FURTHER RESULTS WHEN INTERACTIONS BETWEEN THE PRESENCE OF OBSERVER AND MONTH ARE TAKEN INTO ACCOUNT FOR STEEL VESSELS

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INTRODUTION

Interactions between the presence of an observer and month are investigated for both anchovy and sardine fisheries. 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 how this effect varies over a twelve month period. The evaluation of these interactions and approach gives a clear indication of a trend in the effect of the observer on catch rates for each month. Using the trend that emerged from the interactions, the observer factor was redefined with three levels, two levels indicating the presence of an observer for each six month period of the year and the other level indicating absence of an observer.

This study has been restricted to steel vessels only. The reasons for concentrating on these vessels only were to establish if there is a pattern in the effect of the observer by restricting the analysis to a smaller data set though still with enough observer coverage (steel vessels accounted for almost 40% of the observer coverage for each year over the past six years), and also to be able to add a factor for each vessel into the model.

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

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

where:

- μ is the intercept,
- $\beta_{Observer}$ is the observer factor with two, three or thirteen 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,
- ε is the error term assumed to be log normally distributed with mean zero and variance σ^2.

RESULTS

From Table 1, it is clear that the observer effect is statistically significant at the 5% level with a positive impact on catch per hour of 14% for sardine when this effect is assumed to be the same for each month. Table 2 shows results for the interaction between the month factor and the observer effect. This demonstrates that the observer has a large positive effect between December and May, but between June and November has a varying effect which is smaller in general. The observer factor was redefined based on the trend shown over month in Table 2. The presence of the observer between December and May, as shown in Table3, has a high positive effect of 40 % which is statistically significant at the 5% level, whereas the presence of an observer between June and November has small positive effect of 6% which is not statistically significant at this level.

The results for anchovy are given in Tables 4 to 6. From Table 4 it is clear that the observer effect has a positive effect (14 %) and it is statistically significant at 5% level when this effect is assumed to be the same for each month. Table 5 gives results when an interaction between the observer factor and the month factor are included in the model. The results show that the presence of an observer has a generally small or negative effect between November and April, and a positive effect between May and October. Accordingly the observer factor was redefined to have three levels. Table 6 shows the results when the observer factor is redefined. The presence of an observer between May and October has a high positive effect of 16 % which is statistically significant at the 5 % level whereas the presence of an observer between November and April makes a negligible contribution of 0.1% which is not statistically significant at the 5 % level.

CONCLUSION

These results show that for steel vessels, the effect of the presence of an observer has a positive effect on catch rates, but only for some months of the year. For sardine the effect is 40 % for December to May, but otherwise insubstantial; for anchovy there is an increase of 16 % for the May to November period, but not for the rest of the year.

Table 1: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for sardine where CPUE=catch per hour, when only the main effects are considered (significant levels are indicated in bold). The observer factor has only two levels, the one indicating the presence of the observer and the other the absence of the observer (the level indicating the presence of an observer is given).

		Log(CPUE) model for sardine						
intercept	**Month**		**Observer**	**Year**	**Category**	**Vessels**		**Hauls**
0.86(0.11)	Jan	**0.34**(0.15)	**0.14** (0.087)	1999, **0.17**(0.065)	B -**3.02** (0.040)	21	-0.020(0.095)	**0.043** (0.013)
	Feb	**0.36** (0.085)		2000, **0.15** (0.065)		373		
	Mar	**0.15** (0.075)		2001		374	0.12(0.090)	
	Apr	**0.24**(0.074)		2002, **0.41** (0.061)		376	0.022(0.088)	
	May	**0.31** (0.074)		2003, **0.25** (0.059)		381	**-0.21** (0.085)	
	Jun	**0.31** (0.072)		2004, **0.14** (0.065)		436	0.00020(0.085)	
	Jul	-**0.22** (0.074)				437	-**0.30** (0.12)	
	Aug	0.10 (0.077)				441	-0.052(0.088)	
	Sep					444	-0.12(0.081)	
	Oct	0.14 (0.081)				445	-0.15 (0.093)	
	Nov	**0.37** (0.076)				446	0.058(0.083)	
	Dec	**0.47** (0.095)				449	**0.30** (0.090)	
						451	-0.051(0.082)	
						465	-**0.24** (0.099)	
						466	-0.10(0.11)	
						467	-**0.24** (0.11)	

Table 2: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for sardine, when an interactions between the month factor and the presence of an observer are considered (significant levels are indicated in bold).

