Supplement of

Investigating controls of shell growth features in a foundation bivalve species: seasonal trends and decadal changes in the California mussel

Veronica Padilla Vriesman et al.

Correspondence to: Veronica Padilla Vriesman (vpvriesman@ucdavis.edu)

This supplement contains eight (8) supplemental figures, one (1) supplementary text, and one (1) supplementary table.
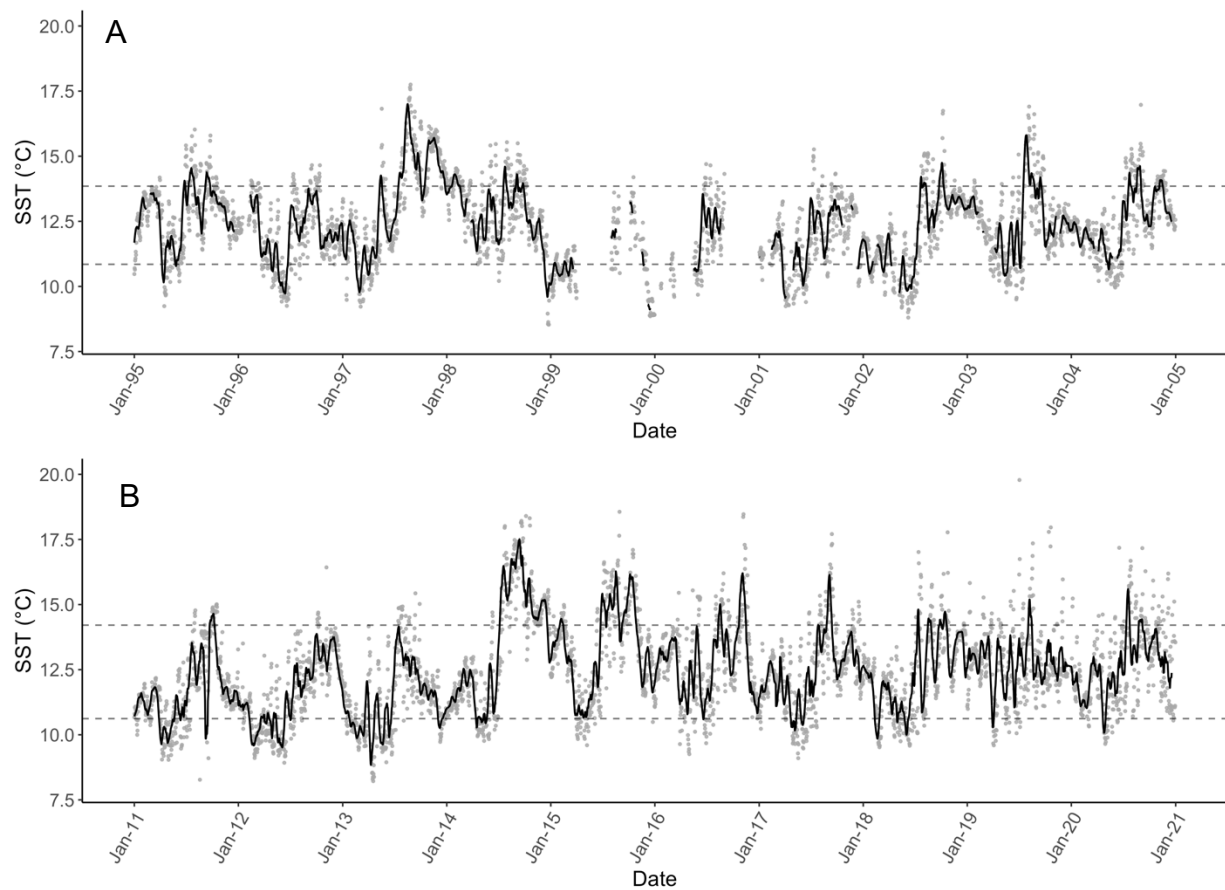
Figure S1. Sea surface temperature (SST) records from Bodega Ocean Observing Node (BOON) for the two study periods. Gray points represent daily SST and solid black lines represent 14-day running mean. Points within the dashed region fall within 2σ of the average daily temperature for each 10-year-long study period. (a) SST record from January 1995 through December 2004. Missing data points in 1999 2000 were due to instrumental malfunction. (b) SST record from January 2011 through December 2020.
