Ecography

ECOG-04560
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Supplementary material

Appendix 1.

Table A1. Phenology of sampled bird species (□: non-breeding; ■: incubation; ■: chick-rearing; ■: post-visit; Capital letters J to D correspond to months January to December).

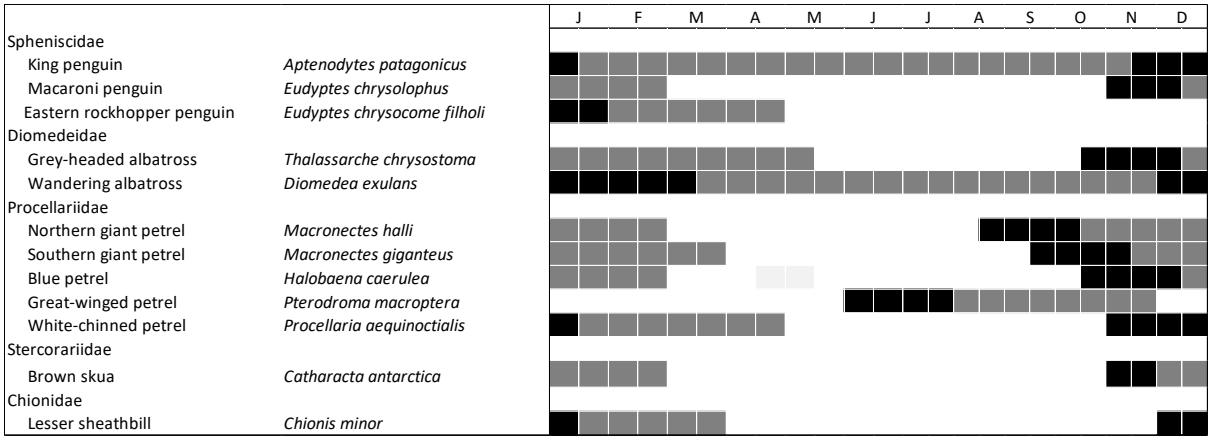


Table A2. Details of the pairwise comparisons with a Bonferroni correction after the PERMANOVA (a) and Kruskal-Wallis test (b) for $\delta^{13}C$ and $\delta^{15}N$ measured in membranes of the 12 bird species. Please see Table 1 for abbreviations.

a)	MP	ERP	GHA	NGP	SGP	WA	LS	GWP	BS	WCP	BP
KP	**0.026**	**0.026**	0.185	1.000	0.290	**0.007**	0.119	**0.026**	**0.020**	**0.026**	**0.007**
MP		**0.020**	**0.007**	**0.007**	**0.007**	**0.007**	**0.026**	**0.007**	**0.007**	**0.007**	**0.007**
ERP			**0.007**	**0.007**	**0.013**	**0.007**	**0.007**	**0.013**	**0.007**	**0.007**	**0.007**
GHA				1.000	**0.007**	**0.007**	**0.013**	**0.007**	**0.013**	**0.007**	**0.007**
NGP					**0.020**	**0.007**	0.106	**0.007**	**0.007**	**0.007**	**0.007**
SGP						**0.007**	**0.013**	**0.007**	**0.007**	**0.013**	**0.007**
WA							**0.007**	**0.007**	**0.007**	**0.007**	**0.007**
LS								**0.007**	1.000	**0.013**	**0.007**
GWP									**0.007**	0.079	**0.007**
BS										**0.007**	**0.007**
WCP											**0.007**

