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FIGURES

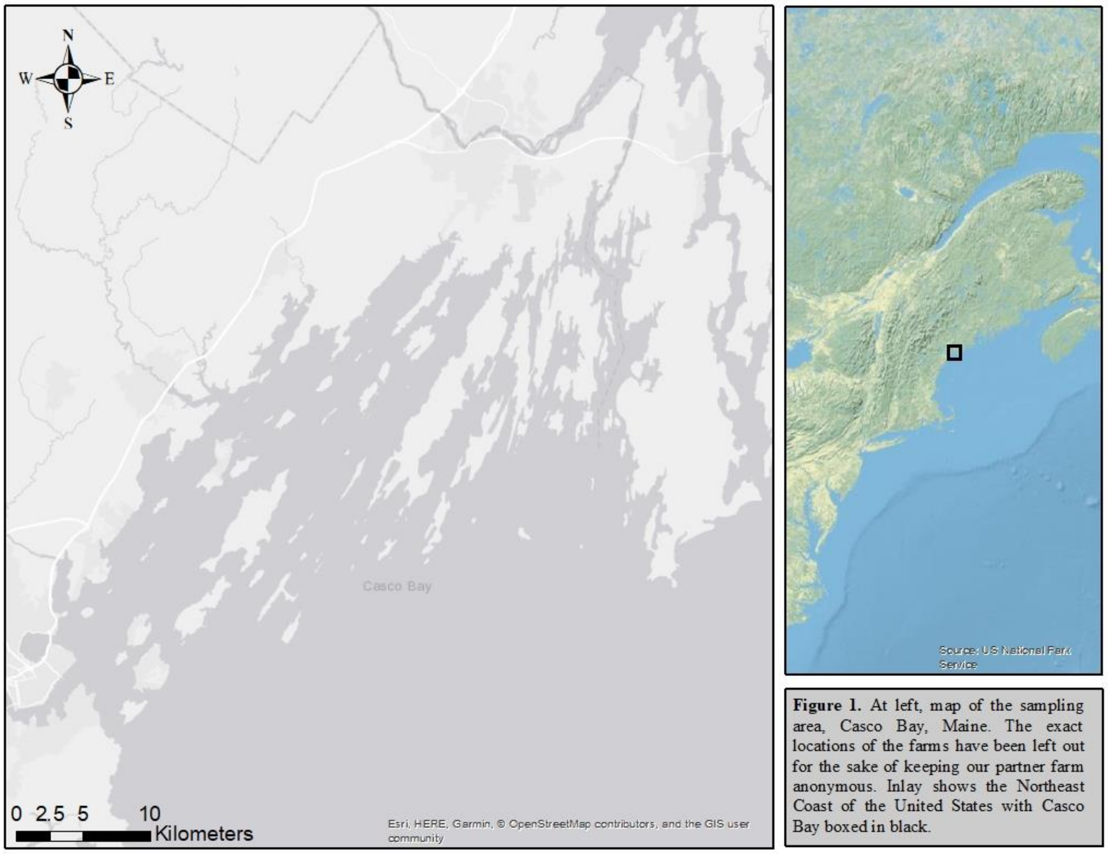


Figure 1. Map of Casco Bay. At left, map of the sampling area, Casco Bay, Maine. The exact locations of the farms have been left out for the sake of keeping our partner farm anonymous. Inlay shows the Northeast Coast of the United States with Casco Bay boxed in black.

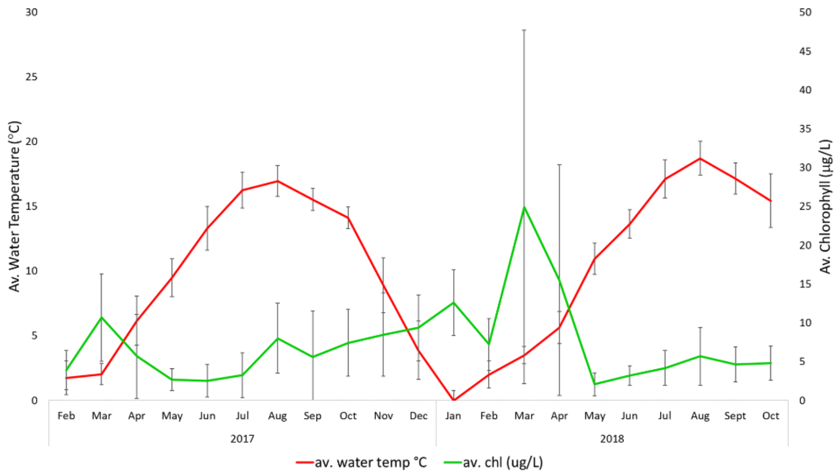
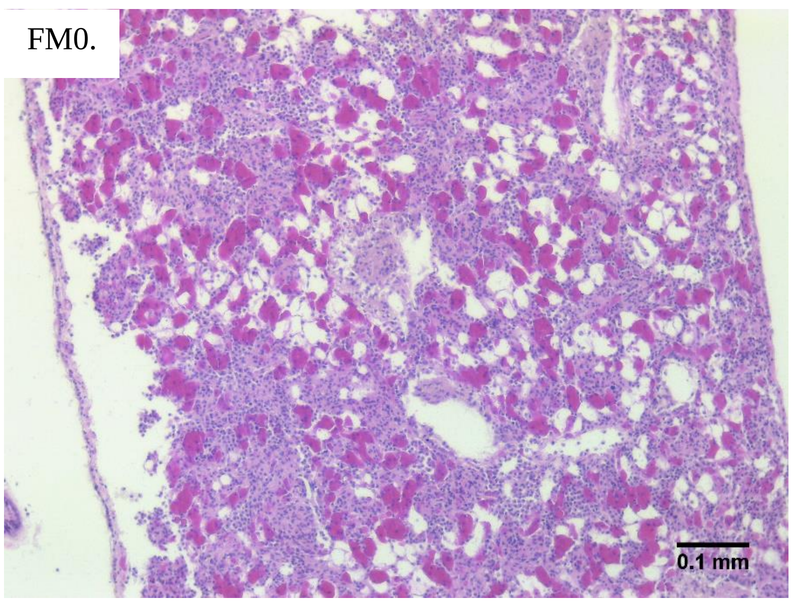
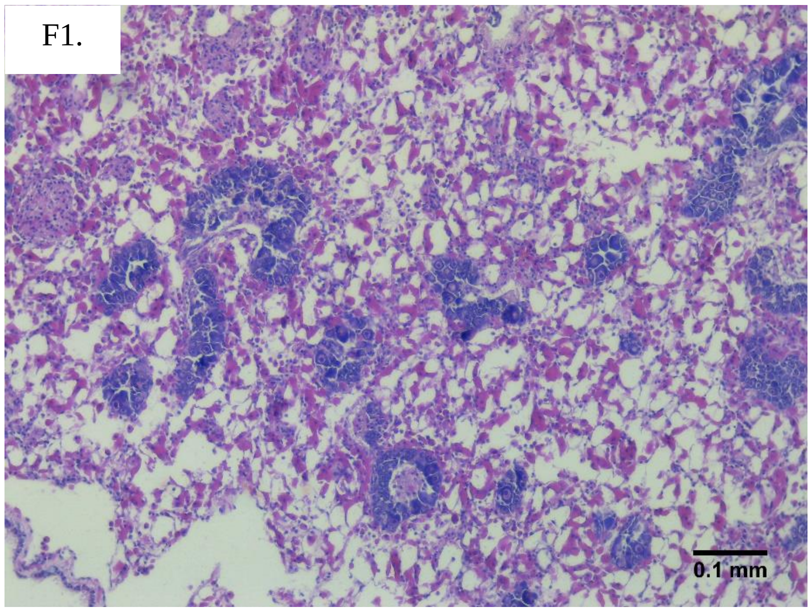


