

Supplementary Information

Table S1. Average morphometrics for all species used in the incubation experiments (mean \pm SD). PSA = planar surface area, WW = wet weight, DW = dry weight, AFDW = ash-free dry weight, C = carbon.

Species	<i>n</i>	PSA (cm ²)	Volume (mL)	WW (g)	DW (g)	AFDW (g)	Organic C content (%)
<i>Vazella pourtalesii</i>	7	4.4 \pm 3.3	14.7 \pm 12.4	28.2 \pm 24.9	2.8 \pm 2.3	0.5 \pm 0.4	5.5 \pm 0.8
<i>Geodia barretti</i>	12	20.6 \pm 13.8	79.7 \pm 69.2	99.7 \pm 71.3	24.4 \pm 18.2	10.8 \pm 8.0	15.9 \pm 2.4
<i>Geodia atlantica</i>	6	86.0 \pm 38.1	308.3 \pm 106.8	438.3 \pm 139.3	42.2 \pm 15.8	21.5 \pm 8.1	20.3 \pm 2.8
<i>Craniella zetlandica</i>	4	41.7 \pm 11.2	232.5 \pm 73.3	242.9 \pm 72.3	54.7 \pm 17.3	24.6 \pm 7.8	20.3 \pm 3.3
<i>Hymedesmia paupertas</i>	3	42.0 \pm 6.1	4.2 \pm 0.6	1.0 \pm 0.7	0.2 \pm 0.2	-	12.6 \pm 1.8
<i>Acantheurypon spinispinosum</i>	4	165.8 \pm 26.7	45.0 \pm 9.7	8.2 \pm 1.0	2.0 \pm 0.3	0.7 \pm 0.1	10.9 \pm 0.8

Table S2. Oxygen (O₂), particulate organic carbon (POC) and dissolved organic carbon (DOC) fluxes in $\mu\text{mol DW}^{-1} \text{h}^{-1}$ of various sponge species from literature. HMA = high microbial, LMA = low microbial, T = temperature (°C). (1) Witte & Graf 1996, (2) Kowalke 2000, (3) Kutti et al. 2013, (4) Leys et al. 2018, (5) Cotter 1978, (6) Murray 2009, (7) Tomassen & Riisgard 1995, (8) Coma 2002, (9) Hadas et al. 2008, (10) Yahel et al. 2003, (11) de Goeij et al. 2013 unpublished data, (12) de Goeij et al. 2008, (13) Reischwig 1974, (14) Hoer et al. 2018.

Sponge	Class	Massive/ Encrusting	HMA/ LMA	T (°C)	O ₂	POC ($\mu\text{mol DW}^{-1} \text{h}^{-1}$)	DOC	Ref.
<i>Craniella cranium</i>	Demospongiae	Massive	HMA	0	40.0	n.a.	n.a.	1 ¹
<i>Thenea abyssorum</i>	Demospongiae	Massive	n.a.	0	47.0	n.a.	n.a.	1
<i>Thenea muricate</i>	Demospongiae	Massive	n.a.	0	41.5	n.a.	n.a.	1
<i>Isodictia kerguelensis</i>	Demospongiae	Massive	n.a.	1.0	6.7	n.a.	n.a.	2 [#]
<i>Mycale acerata</i>	Demospongiae	Massive	LMA	1.8	32.8	n.a.	n.a.	2 ^{*,##}
<i>Hymedesmia paupertas</i>	Demospongiae	Massive	LMA	6.0	5.8	0.6	n.a.	This study
<i>Geodia atlantica</i>	Demospongiae	Massive	HMA	6.3	5.8	0.2	5.6	This study
<i>Acantheurypon spinispinosum</i>	Demospongiae	Massive	LMA	6.3	7.8	n.a.	56.1	This study
<i>Vazella pourtalesii</i>	Hexactinellidae	Massive	LMA	6.7	3.4	1.0	9.2	This study
<i>Geodia barretti</i>	Demospongiae	Massive	HMA	7.2	1.5	n.a.	n.a.	3
<i>Geodia barretti</i>	Demospongiae	Massive	HMA	8.0	1.4	0.04	n.a.	4
<i>Geodia barretti</i>	Demospongiae	Massive	HMA	9.0	1.3	0.02	3.7	This study
<i>Craniella zetlandica</i>	Demospongiae	Massive	HMA	9.0	1.0	0.02	n.a.	This study
<i>Sycon ciliatum</i>	Calcarea	Massive	LMA	13.0	65.8	n.a.	n.a.	5 ⁺
<i>Stellata sp.</i>	Demospongiae	Massive	HMA	13.0	10.9	n.a.	n.a.	6 ⁺
<i>Tethya bergquistae</i>	Demospongiae	Massive	LMA	13.0	8.3	n.a.	n.a.	6 [*]
<i>Mycale sp.</i>	Demospongiae	Massive	LMA	13.0	61.1	n.a.	n.a.	6 [*]
<i>Leucosolenia echinata</i>	Calcarea	Massive	LMA	14.0	40.9	n.a.	n.a.	6 ⁺

