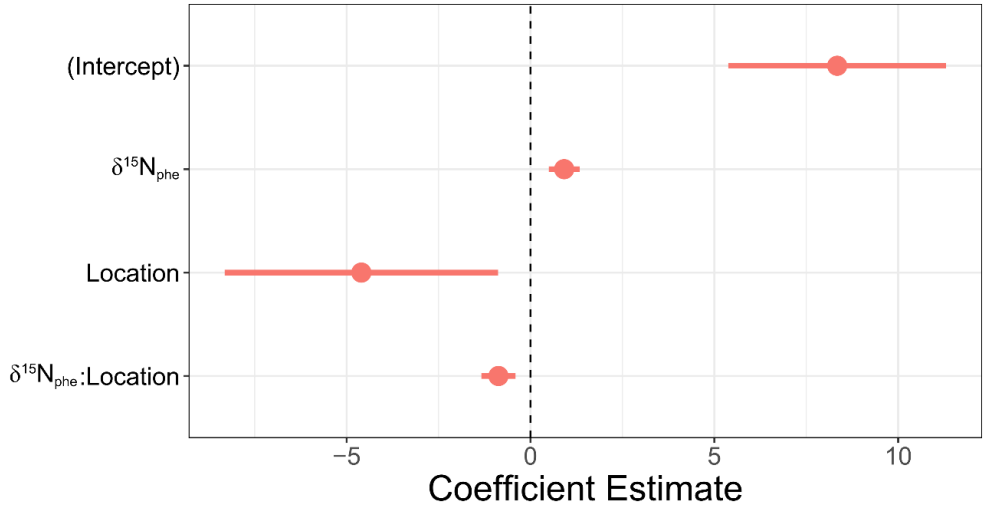

Fig. S1. Parameter estimates and 95% confidence intervals from the full LME model testing the effect of $\delta^{15}N$ values of phenylalanine ($\delta^{15}N_{phe}$), location, and an interaction term ($\delta^{15}N_{phe}$:Location) on $\delta^{15}N_{bulk}$ values from lower squid beaks. The model included the random effect of field season.

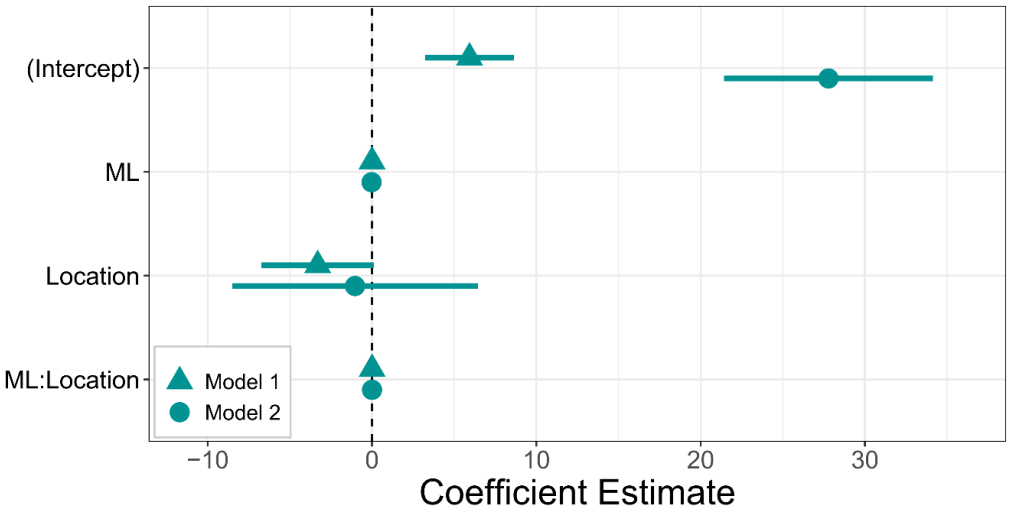

Fig. S2. Results from LME models testing the effect of mantle length (ML), location, and an interaction term (ML:Location) on $\delta^{15}N_{bulk}$ values (Model 1) and relative trophic position (RTP; Model 2). In each case, parameter estimates and standard errors with 95% confidence intervals are for the full models. Both models included the random effects of species and field season.

Table S1. Allometric equations used for the conversion of lower rostral length (LRL, in mm) to mantle length (ML, in mm) retrieved from the SCAR Southern Ocean Diet and Energetics Database (Scientific Committee on Antarctic Research 2018) using the R package *solong* pack (Raymond 2021).

Species	Equation	Reference
Alluroteuthis antarcticus	ML = -4.301 + 34.99 x LRL	(Piatkowski et al. 2001)
Filippovia knipovitchi	ML = -105.707 + 62.369 x LRL	(Xavier & Cherel 2021)
Gonatus antarcticus	ML = -43.4 + 42.87 x LRL	(Clarke 1986)[a]
Histioteuthis eltaninae	ML = -3.65 + 24.48 x LRL	(Lu & Ickeringill 2002)
Martialia hyadesi	ML = 102 + 29.47 x LRL	(Rodhouse & Yeatman 1990)
Brachioteuthis linkovskyi	ML = 16.31 + 20.18 x LRL	(Clarke 1986)

[a]based on *Gonatus* spp.

