

Supplementary Materials

# Euendolithic Infestation of Mussel Shells Indirectly Improves the Thermal Buffering Offered by Mussel Beds to Associated Molluscs, but One Size Does Not Fit All

**Table S1.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation on biomimetic mussel shell temperatures (data pooled for all experimental dates). Model used in this analysis:  $\text{shell\_temp} \sim \text{infestation} + \text{s}(\text{time}, \text{bs} = "cr", \text{by} = \text{infestation}, k = 4) + \text{s}(\text{id}, \text{bs} = "re")$ .

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	34.08	0.34	-	-
	Non-infested	3.12	0.14	496.6	<u>&lt; 0.001</u>
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	2.986	3	1081.55	<u>&lt; 0.001</u>
	s(time):Non-infested	2.990	3	1496.45	<u>&lt; 0.001</u>
	s(id)	84.903	89	19.83	<u>&lt; 0.001</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.919, Deviance explained: 0.927.REML: 2097.6, Scale est: 4.4228, N: 900.

**Table S2.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and biomimetic mussel shell temperatures differ over time (data pooled for all experimental dates).

Model	Resid.df	Resid.dev	df	Deviance	Pr(>Chi)
<b>Model 1 (ref)</b> $\text{shell\_temp} \sim \text{infestation} + \text{s}(\text{time}, \text{bs} = "cr", k = 4) + \text{s}(\text{id}, \text{bs} = "re")$	806.10	3796.00	-	-	-
<b>Model 2</b> $\text{shell\_temp} \sim \text{infestation} + \text{s}(\text{time}, \text{bs} = "cr", \text{by} = \text{infestation}, k = 4) + \text{s}(\text{id}, \text{bs} = "re")$	803.06	3569.70	3.03	226.28	<u>&lt; 0.001</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S3.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and biomimetic mussel shell temperatures over time differ between experimental dates.

Model	Resid.df	Resid.dev	df	Deviance	F-value	p-value
<b>Model 1 (ref)</b> $\text{shell\_temp} \sim \text{infestation} + \text{s}(\text{time}, \text{bs} = "cr", \text{by} = \text{infestation}, k = 4) + \text{s}(\text{id}, \text{bs} = "re")$	803.06	3569.70	-	-	-	-

**Model 2**

shell\_temp ~ infestation + date + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")

816.06	3680.80	12.996	111.04	1.93	< 0.01
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\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S4.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation of the biomimetic mussels on the shell temperatures of the spiny chiton, *Acanthochitona garnoti* (data pooled for all experimental dates). Model used in this analysis: shell\_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 6) + s(id, bs = "re").

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	32.85	0.23	-	-
	Infestation	1.73	0.16	86.73	< 0.001
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	4.57	4.90	177.356	< 0.001
	s(time):Non-infested	4.45	4.85	248.17	< 0.001
	s(id)	30.89	41.00	4.34	< 0.001

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.849, Deviance explained: 0.863. REML: 958.91, Scale est: 3.5744, N: 445.

**Table S5.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of the spiny chiton, *Acanthochitona garnoti*, differ over time (data pooled for all experimental dates).

Model	Resid.df	Resid.dev	df	Deviance	Pr(>Chi)
<b>Model 1 (ref)</b> shell_temp ~ infestation + s(time, bs = "cr", k = 6) + s(id, bs = "re")	399.94	1476.20	-	-	-
<b>Model 2</b> shell_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 6) + s(id, bs = "re")	394.75	1440.80	5.19	35.38	0.09

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S6.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of the spiny chiton, *Acanthochitona garnoti*, over time differ between experimental dates.

Model	Resid.df	Resid.dev	df	Deviance	F-value	p-value
<b>Model 1 (ref)</b> shell_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 6) + s(id, bs = "re")	394.75	1440.80	-	-	-	-
<b>Model 2</b> shell_temp ~ infestation + date + s(time, bs = "cr", by = infestation, k = 6) + s(id, bs = "re")	394.99	1442.60	0.24	1.78	2.08	0.13

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S7.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation on the biomimetic mussel shell temperatures and on the shell temperatures of the spiny chiton, *Acanthochitona garnoti* (data pooled for all experimental dates). Model used in this analysis: shell\_temp ~ infestation + species + s(time, bs = "cr", by = infestation, k = 6) + s(id, bs = "re").

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	32.95	0.30	-	-
	Infestation	2.31	0.27	74.43	<u>&lt; 0.001</u>
	Species	3.66	0.37	95.36	<u>&lt; 0.001</u>
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	4.45	4.84	182.61	<u>&lt; 0.001</u>
	s(time):Non-infested	4.36	4.79	264.60	<u>&lt; 0.001</u>
	s(id)	44.64	70.00	1.99	<u>&lt; 0.001</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.874, Deviance explained: 0.890. REML: 993.99, Scale est: 4.6414, N: 432.

**Table S8.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation of the biomimetic mussels on the shell temperatures of the granular limpet, *Scutellastra granularis* (data pooled for all experimental dates). Model used in this analysis: shell\_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re").

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	29.05	0.39	-	-
	Infestation	1.77	0.29	37.92	<u>&lt; 0.001</u>
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	2.87	2.99	233.20	<u>&lt; 0.001</u>
	s(time):Non-infested	2.92	3.00	255.54	<u>&lt; 0.001</u>
	s(id)	30.76	38.00	5.66	<u>&lt; 0.001</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.883, Deviance explained: 0.902. REML: 535.13, Scale est: 4.4892, N: 228.