		Log(CPUE) model for sardine (**Observer.Month)**						
intercept	**Month**		**Observer**	**Year**	**Category**	**Vessels**		**Hauls**
0.86 (0.11)	Jan	0.40(0.56)	0.18 (0.55)	1999, **0.16**(0.065)	B -**3.02**(0.040)	21	-0.030(0.095)	**0.044** (0.013)
	Feb	**1.02**(0.56)	0.79 (0.54)	2000, **0.14**(0.065)		373		
	Mar	0.35(0.52)	0.32 (0.49)	2001		374	0.12 (0.090)	
	Apr	0.50(0.42)	0.39 (0.38)	2002, **0.41** (0.061)		376	0.020(0.088)	
	May	0.55(0.42)	0.36 (0.38)	2003, **0.24** (0.060)		381	-**0.21** (0.085)	
	Jun	0.38(0.28)	0.19 (0.28)	2004, 0.13 (0.066)		436	0.030	
	Jul	-0.59 (0.29)	-0.27(0.25)			437	-**0.27** (0.12)	
	Aug	0.060(0.43)	0.075 (0.40)			441	-0.030	
	Sep		0.12 (0.18)			444	-0.10	
	Oct	0.22(0.29)	0.20 (0.25)			445	-0.15	
	Nov	0.24(0.30)	-0.014(0.26)			446	0.09	
	Dec	0.76(0.40)	0.42 (0.37)			449	**0.30**(0.090)	
						451	-0.032	
						465	-**0.21** (0.10)	
						466	-0.083	
						467	-**0.23** (0.11)	

Table 3: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for sardine, when only the main effects are considered (significant levels are indicated in bold). The observer factor has three levels in this case, the one indicating the presence of an observer between December and May (first figure indicated by *), the second level indicating the presence of an observer between June and November (second figure indicated by #) and the other level indicating the absence of an observer.

		Log(CPUE) model for sardine						
intercept	**Month**		**Observer**	**Year**	**Category**	**Vessels**		**Hauls**
0.87(0.11)	Jan	**0.32**(0.15)	**0.40** (0.18)*	1999, **0.16**(0.065)	B -**3.02** (0.040)	21[27]	-0.030(0.095)	**0.043** (0.013)
	Feb	**0.35** (0.085)	0.060(0.10)#	2000, **0.14** (0.065)		373[35]		
	Mar	0.14 (0.075)		2001		374[34]	0.12(0.090)	
	Apr	**0.22**(0.075)		2002, **0.40** (0.061)		376[36]	0.020(0.088)	
	May	**0.30** (0.074)		2003, **0.24** (0.059)		381[31]	-**0.21** (0.085)	
	Jun	**0.30** (0.072)		2004, **0.13** (0.065)		436[34]	-0.0030(0.085)	
	Jul	-**0.23** (0.074)				437[32]	-**0.30** (0.12)	
	Aug	0.10 (0.077)				441[27]	-0.060(0.088)	
	Sep					444[37]	-0.12(0.091)	
	Oct	0.14 (0.081)				445[30]	-0.15 (0.093)	
	Nov	**0.37** (0.076)				446[35]	0.057(0.083)	
	Dec	**0.47** (0.096)				449[34]	**0.30** (0.090)	
						451[34]	-0.060(0.082)	
						465[29]	-**0.24** (0.099)	
						466[36]	-0.11(0.11)	
						467[29]	-**0.26** (0.11)	

Table 4: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for anchovy, when only the main effects are considered (significant levels are indicated in bold). The observer factor has only two levels, the one indicating the presence of the observer and the other indicating the absence of the observer (in the table the level indicating the presence of an observer is given).

		Log(CPUE) model for anchovy						
intercept	**Month**		**Observer**	**Year**	**Category**	**Vessels**		**Hauls**
0.37(0.054)	Jan	-0.24(0.14)	**0.14** (0.039)	1999, -**0.10**(0.042)	B **-1.82** (0.029)	21 [27]	0.030(0.048)	**0.087** (0.0072)
	Feb	-**0.34**(0.081)		2000, **0.35** (0.037)		373[35]		
	Mar	-0.022(0.064)		2001		374[34]	**0.17**(0.050)	
	Apr	0.025(0.050)		2002, **0.22** (0.037)		376[36]	0.032(0.052)	
	May	-**0.10**(0.042)		2003, 0.013(0.033)		381[31]	**-0.10** (0.067)	
	Jun	0.010(0.034)		2004, -0.014 (0.037)		436[34]	-0.0051(0.064)	
	Jul	0.060(0.034)				437[32]	**-0.23** (0.062)	
	Aug	0.020(0.040)				441[27]	**0.10**(0.042)	
	Sep					444[37]	-**0.11**(0.054)	
	Oct	-**0.22**(0.049)				445[30]	**0.13** (0.045)	
	Nov	-**0.58**(0.068)				446[35]	**0.21**(0.068)	
	Dec	-**0.26**(0.11)				449[34]	0.04 (0.050)	
						451[34]	0.04(0.046)	
						465[29]	-0.070 (0.053)	
						466[36]	-0.004(0.056)	
						467[29]	**0.16** (0.066)	

