TEXAS A&M UNIVERSITY CORPUS CHRISTI

Shedd AQUARIUM
MOLECULAR & MICROBIAL ECOLOGY GROUP

Seasonal drivers of plastic-specific microbial communities

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Microplastics Science Team Meeting

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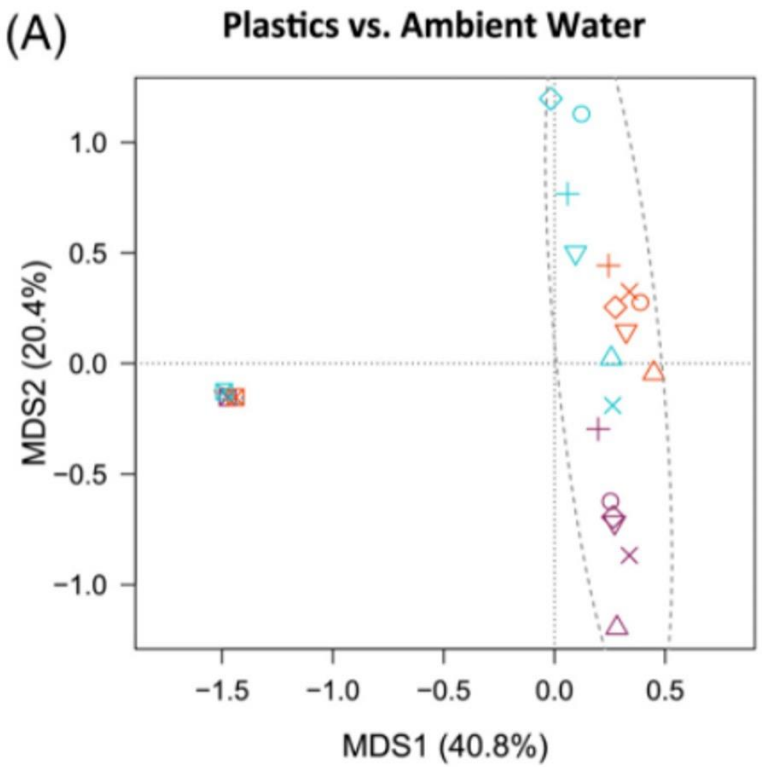
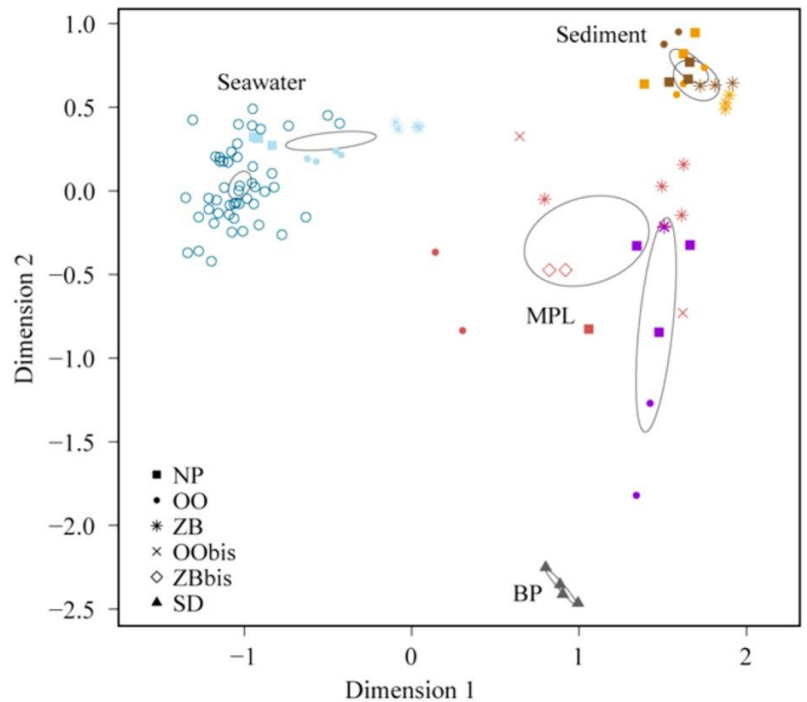
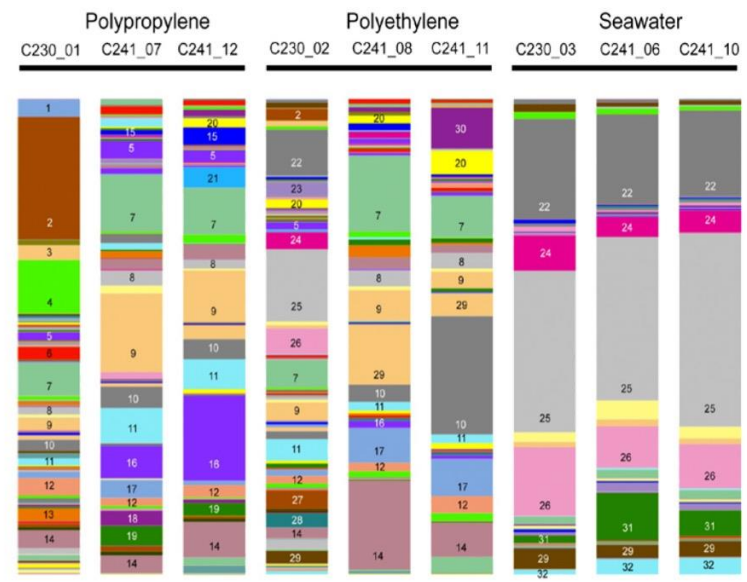
Microbial plastisphere



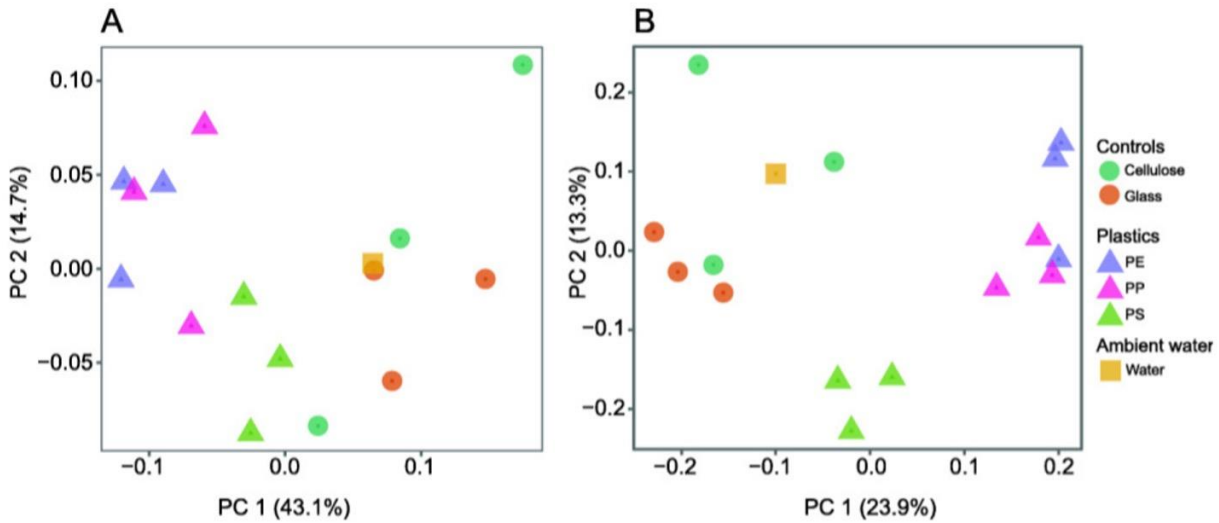




Dudek et al. 2020 Zettler et al. 2013

Plastic specificity?

