Supplementary Material

Table S1. AIC analysis for generalized linear negative binomial models for oyster density from reef substrates in summer 2022. Models were offset by footprint of reef type (Table 1) to standardize to 1 m^2 of river bottom. R = reef; S = site; (F) = log of the offset footprint of individual reef structures.

Model	Variables	k	AIC	AICc	dAICc	wts
m_d1	null + (F)	2	549.41	549.77	62.13	<0.01
m_d2	R + (F)	7	509.09	513.09	25.45	<0.01
m_d3	S + (F)	4	546.03	547.32	59.68	<0.01
m_d4	R + S + (F)	9	480.72	487.64	0	0.99

Table S2. Parameter estimates from the generalized linear model m_d4 for oyster density in summer 2022. Note that the intercept represents oyster shell reef at the Andrews site.

Parameter	Variable	Estimated Mean	SE	z value	Pr(>|z|)
β_0	intercept	9.32	0.14	68.8	<0.01
β_1	granite	-1.25	0.17	-7.46	<0.01
β_2	castle	-1.49	0.17	-8.99	<0.01
β_3	diamond	-2.62	0.17	-15.62	<0.01
β_4	c-dome	-1.12	0.17	-6.77	<0.01
β_5	x-reef	-0.95	0.17	-5.72	<0.01
β_6	exposed	-0.62	0.12	-5.25	<0.01
β_7	protected	0.24	0.12	2.01	0.04

Table S3. Mean oyster density by reef type for the generalized linear negative binomial model m_d4 (Table S3) in summer 2022 standardized to 1 m^2 of river bottom. Note that these means are derived from an emmeans analysis that was performed on m_d4. SE = standard error; df = degrees of freedom; asymp.LCL = asymptotic lower confidence level; asymp.UCL = asymptotic upper confidence level. Results are averaged over the levels of site.

Reef	Response	SE	df	asymp.LCL	asymp.UCL
shell	9852.98	1154.97	Inf	7830.5	12397.84
granite	2829.89	337.47	Inf	2240.08	3575
castle	2219.71	260.4	Inf	1763.77	2793.52
diamond	715.72	85.99	Inf	565.56	905.75
c-dome	3202.3	376.86	Inf	2542.66	4033.07
x-reef	3816.67	447.29	Inf	3033.39	4802.2

Table S4. AIC analysis for linear models for oyster biomass from reef substrates in 2022. All numbers were standardized to 1 m² of river bottom. R = reef, S = site.

Model	Variables	k	AIC	AICc	dAICc	wts
m_b1	null	2	506.97	507.32	24.09	<0.01
m_b2	R	7	486.85	490.85	7.51	<0.01
m_b3	S	4	505.37	506.66	23.42	<0.01
m_b4	R + S	9	476.31	483.24	0	0.99

Table S5. Parameter estimates from the generalized linear model m_b4 for oyster biomass by reef type or site in summer 2022. Note that the intercept represents oyster shell reef at the Andrews site.

Parameter	Variable	Estimated Mean	SE	z value	Pr(>|z|)
β_0	intercept	793.74	75.2	10.56	<0.01
β_1	granite	-463.06	92.1	-5.03	<0.01
β_2	castle	-397.97	92.1	-4.32	<0.01
β_3	diamond	-626.42	92.1	-6.8	<0.01
β_4	c-dome	-325.56	92.1	-3.53	<0.01
β_5	x-reef	-212.15	92.1	-2.3	0.03
β_6	exposed	-188.39	65.12	-2.89	<0.01
β_7	protected	38.86	65.12	0.6	0.56

Table S6. Means for the linear model m_b4 for oyster biomass (g AFDW/m²) by reef type in summer 2022. Note that these means are derived from an emmeans analysis that was performed on m_b4 (Table S6).

Reef Type	mean	SE	df	lower.CL	upper.CL
shell	743.9	65.12	28	610.5	877.3
granite	280.83	65.12	28	147.44	414.23
castle	345.92	65.12	28	212.52	479.32
diamond	117.48	65.12	28	-15.92	250.88
c-dome	418.33	65.12	28	284.94	551.73
x-reef	531.75	65.12	28	398.35	665.15

Table S7. AIC results for all models of response variables for macrofaunal community data, ordered by increasing AICc weight (wts). Models with the lowest AICc are in bold. Difference in AICc from the best model is dAICc. Models using distributions other than normal distributions are listed in parentheses below the response variable. All response variables only pertain to macrofaunal unless otherwise stated. k = number of model parameters. R = reef, S = site.

