

High variability in migration and wintering strategies of brown skuas

(*Catharacta antarctica lonnbergi*) in the Indian Ocean

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Electronic Supplementary Material

Fig. S1 Representative GLS tracks illustrating the two migratory movement modes of brown skuas (*Catharacta antarctica lonnbergi*) during the inter-breeding period: i) short-distance longitudinal movements within the sub-Antarctic and subtropical zones, ii) long-distance and mainly anticlockwise loop movements to subtropical (pink) or tropical zones (dark blue and purple) of two Crozet (green triangle) birds and three Kerguelen (red triangle) birds

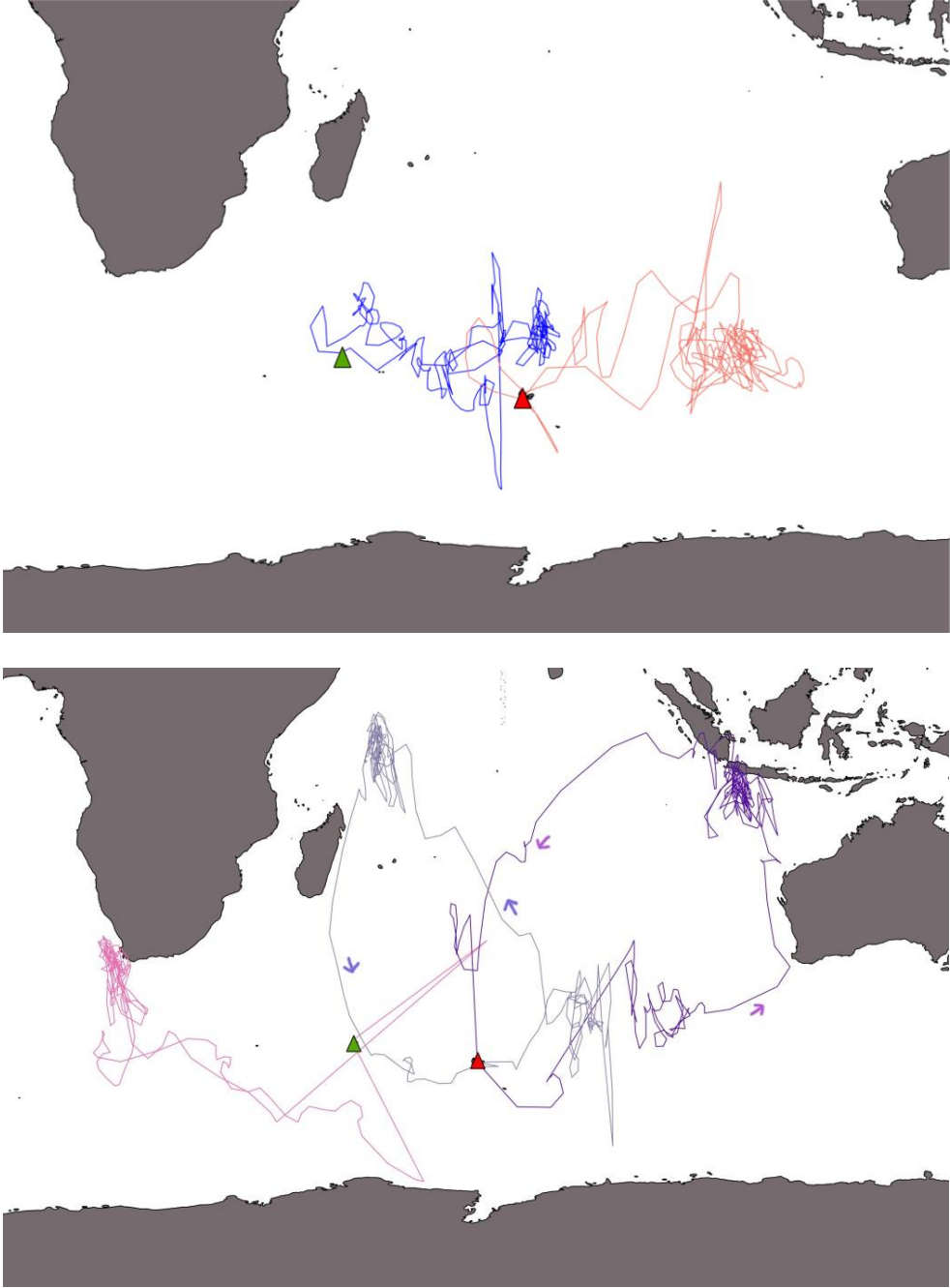


Fig. S2

a) Wintering location (centroids of 50% kernel UD) and b) body feather $\delta^{15}\text{N}$ versus $\delta^{13}\text{C}$ values of four pairs of brown skuas (*Catharacta antarctica lonnbergi*) from Kerguelen Islands. Males (squares) and females (circles) from the same pairs share the same colour. Isotopic values are means \pm SD

