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Short Note

Fatty acid trophic transfer of Antarctic algae to a sympatric amphipod consumer

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Introduction

The shallow benthos along the western Antarctic Peninsula supports brown macroalgal forests with dense amphipod assemblages, commonly including *Gondogeneia antarctica* (Amsler *et al.* 2014). *G. antarctica* and most other amphipods are chemically deterred from consuming the macroalgae (Amsler *et al.* 2014). They primarily consume diatoms, other microalgae, filamentous macroalgae, and a few undefended macroalgal species, including *Palmaria decipiens* (Aumack *et al.* 2017). Although unpalatable when alive, *G. antarctica* and other amphipods will consume the chemically defended brown algae *Himantothallus grandifolius* and *Desmarestia anceps* within a few weeks of death (Amsler *et al.* 2014).

Fatty acids (FA) may be used as 'biomarkers' for tracing trophic pathways in basal consumers (Galloway *et al.* 2014, Aumack *et al.* 2017) although this is poorly characterized in

Antarctica. This experiment compared the FA composition of *G. antarctica* after nine weeks of feeding on diatoms, *P. decipiens*, and aged (freeze-killed) *D. anceps* and *H. grandifolius*.

Materials and Methods

D. anceps, *H. grandifolius, P. decipiens,* epilithic diatom assemblages, and *G. antarctica* were collected near Palmer Station (64° 46' S, 64° 03' W) in March 2017. Living *D. anceps* and *H. grandifolius* are not palatable so material fed to amphipods was freeze-killed. Macroalgae were then thawed in vented plastic bags in 19-L buckets maintained at 1–2°C until being offered to amphipods. Macroalgal samples were collected for FA analysis prior to ('live' throughout) and following the freeze-kill procedure ('dead' throughout) for *D. anceps* and *H. grandifolius*. Only live diatoms and *P. decipiens* tissue were used.

Haphazardly selected subsets (N=15) of adult amphipods were starved for one week before allocation to 250-ml bottles in their respective diet treatments with another subset analyzed to characterize 'wild' amphipod FA profiles. Amphipods were initially maintained in an environmental room (1±0.5 °C) with tissue from dead *D. anceps* or *H. grandifolius* or with live diatoms or *P. decipiens*. Due to high mortality rates with the dead algae after 3.5 weeks, all amphipods were pooled by diet and transferred to 4-L bottles fitted with mesh screens in a flow-through ambient seawater table (1–2 °C) for an additional 5.5 weeks, then starved for three days to clear their digestive systems before being frozen at -80°C. No growth or ingestion metrics were recorded.

Samples of each alga and three sets of pooled samples of amphipods fed each diet were lyophilized, homogenized, lipid extracted, and transesterified to produce quantitative measurements ($\mu g\ mg^{-1}$) of FA methyl esters for analysis by gas chromatography mass

spectrometry using internal and external standards (Taipale *et al.* 2016). Proportional FA profiles were analyzed using permutational multivariate analysis of variance (PERMANOVA), similarity percentage (SIMPER), and non-metric multidimensional scaling (nMDS) in Primer v6.1.13 with the PERMANOVA+ v.1.0.3, as described in Kelly and Scheibling (2012). Differences in the untransformed FA profiles of fresh and dead macroalgae and amphipods fed dead macroalgae were analyzed with PERMANOVA (9999 permutations, Type III SS). FA results were not sensitive to transformation and all analyses used Euclidean distance.

Results and Discussion

The FAs of *G. antarctica* differed according to algal diet (Fig. 1). The FA profiles of the algae, dead and alive, differed from amphipods that had been maintained on a given alga (Fig. 1, Table S1; p=0.001). Detailed PERMANOVA results are in Table S1 and FA proportion and concentration tables are in Tables S2- S5. The macroalgae and amphipod FA had little overlap with wild amphipods and those maintained on monoculture diets fell inside the resource triangle of the diets tested (Fig. 1). Organismal FA profiles commonly group based on phylogenetic relationships (Kelly & Scheibling 2012) so the lack in overlap between macroalgae and amphipods was not surprising.