Ogonowski et al. 2018 (cellulose and glass)



Oberbeckmann et al. 2018 (wood)

	Groups	PERMANOVA		perms	p(BH)	PERMDISP
		t	*p*			*p*
Global			**0.001**	995		0.148
Pairwise	PE, PS	0.733	0.816	999	0.816	0.726
	PE, L	1.826	**0.008**	999	**0.010**	0.794
	PS,L	1.783	**0.005**	998	**0.007**	0.584
	PE,3	2.033	**0.002**	999	**0.003**	**0.015**
	PS,3	2.072	**0.001**	998	**0.003**	**0.015**
	L, 3	2.028	**0.002**	999	**0.003**	**0.034**
	PE,0.2	2.642	**0.001**	998	**0.003**	0.925
	PS,0.2	2.706	**0.001**	999	**0.003**	0.687
	L,0.2	2.572	**0.001**	999	**0.003**	0.914
	3,0.2	1.573	**0.017**	998	**0.019**	0.061

Analyses are based on 16S rRNA data from all 7 stations. Significant results ($P < 0.05$) are highlighted in bold. perms, permutations; BH, Benjamini-Hochberg correction.

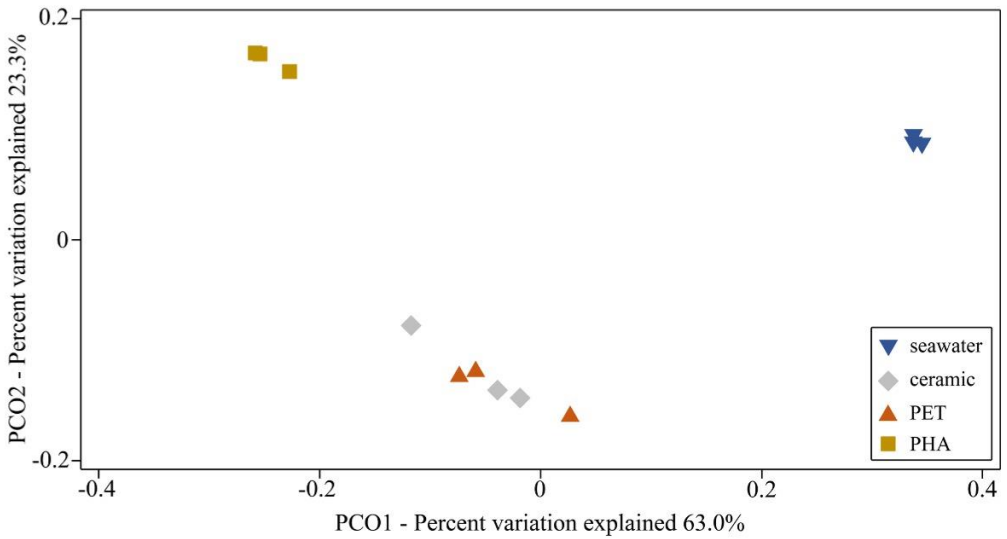
Oberbeckmann et al. 2016 (glass)

Subset: Factors	marker	df	SS	Pseudo F	p(perm)	Unique perm	p(MC)	p(PERMDISP)
PET: Station	16S	2	10987	2.5436	**0.001** *	999	**0.004** *	0.542
	18S	2	10258	2.8614	**0.001** *	999	**0.001** *	0.632
PET: Season	16S	2	14855	3.7968	**0.001** *	997	**0.001** *	0.281
	18S	2	9542.3	2.5881	**0.002** *	999	**0.004** *	0.794
Summer: Treatment (PET-3-0.2)	16S	2	9435.2	3.0775	**0.003** *	991	**0.011** *	0.125
	18S	2	12006	3.4363	**0.001** *	905	**0.007** *	0.956
Spring: Treatment (PET-glass)	16S	1	3746.9	1.9241	0.058	980	0.057	0.841
	18S	1	1968.7	1.1056	0.29	905	0.344	0.894
Summer: Station (Warp-Gabbard-Dowsing)	16S	2	10097	3.4277	**0.003** *	994	**0.008** *	**0.005** *
	18S	2	9426.7	2.2778	**0.026** *	937	**0.042** *	0.38
Spring: Station (Warp-Gabbard-Dowsing)	16S	2	9373.4	2.7822	**0.002** *	997	**0.001** *	0.848
	18S	2	12674	6.111	**0.001** *	997	**0.002** *	0.573
Summer: "Attached" versus Free-living	16S	1	6692.7	4.0966	**0.003** *	843	**0.013** *	0.124
	18S	1	5358.4	2.3385	**0.025** *	416	0.084	**0.023** *

PERMANOVA main tests compare both bacterial/archaeal and eukaryotic (16S and 18S rRNA gene, respectively, denoted by 'marker') community structure across seasons, stations, and treatments. Tests are displayed for three data subsets (PET, spring, summer). Significant results ($p < 0.05$) highlighted in bold and marked with *. P-values were obtained using type III sums of squares and 999 permutations ['p(perm)'] or calculating Monte-Carlo tests ['p(MC)']. Pseudo F, PERMANOVA F statistic; d.f., degrees of freedom; SS, sums of squares; Unique perm, unique permutations. p(PERMDISP) are p-values of PERMDISP tests, calculated to centroids.

doi:10.1371/journal.pone.0159289.t001

Pinnell & Turner 2019 (ceramic)