Figure 2. Study Site Environmental Conditions. Average monthly water temperature (red) and chlorophyll concentration (green) for the duration of this study, in Casco Bay. Standard Deviation bars shown.

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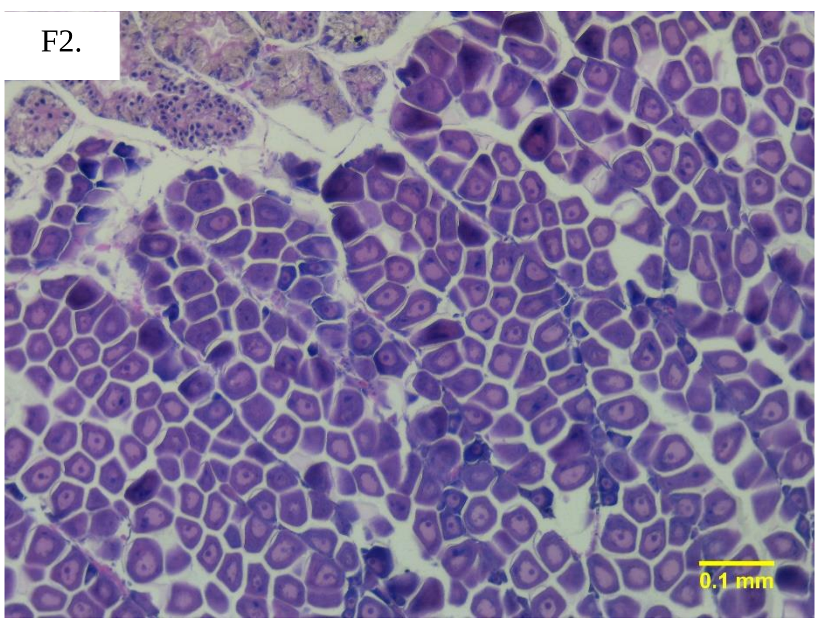
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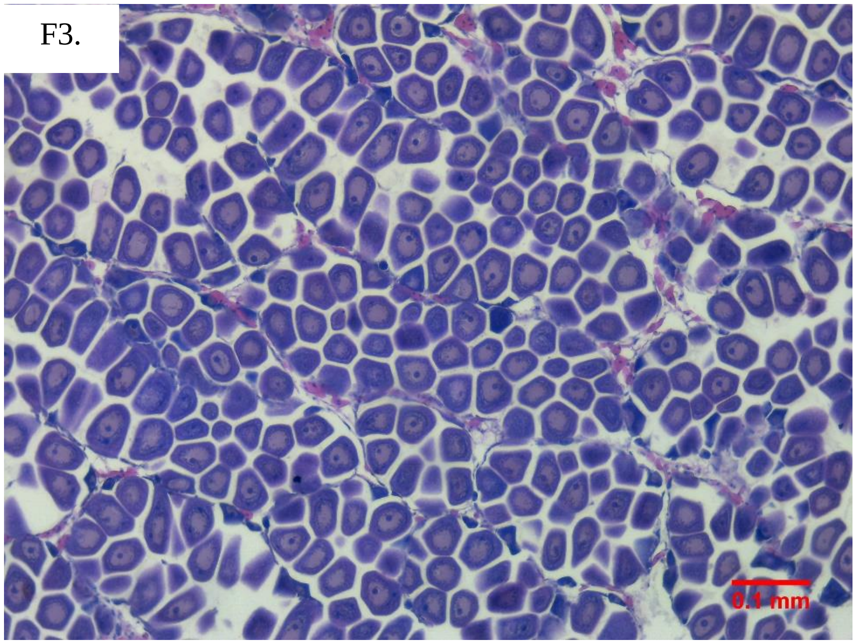
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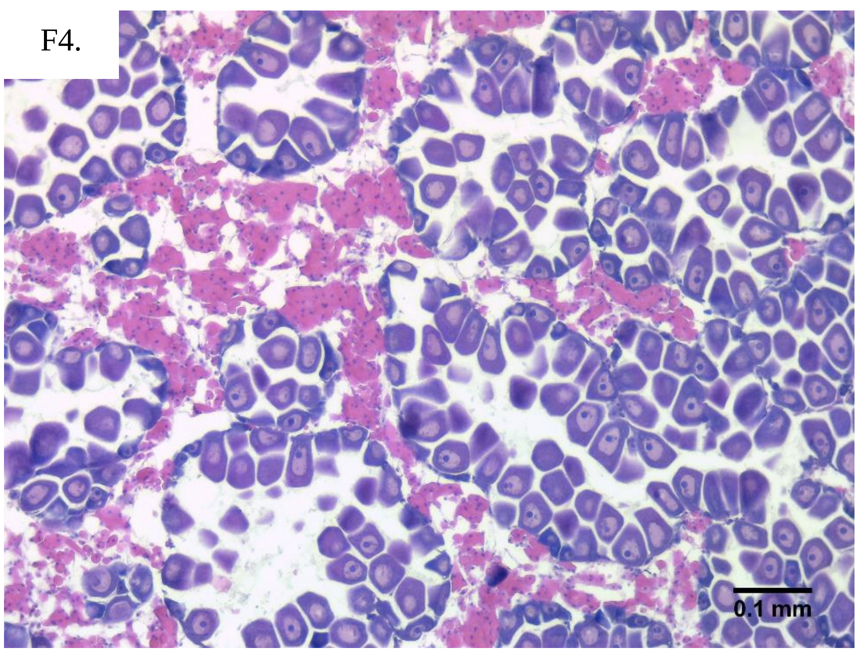
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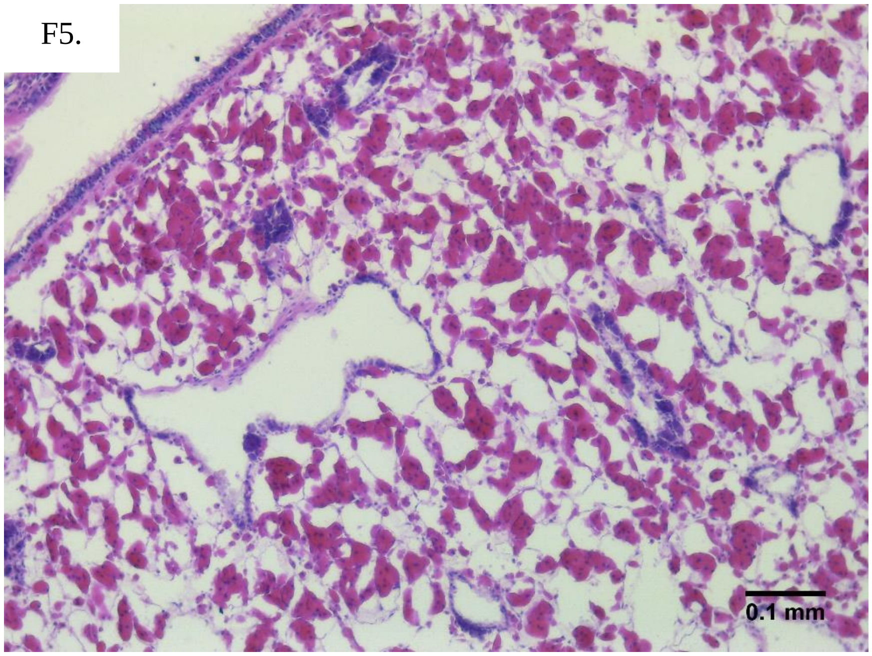