b) $\delta^{13}C$ / $\delta^{15}N$	KP	MP	ERP	GHA	NGP	SGP	WA	LS	GWP	BS	WCP	BP
KP		0.176	0.554	0.554	1.000	1.000	0.051	0.381	0.178	0.343	0.178	0.106
MP	0.178		**0.022**	**0.029**	1.000	**0.012**	**0.008**	1.000	**0.012**	0.335	**0.012**	**0.004**
ERP	0.178	0.076		-	1.000	0.066	**0.003**	0.638	**0.012**	**0.035**	**0.012**	**0.004**
GHA	1.000	**0.012**	**0.012**		1.000	**0.038**	**0.004**	0.843	**0.012**	**0.028**	**0.012**	**0.004**
NGP	1.000	**0.001**	**0.001**	1.000		**0.025**	0.109	-	**0.002**	1.000	**0.001**	**0.000**
SGP	0.178	**0.012**	**0.012**	**0.012**	0.063		**0.001**	0.059	**0.012**	**0.010**	**0.012**	**0.007**
WA	0.051	**0.001**	**0.001**	**0.001**	**0.000**	**0.001**		**0.036**	**0.005**	1.000	**0.001**	**0.000**
LS	0.381	0.050	0.139	0.050	0.053	1.000	**0.008**		0.050	0.393	0.050	**0.024**
GWP	1.000	**0.012**	**0.012**	1.000	1.000	0.187	**0.001**	0.192		**0.023**	0.187	**0.004**
BS	0.959	**0.002**	**0.012**	0.078	0.094	1.000	**0.000**	1.000	0.365		**0.006**	**0.001**
WCP	1.000	**0.012**	**0.012**	1.000	1.000	**0.012**	**0.001**	0.050	1.000	**0.018**		**0.004**
BP	0.106	0.504	**0.012**	**0.004**	**0.000**	**0.004**	**0.000**	**0.024**	**0.004**	**0.001**	**0.004**	

Table A3. Details of the pairwise comparisons with a Bonferroni correction after the PERMANOVA (a) and Kruskal-Wallis test (b) for $\delta^{13}C$ and $\delta^{18}O$ measured in shells of the 12 bird species.

a)	MP	ERP	GHA	NGP	SGP	WA	LS	GWP	BS	WCP	BP
KP	0.053	**0.046**	1.000	1.000	1.000	**0.007**	0.680	**0.020**	**0.007**	**0.026**	1.000
MP		**0.007**	**0.007**	**0.013**	**0.007**	**0.007**	**0.026**	**0.013**	**0.007**	**0.007**	**0.007**
ERP			**0.007**	**0.007**	**0.007**	**0.007**	**0.013**	**0.007**	**0.007**	**0.013**	**0.007**
GHA				1.000	0.284	0.106	0.693	**0.007**	**0.007**	**0.007**	1.000
NGP					0.119	0.330	1.000	**0.007**	**0.007**	**0.007**	0.244
SGP						**0.007**	**0.040**	**0.007**	**0.007**	**0.007**	1.000
WA							**0.013**	**0.007**	**0.007**	**0.007**	**0.007**
LS								**0.020**	**0.040**	**0.013**	**0.007**
GWP									**0.007**	0.125	**0.007**
BS										**0.007**	**0.007**
WCP											**0.007**

b) $\delta^{18}O$ $\delta^{13}C$	KP	MP	ERP	GHA	NGP	SGP	WA	LS	GWP	BS	WCP	BP
KP		0.262	0.178	0.178	1.000	1.000	**0.039**	1.000	0.178	0.082	0.176	0.439
MP	1.000		1.000	**0.012**	**0.001**	**0.012**	**0.000**	1.000	**0.012**	**0.008**	**0.012**	**0.004**
ERP	0.264	0.067		**0.012**	**0.001**	**0.012**	**0.000**	1.000	**0.012**	0.078	**0.012**	**0.004**
GHA	1.000	1.000	**0.012**		0.070	0.086	1.000	0.192	0.303	**0.002**	1.000	1.000
NGP	1.000	0.081	**0.005**	1.000		1.000	**0.000**	0.449	**0.001**	**0.000**	**0.005**	1.000
SGP	1.000	1.000	1.000	0.748	0.108		**0.001**	1.000	**0.012**	**0.002**	**0.022**	1.000
WA	**0.039**	**0.000**	**0.000**	0.454	1.000	**0.001**		**0.018**	**0.036**	**0.000**	0.707	1.000
LS	0.980	0.100	0.050	1.000	1.000	0.263	1.000		0.071	**0.021**	0.099	0.222
GWP	0.178	**0.012**	**0.012**	**0.022**	**0.002**	**0.012**	**0.010**	0.071		**0.002**	1.000	**0.030**
BS	0.149	**0.005**	**0.002**	1.000	1.000	**0.006**	1.000	1.000	0.556		**0.002**	**0.001**
WCP	0.178	**0.012**	**0.012**	**0.012**	**0.001**	**0.012**	**0.001**	0.050	0.238	**0.006**		0.258
BP	1.000	1.000	**0.012**	1.000	0.181	1.000	**0.000**	0.589	**0.004**	**0.004**	**0.004**	

Table A4: Pairwise comparisons of posterior estimates of standard ellipsoid volume (Rossman et al. 2016). The value represents the probability of the standard ellipsoid volume of both groups being different. Values between 0.30 and 0.70 are considered as “low probability of differing”; between 0.00 and 0.29, and 0.71 and 1.00, as “high probability of differing” (Morera-Pujol et al. 2018).