Within the algal FA profiles, there was clear separation between the FA of the algal diets (Fig. 1, Table S1, p=0.001) and between the live and dead macroalgae (Table S1, p=0.001). There was a significant interaction between macroalgal species and whether the tissue was live or dead (Table S1, p=0.001), indicating that not all of the FAs changed in the same way when macroalgae were freeze-killed. Similar to the macroalga comparisons, amphipod FAs differed based on diet (Fig. 1, Table S1, p=0.001). By the end of the feeding trial the amphipod FAs had

changed from their initial 'wild' profiles and these changes were driven by several FAs frequently used as trophic biomarkers (Fig. 1).

Common FAs that have been used as biomarkers for differentiating diatoms (16:1ω7, 16:0, and 16:3ω4), brown (18:1ω9 and 20:4ω6), and red macroalgae (e.g., particularly 20:5□3; Kelly & Scheibling 2012). Eicosapentaenoic acid (20:5ω3) is an essential FA found in many primary producers but often occur in the highest proportions in red macroalgae (Kelly & Scheibling 2012), and was a strong driver of the FA results in our experiment (Fig. 1). There was clear separation between amphipods fed macroalgae or diatoms but due to their higher proportions of 20:5ω3 than their diet tissues (Tables S2, S3), amphipods tended to group more closely to the tissues of *P. decipiens* (Fig. 1), suggesting that 20:5ω3 can be either synthesized or selectively retained by amphipods. *G. antarctica* fed *H. grandifolius* and *P. decipiens* also had higher 20:5ω3 than amphipods maintained on other diets (Table S3, S5).

The low variation within a treatment group for wild and lab maintained amphipods suggest that wild *G. antarctica* are consuming similar diets, with high proportions of diatoms, as suggested by Aumack *et al.* (2017). The present results suggest that diatoms do not make up the entire diet of *G. antarctica*, evidenced by the consistent shift of wild amphipods to the right on the nMDS plot, and similarly correlated with increased proportion of 20:5ω3 (Fig. 1). This work demonstrates the clear assimilation of dietary FA in an Antarctic amphipod and demonstrates that the amphipods ordinate within the 'resource library' of likely algal food sources for wild individuals (e.g., Galloway *et al.* 2014).

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Author Contributions

AWEG, CDA, MOA, and JBM developed the experimental design, MOA and CDA performed field experiments, JBS performed FA extractions, data analysis, and wrote the first draft. All authors contributed to preparing the final manuscript.

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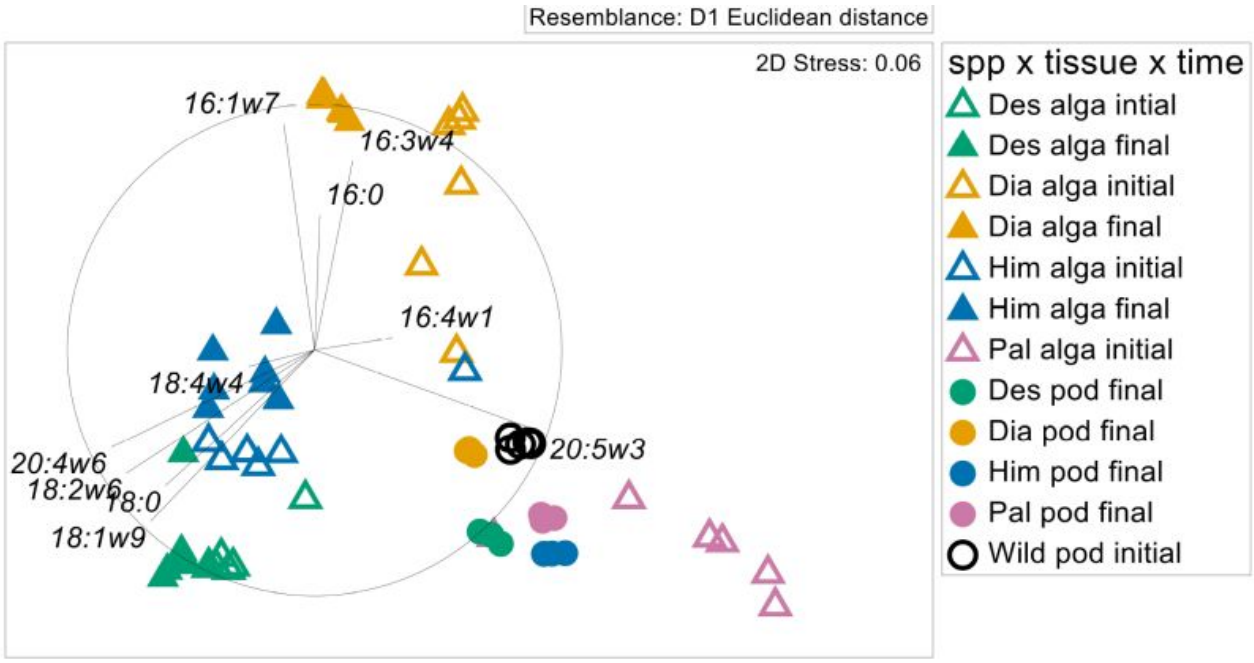
Figure legend

