Responses to some of the conclusions and recommendations from the JARPAII Review Panel for stomach contents analyses (SC/F14/J14) regarding to long-term trend of stomach content weight in the Antarctic minke whale

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ABSTRACT

The authors presented a paper showing a decline of stomach contents throughout JARPA and JARPA II period in the JARPA II Review Workshop. In the present paper, the authors have performed some additional regression analyses with diagnostic plots that were recommended by the Review Panel, but only for the JARPA period. In the original paper, which is now published in a journal (Konishi et al. 2014 as SC/65b/Forinfoxx), the best model was selected by the use of AIC. The best model selected by BIC also has a negative year effects, supporting the finding of a decline of stomach content weight throughout the JARPA period as the authors have reported. The diagnostic plots did not show any problem for the best model. The conclusion must be that the negative trend of stomach content weight in the Antarctic minke whale is real and should be interpreted as a result of a decline in prey availability.

KEY WORDS: ANTARCTIC, ANTARCTIC MINKE WHALE, STOMACH CONTENTS, BIOLOGICAL PARAMETER TREND

INTRODUCTION

The workshop to review the progress made in the research conducted under the Japanese Whale Research Program under Special Permit in the Antarctic–Phase II (JARPAII) in its first six years (2005/06-2010/11) was carried out in February 2014. During the workshop the authors presented a document (SC/F14/J14, later published as Konishi et al. 2014 as SC/65b/Forinfoxx) regarding to temporal trend of stomach content weight in the Antarctic minke whale. In the Review Panel Report of the JARPA II Special Permit Review Workshop (SC/65b/Rep02), comments and recommendations on Document SC/F14/J14 were reported. Here the authors present detailed responses to those comments and recommendations. The comments on SC/F14/J14 from the Review Panels are summarized below:

Comments A

'Following the selection of which factors to consider in the modelling, the following steps should be undertaken:

1. *identify whether any of the covariates are highly correlated and either (a) exclude a subset of the covariates so that the remaining covariates are uncorrelated or (b) develop new covariates which represent independent aspects of the current covariates (using for example PCA);*
2. *select a 'full model' (this may be difficult if the data set is unbalanced) and base selection of which factors and their interactions to treat as random effects - the models should be fitted using REML and a model selection approach such AIC, BIC or standard hypothesis testing approach applied; and*
3. *select the fixed effects structure given the random effects structure selected at step (2), where the models are fitted using maximum likelihood;*
4. *use REML to fit the best model identified in (3) above.'*

Comments B
'SC/F14/J13 and SC/F14/J14 do not report many fit diagnostics. The Panel ***recommends*** *that any revised papers provide at least plots of the residuals versus the predictor variables (including year and stratum), histograms of residuals and random effects, plots of residuals spatially, and Q-Q plots for the 'best model'.'*

Comments C
'The Panel also ***recommends*** *that future analyses of the data on the condition of Antarctic minke whales include (a) consideration of a model in which year is a categorical variable and is treated as a random effect if a plot of residuals against year show there are residual patterns by year,'*

The review panel also commented that it would like to see the results if BIC was used for model selection, since the authors have used this criterion in their other paper to the review meeting.

The present paper presents the regression results according to the comments and recommendations above, but only for the JARPA period, since possible changes in energy storage in minke whales during this period have been intensively discussed in the SC during the last few years.

RESULTS AND DISCUSSION

Response to Comments A
To respond to comment on (1), the correlation matrix for the independent variables is provided in Appendix 1. The matrix shows that all the other correlations between the independent variables have values less than about 0.2 (except the correlation between longitude and latitude caused by the catches in the Ross Sea and between Latitude and Date). For this reason the authors have not considered it necessary either to exclude any of the other variables or to develop new independent variables by the use of principal component analysis (PCA).