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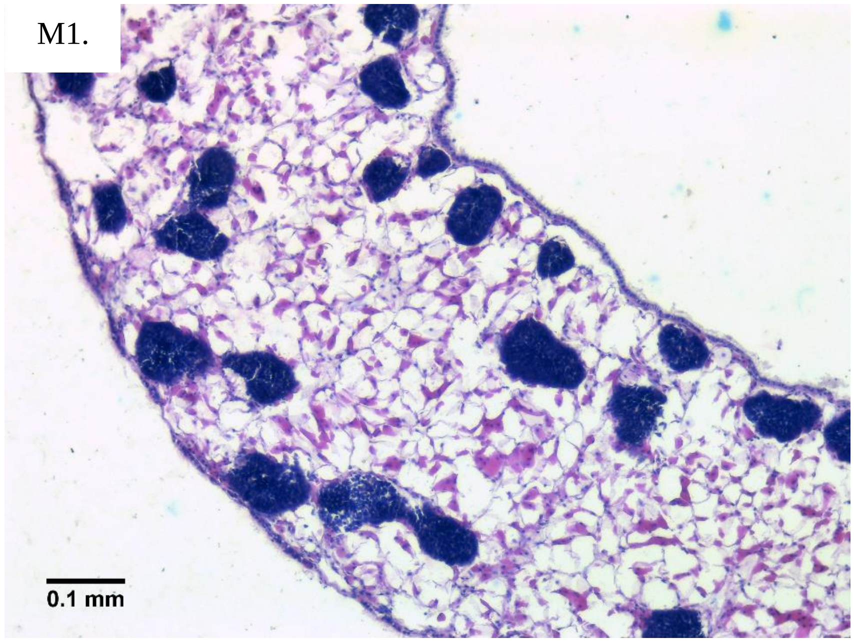

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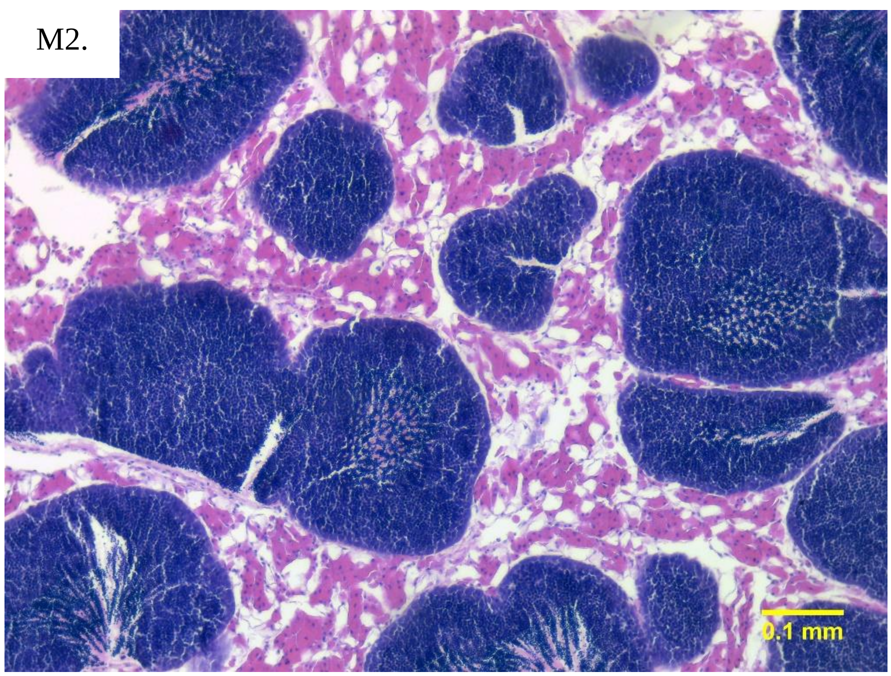