Table S2. Summary from candidate LME model comparisons. Models were tested with varying combinations of predictors (fixed effects) which included $\delta^{15}N$ values of phenylalanine (a *source* amino acid; $\delta^{15}N_{phe}$), location and an interaction term ($\delta 15N_{phe}$:Location) for (a) $\delta^{15}N_{bulk}$, and mantle length (ML) calculated from allometric equations (Table S1), location, and an interaction term (ML:Location) for (b) $\delta^{15}N_{bulk}$ and (c) relative trophic position (RTP). Random effects included field season for models in (a), and species and field season for models in (b) and (c). Best performing models are highlighted in bold.

Response	Predictors	K	AIC	ΔAIC	Marginal r^2/Conditional r^2
a) Beak $\delta^{15}N_{bulk}$	**$\delta^{15}N_{phe}$ + Location + $\delta^{15}N_{phe}$:Location**	**6**	**112.12**	**0.00**	**0.47/0.76**
	$\delta^{15}N_{phe}$	4	117.70	5.59	0.11/0.50
	Location	4	466.74	354.62	0.37/0.65
	Intercept only	3	466.86	354.74	0.00/0.64
b) Beak $\delta^{15}N_{bulk}$	**ML**	**5**	**351.98**	**0.00**	**0.06/0.88**
	ML + Location	6	352.23	0.25	0.28/0.89
	ML + Location + ML:Location	7	352.49	0.51	0.28/0.89
	Location	5	355.73	3.75	0.31/0.86
	Intercept only	4	356.34	4.36	0.00/0.85
c) RTP ($\delta^{15}N_{Glx - Phe}$)	**ML**	**5**	**136.46**	**0.00**	**0.24/0.81**
	ML + Location	6	139.54	3.09	0.24/0.81
	Intercept only	4	142.58	6.12	0.00/0.72
	ML + Location + ML:Location	7	143.24	6.78	0.24/0.81
	Location	5	145.57	9.11	0.04/0.72

Table S3. Comparison of relative trophic position (RTP) estimates and trophic position estimates from compound specific isotope analysis (TP_{CSIA}) for Macquarie Island and Kerguelen Islands. Values are range, mean and sample size (n). TP_{CSIA} was calculated according to Cherel et al. (2019). Also shown for further comparison are mean trophic position estimates using bulk $\delta^{15}N$ (TP_{bulk}) values of squid beaks (chitin corrected) as presented in Cherel et al. (2008).

	Macquarie Island			Kerguelen Islands			Cherel et al. (2008)
	RTP	TP_{CSIA}		RTP	TP_{CSIA}		TP_{bulk}
Species	Range	Range	Mean (n)	Range	Range	Mean (n)	Mean (n)
Alluroteuthis antarcticus	22.1 - 23.8	4.3 – 4.7	4.5 (4)	23.4 – 26.9	4.6 – 5.3	4.9 (2)	NA
Filippovia knipovitchi	20 – 24.6	3.9 – 4.8	4.5 (5)	20.9	4.1		4.4 (5)
Gonatus antarcticus	26.9 – 27.2	5.3 – 5.3	5.3 (2)	23.8 – 25.4	4.7 – 5.0	4.9 (3)	5.2 (10)
Histioteuthis eltaninae	23.2 – 24.3	4.5 – 4.8	4.7 (2)	21.8	4.3		4.2 (10)
Martialia hyadesi	12 – 18.6	2.3 – 3.6	3.0 (4)	14.2 – 19	2.7 – 3.7	3.2 (2)	3.4 (10)
Brachioteuthis linkovskyi	22.3	4.4					NA

Table S4. Species-specific linear regression models testing for ontogenetic shifts in diet using lower rostral length (mm) as a predictor of $\delta^{15}N_{bulk}$ values (proxy for trophic position). * Indicates a statistically significant relationship ($p < 0.05$).

	Kerguelen Islands					**Macquarie Island**				
Species	Intercept (SE)	Slope (SE)	*F* statistic	r^2	p-value	Intercept (SE)	Slope (SE)	*F* statistic	r^2	p value
Alluroteuthis antarcticus	4.919 (1.6)	0.315 (0.3)	$F_{1,8} = 1.31$	0.14	0.285	-0.710 (2.3)	1.171 (0.5)	$F_{1,10} = 6.22$	0.38	< 0.05*
Filippovia knipovitchi	5.215 (1.7)	0.261 (0.2)	$F_{1,8} = 1.41$	0.15	0.270	3.108 (1.4)	0.376 (0.3)	$F_{1,12} = 1.80$	0.13	0.205
Gonatus antarcticus	8.836 (1.3)	–0.005 (0.2)	$F_{1,8} = 0.00$	9.11×10^{-5}	0.980	3.881 (1.6)	0.385 (0.3)	$F_{1,5} = 1.24$	0.20	0.317
Histioteuthis eltaninae	4.325 (1.0)	0.796 (0.3)	$F_{1,13} = 5.93$	0.31	0.030*	-0.825 (3.6)	1.856 (1.1)	$F_{1,8} = 3.05$	0.28	0.119
Martialia hyadesi	2.121 (2.0)	0.167 (0.3)	$F_{1,8} = 0.26$	0.03	0.625	-1.661 (2.3)	0.517 (0.3)	$F_{1,12} = 1.85$	0.13	0.120
Brachioteuthis linkovskyi						-5.863 (6.1)	2.776 (1.6)	$F_{1,8} = 3.08$	0.28	0.117

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