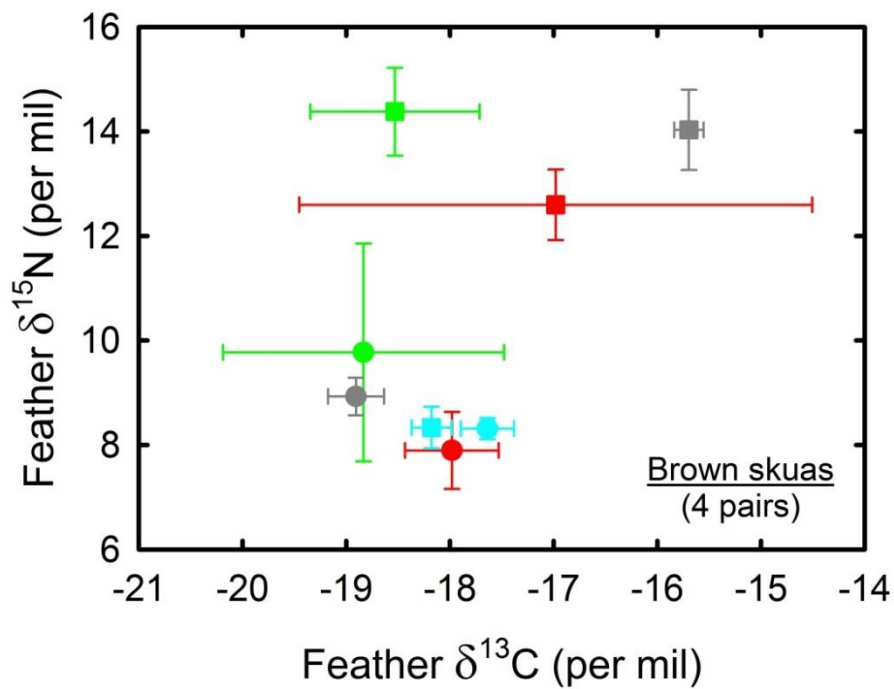
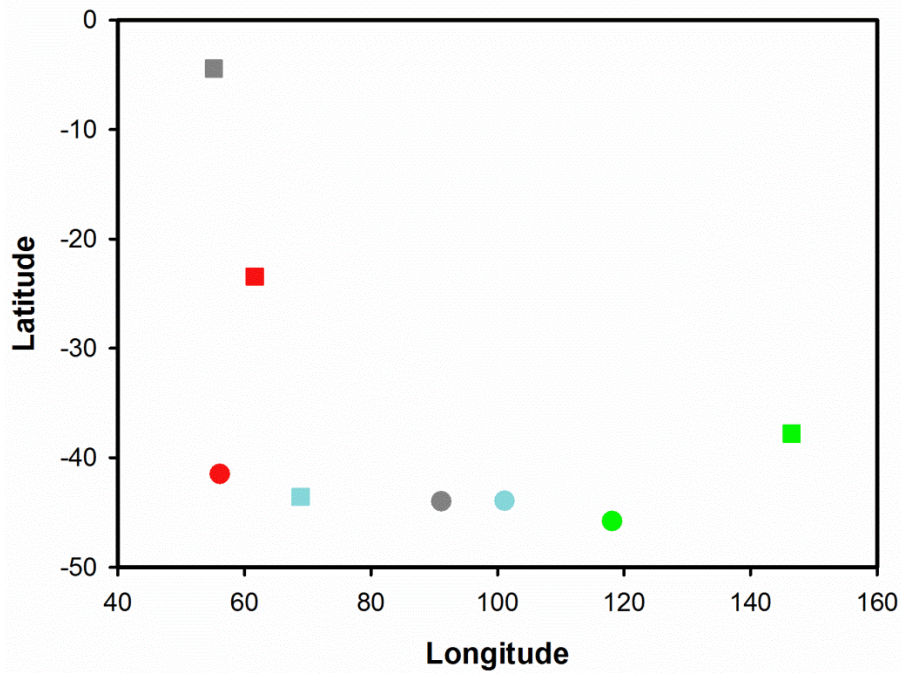


Fig. S3

Activity patterns (daily proportion of time spent on the water) during daytime (a) and during darkness (b) calculated from geolocator-immersion loggers for brown skuas (*Catharacta antarctica lonnbergi*) wintering in sub-Antarctic (black), subtropical (grey) and tropical areas (dark grey). Means are presented \pm SD