Figure 1. nMDS plot of FA profiles of macroalgae and amphipods fed experimental diets (Des = *Desmarestia anceps,* Him = *Himantothallus grandifolius,* Pal = *Palmaria decipiens,* Dia = diatoms; alga = algal tissue, pod = amphipod tissue; live = fresh, live tissue, dead = freeze-killed macroalgal tissue) with a vector overlay indicating the top 5 FA identified by SIMPER as contributing to the dissimilarity between treatment groups. Note: 'wild pod' treatment group represents initial collections.



Supplementary material

Fatty acid extraction method

Collected macroalgal and amphipod samples were kept frozen until lyophilization and FA analysis at the Oregon Institute of Marine Biology (OIMB). Following lyophilization, samples of each macroalga and three sets of pooled samples of amphipods fed each diet were homogenized, lipid extracted, and transesterified to produce fatty acid methyl esters (FAME) for analysis (Taipale et al. 2016). During the initial lipid extraction, we added C19:0 as an internal standard to each sample. To extract total lipids, homogenized tissue samples were digested in a 4:2:1 chloroform: methanol:0.9% NaCl solution twice. From the resulting pooled organic layers, 1-ml was removed for transesterification, evaporated under N_2 flow, and the organics were re-suspended in a toluene and 1% sulfuric-acid methanol solution and maintained at 90°C for 90 min to trans-esterify FAME. FAME solutions were then neutralized with 2% $KHCO_3$, diluted with hexane, vortexed, and centrifuged before carefully transferring the FAME layer to 2-ml glass vials for gas chromatography. FAME dissolved in hexane were analyzed, identified, and quantified using gas chromatography mass spectrometry following Taipale et al. (2016). We quantitatively measured FAME concentrations using a serial dilution of a mixed external FA standard (Nu-chek Prep 566C) and calculated relative proportions of each identified FA from the area under each sample peak.

References

TAIPALE, S.J., HILTUNEN, M., VUORIO, K. & PELTOMAA, E. 2016. Suitability of phytosterols alongside fatty acids as chemotaxonomic biomarkers for phytoplankton. *Frontiers in Plant Science*, **7**, 212.

Table S1. Results of PERMANOVA analysis of proportions of identified FA contributing ≥ 1% of identified FA for macroalgae and *G. antarctica* (data untransformed, Euclidean distance) for comparisons between tissue types (alga vs. amphipod), algal species (live vs. dead for macroalgae and initial vs. final for diatoms), and amphipods maintained on experimental diets.

Source	**df**	**SS**	**MS**	**Pseudo-F**	**P(perm)**	**Unique perms**
Macroalga/amphipod tissue	1	5453	5453	12	0.0001*	9945
Residuals	60	27676	461			
Total	61	33128				
Macroalga species	3	19229	6410	81	0.0001*	9934
Live/Dead	1	1233	1233	16	0.0001*	9960
Interaction	2	1140	570	7	0.0001*	9929
Residuals	37	2938	79			
Total	43	26599				
Amphipod diet	4	1062	265	230	0.0001*	9949
Residuals	13	15	1			
Total	17	1077				

Table S2. The fatty acid (FA) composition of tissues from Antarctic macroalgae. The mean ± standard deviation (sd) are reported as a proportion of FA identified. FA that contributed to ≥ 1% for at least one tissue type analyzed (for macroalgae or amphipods) are reported. --- indicates instances in which FA proportions were < 0.001.