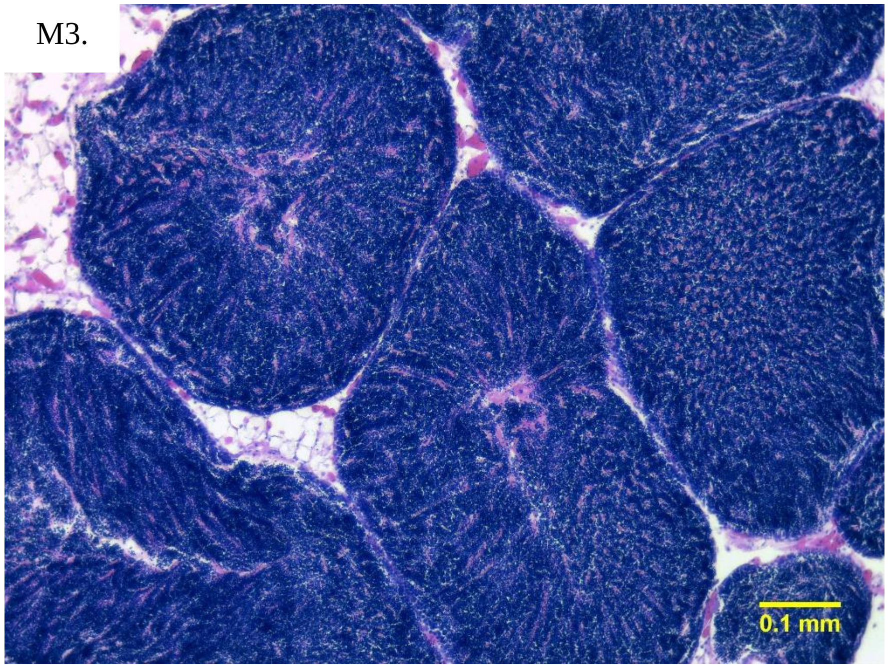

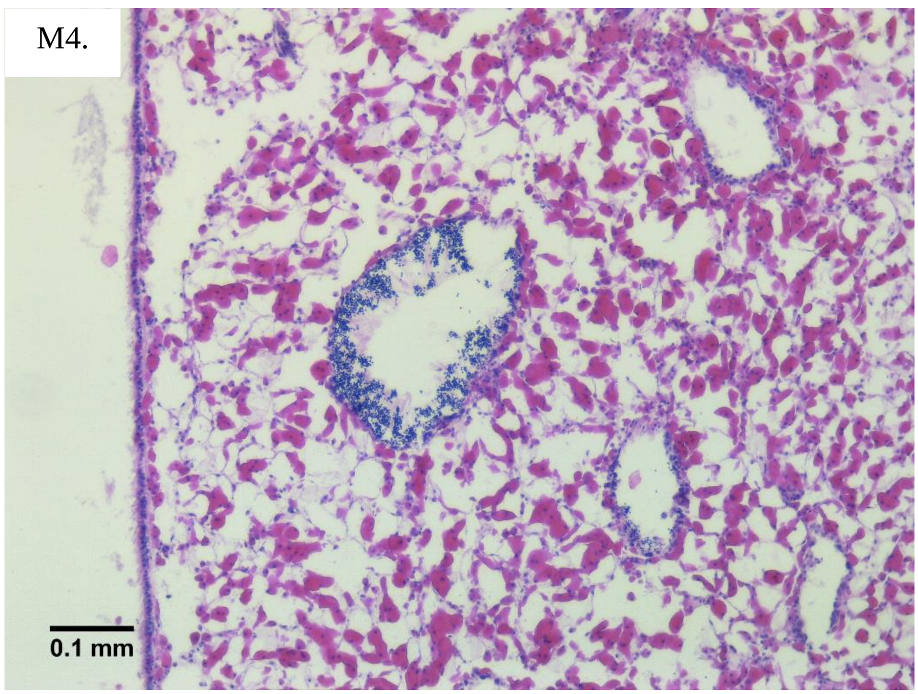

Figure 3. Staging Scale. Created for this study modified from Chipperfield 1953 and Duinker et al. 2008. ‘FM0’ denotes Stage 0. ‘F1.-F5.’ represent female stages 1-5. ‘M1.-M4.’ represent male stages 1-5.

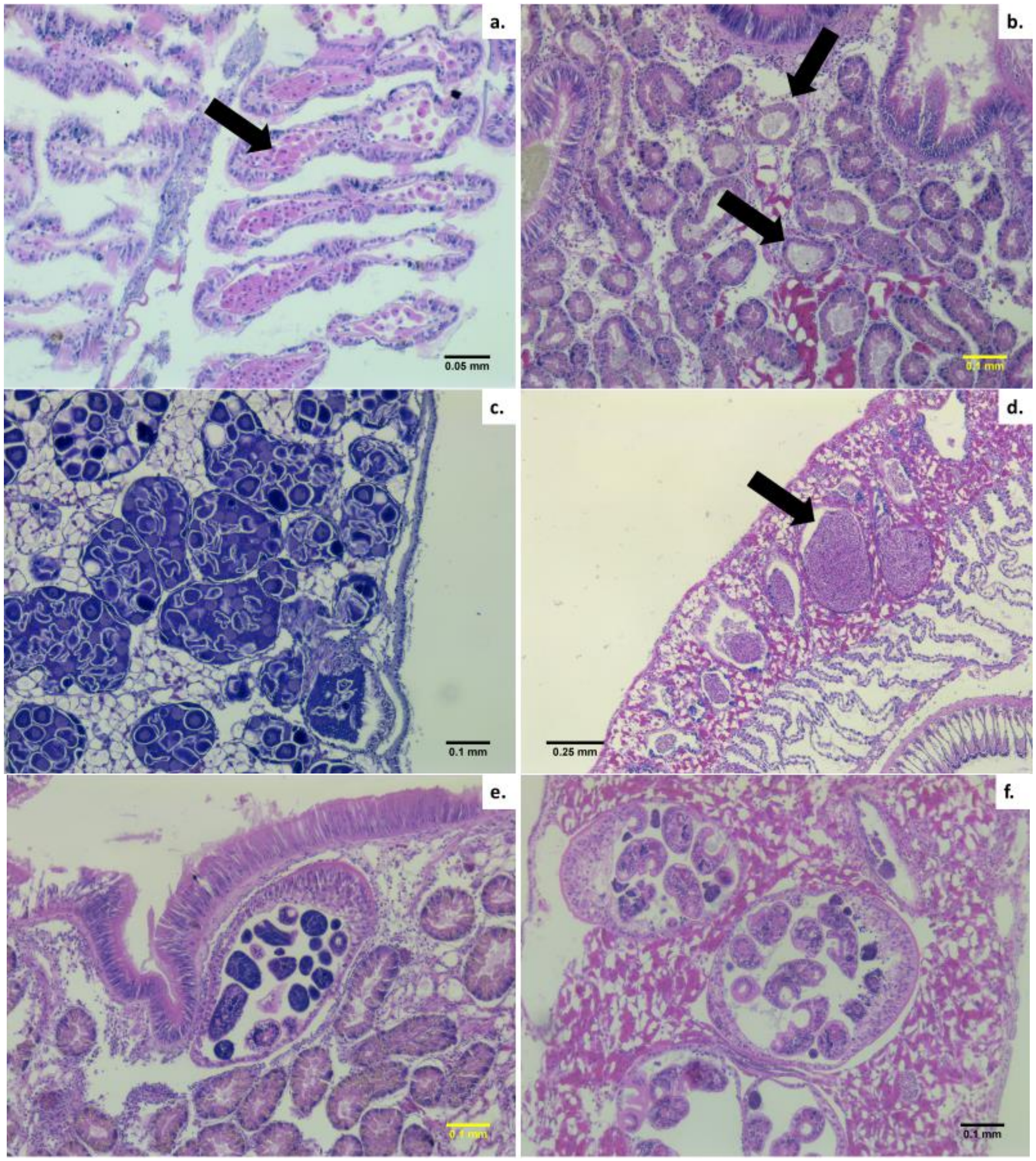

Figure 4. Pathology Micrographs. Examples of the five pathologies of focus for this study. (a.) Black arrow pointing to gill ciliates in the gills of a mussel. (b.) Digestive gland atrophy (DGA), black arrows pointing out tubules with thinned walls. (c.) Oocyte atresia. (d.) Hemocyte filled mantle follicles. (e. & f.) Trematode sporocysts containing cercaria, adjacent to digestive tubules (e.) and in the mantle (f.).

