Table S1. Total time in seconds that each lobster was visible to the camera during video recordings (recordings were at least 30 minutes, or 1,800 seconds). A "0" indicates that a lobster was not visible or otherwise not observable during the measurement time point, and therefore that video was excluded from analysis. "Hatched" denotes that a lobster had initiated hatching at the time of the measurement timepoint, and therefore that video was excluded from analysis.

Lobster ID	Jan. Time Visible (sec.)	Feb. Time Visible (sec.)	Mar. Time Visible (sec.)
T10_L2	3480	1175	1162
T10_L1	1602	0	*Hatched*
T11_L1	1170	1568	0
T11_L2	774	*Hatched*	*Hatched*
T12_L1	1326	853	959
T12_L2	4204	0	*Hatched*
T13_L1	2146	652	350
T13_L2	2322	2830	0
T14_L1	265	1186	1119
T14_L2	0	0	*Hatched*
T3_L1	1399	*Hatched*	*Hatched*
T3_L2	1436	429	0
T4_L1	1227	450	119
T4_L2	691	271	0
T5_L1	143	1198	1032
T5_L2	136	1095	*Hatched*
T6_L1	373	1224	1156
T6_L2	1507	2128	*Hatched*
T7_L1	2116	753	1211
T7_L2	2451	0	0
T8_L1	306	*Hatched*	*Hatched*
T8_L2	344	283	0
T9_L1	1605	1287	599
T9_L2	1657	1160	*Hatched*

Table S2. Results of model selection analyses for candidate generalized linear mixed effects models describing the relationship between lobster brood grooming response variables, pH, temperature, and their interaction, and models describing the relationship between egg loss response variable, pH, temperature, carapace length, and their interactions. Parentheses denote random effects. Subset of models tested are shown. The lowest AIC score model was selected where the difference in AIC score was greater than two, the most inclusive model was selected (i.e., model including most terms and interactions).

Response Variable	Model	Model Parameters	AIC
Tail Extension	1	Prop. time extended = Temp. + pH + (Random ID)	639.6
	2	Prop. time extended = Temp. * pH + (Random ID)	641.1
	3	Prop. time extended = Temp. + pH + PEI + Random ID)	**635.6**
Fanning	1	Prop. time fanning = Temp. + pH + (Random ID)	590.3
	2	Prop. time fanning = Temp. * pH + (Random ID)	592.0
	3	Prop. time fanning = Temp. + pH + PEI + (Random ID)	**577.9**
	4	Prop. time fanning = Temp. * pH * PEI + (Random ID)	582.0
Probing	1	Prop. time probing = Temp. + pH + (Random ID)	443.9
	2	Prop. time probing = Temp. * pH + (Random ID)	445.7
	3	Prop. time probing = Temp. + pH + PEI + (Random ID)	445.7
Egg Loss	1	Prop. Egg Mass Volume = Temp*pH + (1|CL) + (1|Lobster ID)	**454.65**
	2	Prop. Egg Mass Volume = Temp + pH + (1|CL) + (1|Lobster ID)	452.67

Table S3. Results of Pearson's Correlation Coefficient test comparing lobster fecundity (Egg Mass Volume) with carapace length. Test statistic (t), degrees of freedom (df), p-value (*p*), confidence interval (conf) and sample estimates (cor) displayed for each test.

Response Variables	t	df	*p*	conf	cor
CL vs. Initial Fecundity	1.862	20	0.077	-0.044-0.694	0.384
Time Spent Probing vs. Fecundity	-0.541	26	0.593	-0.461-0.279	-0.105

Table S4. Generalized linear mixed model (GLMM), with associated estimates and standard errors, comparing the likelihood of engaging in probing behavior for lobsters held at different temperature and pH levels. Probing was treated as a binary variable, with lobsters either observed probing during a video (1) or not observed probing during a video (0). Source population and the time point when behavior measurements were taken were included as random effects, and estimates are in log odds. Parameters with a statistically significant effect ($p < 0.05$) on the response variable are shown in bold.