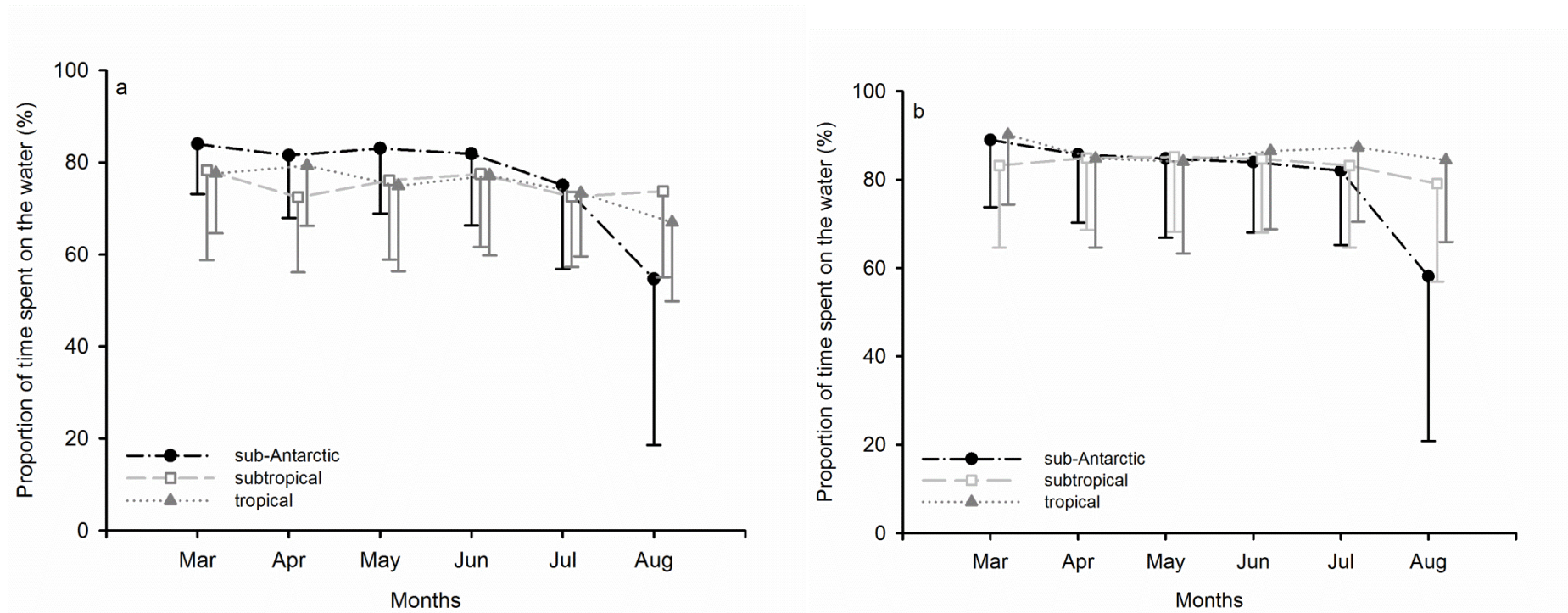


Table S1 Fixed-effect parameter estimates of the generalized linear model describing variation of the migration pattern (departure date of outward migration) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. The variable selected in the best model (see Table 3) and its reference value is female (SexF).

	Value	Std. Error	t-value	p-value
(Intercept)	9,71	0,00	4496,03	0,000
SexM	0,00	0,00	0,10	0,925

Table S2 Fixed-effect parameter estimates of generalized linear model describing variation of the migration pattern (duration of outward migration) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. Variables selected in the best model (see Table 3) and their reference values are female (SexF) and wintering area (sub-Antarctic).

	Value	Std. Error	t-value	p-value
(Intercept)	2,58	0,11	22,91	0,000
SexM	-1,66	0,34	-4,95	0,000
climatesubtropical	0,60	0,14	4,14	0,000
climatetropical	0,74	0,18	4,19	0,000
SexMolM:climatesubtropical	2,02	0,36	5,59	0,000
SexMolM:climatetropical	0,71	0,39	1,83	0,067

Table S3 Fixed-effect parameter estimates of a generalized linear model describing the variation of the migration pattern (arrival date of inward migration) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. The variables selected in the best model (see Table 3) and its reference value is female (SexF).

	Value	Std. Error	t-value	p-value
(Intercept)	9,72	0,00	4528,57	0,000
SexM	0,00	0,00	-0,13	0,893

Table S4 Fixed-effect parameter estimates of a generalized linear model describing the variation of the migration pattern (duration of inward migration) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. Variables selected in the best model (see Table 3) and their reference values are female (SexF) and wintering area (sub-Antarctic).