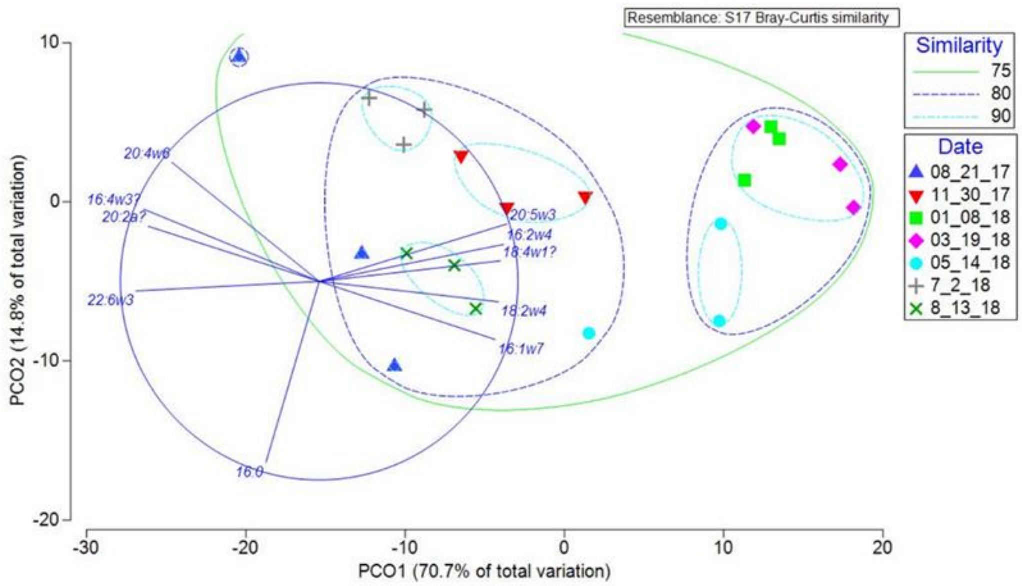

Figure 5. Fatty Acid Principal Coordinates Analysis. Principal coordinates analysis describing the degree of similarity between samples based on their fatty acid composition (in terms of percentage per sample, not wet weight). Symbols represent sampling dates, each sampling date has three replicate mussel samples. Samples within the green (75) circle are at least 75% similar in fatty acid composition. All samples are at least this similar as they are all the same species, sampled in close proximity to each other. Samples within the dotted blue (80) circles are at least 80% similar in fatty acid composition. This is split into two groups that can roughly be classified as Summer & Fall samples (left) and Winter & Spring samples (right). Samples within the dotted light blue (90) circles are at least 90% similar in their fatty acid composition. These circles represent samples taken on the same day or similar days. Indicating that these mussels were all of similar condition and feeding on similar items.

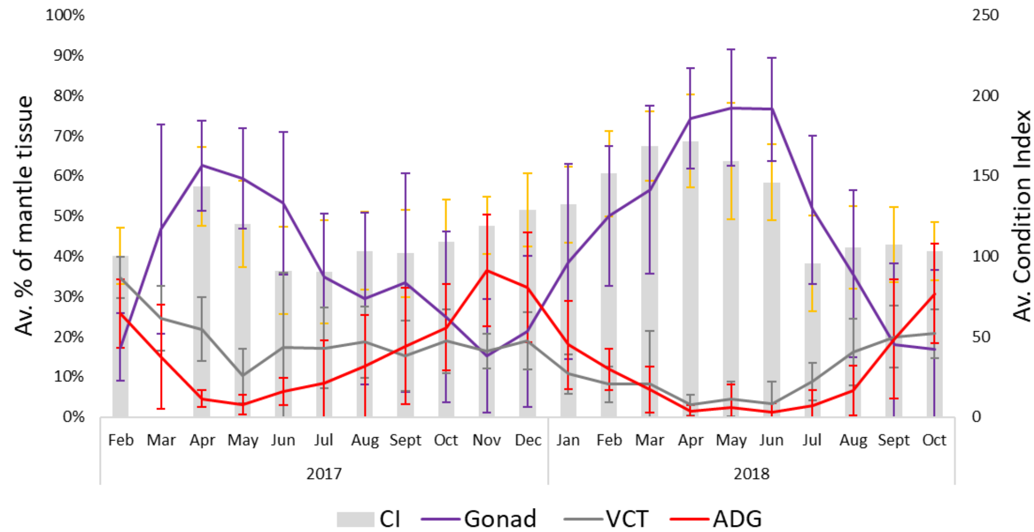

Figure 6. Condition Index and Energy Investment. Average percentage of the mantle occupied by gonad tissue (purple line), vesicular connective tissue (VCT, glycogen) (gray line) and adipogranular tissue (ADG, protein, lipid, glycogen) (red line) for each month of this study with standard deviation shown. Average Condition Index for each month represented by gray bars. Sexes combined for each line/bar. (SD bars: gonad in purple, VCT in gray, ADG in red, CI in gold)

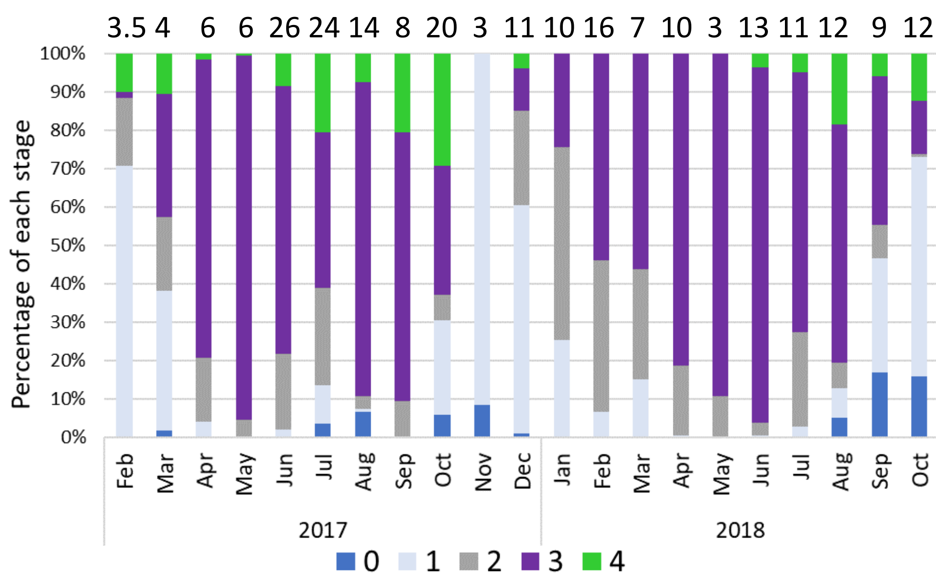

Figure 7. Female Staging Results. Female mussels, percentage of each maturity stage, per month. Number of mussels analyzed each month shown above bar.