Response	Model	k	Parameters	AIC	AICc	dAICc	wts
Community Density (Negative Binomial)	u_1	2	null	700.72	696.72	54.52	<0.01
	u_2	7	R	698.49	684.49	42.29	<0.01
	u_3	4	S	678.7	670.7	28.5	<0.01
	u_4	**9**	R + S	**660.2**	**642.2**	**0**	**0.99**
Community Biomass	u_1	2	null	451.13	451.49	19.36	<0.01
	u_3	4	S	450.05	451.34	19.21	<0.01
	u_2	7	R	433.28	437.28	5.15	0.07
	u_4	**9**	R + S	**425.21**	**432.13**	**0**	**0.93**
Secondary Productivity*	u_3	4	S	250.34	251.63	30.54	<0.01
	u_1	2	null	247.68	248.05	26.95	<0.01
	u_4	9	R + S	216.76	223.69	2.6	0.21
	u_2	**7**	R	**217.09**	**221.09**	**0**	**0.79**
Secondary Productivity including Oysters*	u_1	2	null	285.87	286.23	31.80	<0.01
	u_3	4	S	286.58	287.87	33.44	<0.01
	u_2	7	R	254.93	258.93	4.50	0.09
	u_4	**9**	R + S	**247.51**	**254.43**	**0**	**0.90**

* Linear model with a square root transformation.

Table S8. Parameter estimates for macrofaunal community data from 2022. Estimates were derived from the models supported with wts > 0.1 as listed in Table S7. Significant parameters ($\alpha \leq 0.05$) are in bold, and SE is included with the ± indicator. X indicates that the parameter is not included in the selected models. Model parameters follow those listed in Table S7. β_0 is the intercept and a mean of the oyster shell reef at Andrews site. The family of model used per response variable is listed in parentheses next to that response variable. LM = general linear model. Note that models that only found site as a significant factor were compared using a likelihood-ratio X^2 test to models that included both site and reef, and no significant differences were found. In the case where only site was significant, this table presents the model that include both site and reef as factors to examine the effect of alternative reefs on the univariate response variables.

Response	Model	β_0 Intercept	β_1 Granite	β_2 Castle	β_3 Diamond	β_4 C-dome	β_5 X-reef	β_6 Exposed	β_7 Protected
Density (Neg. Bin.)	u4	**10.87 ± 0.20**	**0.82 ± 0.25**	0.05 ± 0.25	**-0.81 ± 0.25**	0.22 ± 0.25	0.09 ± 0.25	**0.93 ± 0.17**	**-1.55 ± 0.17**
Biomass (LM)	u4	**245.08 ± 36.98**	**144.84 ± 45.29**	-48.17 ± 45.29	**-145.04 ± 45.29**	23.01 ± 45.29	45.60 ± 45.29	**-106.29 ± 32.02**	-63.65 ± 32.02
Secondary Production (LM*)	u2	**644.50 ± 3.30**	8.47 ± 6.60	**-39.25 ± 6.60**	**-241.18 ± 6.60**	**-30.50 ± 6.60**	**-58.91 ± 6.60**	X	X
Secondary Productivity including Oysters (LM*)	u4	**-2960.99 ± 3.13**	**-148.06 ± 3.13**	**-243.05 ± 3.84**	**-1126.74 ± 3.84**	**-169.42 ± 3.84**	**-104.43 ± 3.84**	**-46.28 ± 2.71**	1.96 ± 2.71

* Parameters back-transformed by squaring.

Table S9. Parameter means for response variables for macrofaunal community data from 2022. Note that all means are derived from an emmeans analysis that was performed on the models listed on the "Model" column for each response variable. X indicates that the factor was not included in that model. The transformations applied to the models used to derive the means for each row are listed in parentheses next to that response variable. Model parameters follow those listed in Table S7.

Response	Model	Shell	Granite	Castle	Diamond	C-dome	X-reef	Exposed	Protected	Andrews
Density (Neg. Bin.) – individuals/m^2	u_4	22859 ± 3995	51696 ± 9027	24098 ± 4206	10168 ± 1776	28672 ± 5006	24961 ± 4358	21933 ± 2708	11788 ± 1457	55676 ± 6871
Biomass (LM) – g AFDW	u_4	188.4 ± 32	333.3 ± 32	140.3 ± 32	43.4 ± 32	211.4 ± 32	234.0 ± 32	142 ± 22.6	185 ± 22.6	248 ± 22.6
Secondary Production (LM*) - g C/m^2/yr	u_2	644.48 ± 3.30	800.70 ± 3.30	365.64 ± 3.30	97.16 ± 3.30	394.56 ± 3.30	313.71 ± 3.30	X	X	X
Secondary Production with Oysters (LM*) - g C/m^2/yr	u_4	2768.19 ± 2.71	1635.88 ± 2.71	1370.74 ± 2.71	362.78 ± 2.71	1567.97 ± 2.71	1797.29 ± 2.71	1625.80 ± 1.92	1123.50 ± 1.92	1740.65 ± 1.92

* Means back-transformed from a model that used square-root transformed data

Table S10. Summary of PERMANOVA results for community density and biomass across reef type and site. Significant results are in bold.