	Value	Std. Error	t-value	p-value
(Intercept)	2,55	0,11	22,39	0,000
SexM	-0,72	0,23	-3,13	0,002
climatesubtropical	0,60	0,15	4,09	0,000
climatetropical	0,73	0,18	4,06	0,000
SexMolM:climatesubtropical	0,61	0,28	2,20	0,028
SexMolM:climatetropical	0,29	0,29	0,99	0,320

Table S5 Fixed-effect parameter estimates of a linear mixed-effect model of the variation of the activity pattern (mean daily proportion of time spent on the water during daytime) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. Variables selected in the best model (see Table 4) and their reference values are March (month3) and wintering area (sub-Antarctic).

	Value	Std. Error	t-value	p-value
(Intercept)	1,18	0,03	35,95	0,000
month4	-0,04	0,02	-2,00	0,046
month5	-0,02	0,02	-1,09	0,276
month6	-0,03	0,02	-1,29	0,198
month7	-0,11	0,02	-5,77	0,000
month8	-0,43	0,02	-18,34	0,000
climatesubtropical	-0,04	0,05	-0,71	0,487
climatetropical	-0,08	0,05	-1,59	0,128
month4:climatesubtropical	-0,02	0,03	-0,64	0,524
month5:climatesubtropical	-0,03	0,03	-0,79	0,429
month6:climatesubtropical	0,01	0,03	0,18	0,855
month7:climatesubtropical	0,02	0,03	0,56	0,572
month8:climatesubtropical	0,37	0,04	10,32	0,000
month4:climatetropical	0,06	0,03	1,84	0,066
month5:climatetropical	0,00	0,03	-0,01	0,990
month6:climatetropical	0,04	0,03	1,30	0,194
month7:climatetropical	0,06	0,03	1,90	0,057
month8:climatetropical	0,30	0,04	7,83	0,000

Table S6 Fixed-effect parameter estimates of a linear mixed-effect model of the variation of the activity pattern (mean daily proportion of time spent on the water during darkness) for brown skua (*Catharacta antarctica lonnbergi*) from French Southern Territories. Variables selected in the best model (see Table 4) and their reference values are March (month3) and wintering area (sub-Antarctic).

	Value	Std. Error	t-value	p-value
(Intercept)	1,30	0,04	33,00	0,000
month4	-0,04	0,02	-1,53	0,125
month5	-0,04	0,02	-1,46	0,145
month6	-0,04	0,02	-1,79	0,073
month7	-0,09	0,02	-3,49	0,001
month8	-0,47	0,03	-16,13	0,000
climatesubtropical	0,00	0,06	0,01	0,989
climatetropical	0,02	0,06	0,25	0,806
month4:climatesubtropical	-0,03	0,04	-0,73	0,464
month5:climatesubtropical	0,00	0,04	0,06	0,953
month6:climatesubtropical	0,00	0,04	-0,04	0,972
month7:climatesubtropical	0,01	0,04	0,25	0,801
month8:climatesubtropical	0,35	0,04	7,88	0,000
month4:climatetropical	-0,04	0,04	-0,88	0,380
month5:climatetropical	-0,05	0,04	-1,19	0,232
month6:climatetropical	0,00	0,04	0,07	0,942
month7:climatetropical	0,05	0,04	1,19	0,235
month8:climatetropical	0,37	0,05	7,83	0,000

Table S7 Phenology of brown skuas (*Catharacta antarctica lonnbergi*) and their main prey species at the French Southern Territories

Prey species		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
<i>Aptenodytes patagonicus</i>	King Penguin	_ _ _ _ _	v v v v v	o v o v o v o	x o x o x o x	x o x o x o x	x x x x x x x	x x x x x x x	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
<i>Eudyptes chrysolophus</i>	Macaroni penguin		_ _ _	o o _ _ _	x x _ _ _	_ _ _ _ _	_ _ _ _ _	v	<i>Moult</i>				
<i>Eudyptes chrysocome</i>	Rockhopper penguin			_ _ _	o o _ _ _	x x _ _ _	_ _ _ _ _	v v	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
<i>Pygoscelis papua</i>	Gentoo penguin	o x o x o x o	x o x o x o x	o v v x v v v	v v v v v v v	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	o o o o o	x o x
<i>Pachyptila belcheri</i>	Thin-billed prion	_ _ _ _ _	_ _ _ _ _	o o _ _ _	x x x _ _ _	_ _ _ _ _	_ _ _ _ _	v v	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
<i>Halobaena caerulea</i>	Blue petrel	_ _ _ _ _	o o o _ _ _	x x x _ _ _	v v	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	<i>Post-breeding</i>				
<i>Catharacta antarctica lonnbergi</i>	Brown skua	_ _ _ _ _	o o o o o	_ _ x x x	_ _ _ _ _	v v v v v v v	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _

Phenology periods: o: laying; x : hatching; v : fledging; _ : presence on land or at colony