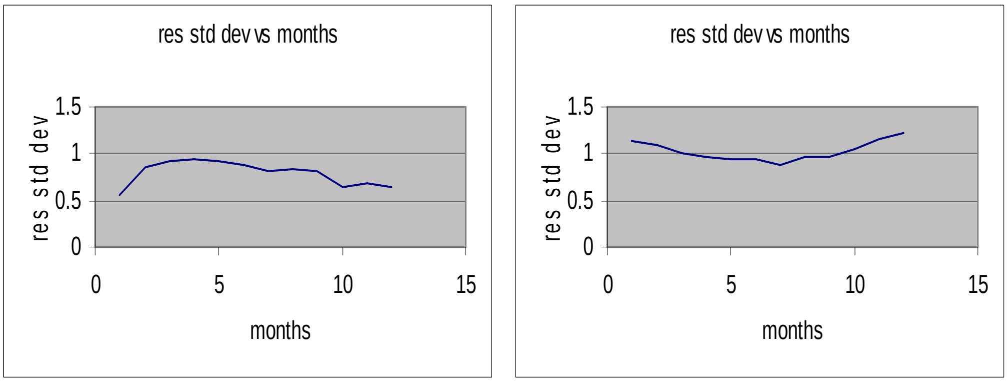


Figure 2: The standard deviations of the residuals considered in Fig.1 plotted against month and hauls for the *LogCPUE* (left side plots) and *catch* (right side plots) models for sardine for scenario iii), i.e. aggregated observer-month interactions.



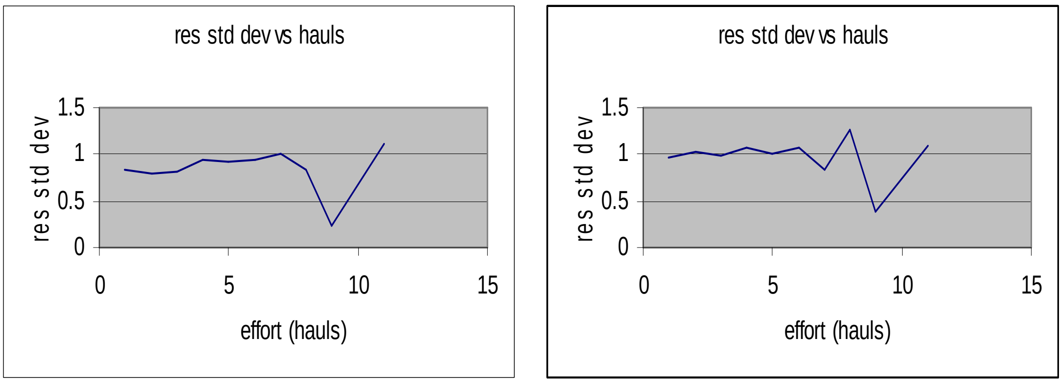


Figure 3: The means of standardised residuals or deviance residuals plotted against month and hauls for the *LogCPUE* (left side plots) and *catch* (right side plots) models for anchovy for scenario iii), i.e. aggregated observer-month interactions.

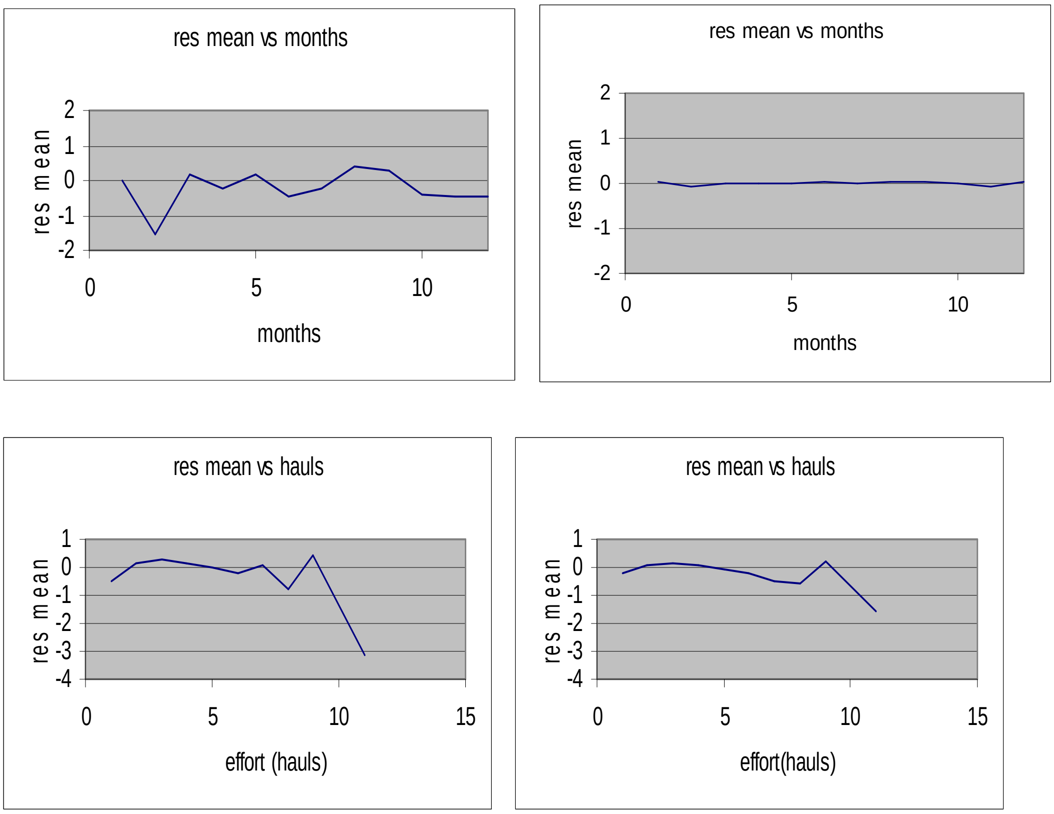


Figure 4: The standard deviations of the residuals considered in Fig. 3 plotted against month and hauls for the *LogCPUE* (left side plots) and *catch* (right side plots) models for anchovy for scenario iii), i.e. aggregated observer-month interactions.