Probing (Binary)	*Probing ~ Temperature*pH*PEI + (1| Measurement Time Point) + (1|Source Population)*		
	Chisq	*Df*	Pr(>Chisq)
Intercept	1.101	1	0.294
Temperature	0.001	1	0.973
pH	0.872	1	0.350
PEI	1.266	1	0.261
Temperature*pH	0.229	1	0.632
Temperature*PEI	2.219	1	0.136
pH*PEI	1.476	1	0.225
Temperature*pH*PEI	2.632	1	0.105

Table S5. Results of a one-way ANOVA analysis comparing female lobster condition and embryo development among treatment groups at the start of the experiment, before exposure to treatment groups began. Degrees of freedom (df), F-values, and p-values (*p*) are reported.

Response Variable	**df**	**F-value**	***p***
Perkins Eye Index	3	0.283	0.837
Carapace Length	3	1.239	0.325
Fecundity	3	0.461	0.713

Table S6. Results of an unpaired two-sample *t*-test comparing both the initial egg mass volume and egg loss of lobsters with and without damaged 5th pereopods.

Response Variable	Female Condition	Mean	t-cal	df	p
Initial Egg Mass Volume	Intact 5th pereopods	229.968	-0.761	20	0.456
	Damaged 5th pereopods	265.475			
Egg Loss	Intact 5th pereopods	0.455	-0.558	20	0.583
	Damaged 5th pereopods	0.497			

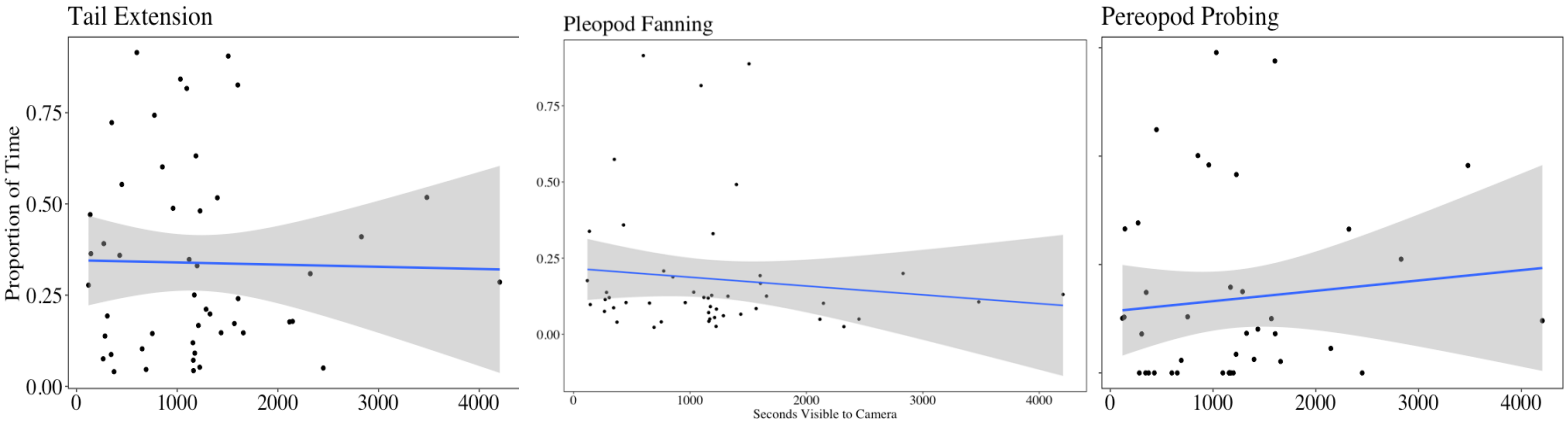

Figure S1. Relationship between time ovigerous lobsters spent visible to the camera and proportion of time the lobsters spent engaging in (a) tail extension, (b) pleopod fanning, and (c) pereopod probing. Blue lines represent linear lines of best fit. Gray shading represents 95% confidence interval.