Table 5: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for anchovy, when an interactions between the month factor and the presence of an observer are considered (significant levels are indicated in bold).

		Log(CPUE) model for anchovy (**Observer.Month)**						
intercept	**month**		**Observer**	**Year**	**Category**	**vessels**		**Hauls**
0.39(0.055)	Jan	-**1.10**(0.43)	-0.89(0.49)	1999, -**0.10**(0.042)	B **-1.81** (0.028)	21 [27]	0.021(0.048)	**0.087** (0.0072)
	Feb	-**1.32**(0.60)	-0.93(0.60)	2000, **0.35** (0.037)		373[35]		
	Mar	-0.045(0.065)	0.034(0.072)	2001		374[34]	**0.16**(0.050)	
	Apr	-0.20(0.20)	-0.19(0.19)	2002, **0.22** (0.036)		376[36]	0.032(0.049)	
	May	0.14(0.19)	0.31(0.18)	2003, 0.014(0.034)		381[31]	-0.10 (0.067)	
	Jun	0.16(0.20)	0.21(0.11)	2004, -0.010 (0.038)		436[34]	-0.0051(0.064)	
	Jul	0.086(0.13)	0.079(0.11)			437[32]	-**0.23** (0.062)	
	Aug	0.20(0.12)	**0.24**(0.11)			441[27]	**0.10**(0.042)	
	Sep		0.034(0.072)			444[37]	-0.10(0.054)	
	Oct	0.030(0.10)	**0.34**(0.10)			445[30]	**0.12** (0.048)	
	Nov	-**0.55**(0.16)	0.074(0.17)			446[35]	**0.20**(0.067)	
	Dec	-**0.29**(0.11)	0.034(0.072)			449[34]	0.04 (0.050)	
						451[34]	0.04(0.046)	
						465[29]	-0.070 (0.053)	
						466[36]	-0.004(0.056)	
						467[29]	**0.24** (0.071)	

Table 6: Estimates of the factors investigated (together with their standard errors) for a LOG (CPUE) model for anchovy, when only the main effects are considered (significant levels are indicated in bold). The observer factor has three levels in this case, the first indicating the presence of an observer between November and April (first figure indicated by *), the second indicating presence of an observer between May and October (second figure indicated by #) and the other indicating the absence of an observer.

		Log(CPUE) model for anchovy						
intercept	**month**		**Observer**	**Year**	**Category**	**Vessels**		**Hauls**
0.37(0.054)	Jan	-0.23(0.14)	0.0010(0.098)*	1999, -**0.10**(0.042)	B **-1.82** (0.029)	21 [27]	0.030(0.048)	**0.087** (0.0072)
	Feb	-**0.34**(0.081)	**0.16**(0.043)#	2000, **0.35** (0.038)		373[35]		
	Mar	-0.020(0.064)		2001,		374[34]	**0.17**(0.050)	
	Apr	0.034(0.050)		2002, **0.22** (0.035)		376[36]	0.032(0.052)	
	May	-**0.093**(0.042)		2003, 0.012(0.033)		381[31]	-**0.10** (0.067)	
	Jun	0.080(0.039)		2004, -0.010 (0.037)		436[34]	-0.0051(0.064)	
	Jul	0.063(0.039)				437[32]	-**0.23** (0.062)	
	Aug	0.020(0.041)				441[27]	**0.10**(0.042)	
	Sep					444[37]	-0.075(0.054)	
	Oct	-**0.22**(0.049)				445[30]	**0.13** (0.045)	
	Nov	-**0.55**(0.069)				446[35]	**0.22**(0.069)	
	Dec	-**0.26**(0.12)				449[34]	0.062 (0.055)	
						451[34]	0.072(0.050)	
						465[29]	-0.032 (0.057)	
						466[36]	0.032(0.060)	
						467[29]	**0.24** (0.071)	