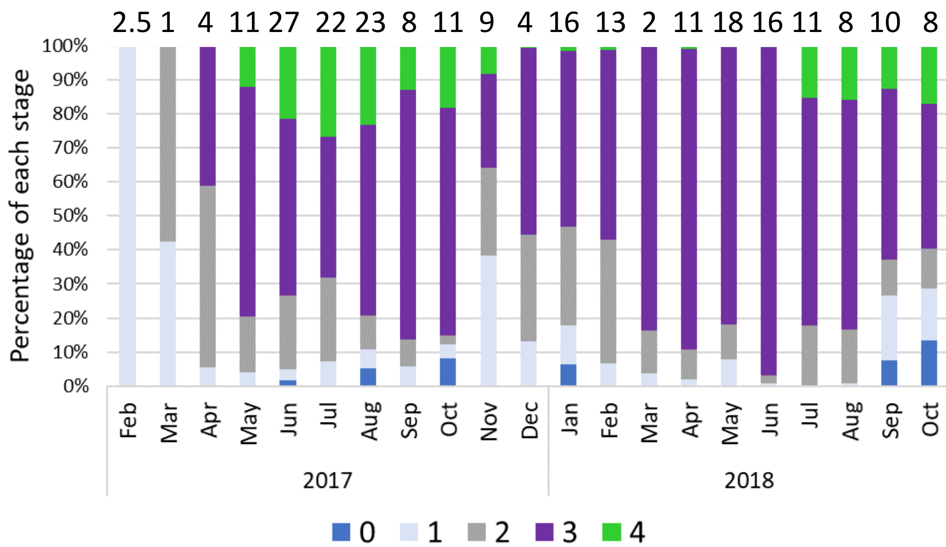

Figure 8. Male Staging Results. Male mussels, percentage of each maturity stage, per month. Number of mussels analyzed each month shown above bar.

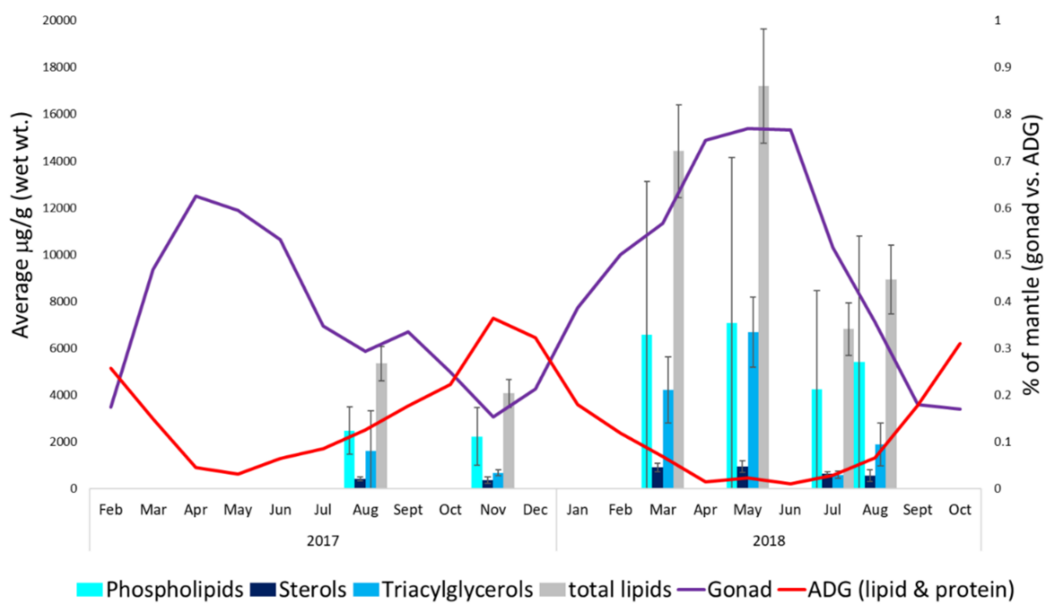

Figure 9. Lipids and Energy Investment. Average wet weights (µg/g) for select lipids. The most abundant lipid classes were chosen for this figure. The gray bars (total lipids) represents an average wet weight all of the lipids detected for each month. SD bars shown. Overlaid are the curves of average percentage of the mantle occupied by gonad tissue (purple line) and adipogranular tissue (ADG, protein, lipid, glycogen) (red line) for each month of this study.

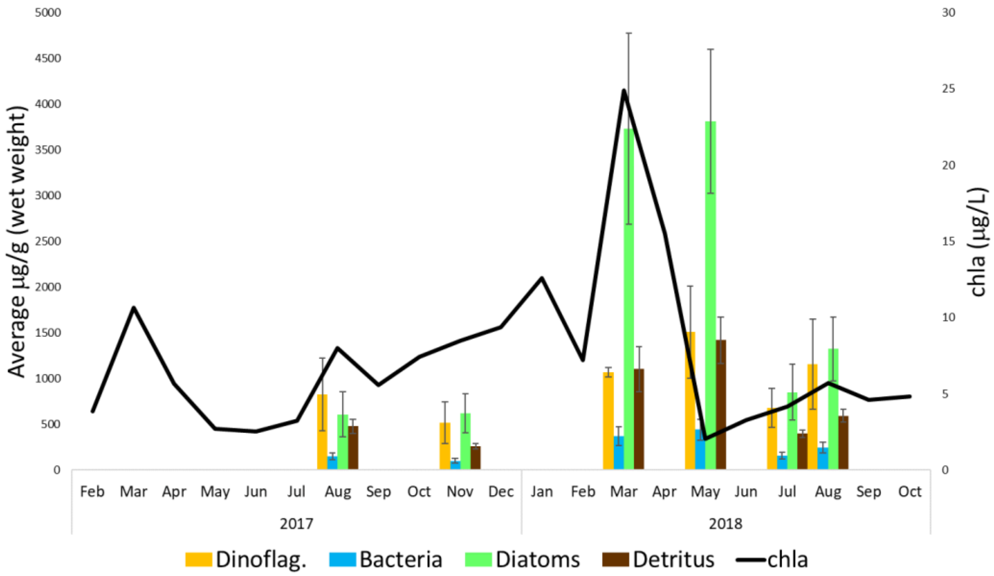

Figure 10. Fatty Acids and Chlorophyll Concentration. Average wet weights (µg/g) for select fatty acid biomarkers. SD bars shown. Biomarkers were chosen based on the main components of a blue mussel's diet; dinoflagellates, bacteria, diatoms and detritus. Average monthly chlorophyll concentration represented by black line.