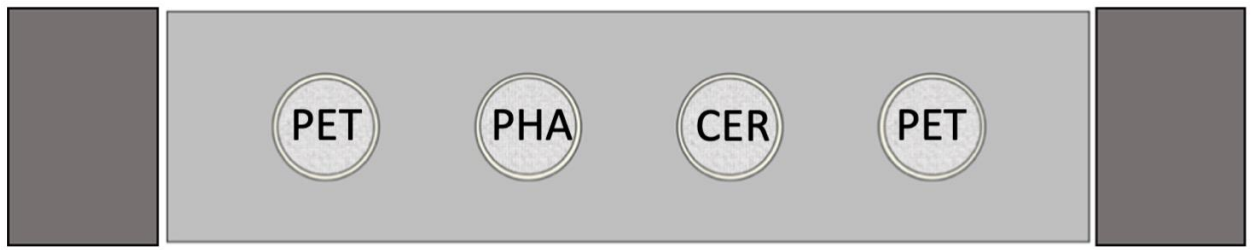


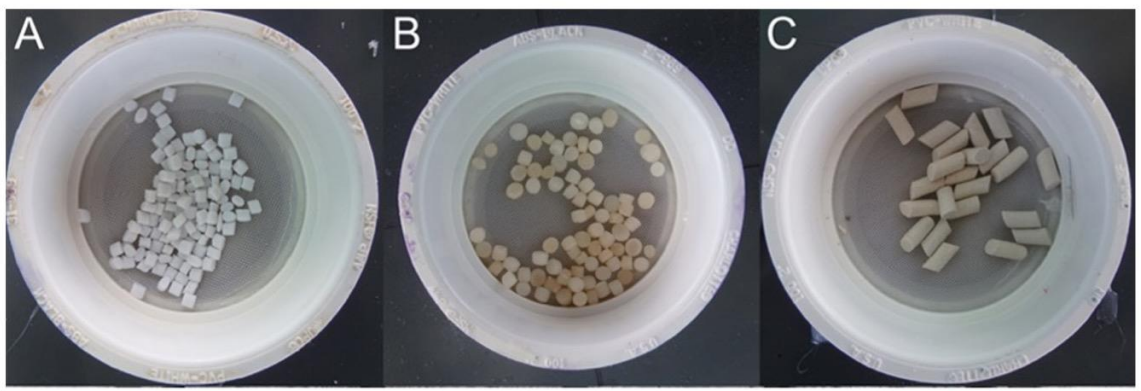
Knowledge gaps

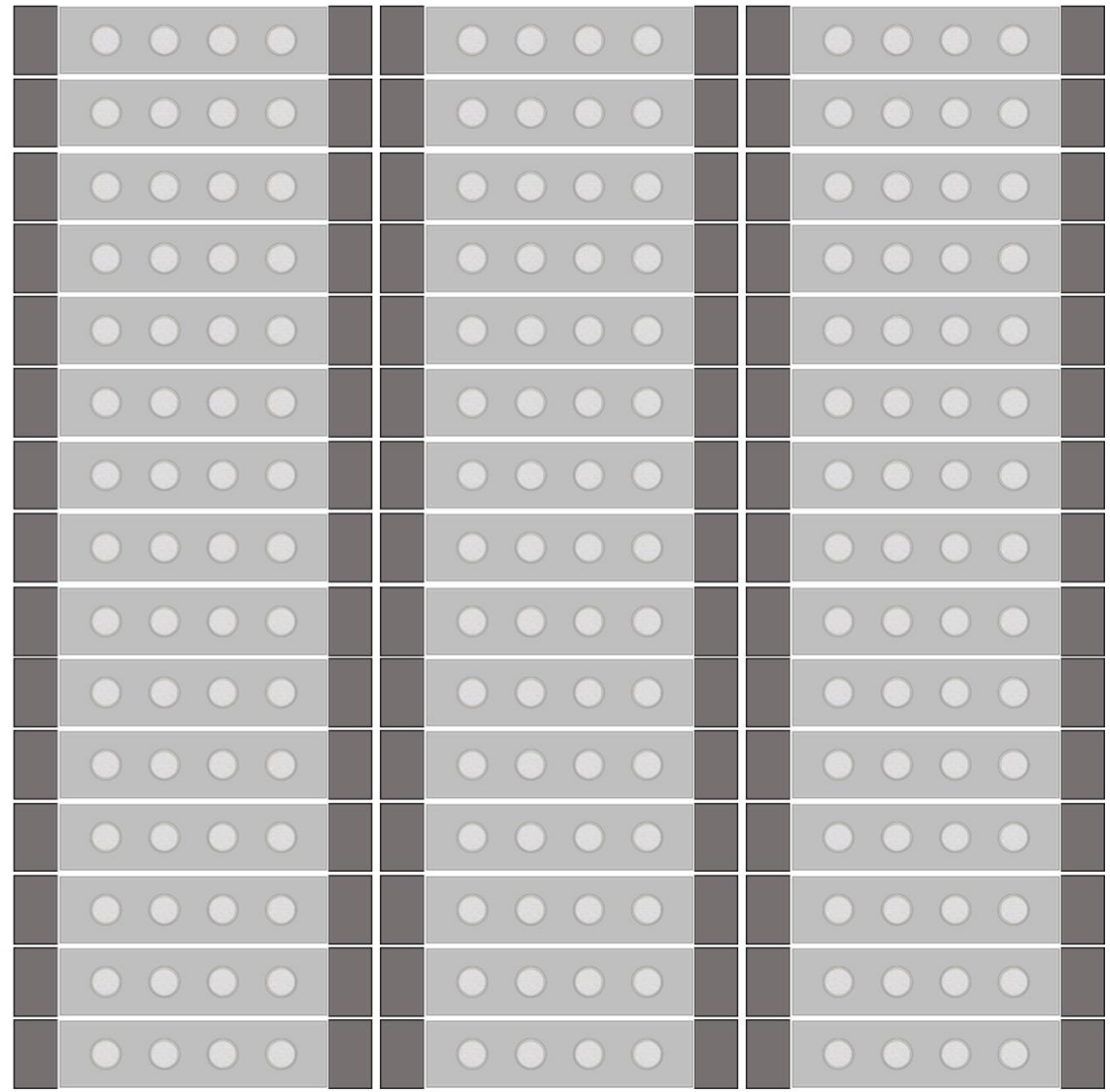
- Does plastic recruit a specific group of marine microbes compared to an *inert*, biofilm control?
- If so, what drives the formation of a plastic-specific community?

Sample deployment

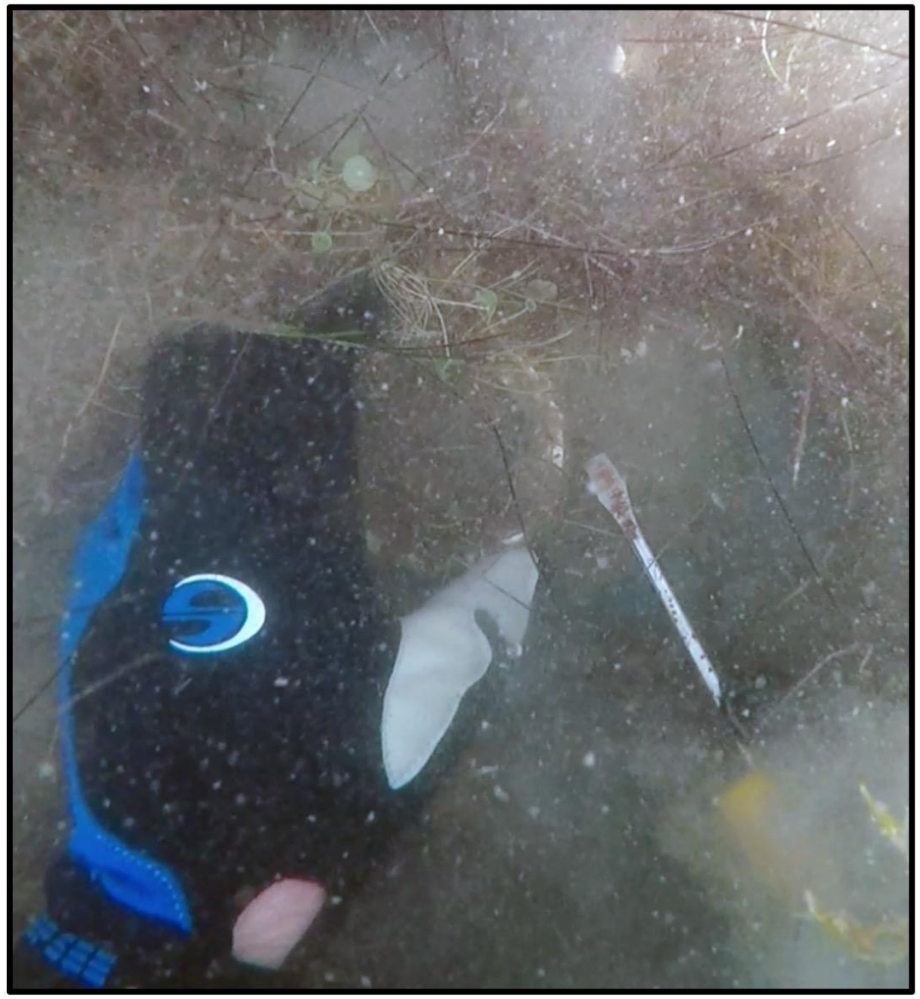
- Sediment-water interface
- 424 days total exposure
- Collected monthly samples