	BP	GWP	GHA	KP	MP	NGP	LS	ERP	SGP	BS	WA	WCP
BP	-	0.36	0.57	**0.11**	0.70	**0.29**	**0.11**	0.63	0.56	**0.01**	**0.90**	**0.06**
GWP	0.64	-	0.69	**0.20**	**0.79**	0.44	**0.20**	**0.74**	0.68	**0.04**	**0.94**	**0.13**
GHA	0.43	0.31	-	**0.10**	0.62	**0.25**	**0.10**	0.56	0.49	**0.01**	**0.84**	**0.05**
KP	**0.89**	**0.80**	**0.90**	-	**0.94**	**0.79**	0.53	**0.92**	**0.90**	**0.28**	**0.99**	0.45
MP	0.30	**0.21**	0.38	**0.06**	-	**0.14**	**0.05**	0.44	0.37	**0.00**	**0.73**	**0.03**
NGP	**0.71**	0.56	**0.76**	**0.21**	**0.86**	-	**0.21**	**0.80**	**0.75**	**0.03**	**0.98**	**0.12**
LS	**0.89**	**0.80**	**0.90**	0.47	**0.95**	**0.80**	-	0.93	**0.90**	**0.23**	**0.99**	0.42
ERP	0.37	**0.26**	0.44	**0.08**	0.56	**0.20**	**0.07**	-	0.44	**0.01**	**0.78**	**0.04**
SGP	0.44	0.32	0.51	**0.10**	0.63	**0.25**	**0.10**	0.56	-	**0.01**	**0.84**	**0.05**
BS	**0.99**	**0.96**	**0.99**	**0.72**	**1.00**	**0.97**	**0.77**	**0.99**	**0.99**	-	**1.00**	**0.71**
WA	**0.10**	**0.06**	**0.16**	**0.01**	**0.27**	**0.02**	**0.01**	**0.22**	**0.16**	**0.00**	-	**0.00**
WCP	**0.94**	**0.88**	**0.95**	0.55	**0.97**	**0.88**	0.58	**0.96**	**0.95**	**0.29**	**1.00**	-

Table A5. Details of the pairwise comparisons of posterior estimates of centroid locations (Rossman et al. 2016). The value represents the probability of the centroid locations of both groups being different. Values between 0.30 and 0.70 are considered as “low probability of differing”; between 0.00 and 0.29, and 0.71 and 1.00, as “high probability of differing” (Morera-Pujol et al. 2018).

	GWP	GHA	KP	MP	NGP	LS	ERP	SGP	BS	WA	WCP
BP	**1.00**	**1.00**	**0.99**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
GWP		**1.00**	**0.99**	**1.00**	**0.99**	**0.99**	**1.00**	**1.00**	**1.00**	**1.00**	**0.83**
GHA			0.57	**1.00**	0.55	**0.94**	**1.00**	**0.92**	**1.00**	**1.00**	**1.00**
KP				**0.98**	0.64	0.65	**0.95**	0.37	**0.97**	**1.00**	**1.00**
MP					**1.00**	**0.81**	0.60	**1.00**	**0.99**	**1.00**	**1.00**
NGP						**0.85**	**1.00**	**0.96**	**1.00**	**1.00**	**1.00**
LS							**0.74**	**0.88**	**0.88**	**1.00**	**1.00**
ERP								**1.00**	**0.99**	**1.00**	**1.00**
SGP									**1.00**	**1.00**	**1.00**
BS										**1.00**	**1.00**
WA											**1.00**