<i>Halichondria panicea</i>	Demospongiae	Massive	LMA	20.0	75.1	n.a.	n.a.	7*
<i>Dysidea avarata</i>	Demospongiae	Massive	LMA	22.5	25.8	n.a.	n.a.	8*
<i>Negombata magnifica</i>	Demospongiae	Massive	n.a.	23.0	14.9	n.a.	n.a.	9
<i>Theonella swinhoei</i>	Demospongiae	Massive	HMA	26.5	8.6	1.5	1.6	10 ‡
<i>Chondrilla caribensis</i>	Demospongiae	Encrusting	HMA	26.5	181	n.a.	n.a.	11
<i>Halisarca caerulea</i>	Demospongiae	Encrusting	LMA	26.5	336	20.0	218	12
<i>Mycale microsigmatosa</i>	Demospongiae	Encrusting	LMA	26.5	n.a.	20.0	253	12
<i>Merlia normani</i>	Demospongiae	Encrusting	LMA	26.5	n.a.	13.3	226	12
<i>Scopalina ruetzleri</i>	Demospongiae	Encrusting	LMA	26.5	134	n.a.	n.a.	11
<i>Haliclona implexiformis</i>	Demospongiae	Encrusting	LMA	26.5	173	n.a.	n.a.	11
<i>Verongia gigantea</i>	Demospongiae	Massive	HMA	28.0	128	n.a.	n.a.	13###,‡‡
<i>Hyrtios sp.</i>	Demospongiae	Massive	HMA	28.0	79	n.a.	n.a.	6*
<i>Xestospongia muta</i>	Demospongiae	Massive	HMA	28.0	10	0.4	1.9	14*
<i>Tethya crypta</i>	Demospongiae	Massive	LMA	28.0	29	n.a.	n.a.	13###,‡‡
<i>Dysidea herbacea</i>	Demospongiae	Massive	LMA	28.0	70	n.a.	n.a.	6*
<i>Mycale sp.</i>	Demospongiae	Massive	LMA	28.0	197	n.a.	n.a.	13###,‡‡,*

‡ Also named *Tethya cranium*, # Ash content based on Morley (2016), ## Ash content based on McClinktock (1987), * HMA/LMA based on Moutinho-Silva (2017), + HMA/LMA based on Vacelet & Donaday (1977), ‡ Temperature from on Yahel (2002), ### Ash content from Reising (1971a), ‡‡ Temperature from Osinga et al. (1999), • Conversion volume – dry weight from Fiore et al. (2013)

