

Seasonal variation in oceanographic habitat and behaviour of white-chinned petrels *Procellaria aequinoctialis* from Kerguelen Island

Clara Péron^{1,*}, Karine Delord¹, Richard A. Phillips², Yohan Charbonnier¹, Cédric Marteau³, Maité Louzao^{1,4}, Henri Weimerskirch¹

¹Centre d'Etudes Biologiques de Chizé, CNRS UPR 1934, 79369 Villiers en Bois, France

²British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 0ET, UK

³Terres Australes et Antarctiques Françaises, rue Gabriel Dejean, 97458 St Pierre - BP 400- La Réunion, France

⁴Helmholtz Centre for Environmental Research—UFZ, Permoserstrasse 15, 04318 Leipzig, Germany

*Email: peron@cebc.cnrs.fr

Marine Ecology Progress Series 416:267–284 (2010)

Supplement. Details on logger deployment, processing of tracking data and statistical analysis

Table S1. Description of the locations provided by the 25 GLS loggers after the filtering procedure. The percentage of locations retained after the filtering procedure is reported. Dates are given as dd/mm/yy

ID	Fitted date	Recovery date	Deployment duration (d)	Light end	Activity end	Signal duration (d)		No. locations	% retained
						Light	Act		
2006									
1080_1	19/01/2006	08/12/2008	1054	08/12/2008	23/02/2007	1054	400	316	55.2
1082	19/01/2006	27/11/2006	312	27/11/2006	27/11/2006	312	312	402	68.2
1083_1	19/01/2006	08/12/2008	1054	08/12/2008	23/02/2007	1054	400	312	51.6
1084	18/01/2006	05/01/2007	352	05/01/2007	05/01/2007	352	352	190	39.9
1086	18/01/2006	27/11/2006	313	27/11/2006	27/11/2006	313	313	388	69.6
1087	19/01/2006	06/11/2007	656	14/12/2006	14/12/2006	329	329	311	52.3
1088	18/01/2006	29/12/2006	345	29/12/2006	29/12/2006	345	345	275	48.3
1089	18/01/2006	28/11/2007	679	15/02/2007	15/02/2007	393	393	356	53.8
2008									
1080_2	19/01/2006	08/12/2008	1054	08/12/2008	23/02/2007	1054	400	422	71.0
1083_2	19/01/2006	08/12/2008	1054	08/12/2008	23/02/2007	1054	400	412	63.1
2509	26/12/2007	27/10/2008	306	27/10/2008	27/10/2008	306	306	285	50.9
2510	24/12/2007	27/10/2008	308	27/10/2008	27/10/2008	308	308	318	55.3
2514	26/12/2007	27/10/2008	306	27/10/2008	27/10/2008	306	306	279	48.0
2515	27/12/2007	11/12/2008	350	11/12/2008	11/12/2008	350	350	235	35.0
8011	24/12/2007	08/12/2008	350	08/12/2008	08/12/2008	350	350	242	38.8
8012	24/12/2007	08/12/2008	350	20/01/2009	20/01/2009	350	350	190	31.6
8013	24/12/2007	11/12/2008	353	14/11/2008	14/11/2008	326	326	308	53.5
8014	24/12/2007	01/01/2009	374	01/07/2008	01/07/2008	190	190	152	42.8
8015	27/12/2007	10/01/2009	380	10/01/2009	10/01/2009	380	380	230	35.3
8016	27/12/2007	10/01/2009	380	20/08/2008	20/08/2008	237	237	270	58.8
8017	27/12/2007	11/12/2008	350	11/12/2008	11/12/2008	350	350	254	39.2
8018	24/12/2007	10/01/2009	383	10/01/2009	10/01/2009	383	383	193	30.9
8020	24/12/2007	08/12/2008	350	27/07/2008	27/07/2008	216	216	145	35.1
2506	24/12/2007	10/01/2009	383	10/01/2009	10/01/2009	383	383	265	43.0
2507	27/12/2007	11/12/2008	350	11/12/2008	11/12/2008	350	350	251	41.6
2508	27/12/2007	09/12/2008	348	09/12/2008	09/12/2008	348	348	284	45.4
2513	24/12/2007	11/12/2008	353	11/12/2008	11/12/2008	353	353	320	52.3

Fig. S1. *Procellaria aequinoctialis*. Example of the annual activity pattern of the individual 1080_1. Daily activity corresponds to the time spent on water. The 40% threshold was used to define the start and end dates of the wintering period.