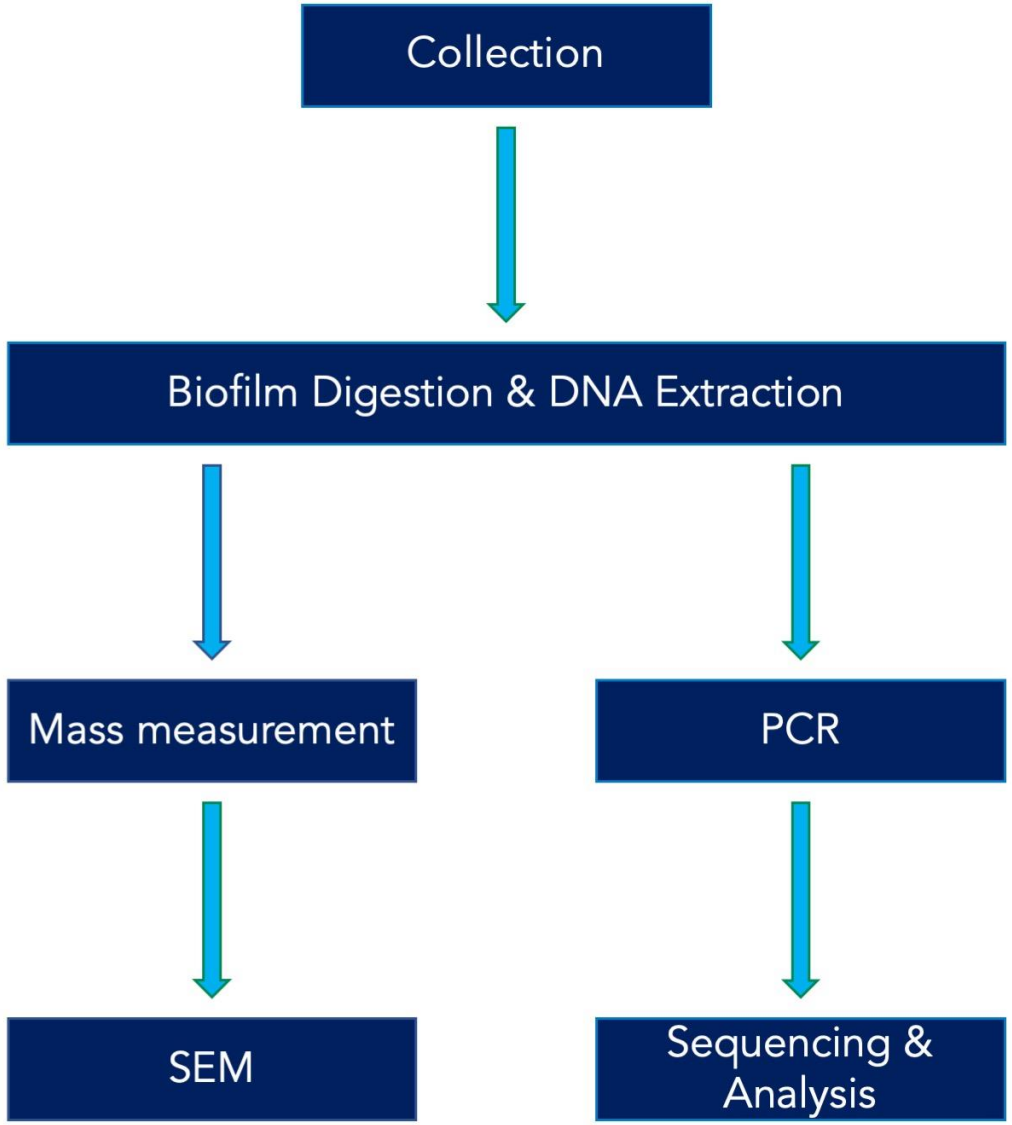






Sample collection





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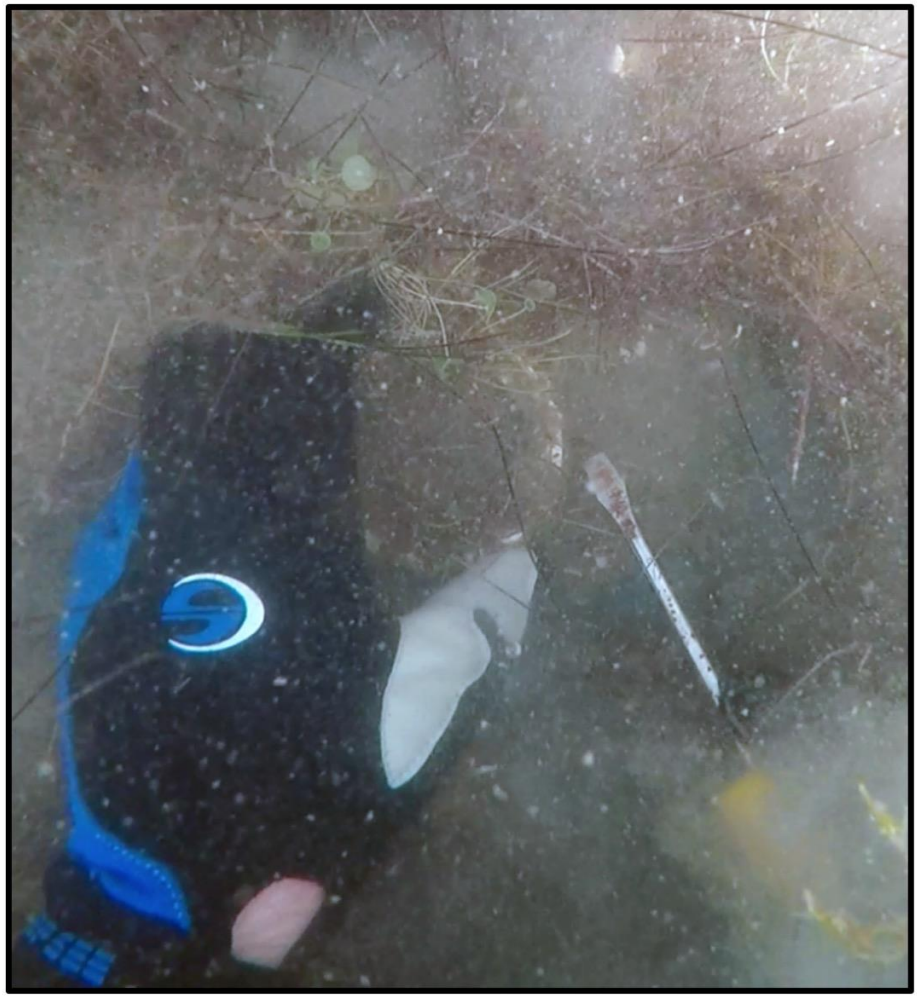