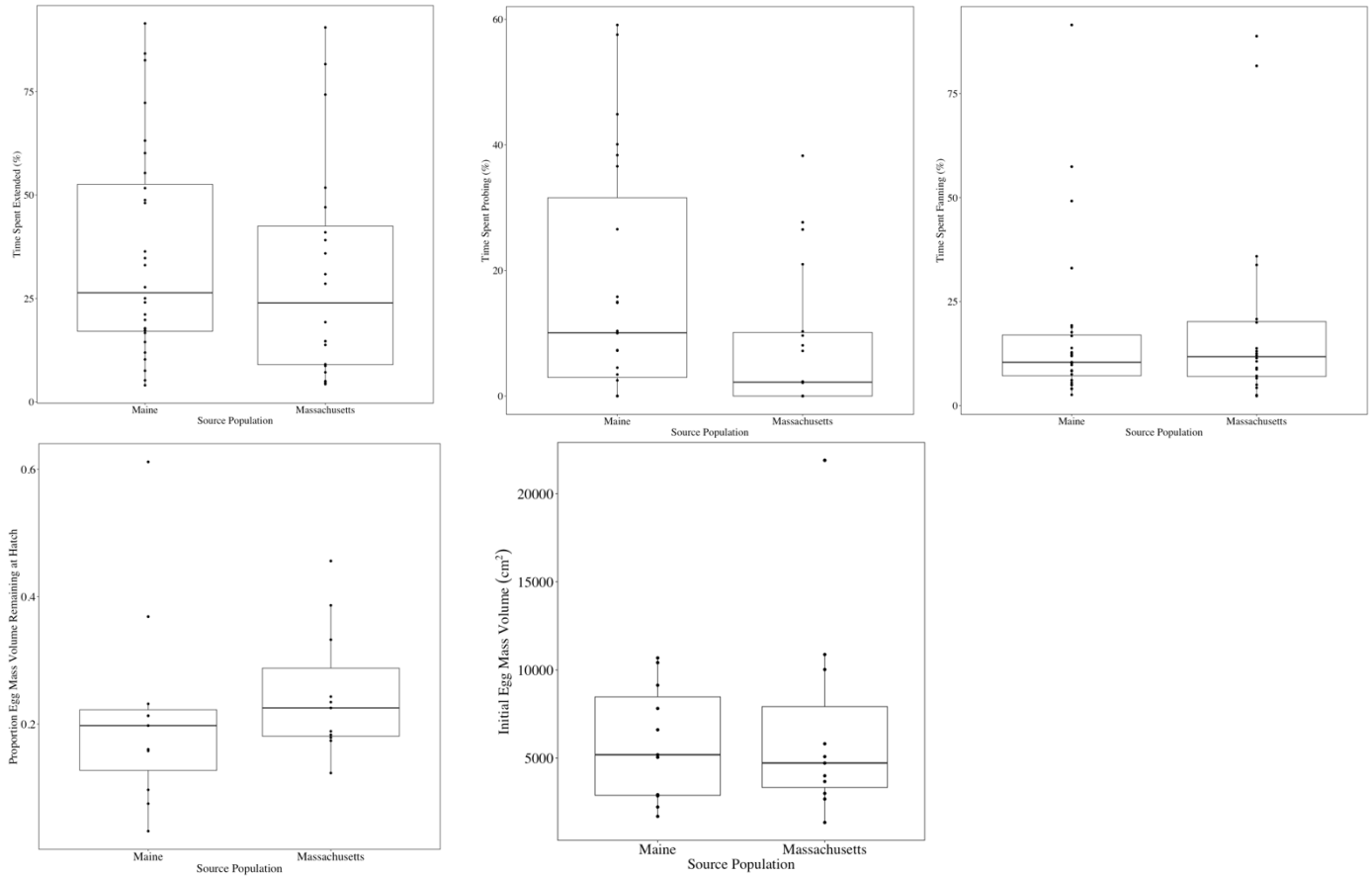

Figure S2. Boxplots of the relationship between lobster source population and the percentage of time lobsters spent engaging in fanning behavior, probing behavior, or with their tails extended and the initial egg mass volume. Points represent raw data. Lower and upper fences represent the 1st and 3rd quartile, respectively, with the center bar representing the median. Whiskers are calculated as Quartile 1 – 1.5*Interquartile Range (lower whisker) or Quartile 3 + 1.5*Interquartile Range (upper whisker). Data points beyond the whiskers represent outliers.