According to comments on (2) to (4):

a) We have followed the selection procedure as same as SC/65b/EM02. There is no objective 'full model' and the choice of the 'full model' is dependent on what one regards as relevant and plausible assumptions. In the following the authors comment only on the modelling of stomach content weight during the JARPA period, since this is the period which has been discussed repeatedly in the SC.
b) Because the AIC was used in the previous model selection in SC/F14/J14, we have this time made model selection by BIC with adding the random effects which were suggested by the Review Panel.
c) The random term should first have been explored as an interaction term. An basic full model is

   log(Stomach content weight) ~ Date^2 + Latitude + Longitude + Year + Local time + Sex + Body + length(m)

The authors have now performed these calculations for the interaction terms which were suggested by the SC in 2013 and an interaction term which they found useful based on de la Mare et al.'s models from their paper SC/F14/O6. The models and the results are presented in Appendix 2. This adjustment did not result in any important change in model selection (based on lowest BIC value) in any of the cases we have explored. The best model selected by AIC in Konishi et al.2014 (SC/65b/Forinfoxx) had larger BIC values both in the best model lm.sto1.1 for the data used in the published paper and for the JARPA data only as used in the present investigation, but the year effect and its SE are not very different (Appendix 2)." . The information that BIC should be preferred compared to AIC when the data set is large as in JARPA and JARPA II surveys was described in SC-F14-R5.

Response to Comments B
The authors have now developed the plots recommended by the Review panel for the best model. (Appendix 3). These diagnostic plots show no particular problems for the best models.

Response to Comments C

As can be seen clearly from Appendix 3 the plots of residuals against year show no cyclic or otherwise disturbing pattern for any of the models explored. For this reason the authors see no reason to consider a model in which year is a categorical variable and is treated as a random effect. Although the histogram of residuals for the best model skewed to the left, the regression analyses as robustness trial using ranked and non-transformed stomach content weight supported main regression results (SC/F14/J14 also SC/65b/Forinfoxx).

In conclusion, the negative trend of stomach contents in the Antarctic minke whale during the JARPA period is valid, supporting the previously reported synchronous decline of body condition during JARPA period (Konishi et al. 2008, SC/F14/J13).