	Desmarestia				diatom				*Himantothallus*				*Palmaria*	
	live (N = 6)		dead (N = 7)		initial (N = 6)		final (N = 6)		live (N = 6)		dead (N = 7)		live (N = 6)	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
14:0	6.0	1.0	6.4	1.4	8.2	2.0	8.1	0.4	5.6	1.0	5.0	0.6	4.8	2.1
16:0	8.8	3.2	10.1	6.5	18.0	0.8	19.7	0.5	19.8	1.5	24.1	2.0	15.7	2.1
16:1ω7	4.6	0.9	5.3	0.9	18.1	3.6	37.6	1.1	7.9	5.6	14.4	3.8	3.9	2.3
16:1ω5	1.0	0.3	1.1	0.5	0.4	0.1	0.6	0.0	1.9	0.9	1.8	0.7	0.2	0.1
16:3ω4	0.3	0.3	0.0	0.0	23.8	6.2	9.0	0.4	0.7	1.4	0.2	0.2	0.1	0.1
16:4ω1	---	---	---	---	0.7	0.4	0.8	0.0	0.0	0.0	---	---	0.1	0.3
18:0	8.1	2.9	9.6	3.5	1.2	0.4	0.6	0.1	2.9	0.9	2.3	0.3	1.6	0.5
18:1ω9	22.0	3.5	24.8	1.9	4.2	3.0	1.6	0.2	13.1	3.6	13.4	2.4	5.6	4.2
18:1ω7	0.5	0.3	0.6	0.5	1.9	1.9	1.0	0.1	0.6	0.2	2.2	1.4	3.1	1.4
18:2ω6	9.0	2.1	9.0	2.3	0.7	0.1	0.7	0.0	4.4	1.5	3.7	0.4	0.9	0.4
18:3ω6	0.5	0.1	0.5	0.1	0.3	0.0	3.2	0.1	0.0	0.0	---	---	0.0	0.1
18:3ω3	4.5	0.5	3.4	0.4	1.3	0.2	0.5	0.0	4.9	1.7	3.6	0.7	0.3	0.2
18:4ω4	4.2	1.5	2.0	0.6	0.8	0.5	2.2	0.1	3.7	0.9	2.6	1.0	0.4	0.3
20:0	2.1	0.7	2.8	0.7	0.1	0.0	0.0	0.0	1.5	0.5	1.8	0.8	0.1	0.0
20:1ω9	0.0	0.0	0.1	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.2	1.0	0.3
20:3ω6	1.3	0.4	1.5	0.5	---	---	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.2
20:4ω6	13.9	1.7	13.4	1.2	1.4	0.2	1.0	0.1	14.4	5.6	11.5	2.6	1.1	2.2
20:5ω3	10.9	2.2	7.1	1.0	13.7	4.7	11.3	0.6	11.8	7.8	6.7	1.9	48.8	10.3
22:1ω9	0.6	0.8	0.3	0.2	0.0	0.0	---	---	2.5	1.7	2.2	0.6	4.6	3.0
22:2ω6	---	---	---	---	0.2	0.1	0.1	0.0	0.0	0.0	---	---	0.1	0.2
24:0	0.0	0.0	---	---	0.8	1.5	0.1	0.0	2.4	1.2	1.8	0.5	0.3	0.6
ω-3	15.3	2.6	10.5	1.4	15.0	5.0	11.8	0.6	16.7	9.6	10.3	2.6	49.1	10.5
ω-6	10.3	2.5	10.5	2.8	0.9	0.2	0.8	0.0	4.5	1.6	3.7	0.5	1.1	0.8
ω-3: ω-6	1.5	1.0	1.0	0.5	17.3	31.6	14.5	12.6	3.7	5.9	2.8	4.8	44.9	13.2
SAFA	25.1	7.9	29.0	12.1	28.3	4.8	28.6	1.0	32.1	5.0	35.0	4.2	22.6	5.3
MUFA	28.7	5.8	32.2	3.9	24.8	8.8	40.7	1.5	26.0	12.1	34.2	9.0	18.4	11.3
PUFA	35.6	6.5	27.9	3.7	42.0	12.3	28.0	1.3	35.6	17.6	24.7	6.5	51.0	13.7
LCPUFA	26.2	4.2	22.0	2.7	15.1	5.0	12.3	0.7	26.2	13.6	18.3	4.6	50.1	12.6