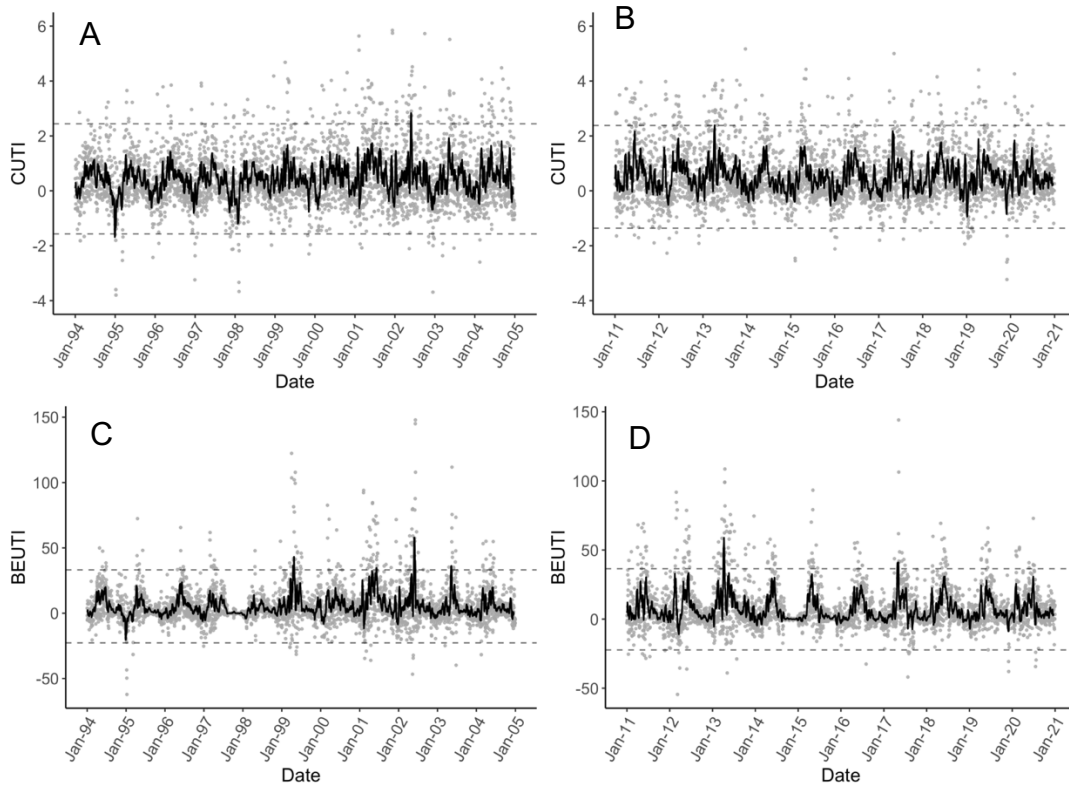
Figure S2. Coastal Upwelling Transport Index (CUTI) and Biologically Effective Upwelling Transport Index (BEUTI) from Jacox et al. (2018) accessible at https://mjacox.com/upwelling-indices/. Gray dots represent daily indices and **solid** black lines represent a 14-day running mean. Points within the dashed region fall within 1σ of the average daily index for each upwelling index of each 10-year-long study period. (a) CUTI record from January 1994 through December 2004. (b) CUTI record from January 2011 through December 2020. (c) BEUTI record from January 1994 through December 2004. (d) BEUTI record from January 2011 through December 2020.
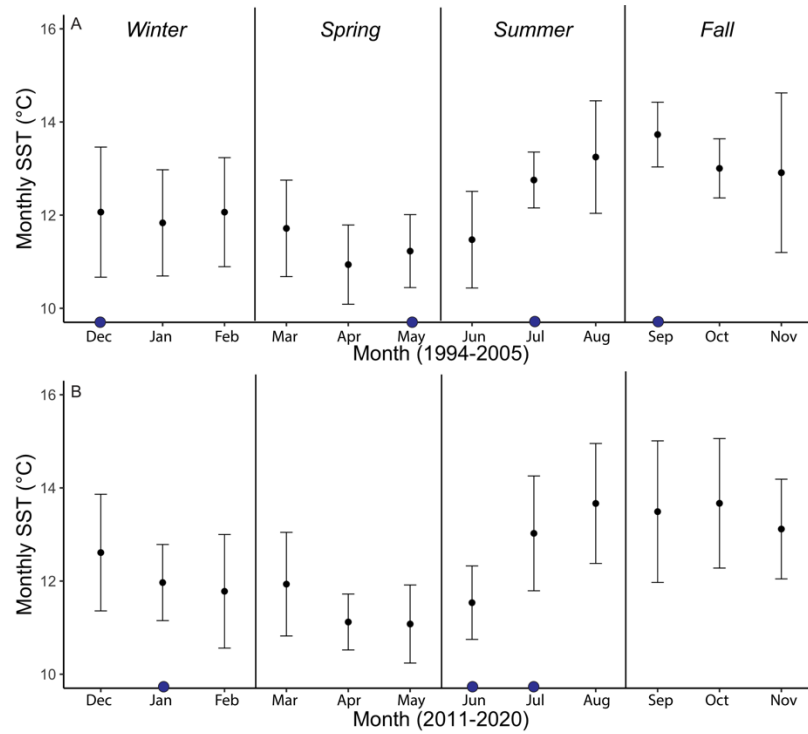
Figure S3. Aggregated monthly SST (°C) for both study periods to identify monthly and seasonal trends. Blue circles on x-axes represent months during which mussels were collected. (a) SST averaged for all months 1995-2004 (e.g., Jan = mean SST of all January months from 1995-2004). (b) SST averaged for all months 2011-2020 (e.g., Jan = mean SST of all January months from 2011-2020).