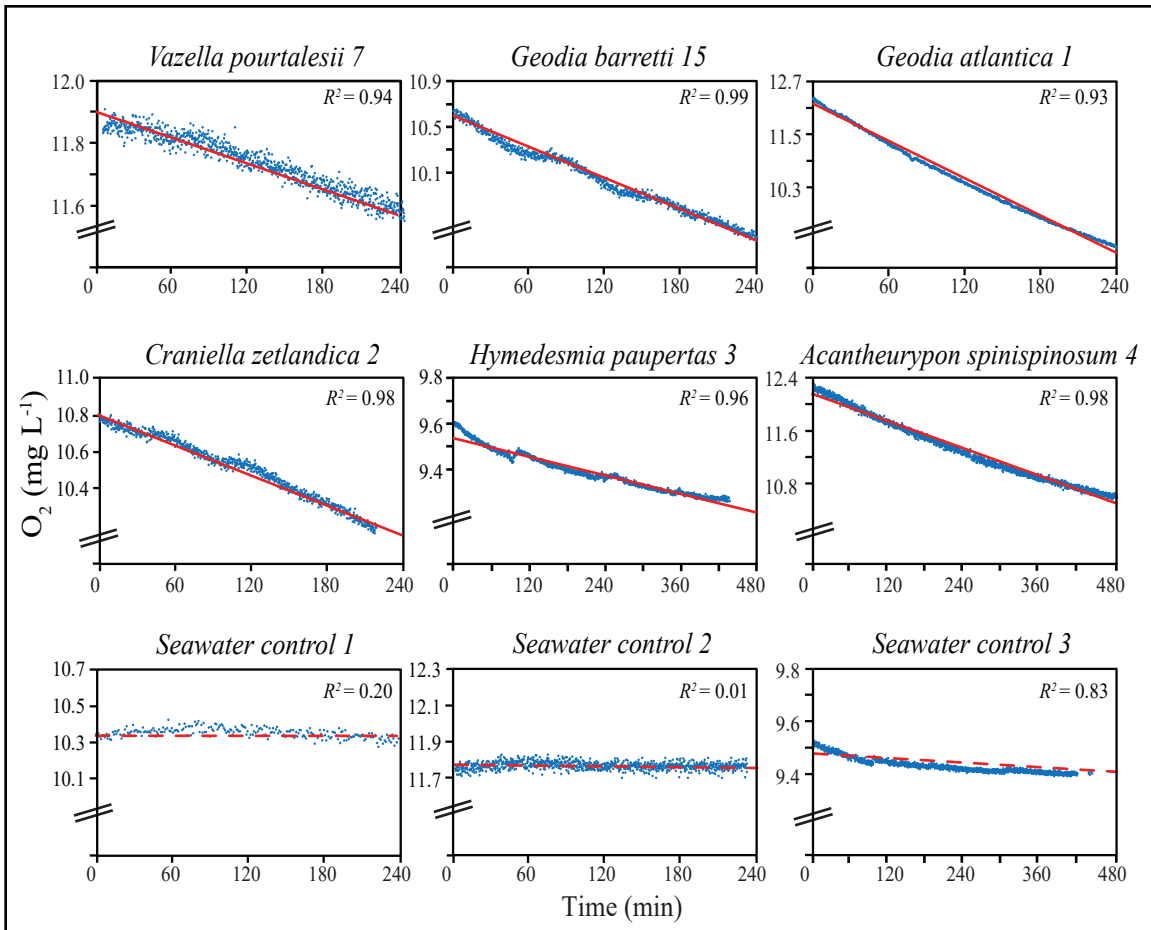


Figure S1. Examples of O_2 concentrations over time during individual ex situ sponge incubations and seawater controls. Note that x- and y-axis do not show similar ranges throughout the incubations. The number following the species name indicates the specimen code.