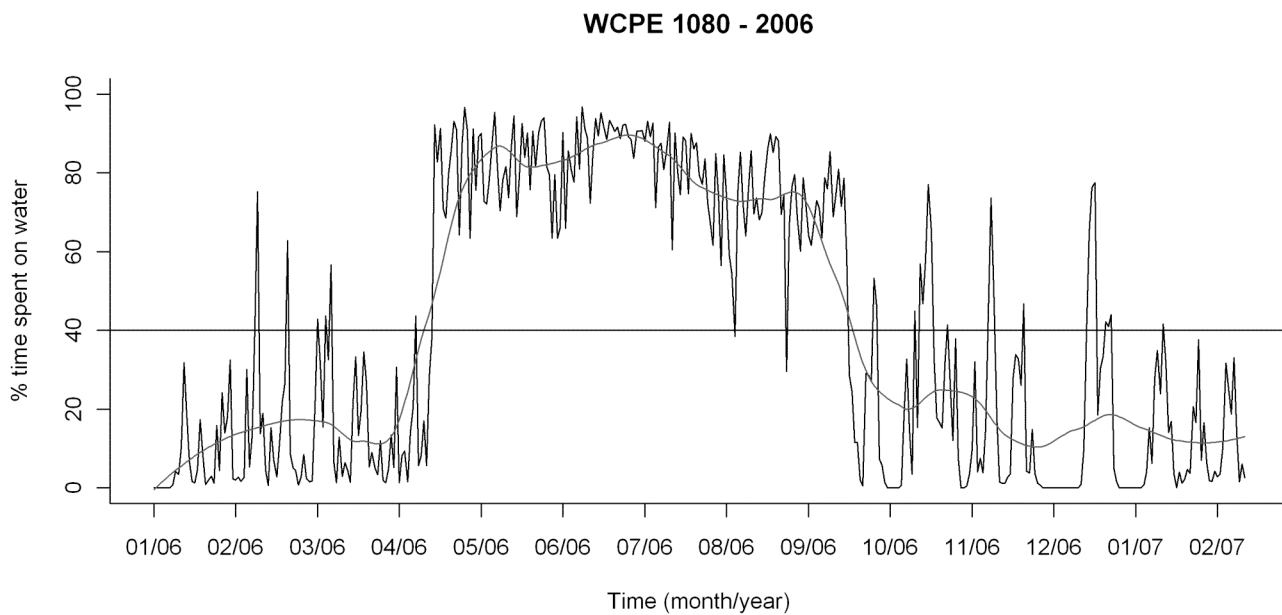


Table S2. *Procellaria aequinoctialis*. Estimated dates of departure and return of white-chinned petrel's wintering migration and time spent in the wintering grounds. Dates are given as dd/mm/yy

ID	Estimated wintering start date	Estimated wintering end date	Time spent in winter grounds (d)
2006			
1080_1	28/04/2006	02/10/2006	157
1082	30/03/2006	11/10/2006	195
1083_1	18/04/2006	22/11/2006	218
1084	19/03/2006	26/09/2006	191
1086	25/03/2006	22/09/2006	181
1087	16/04/2006	22/09/2006	159
1088	04/04/2006	23/09/2006	172
1089	28/03/2006	29/09/2006	185
2008			
1080_2	17/03/2008	30/09/2008	197
1083_2	20/03/2008	20/10/2008	135
2509	11/03/2008	21/09/2008	194
2510	21/04/2008	30/09/2008	162
2514	22/04/2008	29/09/2008	160
2515	28/04/2008	06/10/2008	161
8011	14/04/2008	18/09/2008	157
8012	22/04/2008	21/09/2008	152
8013	28/03/2008	09/09/2008	165
8014	07/05/2008	01/07/2008	55
8015	19/03/2008	05/09/2008	170
8016	05/03/2008	20/08/2008	168
8017	19/03/2008	28/09/2008	193
8018	29/04/2008	03/10/2008	157
8020	14/04/2008	27/07/2008	104
2506	22/04/2008	24/09/2008	155
2507	28/04/2008	11/10/2008	166
2508	24/04/2008	05/10/2008	164
2513	19/04/2008	05/10/2008	169