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Appendix 1

Correlations among independent variables

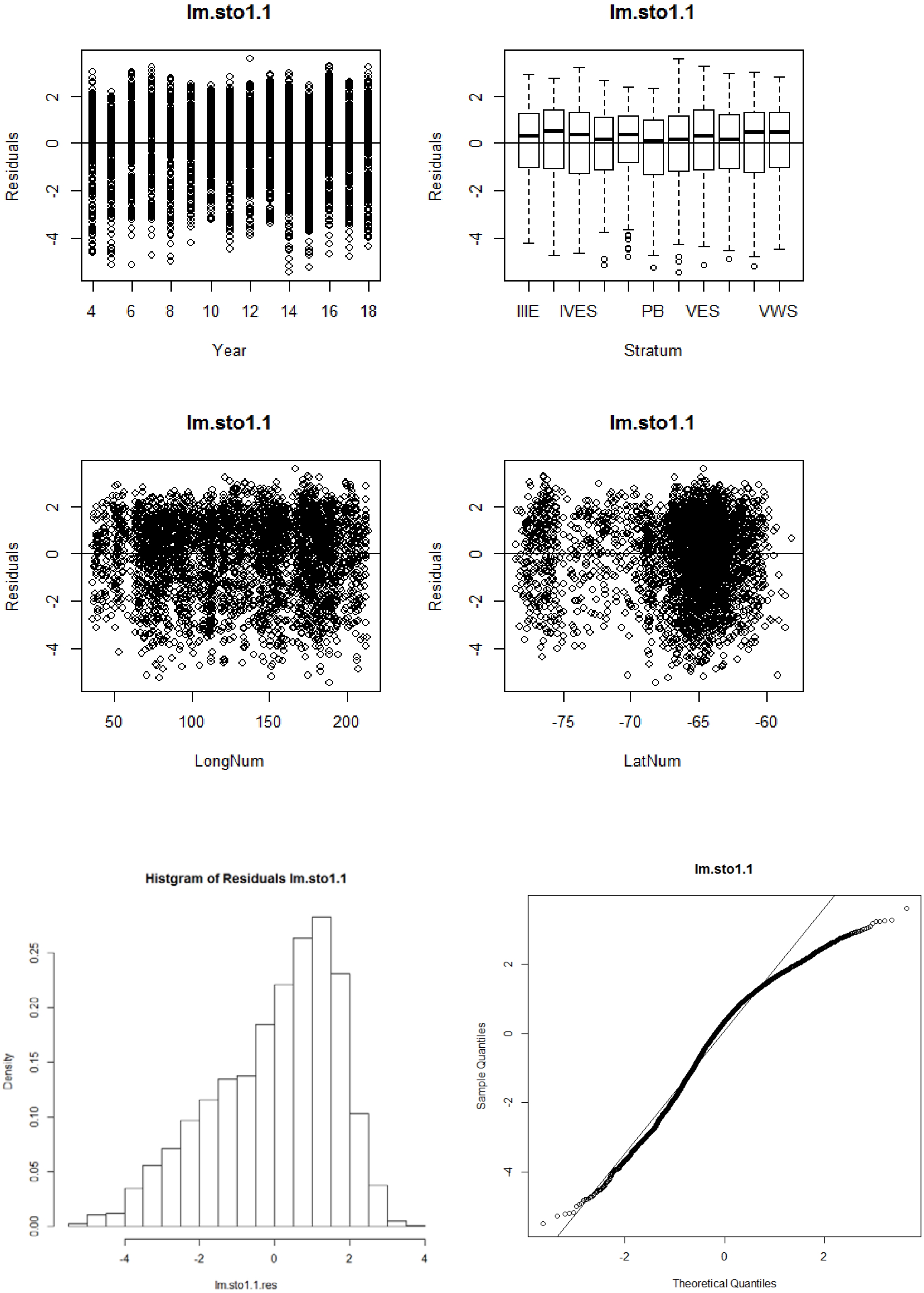
Pearson correlations:						
	BLm	DateNum	LatNum	LongNum	LtimeNum	YearNum
BLm	1.000	-	-	-	-	-
DateNum	0.098	1.000	-	-	-	-
LatNum	-0.203	-0.378	1.000	-	-	-
LongNum	0.036	0.173	-0.511	1.000	-	-
LtimeNum	-0.014	-0.093	0.056	-0.070	1.000	-
YearNum	-0.034	-0.092	-0.091	0.057	-0.024	1.000

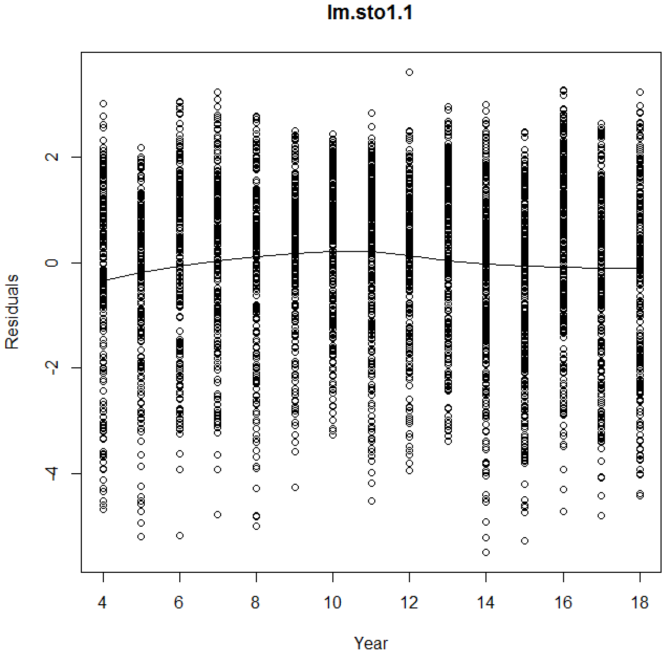
Appendix 2 The models and the results of models for Stomach content weight.