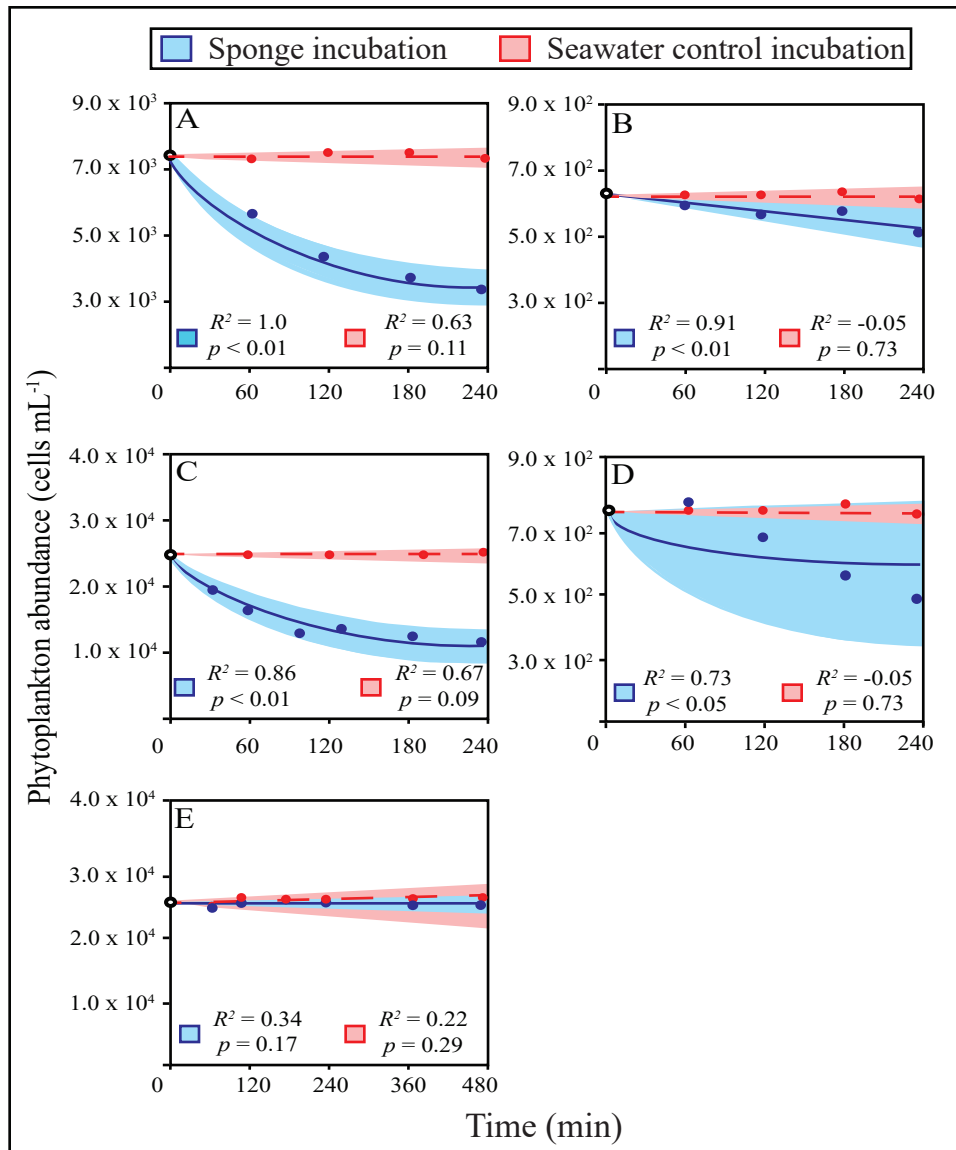


Figure S2. Average abundances of live phytoplankton over time during incubations with five dominant North-Atlantic deep-sea sponge species (blue) in comparison to seawater control incubations (red). (A) *Vazella pourtalesii* (n = 7) (B) *Geodia barretti* (n = 9) (C) *Geodia atlantica* (n = 6) (D) *Craniella zetlandica* (n = 4) (E) *Acantheurypon spinispinosum* (n = 4). Phytoplankton decrease is modelled with an exponential fit, shades depict 95 % confidence intervals of the model. Note that x- and y-axis show different ranges per species.