Table S3. The fatty acid (FA) composition of tissues from *Gondogeneia antarctica* maintained on experimental diets. The mean ± standard deviation (sd) are reported as a proportion of FA identified. FA that contributed to ≥ 1% for at least one tissue type analyzed (for macroalgae or amphipods) are reported. Pseudo N refers to the number of amphipods analyzed from each treatment because amphipods were not maintained individually for the full duration of the experimental period. --- indicates instances in which FA proportions were < 0.001.

	wild		*Desmarestia*		diatom		*Himantothallus*		*Palmaria*	
	pseudo N = 6		pseudo N = 3		pseudo N = 3		pseudo N = 3		pseudo N = 3	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
14:0	2.5	0.1	0.8	0.1	1.6	0.0	0.2	0.0	1.4	0.1
16:0	12.7	0.2	14.4	0.2	15.8	0.2	14.9	0.3	15.4	0.1
16:1ω7	8.5	0.2	2.5	0.3	10.6	0.3	0.6	0.0	3.7	0.3
16:1ω5	0.2	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0
16:3ω4	2.5	0.2	0.3	0.1	3.1	0.1	---	---	0.7	0.1
16:4ω1	7.9	0.3	0.6	0.2	0.5	0.0	---	---	1.5	0.2
18:0	1.1	0.1	2.5	0.0	2.0	0.0	2.7	0.2	2.0	0.1
18:1ω9	7.0	0.6	14.0	0.1	11.3	0.1	13.1	0.3	12.0	0.2
18:1ω7	3.5	0.1	3.4	0.0	3.8	0.0	3.0	0.1	4.2	0.1
18:2ω6	1.4	0.2	1.8	0.1	1.0	0.0	0.8	0.0	1.1	0.0
18:3ω6	0.6	0.0	0.1	0.0	1.0	0.0	0.0	0.0	0.2	0.0
18:3ω3	1.8	0.2	0.8	0.1	0.5	0.0	0.3	0.0	0.6	0.1
18:4ω4	6.6	0.2	1.0	0.2	1.0	0.0	0.1	0.0	1.6	0.3
20:0	0.0	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0
20:1ω9	0.7	0.0	1.2	0.0	1.1	0.0	1.3	0.0	1.6	0.1
20:3ω6	0.2	0.0	0.3	0.0	0.2	0.0	0.1	0.0	0.2	0.0
20:4ω6	0.6	0.0	5.5	0.1	1.9	0.1	3.0	0.2	1.1	0.1
20:5ω3	29.1	0.9	31.8	1.0	27.7	0.5	36.7	1.0	34.8	0.8
22:1ω9	0.2	0.0	0.2	0.0	0.2	0.0	0.1	0.0	0.5	0.0
22:2ω6	1.1	0.1	0.5	0.0	0.7	0.0	0.4	0.0	0.7	0.0
24:0	1.1	0.1	1.5	0.1	1.5	0.1	1.6	0.0	1.9	0.2
ω-3	30.9	1.0	32.6	1.1	28.2	0.5	37.0	1.0	35.4	0.8
ω-6	2.8	0.3	2.6	0.1	1.9	0.0	1.3	0.1	2.0	0.1
ω-3: ω-6	11.2	3.3	12.7	8.9	14.9	17.5	29.0	14.2	18.2	14.7
SAFA	17.5	0.4	19.4	0.4	20.9	0.3	19.4	0.6	20.8	0.5
MUFA	19.9	0.9	21.4	0.5	27.1	0.5	18.2	0.5	22.1	0.6
PUFA	49.3	1.8	40.5	1.6	36.0	0.8	40.1	1.3	40.6	1.4
LCPUFA	29.8	0.9	37.6	1.1	29.8	0.6	39.8	1.2	36.1	0.8

Table S4. The concentration of fatty acids (FA) in tissues from Antarctic macroalgae (mean ± sd, μg mg^{-1} dry tissue). FA that contributed to ≥ 1% for at least one tissue type analyzed (for macroalgae or amphipods) are reported. --- indicates instances in which FA concentrations were < 0.001.