Table S3. *Procellaria aequinoctialis*. Details of satellite tracking of 32 foraging trips performed by white-chinned petrel fitted with Argos PTTs when incubating or chick rearing at Kerguelen Island, and percentage of retained locations using the sda filter. * means incomplete track. Dates are given as dd/mm/yy

ID track	ID bird	Start date (GMT)	End date (GMT)	Battery	Foraging trip type	No. locations	% retained
Incubation							
78353	78353	20/12/2007 23:07	05/01/2008 03:13	BATT	LONG	362	54.7
78354	78354	17/12/2007 19:17	02/01/2008 08:20	BATT	LONG	373	54.5
78355	78355	17/12/2007 18:16	03/01/2008 22:33	BATT	LONG	387	57.8
78356	78356	16/12/2007 21:57	05/01/2008 00:26	BATT	LONG	469	54.8
78357	78357	16/12/2007 23:01	30/12/2007 22:27	BATT	LONG	347	53.9
78358	78358	20/12/2007 18:47	04/01/2008 10:52	BATT	LONG	360	52.4
78359	78359	21/12/2007 22:44	09/01/2008 05:47	BATT	LONG	448	55.8
Chick rearing							
86_310_1	86_310	20/01/2006 18:54	21/01/2006 02:25	BATT	SHORT	10	71.4
86_310_2	86_310	21/01/2006 21:03	01/02/2006 14:28	BATT	LONG	250	71.4
86_390_1	86_390	16/01/2006 03:38	17/01/2006 04:43	BATT	SHORT	27	63.4
86_390_2	86_390	17/01/2006 18:08	19/01/2006 16:52	BATT	SHORT	41	84.4
87_305_1	87_305	17/01/2006 20:41	19/01/2006 00:11	BATT	SHORT	26	71.9
87_305_2	87_305	19/01/2006 22:18	26/01/2006 15:21	BATT	LONG	152	72.2
87_454_1	87_454	27/01/2006 17:16	30/01/2006 07:38	BATT	SHORT	49	59.8
88_356_1	88_356	15/01/2006 21:11	17/01/2006 02:13	BATT	SHORT	31	72.1
88_356_2	88_356	17/01/2006 21:27	18/01/2006 17:53	BATT	SHORT	21	88.6
88_356_3	88_356	18/01/2006 15:44	18/01/2006 20:32	BATT	SHORT	6	70.0
88_356_4	88_356	18/01/2006 22:25	19/01/2006 14:50	BATT	SHORT	14	66.7
88_386_1	88_386	20/01/2006 21:11	01/02/2006 02:34	BATT	LONG	251	77.8
88_386_2	88_386	01/02/2006 01:55	08/02/2006 13:27	BATT	LONG*	117	64.7
89_308_1	89_308	17/01/2006 20:12	18/01/2006 14:42	BATT	SHORT	18	67.6
89_308_2	89_308	18/01/2006 15:59	26/01/2006 08:41	BATT	LONG	171	78.3
89_455_1	89_455	27/01/2006 20:51	06/02/2006 10:29	BATT	LONG	195	61.7
90_398_1	90_398	19/01/2006 10:08	09/02/2006 00:41	SOLAR	LONG	80	62.1
90_460_1	90_460	09/02/2006 04:17	21/02/2006 06:51	SOLAR	LONG	50	62.0
92_317_1	92_317	15/01/2006 23:05	27/01/2006 07:36	SOLAR	LONG	83	59.5
92_366_1	92_366	27/01/2006 14:20	06/02/2006 06:10	SOLAR	LONG	67	58.0
92_366_2	92_366	06/02/2006 06:42	14/02/2006 04:31	SOLAR	LONG	55	67.7
93_395_1	93_395	18/01/2006 16:04	26/01/2006 09:50	SOLAR	LONG	59	65.5
93_395_2	93_395	27/01/2006 13:08	03/02/2006 15:09	SOLAR	LONG	38	64.1
93_458_1	93_458	03/02/2006 22:00	05/02/2006 07:42	SOLAR	SHORT	8	69.1
93_458_2	93_458	06/02/2006 17:44	18/02/2006 20:45	SOLAR	LONG	65	88.9