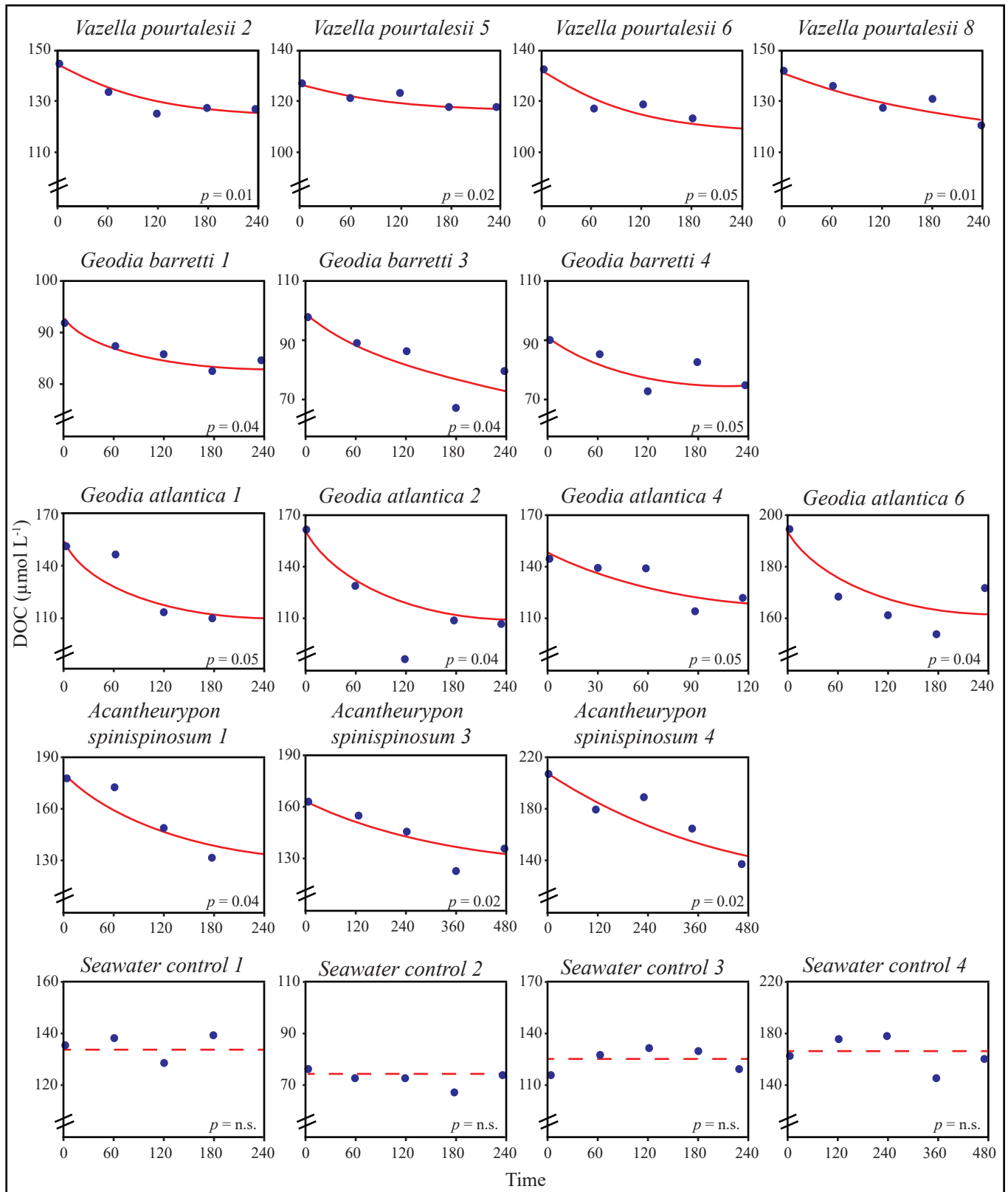


Figure S3. DOC concentrations over time during all individual sponge incubations and four seawater control incubations. Trendlines are given by a 2G-model fit. Note that x- and y-axis do not show similar ranges throughout the incubations. The number following the species name indicates the specimen code.