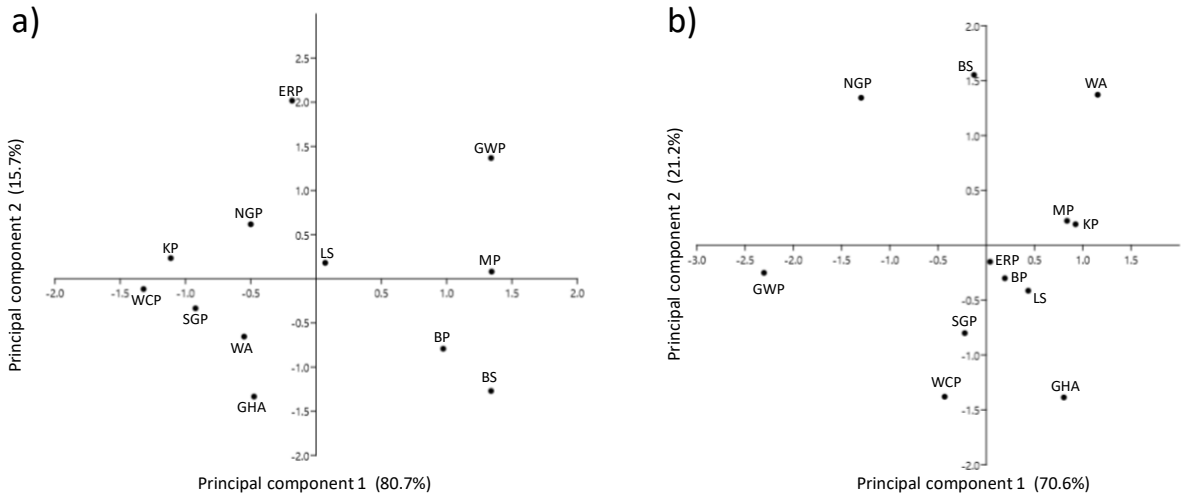


Figure A1. Principal component analyses conducted using the isotopic metrics (divergence, dispersion, evenness, uniqueness) calculated for egg (a) membranes and (b) shells. See Table 1 for species abbreviations.