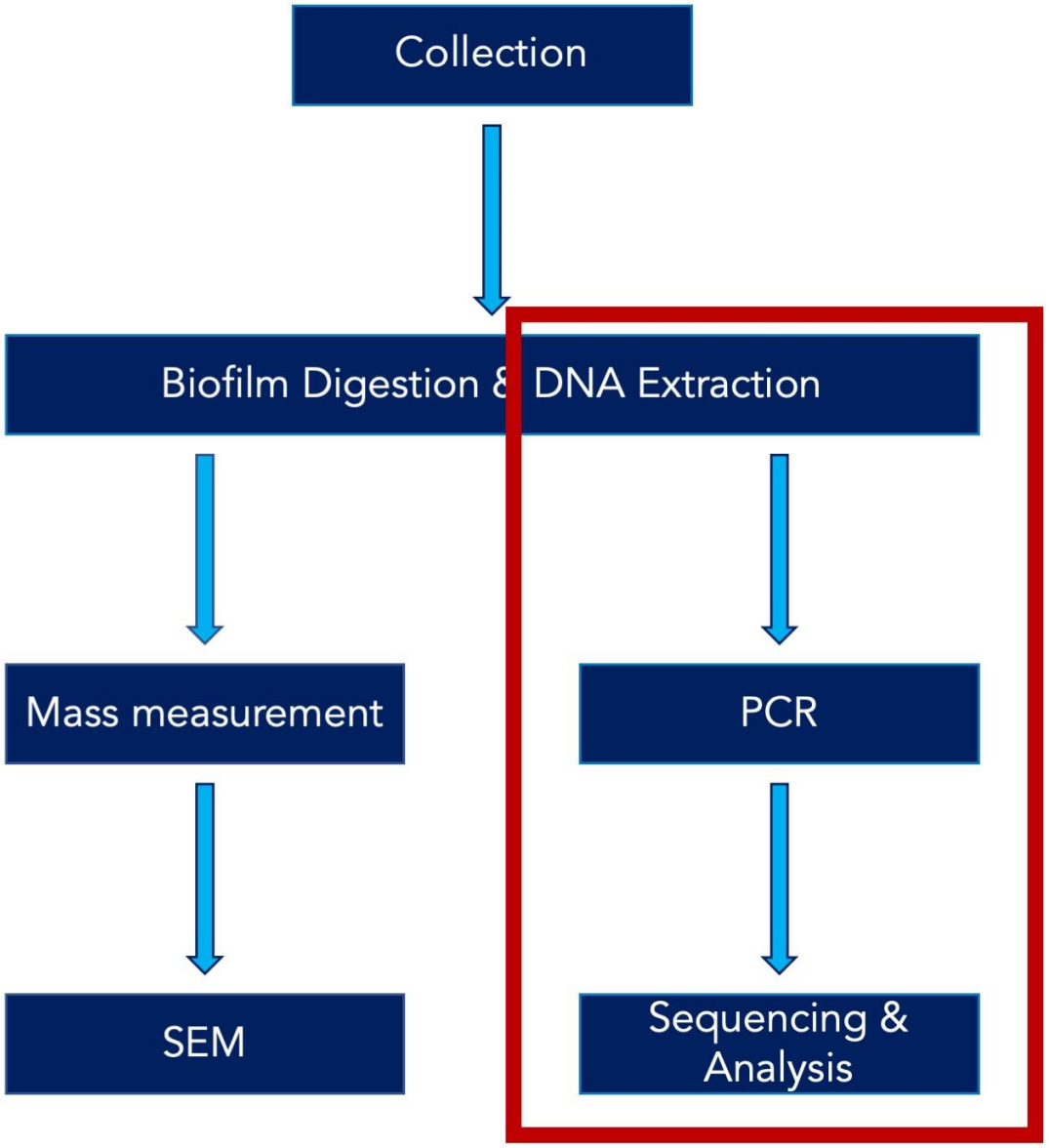
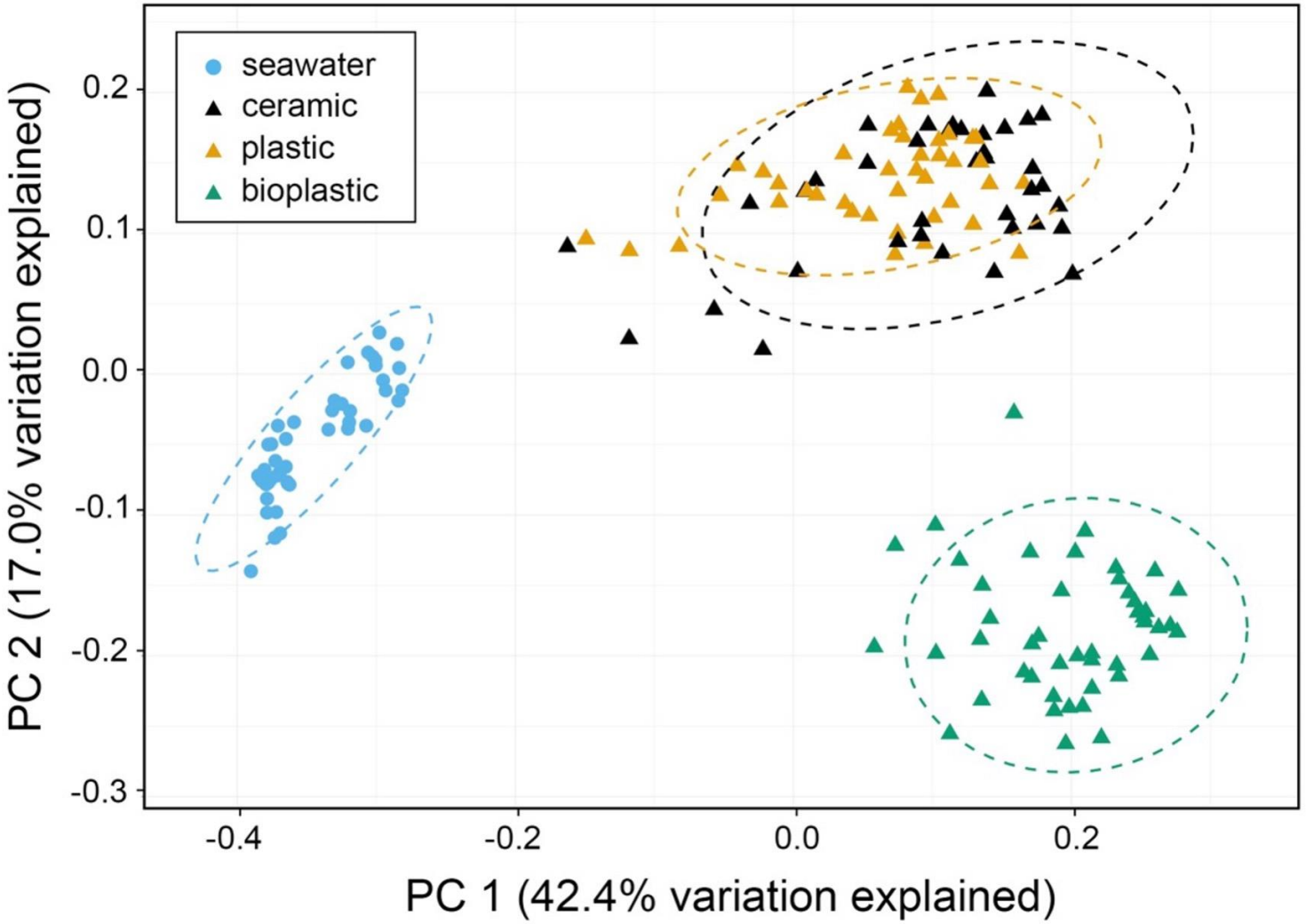
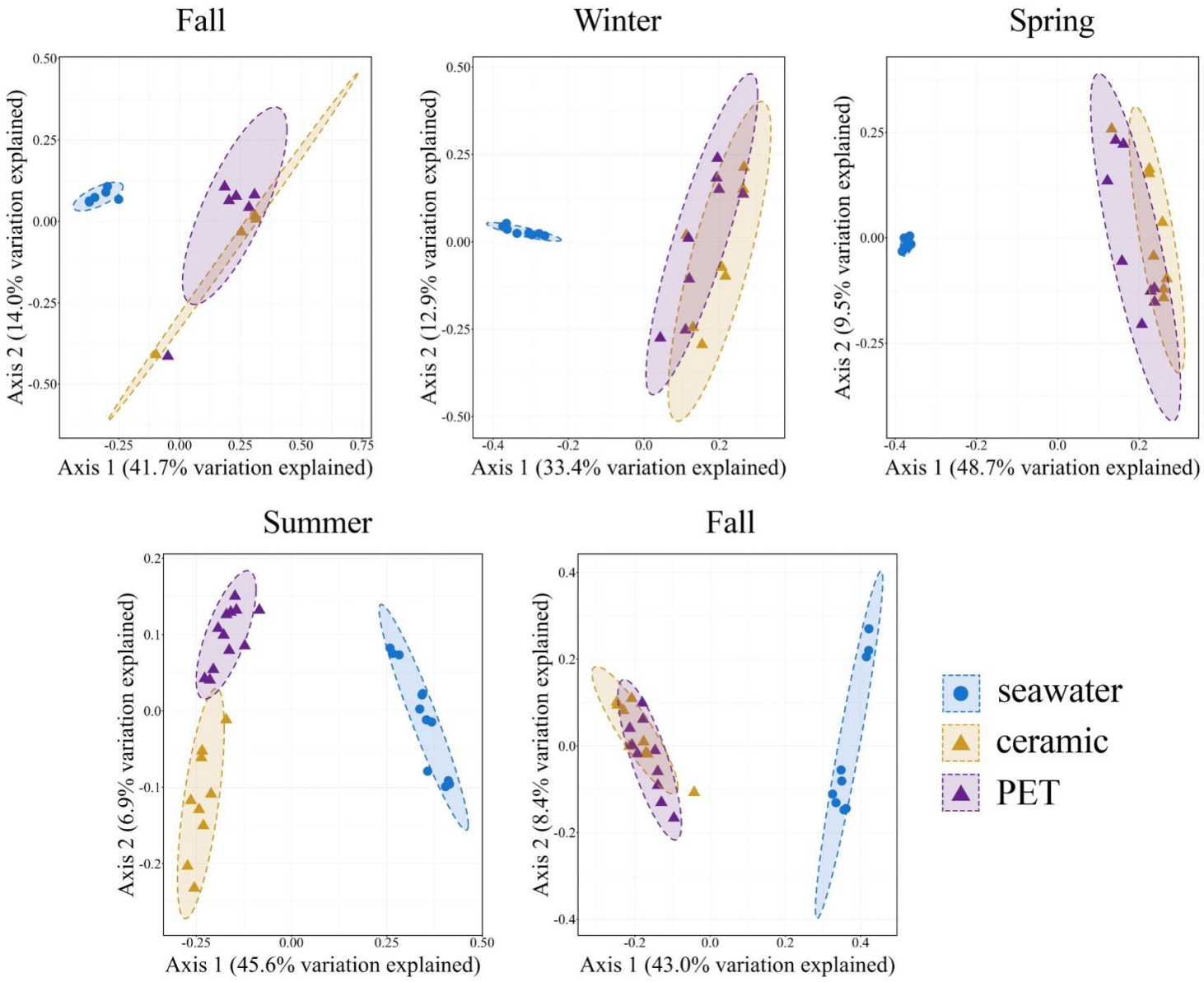