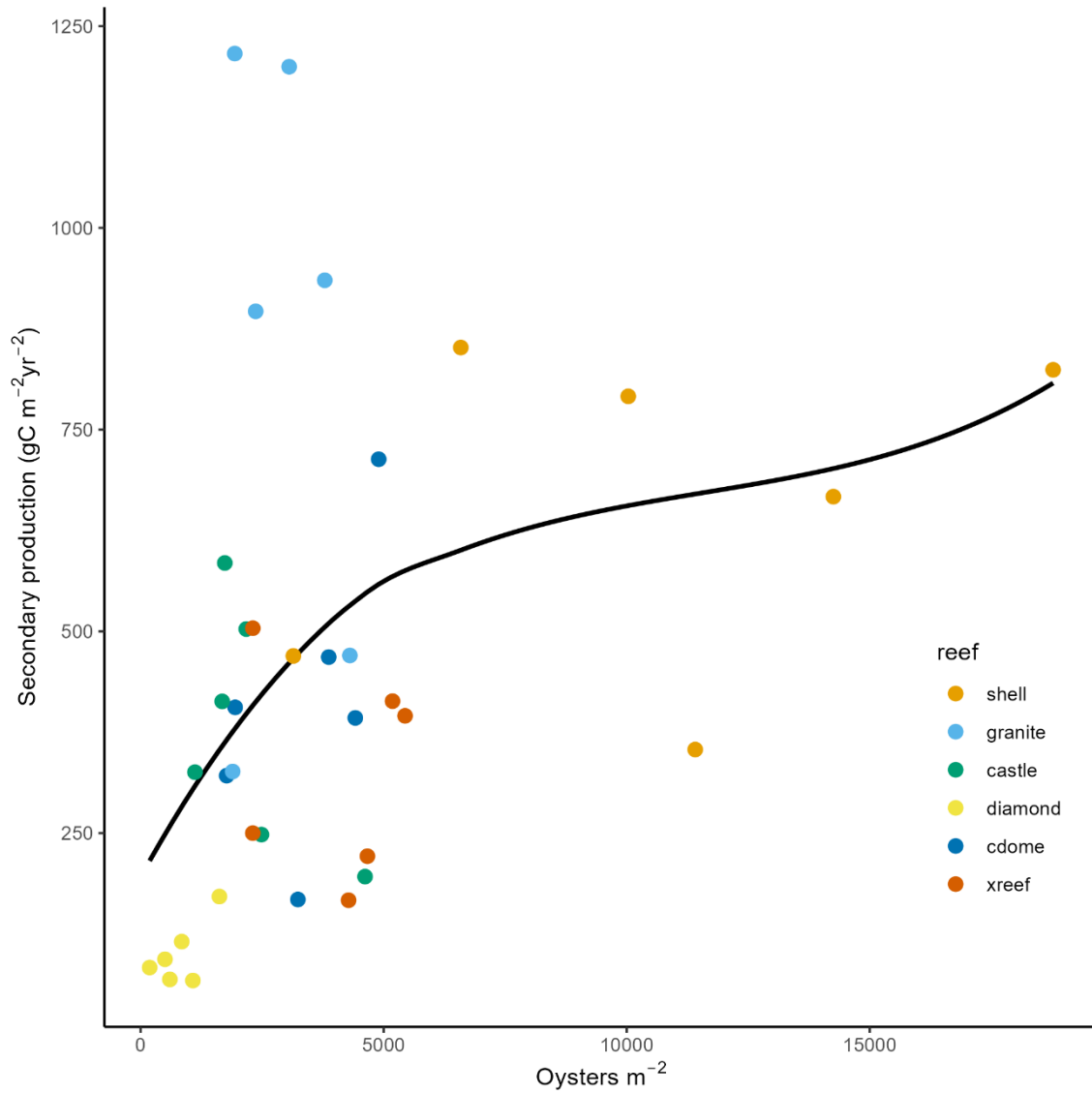| Source of Variation	df	SS	MS	Pseudo-F	P(perm)
Density					
Reef	5	11314	2262	6.659	**0.001**
Site	2	9946	4973	14.634	**0.001**
Reef x Site	10	3080	308	0.906	0.644
Residuals	18	6116	339		
Biomass					
Reef	5	14047	2810	4.251	**0.001**
Site	2	9643	4822	7.296	**0.001**
Reef x Site	10	6817	681	1.032	0.419
Residuals	18	11896	660		

Figure S1. Relationship between oyster density and macrofaunal secondary production (excluding oysters); black line represents the LOESS curve (span = 1.0).