Results of regressions for stomach content weight during JARPA period (1990/91-2004/05)							
Covariates of random effects	No.	BIC	Year effct	SE	t	model	
	1	**13977**	**-0.020**	**0.007**	**-3.10**	**lm.sto1 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm)**	
YearNum-LatNum	2	13978	0.103	0.116	0.89	lm.sto2 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + Year:LatNum)	
	3	15087	-0.011	0.007	-1.58	lmer.sto2 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (Year|LatNum), REML = T)	
LonSect-Year	4	14116	-0.783	0.361	-2.17	lm.sto3 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + LonSect:Year)	
	5	14143	0.021	0.019	1.15	lmer.sto3 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (LonSect|Year), REML = T)	
Date-LonSect	6	13985	-0.020	0.007	-3.01	lm.sto4 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + DateNum:LonSect)	
	7	14073	-0.020	0.007	-2.97	lmer.sto4 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (DateNum|LonSect), REML = T)	
Date-LongNum	8	13985	-0.020	0.007	-3.01	lm.sto5 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + DateNum:LongNum)	
	9	14069	-0.020	0.007	-3.07	lmer.sto5 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (DateNum|LongNum), REML = T)	
YearNum-Ice	10	13985	-0.019	0.008	-2.52	lm.sto6 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + YearNum:Ice)	
	11	14069	-0.013	0.020	-0.64	lmer.sto6 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (YearNum|Ice), REML = T)	
Year-LtimeNum	12	13991	-0.028	0.022	-1.28	lm.sto7 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + Year:LtimeNum)	
	13	15124	-0.023	0.008	-2.99	lmer.sto7 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (Year|LtimeNum), REML = T)	
LtimeNum-Year	14	13991	-0.028	0.022	-1.28	lm.sto8 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + LtimeNum:Year)	same as lm.sto7
	15	14002	-0.016	0.018	-0.89	lmer.sto8 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (LtimeNum|Year), REML = T)	
YearNum-Lat70	16	13979	0.002	0.011	0.22	lm.sto9 <- lm(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + YearNum:Lat70)	
	17	14071	-0.014	0.011	-1.25	lmer.sto9 <- lmer(log(FirstS) ~ I(DateNum^2) + LatNum + LongNum + YearNum + LtimeNum + Sex + BLm + (YearNum|Lat70), REML = T)	
Best model from Konishi et al. (2014)	18	14056	-0.026	0.007	-3.93	LMER24<- lmer(log(FirstS)~(I(DateNum^2)-1|LatCat11:Year)+(I(DateNum^2)-1|LongCat11:Year)+YearNum + LtimeNum + BLm + Sex, REML = T) #	
Modified lm.sto1	**19**	**13969**	**-0.020**	**0.007**	**-3.10**	**lm.sto1.1 <- lm(log(FirstS) ~ I(DateNum^2) + LongNum + YearNum + LtimeNum + Sex + BLm) #lm.sto1 - LatNum**	

Results of Modified lm.sto1 and the Fixed effects in the best model based on Konishi et al (2014) during JARPA period								
lm.sto 1						Fixed effects of the best model in Konishi et al. (2014)		
Residuals:								
Min 1Q Median 3Q Max								
-5.4882 -1.1189 0.3483 1.2780 3.6083								
Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)		Estimate	Std. Error	t value
(Intercept)	*1.37E+00*	*0.269*	*5.086*	*3.85e-07 ****		1.04E+00	0.259	4.021
DateNum ^{2}	*3.94E-05*	*0.000*	*4.452*	*8.76e-06 ****		-	-	-
LongNum	*-3.96E-03*	*0.001*	*-6.614*	*4.29e-11 ****		-	-	-
YearNum	*-2.03E-02*	*0.007*	*-3.103*	*0.00193 ***		-2.57E-02	0.007	-3.929
LtimeNum	*-1.24E-01*	*0.008*	*-16.163*	*< 2e-16 ****		-1.24E-01	0.008	-16.126
Sex[T.M]	*2.41E-01*	*0.056*	*4.316*	*1.63e-05 ****		2.46E-01	0.056	4.398
BLm	*3.29E-01*	*0.027*	*12.153*	*< 2e-16 ****		3.32E-01	0.027	12.199

Appendix 3 Diagnosis plots for the model (Modified lm.sto = lm.sto1.1)





Residual plots against year with locally weighted scatterplot smoothing for the best model (lm.sto1.1)