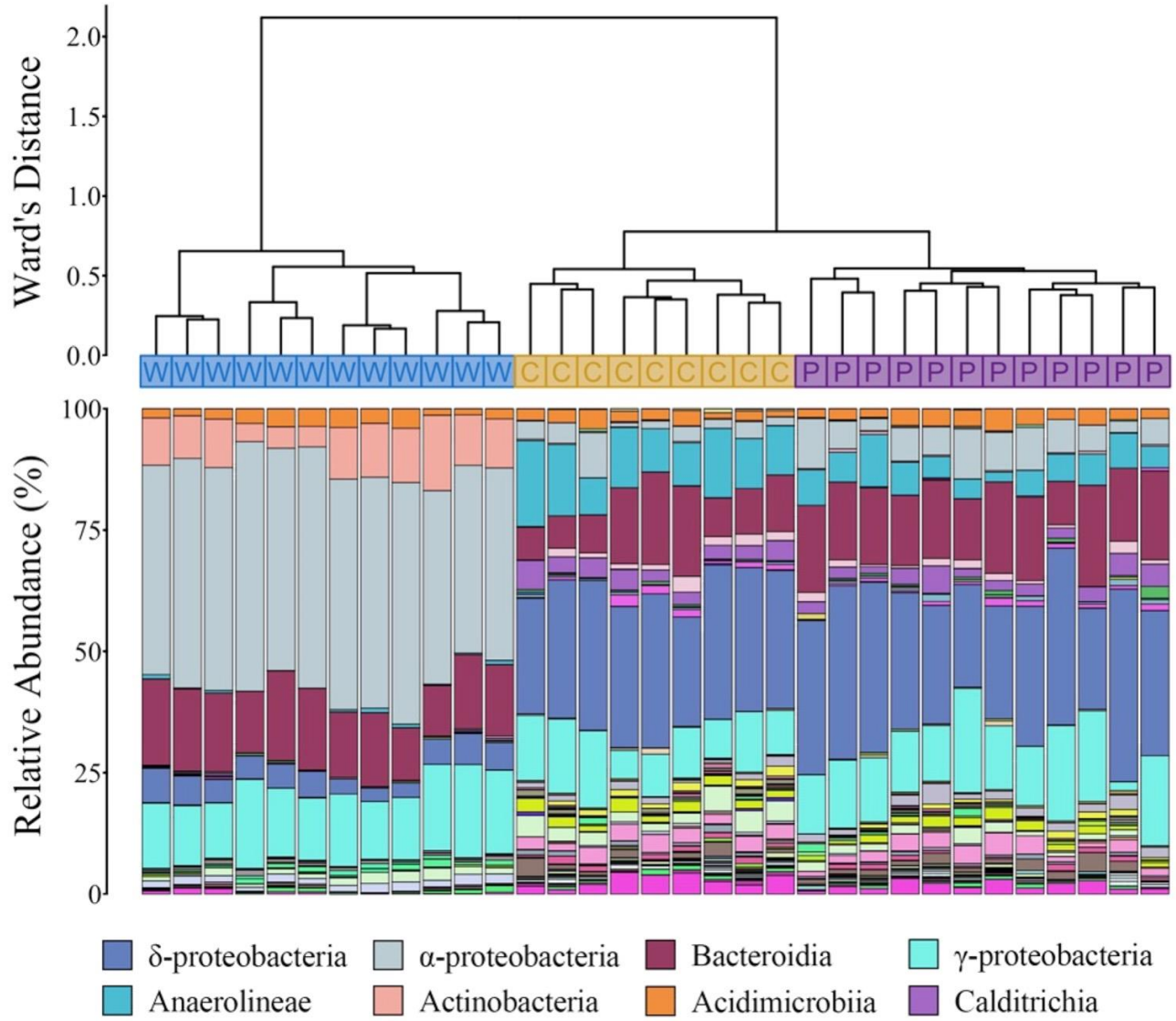
A ‘snapshot’ look



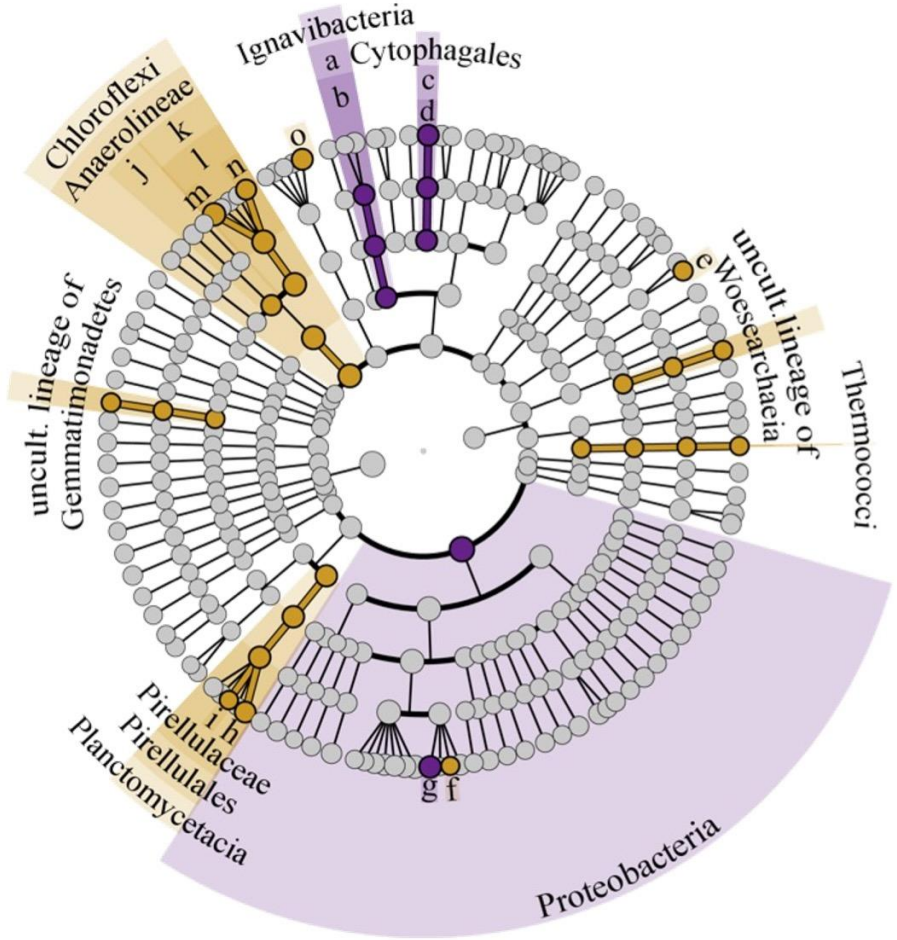
Seasonal differences



Summer communities



Plastic-discriminant taxa

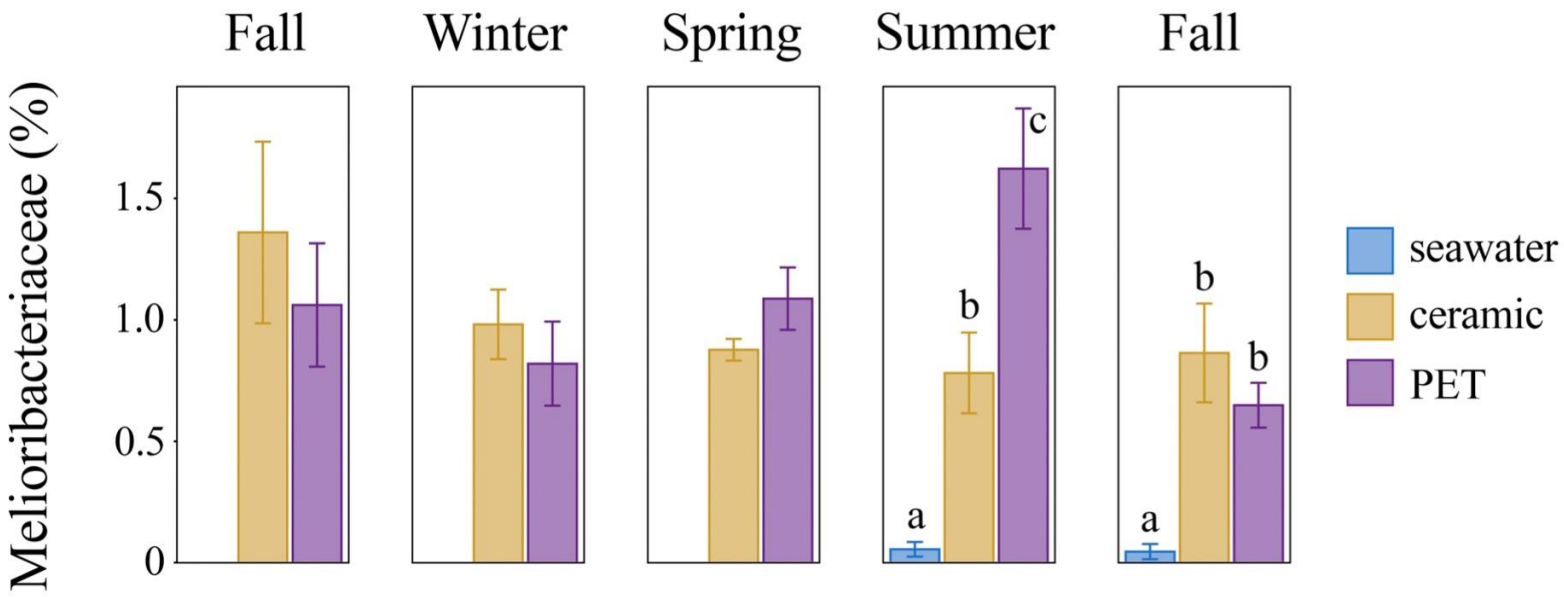


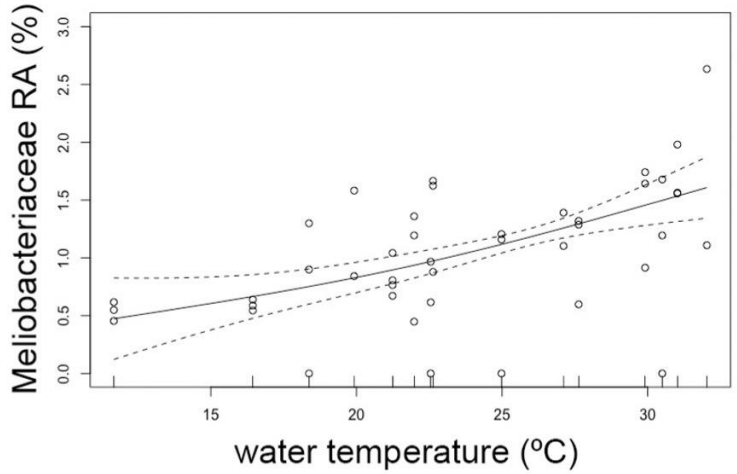
- a: Ignavibacteriales
- b: Melioribacteraceae
- c: Cyclobacteriaceae
- d: uncult. Cyclobacteriaceae