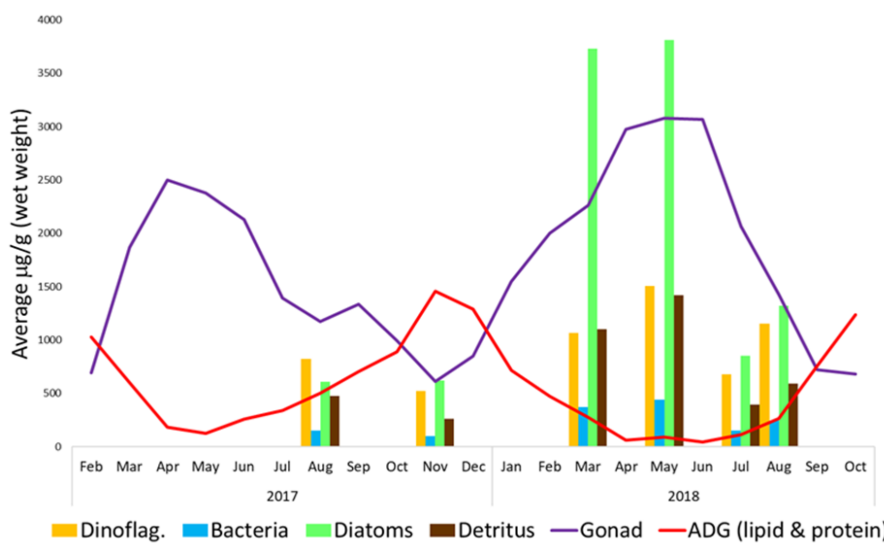

Figure 11. Fatty Acids and Energy Investment. Average wet weights (µg/g) for select fatty acid biomarkers. Biomarkers were chosen based on the main components of a blue mussel's diet; dinoflagellates, bacteria, diatoms and detritus. Overlaid are the curves of average percentage of the mantle occupied by gonad tissue (purple line) and adipogranular tissue (ADG, protein, lipid, glycogen) (red line) for each month of this study.

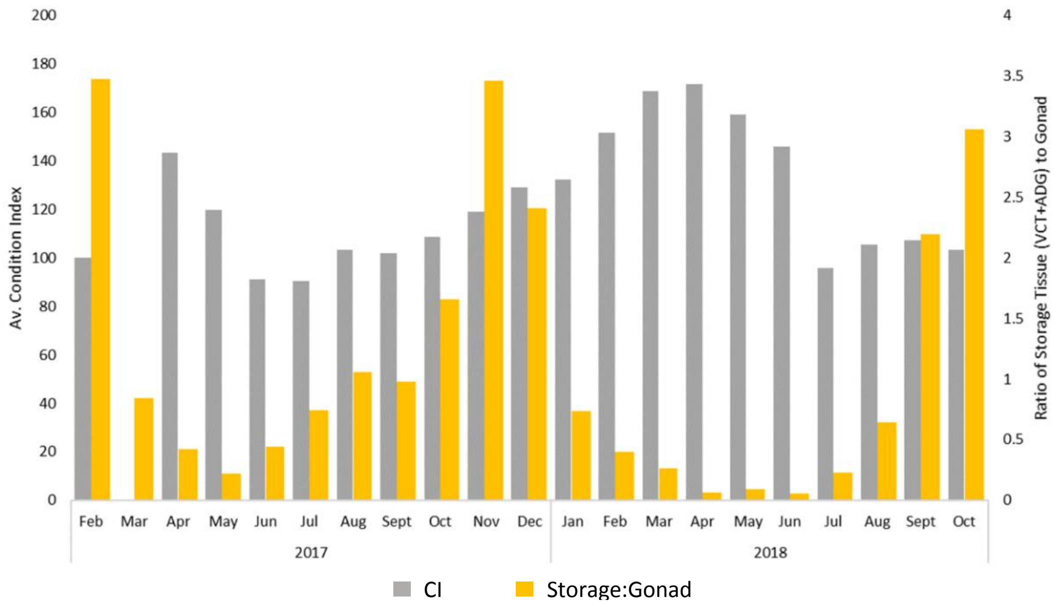

Figure 12. Condition Index and Storage: Gonad. Average Condition Index for each month (gray bars) and ratio of Storage tissue (VCT and ADG) to Gonad tissue (yellow bars).

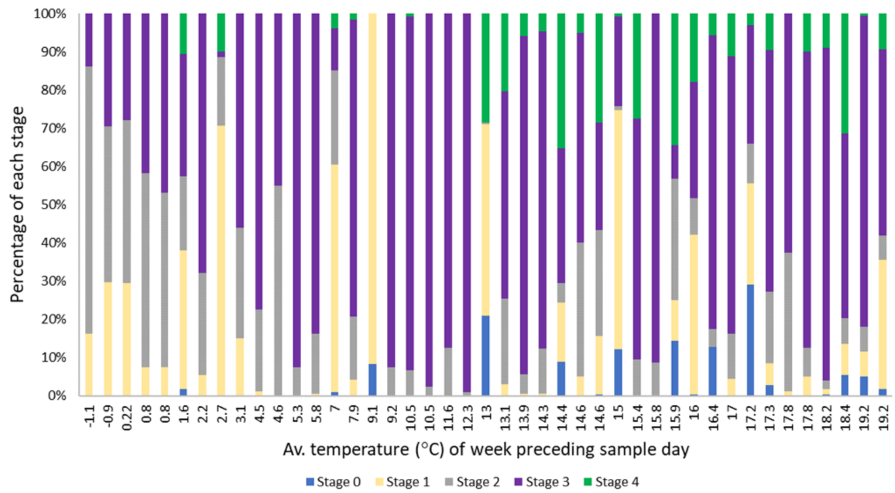

Figure 13. Female Staging Results vs. Temperature. Female staging results plotted versus average water temperature from the week preceding the sampling event. All sampling events for the duration of this study are shown (n=43). The reproductive cycle, as it relates to water temperature can be broken down into three distinct periods. From -1.1°C – 9.1°C the mussels are in a developing period characterized by high levels of Stage 1 and 2 follicles, with Stage 3 follicles increasing in percentage as temperature increases. From 9.2°C – 12.3°C the mussels are mature, nearly 90% of the follicles from these sampling dates were filled with mature and ready to be spawned oocytes. At this point there was little presence of Stage 4 follicles, indicating that mussels had not begun large spawning efforts. The third period, spawning and redeveloping, occurs between 13°C – 19.2°C. This is when the highest percentage of post spawning stages are observed. Many lower stages are observed during these temperatures as well, indicating mussels that may be redeveloping after spawning in preparation for another spawning event.