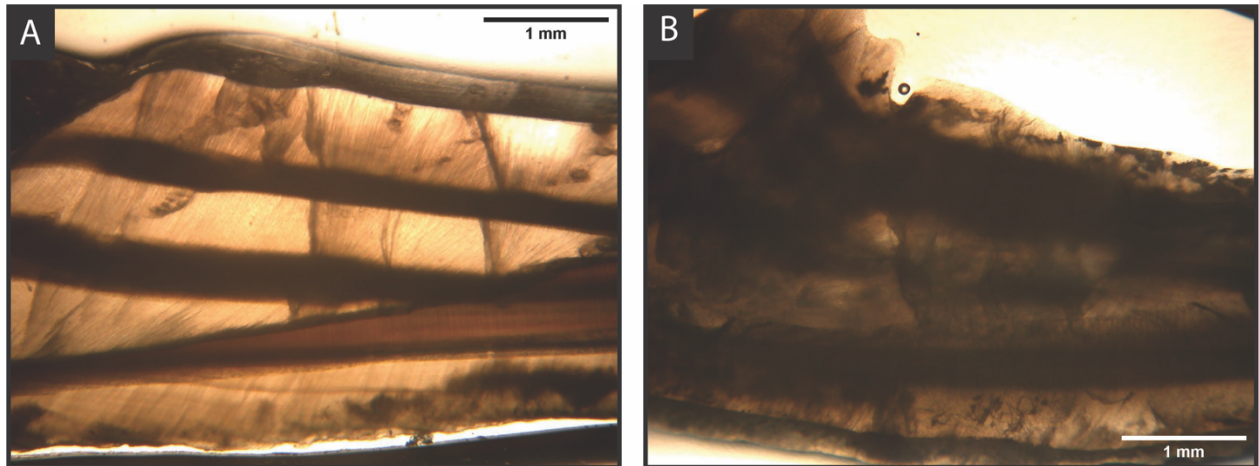
Figure S4. Photomicrographs taken in the region of interest for two M. californianus specimens polished to a uniform thickness (300 μm) to measure contrast between dark and light bands. (a) An example of high contrast between dark-light growth bands (standardized gray-value variance = 2.89) in the inner calcite layer. (b) An example of low contrast between dark-light growth bands in a different specimen (standardized gray-value variance = -0.78).
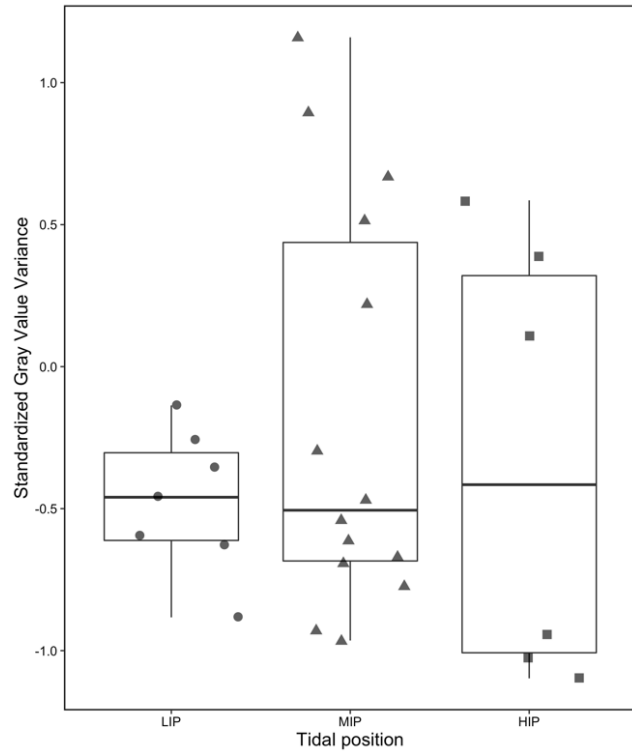
Figure S5. Box plot showing standardized gray value variance in modern specimens only (n = 27). Archival specimens were excluded in this plot since all archival specimens were collected from MIP.