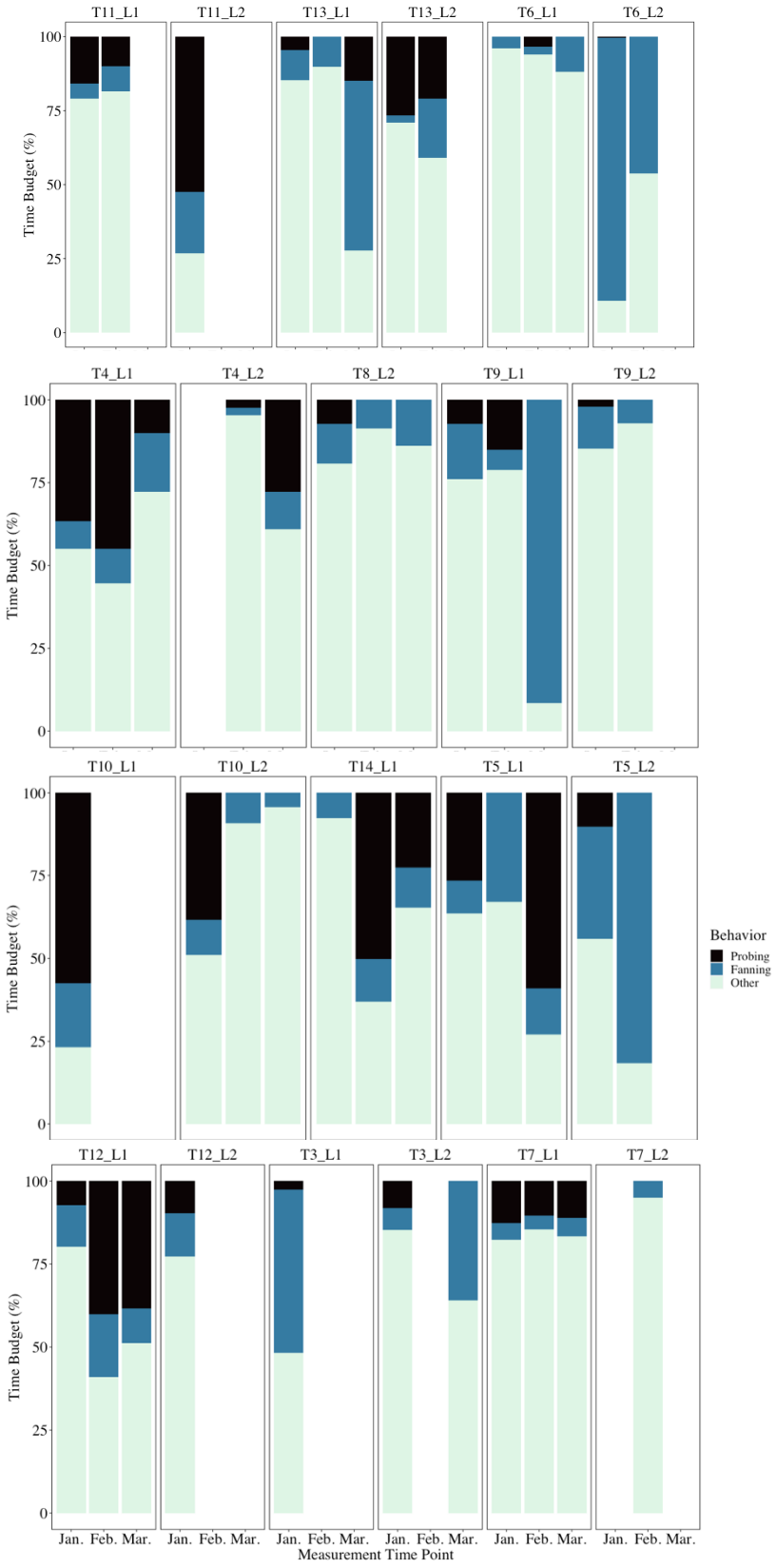

Figure S3. Time budget for individual ovigerous lobsters during three measurement time points for the Control Temperature/Control pH treatment (a), the Elevated Temperature/Control pH treatment (b), the Control Temperature/Low pH treatment (c) and the Elevated Temperature/Low pH treatment (d). Each female lobster was recorded for ~30 minutes in each of January, February, and March of 2021. The time a lobster spent fanning or probing the brood was recorded. The time that lobsters engaged in a variety of other behaviors and activities during each recording (e.g., locomotion, resting, moving