Table S4. Summary of cross-correlation analysis (by means of Spearman rank correlation coefficients) of time spent per unit area. Strongly correlated ($|r_s| > 0.6$) predictors are marked in bold. BATHY : bathymetry, BATHYG: bathymetry gradient, SST: sea surface temperature (°C), SSTG: SST gradient, CHLA: chlorophyll *a* concentration (mg m⁻³), CHLAG: CHL gradient, DIST-ICE: Distance to summer limit of pack-ice (km).

Incubation	BATHY	BATHYG	SST	SSTG	CHLA	CHLAG	DIST-ICE
BATHY							
BATHYG	-0.311						
SST	-0.313	0.156					
SSTG	0.307	-0.003	-0.131				
CHLA	-0.102	-0.057	0.211	-0.054			
CHLAG	-0.194	-0.005	0.101	-0.072	0.715		
DIST-ICE	-0.565	0.309	0.788	-0.235	0.182	0.103	
Chick rearing							
BATHY							
BATHYG	-0.337						
SST	-0.327	0.160					
SSTG	0.008	-0.013	-0.045				
CHLA	-0.503	0.015	0.298	0.090			
CHLAG	-0.411	-0.066	0.171	0.191	0.701		
DIST-ICE	-0.391	0.235	0.870	-0.053	0.374	0.229	

Table S5. Results of model selection procedures performed on linear mixed models of white-chinned petrel foraging habitat. The most parsimonious model (lowest AIC) had relatively high support ($w_i \sim 90\%$). AIC= Akaike Information Criteria; ! AIC = $AIC_i - AIC_{min}$; w_i = Akaike weights, $\sum w_i$ = Sum of Akaike weights. The remaining models had negligible Akaike weights (<0.01) and are not presented.

Incubation										
	Var1	Var2	Var3	Var4	Var5	AIC	np	ΔAIC	w_i	$\sum w_i$
1	SSTG	CHLAG	DIST-ICE	-	-	8067.33	5	0.00	89.68	89.68
2	BATHY	SSTG	CHLAG	DIST-ICE	-	8072.81	6	5.48	5.79	95.47
3	BATHYG	SSTG	CHLAG	DIST-ICE	-	8073.50	6	6.17	4.09	99.56
4	BATHY	BATHYG	SSTG	CHLAG	DIST-ICE	8079.07	7	11.75	0.25	99.82
5	SSTG	CHLAG	-	-	-	8080.40	4	13.07	0.13	99.95
6	BATHY	SSTG	CHLAG	-	-	8083.13	5	15.80	0.03	99.98
7	BATHYG	SSTG	CHLAG	-	-	8084.48	5	17.15	0.02	100.00
NULL	-	-	-	-	-	8337.68	2	270.36	0.00	100.00
Chick rearing										
1	SST	SSTG	CHLAG	-	-	12229.11	5	0.00	90.88	90.88
2	BATHY	SST	SSTG	CHLAG	-	12234.99	6	5.88	4.80	95.69
3	BATHYG	SST	SSTG	CHLAG	-	12236.25	6	7.14	2.56	98.25
4	SSTG	CHLAG	-	-	-	12237.28	4	8.17	1.53	99.77
5	BATHY	BATHYG	SST	SSTG	CHLAG	12242.30	7	13.20	0.12	99.90
6	BATHY	SSTG	CHLAG	-	-	12243.80	5	14.69	0.06	99.96
7	BATHYG	SSTG	CHLAG	-	-	12244.50	5	15.39	0.04	100.00
NULL	-	-	-	-	-	12370.50	2	141.39	0.00	100.00