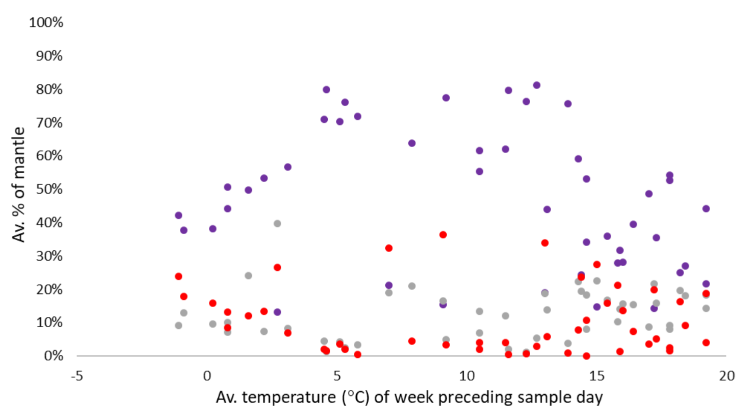

Figure 14. Energy Investment vs. Temperature. Average percentage of the mantle occupied by gonad tissue (purple dots), vesicular connective tissue (VCT, glycogen) (gray dots) and adipogranular tissue (ADG, protein, lipid, glycogen) (red dots) versus the average water temperature of the week preceding the sampling event.

TABLES

Food Source	FA biomarkers used
Diatoms	16:1ω7, 20:5ω3 (EPA)
Dinoflagellates	22:6ω3 (DHA)
Detritus (macroalgae, salt marsh plants, seagrass)	18:1ω9, 18:2ω6, 18:3ω3, 18:4ω3, 20:4ω6, 22:0
Bacteria	i15:0, ai15:0, i17:0, ai17:0, 18:1ω7

Table 1. Fatty Acid Biomarkers. Fatty acid biomarkers used in this study, assigned to the main components of a mussel's diet. Based on Kelly & Scheibling 2012 and Parrish 2013.

	r	rsquare
gonad:ADG	-0.7	0.5
gonad:VCT	-0.7	0.4
gonad:temp	-0.2	0.0
gonad:chla	0.0	0.0
ADG:VCT	0.5	0.2
ADG:temp	-0.1	0.0
ADG:chla	0.1	0.0
VCT:temp	0.2	0.0
VCT:chla	-0.1	0.0

Table 2. Linear Regressions. Correlation coefficients and coefficients of determination based on Model II linear regressions run between components of energy investment and environmental conditions. n for each regression was 375.

	2017				2018			
month	avg. temp	SD (+/-)	avg. chl	SD (+/-)	avg. temp	SD (+/-)	avg. chl	SD (+/-)
Jan	\	\	\	\	0.0	0.8	12.6	4.2
Feb	1.7	1.3	3.9	2.5	2.0	1.1	7.2	3.3
Mar	2.0	0.8	10.7	5.6	3.5	0.7	24.9	22.8
Apr	6.2	1.9	5.7	5.4	5.6	1.2	15.5	14.9
May	9.5	1.5	2.7	1.4	10.9	1.2	2.1	1.5
Jun	13.3	1.7	2.5	2.1	13.6	1.1	3.2	1.2
Jul	16.2	1.4	3.3	2.9	17.1	1.5	4.2	2.2
Aug	16.9	1.2	8.0	4.5	18.7	1.3	5.7	3.7
Sept	15.5	0.9	5.6	5.9	17.2	1.2	4.6	2.3
Oct	14.1	0.8	7.4	4.3	15.4	2.1	4.8	2.2
Nov	8.9	2.1	8.5	5.4	\	\	\	\
Dec	3.9	2.3	9.4	4.2	\	\	\	\

Table 3. Environmental Data Summary. Average environmental conditions for each month of this study and their corresponding standard deviations.

		Digestive Gland Atrophy		Oocyte Atresia		Hemocyte Filled Mantle Follicles		Gill Ciliates		Trematodes	
year	**month**	**Prevalence**	**Intensity**	**Prevalence**	**Intensity**	**Prevalence**	**Intensity**	**Prevalence**	**Intensity**	**Prevalence**	**Intensity**
2017	Feb	0.0	0.0	0.8	1.0	0.2	0.5	0.3	1.5	0.0	\
2017	Mar	0.0	0.0	1.0	2.0	0.4	0.5	0.0	0.0	0.0	\
2017	Apr	0.2	0.8	1.0	2.1	0.1	1.0	0.1	1.0	0.0	\
2017	May	0.3	0.8	1.0	1.8	0.2	1.0	0.0	0.0	0.0	\
2017	Jun	0.4	0.8	1.0	2.1	0.4	4.5	0.1	1.0	0.0	\
2017	Jul	0.6	1.2	0.9	2.4	0.5	4.0	0.2	1.6	0.0	\
2017	Aug	0.6	1.0	0.9	2.4	0.5	5.3	0.1	1.5	0.1	\
2017	Sept	0.5	1.5	0.9	2.8	0.3	5.8	0.2	1.3	0.0	\
2017	Oct	0.5	1.0	0.6	2.3	0.4	3.3	0.2	0.9	0.0	\
2017	Nov	0.3	1.8	0.2	0.5	0.2	2.0	0.1	1.0	0.0	\
2017	Dec	0.1	1.0	0.8	1.4	0.4	3.2	0.1	1.0	0.0	\
2018	Jan	0.1	0.3	0.8	2.1	0.6	6.4	0.1	0.7	0.1	\
2018	Feb	0.1	0.2	1.0	2.3	0.6	0.9	0.2	0.7	0.0	\
2018	Mar	0.4	1.0	0.9	1.8	0.4	1.5	0.2	1.0	0.0	\
2018	Apr	0.8	1.3	1.0	1.6	0.2	1.0	0.1	1.0	0.0	\
2018	May	1.0	1.8	1.0	3.3	0.2	1.7	0.2	0.8	0.0	\
2018	Jun	1.0	1.6	1.0	2.6	0.3	1.5	0.2	1.8	0.0	\
2018	Jul	1.0	2.0	0.9	2.7	0.5	4.5	0.5	2.2	0.0	\
2018	Aug	1.0	2.1	0.8	2.5	0.1	2.1	0.1	0.0	0.0	\
2018	Sept	0.9	2.2	0.9	1.9	0.1	2.2	0.2	1.5	0.0	\
2018	Oct	0.9	1.8	0.9	0.9	0.0	1.8	0.1	1.5	0.0	\

Table 4. Pathological Survey Summary. Results of the pathological survey. Presence and intensity of each factor for each month of this study. Because only five mussels were found to contain trematodes, intensities were not calculated. Intensities for digestive gland atrophy and oocyte atresia are on a scale of 0-4; 0 being no detection of condition, 4 being the condition is detected in over 75% of the target tissue.