gravel, cleaning antennae, etc.) was summed and collectively denoted as "other." The time budget was calculated as the percentage of seconds when a lobster was visible to the camera that it spent engaging in one of the three behavior categories. For total amount of time for each observation period, see Table S1.

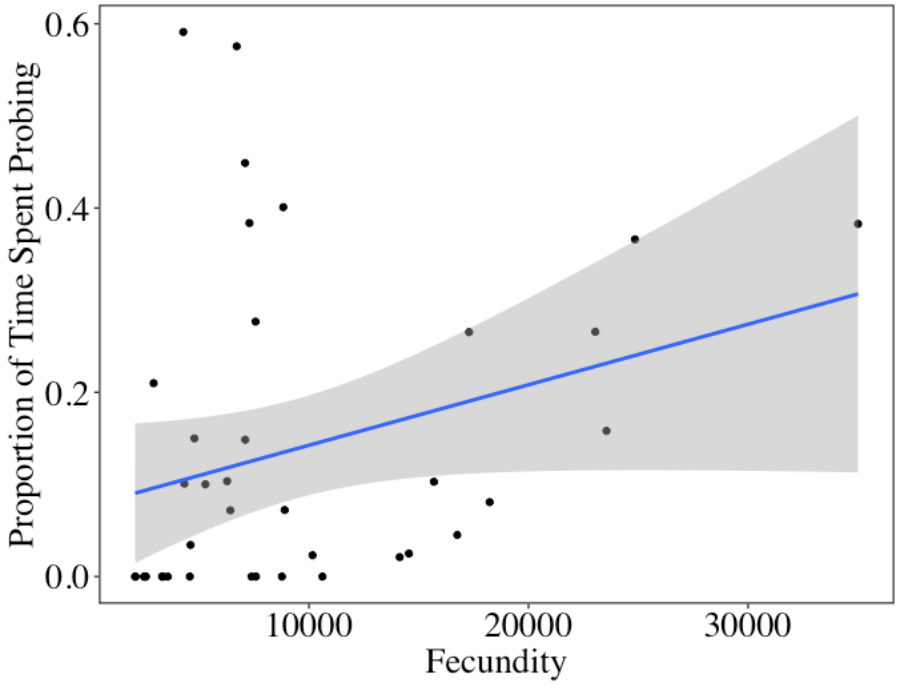

Figure S4. Relationship between lobster fecundity (measured as egg mass volume in cm^3) and the proportion of time that a lobster spent probing the brood. Points represent raw data. Line represents linear best fit equation. Shaded region represents 95% confidence interval for line of best fit.