- g: Candidatus *Electrothrix*

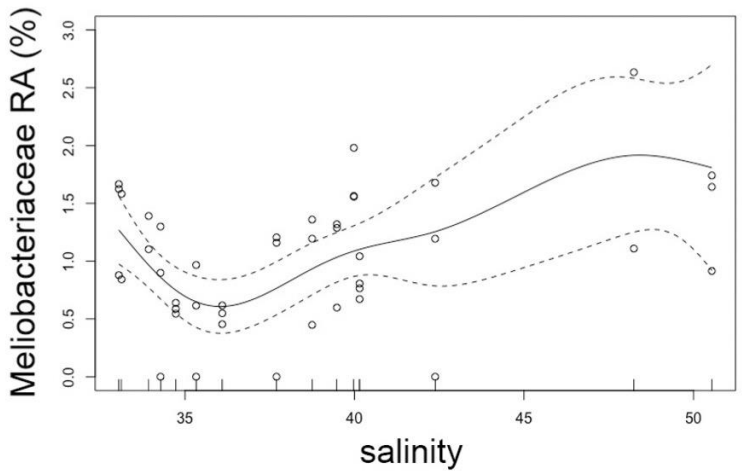
- e: subgroup 10 (Thermoanaerobaculaceae)
- f: *Desulfopila*
- h: uncult. Pirellulaceae
- i: *Rhodopirellula*
- j: SBR1031
- k: Anaerolineales
- l: Anaerolineaceae
- m: uncult. Anaerolineaceae
- n: MAG unclassified genus (Anaerolineaceae)
- o: *Caldithrix*