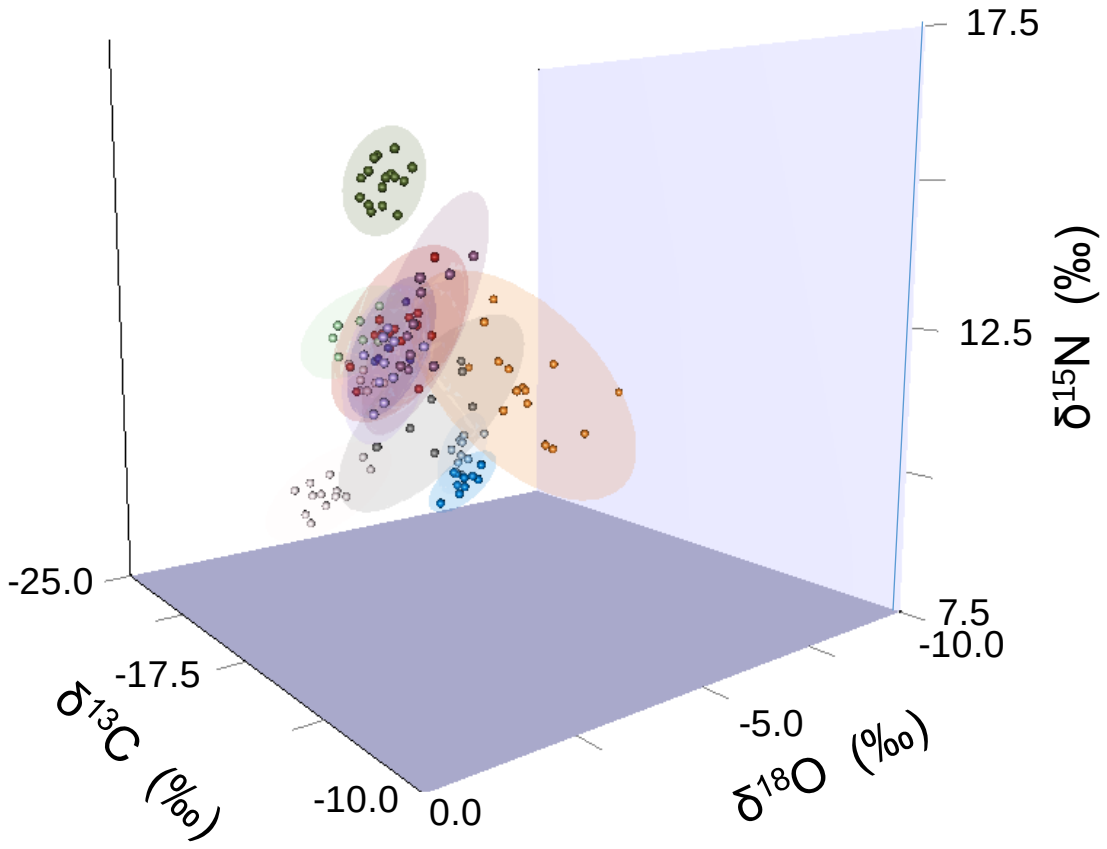
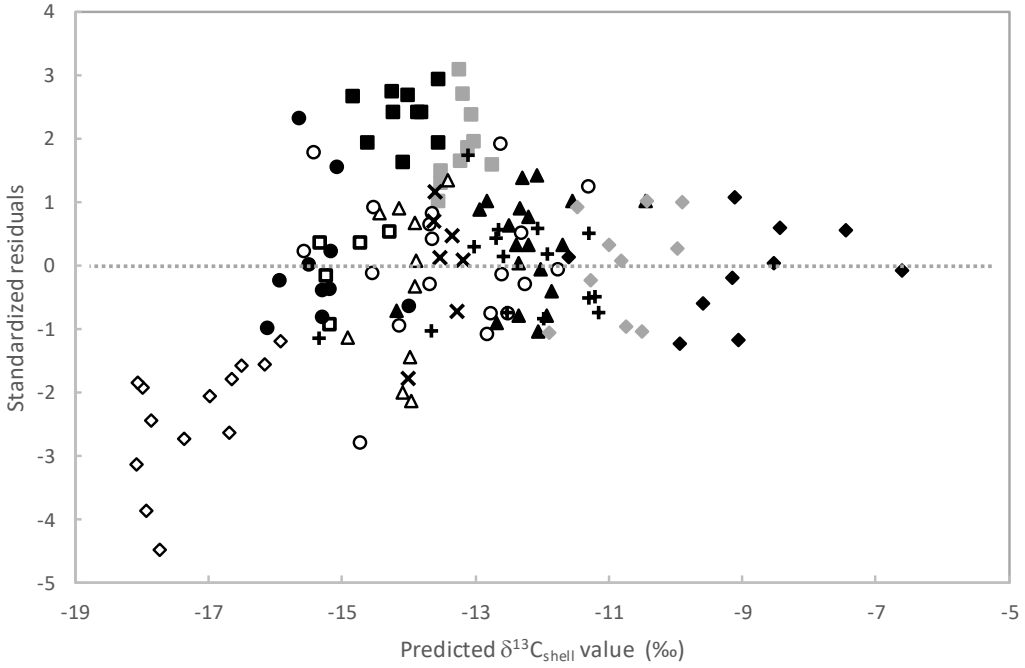


Figure A2. 3D projection of $\delta^{13}C_{memb}$, $\delta^{15}N$ and $\delta^{18}O$ for the 12 bird species breeding on Marion Island. Grey: lesser sheathbill; orange: brown skua; dark green: wandering albatross; light green: grey-headed albatross; dark red: northern giant petrel; light red: southern giant petrel; dark purple: white-chinned petrel; purple: great-winged petrel; light purple: blue petrel; dark blue: king penguin; blue: macaroni penguin; light blue: eastern rockhopper penguin.

Figure A3. Standardized residuals calculated between predicted and measured $\delta^{13}C_{shell}$. If an individual has a standardized residual of 0, it means that the carbons in both tissues are very likely coming from the same pool. See Table 1 for species symbols.



References

Morera-Pujol, V.et al. 2018. Multi-isotopic assessments of spatio-temporal diet variability: the case of two sympatric gulls in the western Mediterranean. – Mar. Ecol. Prog. Ser. 606: 201-214.

Rossman, S. et al. 2016. Beyond carbon and nitrogen: guidelines for estimating three-dimensional isotopic niche space. – Ecol. Evol. 6: 2405-2413.