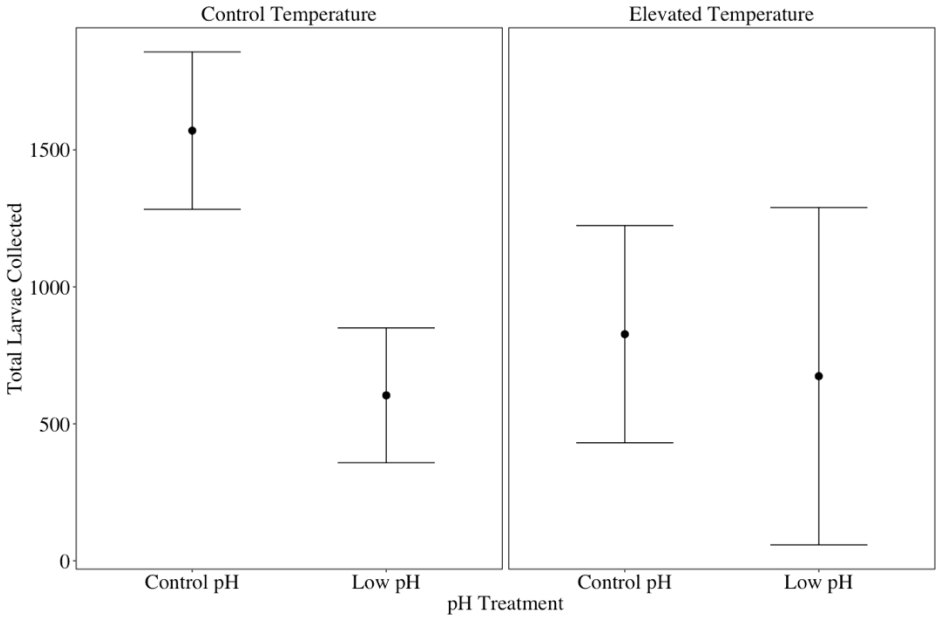

Figure S5. The number of lobster larvae that hatched from a brood in each temperature and pH treatment combination. Points represent the average number of larvae released per brood in each treatment. Error bars represent standard error. The number of broods that started and completed hatching within the experimental period in each treatment combination were: four broods in control temperature, control pH; three broods in elevated temperature, control pH; three broods in control temperature, low pH; three broods in elevated temperature, low pH.