	Desmarestia				diatom				*Himantothallus*				*Palmeria*	
	initial (N = 6)		final (N = 7)		initial (N = 6)		final (N = 6)		initial (N = 6)		final (N = 7)		initial (N = 6)	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
14:0	1.12	0.68	1.94	0.66	0.51	0.07	1.25	0.08	0.11	0.05	0.12	0.03	0.20	0.05
16:0	1.50	0.75	2.76	0.82	1.20	0.48	3.03	0.18	0.39	0.16	0.58	0.14	1.26	1.76
16:1ω7	0.95	0.68	1.74	0.85	1.14	0.22	5.79	0.37	0.18	0.20	0.34	0.09	0.26	0.31
16:1ω5	0.18	0.09	0.33	0.12	0.03	0.01	0.09	0.00	0.04	0.02	0.04	0.02	0.01	0.01
16:3ω4	0.04	0.03	0.01	0.01	1.48	0.28	1.39	0.06	0.02	0.04	0.00	0.00	0.02	0.04
16:4ω1	---	---	---	---	0.05	0.06	0.13	0.00	---	---	---	---	0.04	0.09
18:0	1.79	1.36	3.30	1.86	0.09	0.06	0.10	0.01	0.05	0.01	0.06	0.01	0.18	0.33
18:1ω9	4.52	2.90	7.90	3.28	0.34	0.42	0.24	0.02	0.24	0.09	0.32	0.08	0.90	1.88
18:1ω7	0.08	0.05	0.21	0.22	0.17	0.25	0.15	0.02	0.01	0.01	0.05	0.03	0.28	0.44
18:2ω6	1.90	1.28	3.01	1.50	0.05	0.03	0.10	0.00	0.08	0.04	0.09	0.02	0.12	0.22
18:3ω6	0.11	0.07	0.15	0.08	0.02	0.01	0.49	0.03	0.00	0.00	---	---	0.01	0.02
18:3ω3	0.84	0.46	1.08	0.48	0.08	0.02	0.07	0.00	0.09	0.03	0.09	0.03	0.05	0.10
18:4ω4	0.71	0.32	0.62	0.23	0.07	0.07	0.34	0.01	0.07	0.02	0.06	0.04	0.06	0.14
20:0	0.47	0.36	0.95	0.49	0.00	0.00	0.01	0.00	0.03	0.01	0.04	0.03	0.01	0.02
20:1ω9	0.01	0.01	0.01	0.00	0.02	0.03	0.00	0.00	---	---	0.00	0.00	0.09	0.15
20:3ω6	0.28	0.18	0.50	0.28	---	---	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.04
20:4ω6	2.60	1.41	4.23	1.71	0.09	0.03	0.15	0.01	0.26	0.13	0.28	0.09	0.32	0.76
20:5ω3	1.96	1.01	2.30	1.10	1.04	0.90	1.74	0.04	0.27	0.27	0.16	0.07	3.30	3.70
22:1ω9	0.06	0.02	0.07	0.03	---	---	---	---	0.04	0.02	0.05	0.02	0.16	0.10
22:2ω6	---	---	---	---	0.01	0.01	0.02	0.00	---	---	---	---	0.03	0.07
24:0	0.02	0.04	0.03	0.01	0.26	0.20	0.18	0.02	0.00	0.01	0.02	0.01	0.74	1.82
ω-3	2.94	1.56	3.59	1.67	1.16	0.94	1.86	0.04	0.43	0.28	0.30	0.12	3.59	4.13
ω-6	4.97	2.97	8.04	3.62	0.18	0.08	0.76	0.02	0.35	0.16	0.37	0.11	0.53	1.19
ω-3: ω-6	0.65	0.15	0.45	0.07	5.99	1.82	2.45	0.10	1.46	1.52	0.82	0.24	37.23	20.26
SAFA	5.00	3.23	9.16	3.42	2.08	0.79	4.62	0.20	0.60	0.23	0.83	0.19	2.44	3.96
MUFA	5.80	3.71	10.27	4.38	1.71	0.90	6.26	0.35	0.52	0.24	0.81	0.17	1.72	2.77
PUFA	6.54	3.41	8.89	3.78	2.84	1.25	4.31	0.10	0.72	0.33	0.60	0.21	3.82	4.88
LCPUFA	0.03	0.03	0.04	0.02	0.02	0.02	0.02	0.00	0.05	0.03	0.04	0.02	0.13	0.30