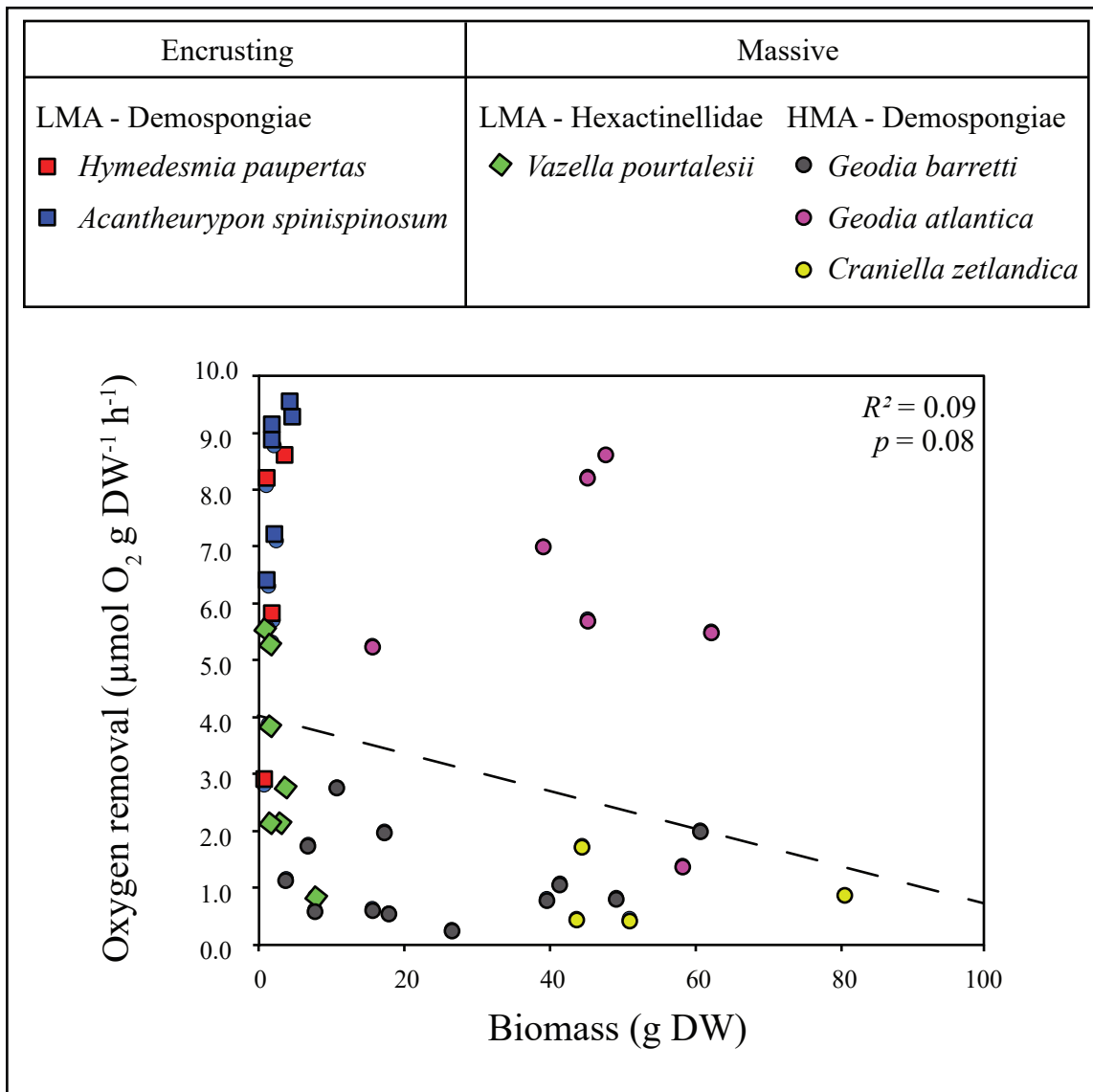


Figure S4. Oxygen removal rates of six dominant North-Atlantic deep-sea sponge species plotted against biomass. *H. paupertas* ($n = 3$), *A. spinispinosum* ($n = 4$), *V. pourtalesii* ($n = 7$), *G. barretti* ($n = 12$), *G. atlantica* ($n = 6$), *C. zetlandica* ($n = 4$).

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