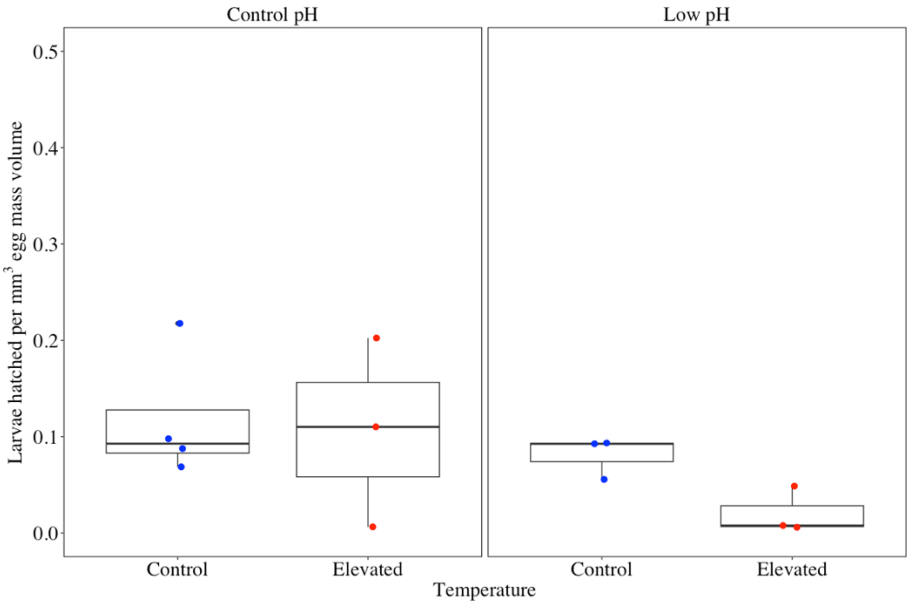

Figure S6. Hatching success among lobsters that released larvae during the 5-month experimental period. Hatching success was calculated as the number of lobster larvae hatched per volume of egg mass. Points represent hatching success for a single lobster. The number of broods that hatched in each treatment combination were: four broods in control temperature, control pH; three broods in elevated temperature, control pH; three broods in control temperature, low pH; three broods in elevated temperature, low pH.

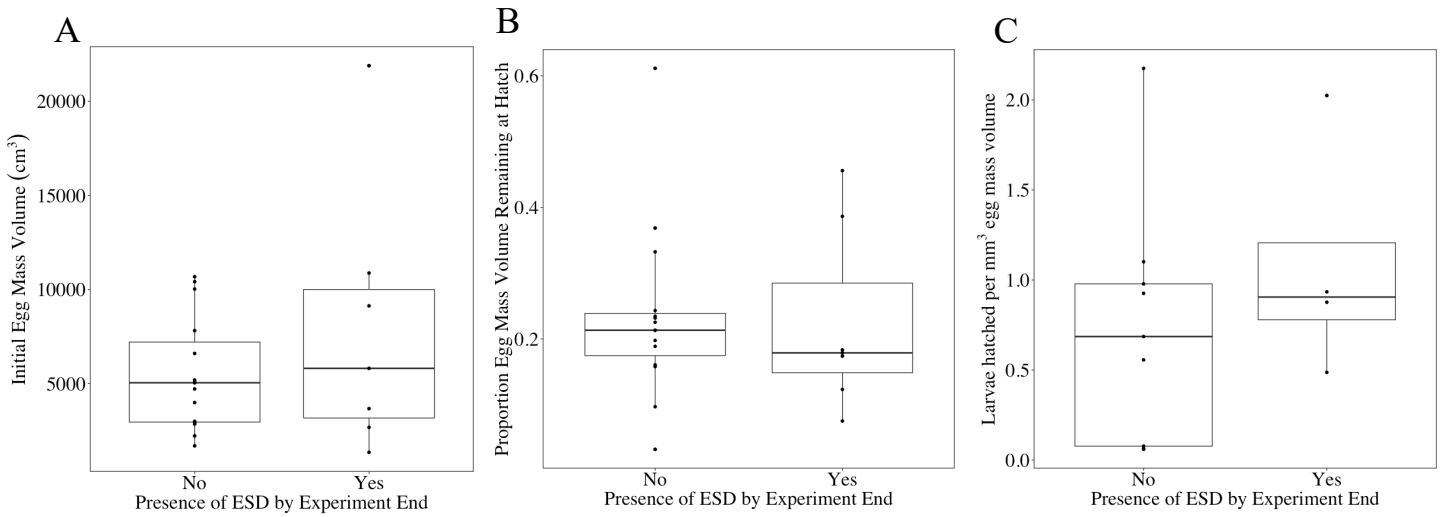

Figure S7. Boxplots of the relationship between indicators of reproductive success and the presence of epizootic shell disease (ESD) in ovigerous lobsters at the end of a five months exposure to conditions of ocean warming and acidification. Points represent raw data. Lower and upper fences represent the 1st and 3rd quartile, respectively, with the center bar representing the median. Whiskers are calculated as Quartile 1 – 1.5*Interquartile Range (lower whisker) or Quartile 3 + 1.5*Interquartile Range (upper whisker). Data points beyond the whiskers represent outliers. Indicators of reproductive success include initial egg mass volume (A), the proportion of egg mass volume remaining at the initiation of hatching or the end of the experiment (B), and the number of larvae hatched per volume of egg mass (C).