PET ceramic

Plastic-discriminant taxa







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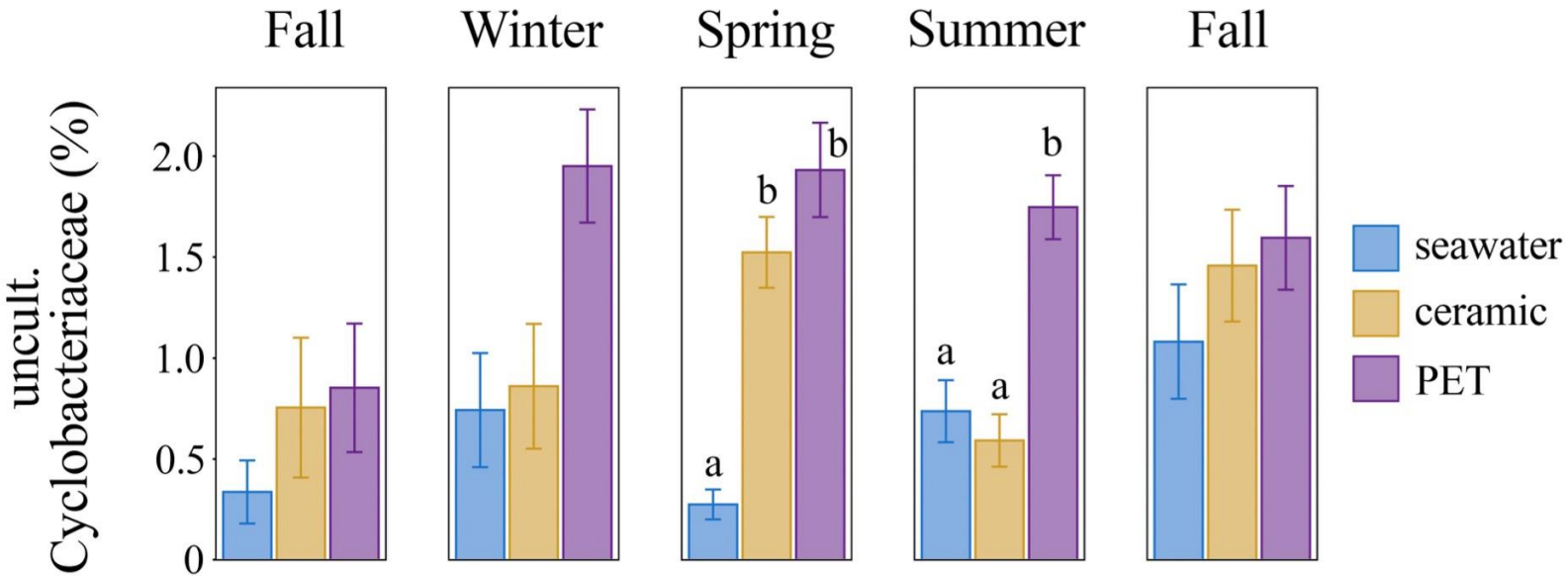
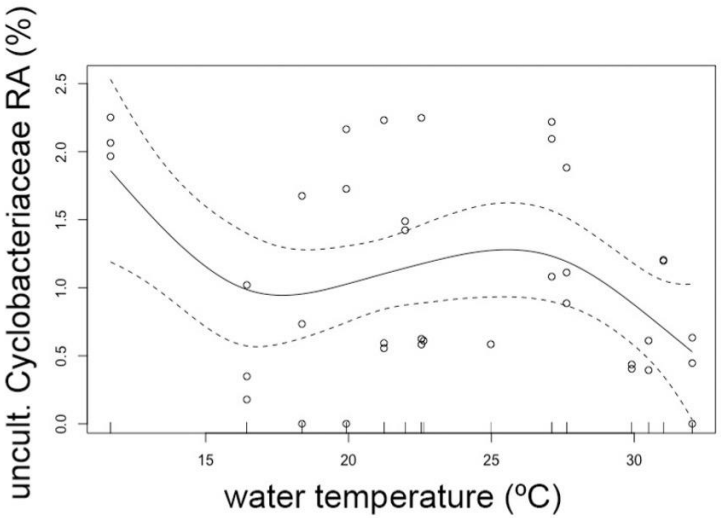
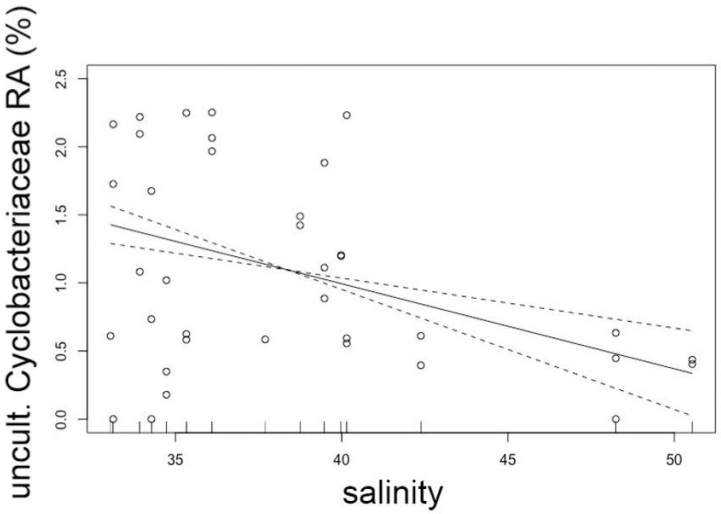
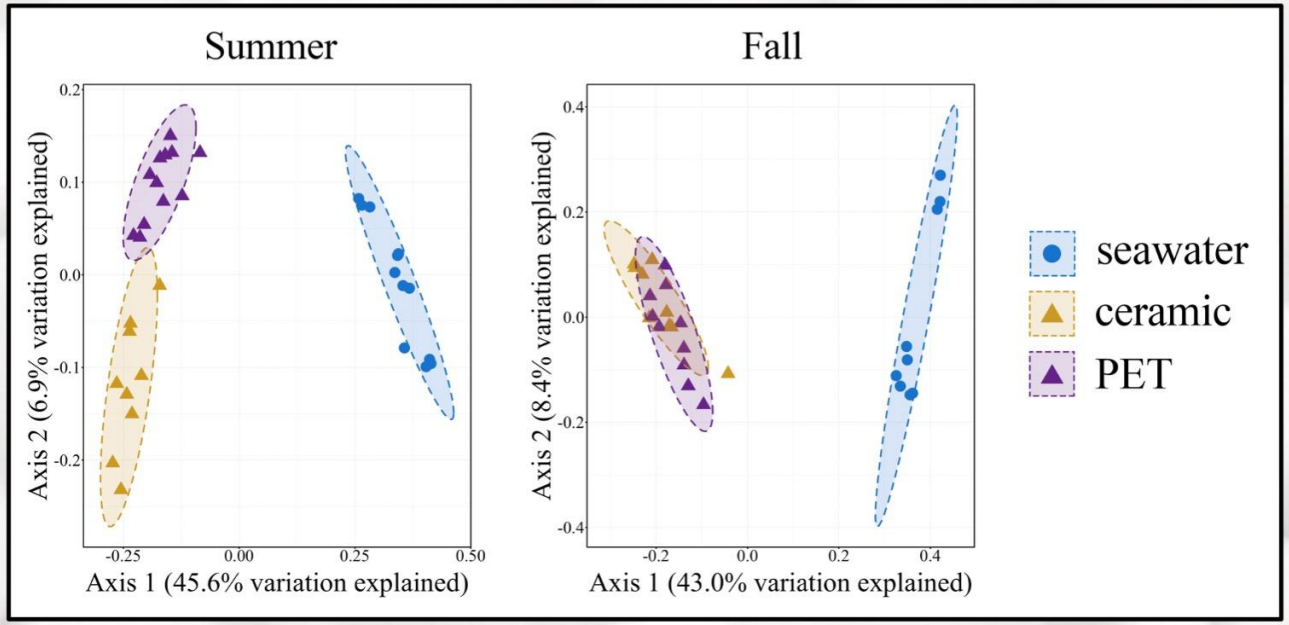






Take-home messages

- The relationship between marine microbes and plastic is complicated!
- Versus an inert biofilm control, plastic-specific communities can form under certain environmental conditions, but can revert back



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Questions?

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