**Table S9.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of the granular limpet, *Scutellastra granularis*, differ over time (data pooled for all experimental dates).

Model	Resid.df	Resid.dev	df	Deviance	Pr(>Chi)
<b>Model 1 (ref)</b>					
shell_temp ~ infestation + s(time, bs = "cr", k = 4) + s(id, bs = "re")	186.51	888.24	-	-	-
<b>Model 2</b>					
shell_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	183.24	850.48	3.27	37.76	<u>&lt; 0.05</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S10.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of the granular limpet, *Scutellastra granularis*, over time differ between experimental dates.

Model	Resid.df	Resid.dev	df	Deviance	F-value	p-value
<b>Model 1 (ref)</b> shell_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	183.24	850.48	-	-	-	-
<b>Model 2</b> shell_temp ~ infestation + date + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	200.81	927.60	17.57	77.12	0.98	0.49

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S11.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation on the biomimetic mussel shell temperatures and on the shell temperatures of the granular limpet, *Scutellastra granularis* (data pooled for all experimental dates). Model used in this analysis: shell\_temp ~ infestation + species + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re").

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	32.32	0.45	-	=
	Infestation	1.97	0.37	28.27	< 0.001
	Species	2.50	0.58	18.68	< 0.001
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	2.90	2.99	274.81	< 0.001
	s(time):Non-infested	2.95	3.00	361.15	< 0.001
	s(id)	45.95	63.00	2.99	< 0.001

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.912, Deviance explained: 0.932. REML: 553.03, Scale est: 4.2857, N: 234.

**Table S12.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation on the biomimetic mussels and on the shell temperatures of the prickly limpet, *Helcion pectunculus*, and the variegated topshell, *Oxystele antoni* (data pooled for all experimental dates). Model used in this analysis: shell\_temp ~ infestation + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re").

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	33.46	0.96	-	=
	Infestation	0.56	0.38	2.18	0.14
	<i>Oxystele antoni</i>	0.24	1.33	0.60	0.55
	<i>Perna perna</i>	1.03	1.25	0.60	0.55
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	2.96	3.00	305.70	< 0.001
	s(time):Non-infested	2.96	3.00	309.80	< 0.001

s(id) 68.16 75.00 11.80 <0.001

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63]. Adjusted R-squared: 0.903, Deviance explained: 0.928. REML: 797.67, Scale est: 6.2238, N: 299.

**Table S13.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of prickly limpet, *Helcion pectunculus*, and the variegated topshell, *Oxys-tele antoni*, differ over time (data pooled for all experimental dates).

Model	Resid.df	Resid.dev	df	Deviance	Pr(>Chi)
<b>Model 1 (ref)</b> shell_temp ~ infestation + species + s(time, bs = "cr", k = 4) + s(id, bs = "re")	217.47	1377.30	-	-	-
<b>Model 2</b> shell_temp ~ infestation + species + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	214.45	1375.00	3.02	2.24	<u>0.95</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S14.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and shell temperatures of the prickly limpet, *Helcion pectunculus*, and the variegated topshell, *Oxystele antoni*, over time differ between experimental dates.

Model	Resid.df	Resid.dev	df	Deviance	F-value	p-value
<b>Model 1 (ref)</b> shell_temp ~ infestation + species + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	214.45	1375.00	-	-	-	-
<b>Model 2</b> shell_temp ~ infestation + date + species + s(time, bs = "cr", by = infestation, k = 4) + s(id, bs = "re")	239.20	1639.10	24.75	264.07	1.71	<u>&lt;0.05</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

**Table S15.** Summary outputs of the Generalized Additive Model (GAM) on the effect of euendolithic infestation on the wet weight of infaunal invertebrates (data pooled for all species and experimental dates). Model used in this analysis: log(wet\_wgt) ~ infestation \* species + s(time, bs = "cr", by = infestation, k = 5) + s(id, bs = "re")

Component	Term	Estimate	Std Error	F-value	p-value
A. Parametric coefficients	(intercept)	7.69	0.06	-	=
	Infestation	0.09	0.09	1.02	0.31
	Species			239.74	< 0.001
	Infestation x Species			0.98	0.40
Component	Term	edf	Ref.df	F-value	p-value
B. Smooth terms	s(time):Infested	1.19	1.36	19.51	<u>&lt;0.001</u>
	s(time):Non-infested	2.01	2.46	7.16	<u>&lt;0.001</u>
	s(id)	1.02	32.00	0.03	<u>0.42</u>

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].

Adjusted R-squared: 0.799, Deviance explained: 0.805.

REML: 202.87, Scale est: 0.16678, N: 359.

**Table S16.** Results of Wald's-like test to assess whether the non-linear relationship between infestation and wet weight of infaunal invertebrates (data pooled for all species and experimental dates) differ over time between species (data pooled for all experimental dates).

Model	Resid.df	Resid.dev	df	Deviance	Pr(>Chi)
<b>Model 1 (ref)</b>					
log(wet_wgt) ~ infestation + species + s(time, bs = "cr", by = infestation, k = 5) + s(id, bs = "re")	346.34	58.30	-	-	-
<b>Model 2</b>					
log(wet_wgt) ~ infestation * species + s(time, bs = "cr", by = infestation, k = 5) + s(id, bs = "re")	343.59	57.84	2.75	0.46	0.38

\* Significant parameters are underlined. Parameter significance was assessed for parametric coefficients using standard F-tests, while the significance of smoothed terms were assessed using adapted Wald's-like tests [63].