Table S5. The concentration of fatty acid (FA) in tissues from *Gondogeneia antarctica* maintained on experimental diets (mean ± sd, μg mg^{-1}). FA that contributed to ≥ 1% for at least one tissue type analyzed (for macroalgae or amphipods) are reported. Pseudo N refers to the number of amphipods analyzed from each treatment because amphipods were not maintained individually for the full duration of the experimental period. --- indicates instances in which FA concentrations were < 0.001.

	wild		*Desmarestia*		diatom		*Himantothallus*		*Palmeria*	
	pseudo N = 6		pseudo N = 3		pseudo N = 3		pseudo N = 3		pseudo N = 3	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
14:0	2.69	0.55	0.31	0.05	0.75	0.04	0.04	0.01	0.76	0.10
16:0	13.41	2.16	5.81	0.27	7.49	0.24	3.86	0.34	8.34	0.76
16:1ω7	8.98	1.53	1.00	0.19	5.03	0.20	0.16	0.02	2.01	0.31
16:1ω5	0.18	0.04	0.05	0.01	0.08	0.00	0.01	0.01	0.07	0.01
16:3ω4	2.67	0.47	0.11	0.04	1.49	0.05	---	---	0.37	0.06
16:4ω1	8.37	1.47	0.26	0.08	0.25	0.01	---	---	0.80	0.17
18:0	1.21	0.22	1.02	0.07	0.93	0.00	0.69	0.09	1.08	0.07
18:1ω9	7.43	1.64	5.63	0.30	5.35	0.11	3.39	0.28	6.46	0.57
18:1ω7	3.66	0.61	1.39	0.10	1.80	0.04	0.79	0.08	2.27	0.25
18:2ω6	1.55	0.48	0.72	0.07	0.47	0.01	0.20	0.02	0.61	0.08
18:3ω6	0.66	0.14	0.05	0.01	0.47	0.02	0.01	0.01	0.11	0.02
18:3ω3	1.93	0.47	0.34	0.06	0.24	0.01	0.07	0.00	0.33	0.07
18:4ω4	6.99	1.33	0.43	0.10	0.49	0.03	0.02	0.01	0.85	0.22
20:0	0.05	0.01	0.07	0.01	0.03	0.00	0.02	0.00	0.04	0.00
20:1ω9	0.71	0.13	0.49	0.02	0.53	0.00	0.35	0.04	0.86	0.05
20:3ω6	0.18	0.04	0.11	0.01	0.09	0.00	0.02	0.01	0.09	0.01
20:4ω6	0.63	0.12	2.21	0.12	0.91	0.03	0.78	0.08	0.57	0.02
20:5ω3	30.65	4.49	12.81	0.40	13.17	0.52	9.52	0.74	18.85	2.18
22:1ω9	0.18	0.03	0.07	0.00	0.07	0.00	0.03	0.01	0.29	0.02
22:2ω6	1.21	0.21	0.21	0.02	0.34	0.00	0.11	0.01	0.36	0.03
24:0	6.93	0.95	5.49	0.37	5.79	0.13	4.90	0.20	6.04	0.24
ω-3	37.12	5.70	14.35	0.49	14.64	0.52	10.28	0.79	21.02	2.34
ω-6	4.48	1.01	3.55	0.23	2.48	0.03	1.24	0.12	1.99	0.17
ω-3: ω-6	8.42	0.73	4.05	0.13	5.90	0.13	8.35	0.74	10.53	0.35
SAFA	24.52	3.88	12.77	0.77	15.08	0.33	9.56	0.64	16.53	1.18
MUFA	21.43	3.93	8.72	0.64	12.99	0.36	4.80	0.42	12.16	1.22
PUFA	52.07	8.35	16.31	0.78	17.12	0.60	10.42	0.79	21.98	2.74
LCPUFA	1.83	0.29	0.98	0.06	1.05	0.01	0.64	0.04	1.48	0.03