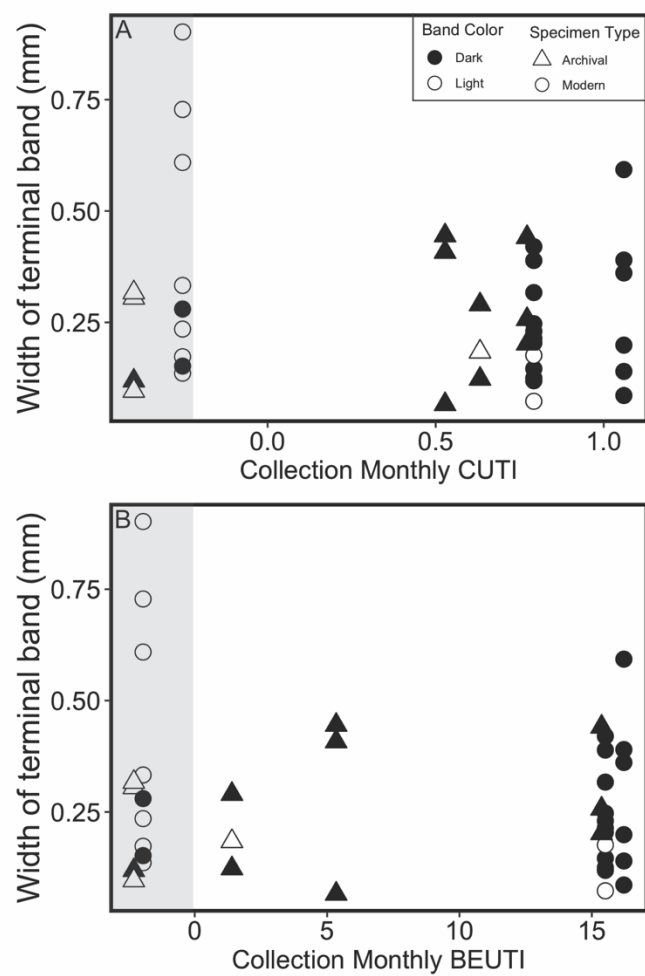
Figure S6. Monthly CUTI and BEUTI values for each specimen. Gray bar denotes range over which all but three specimens precipitated a light terminal band.
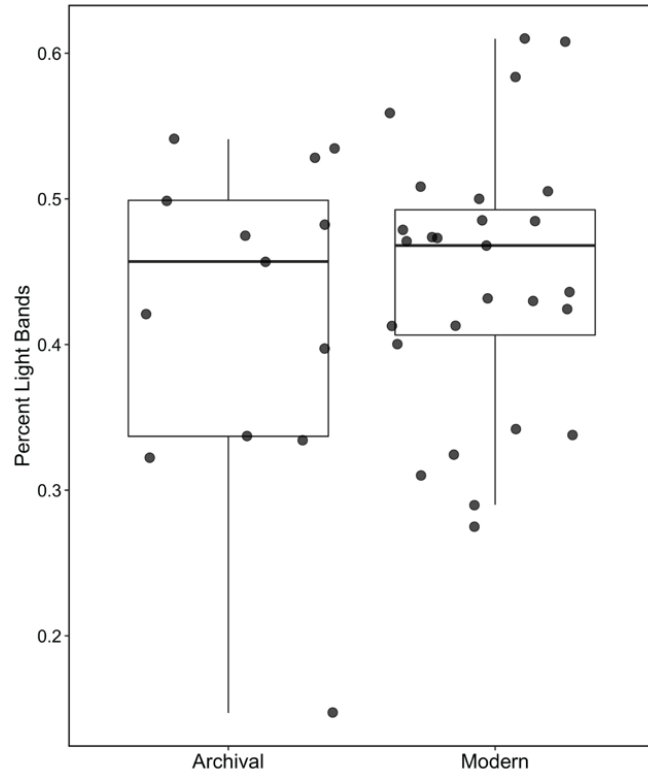
Figure S7. Box plot showing the percentage of light bands in archival and modern specimens. No statistically significant difference in percent of light bands between archival and modern shells.
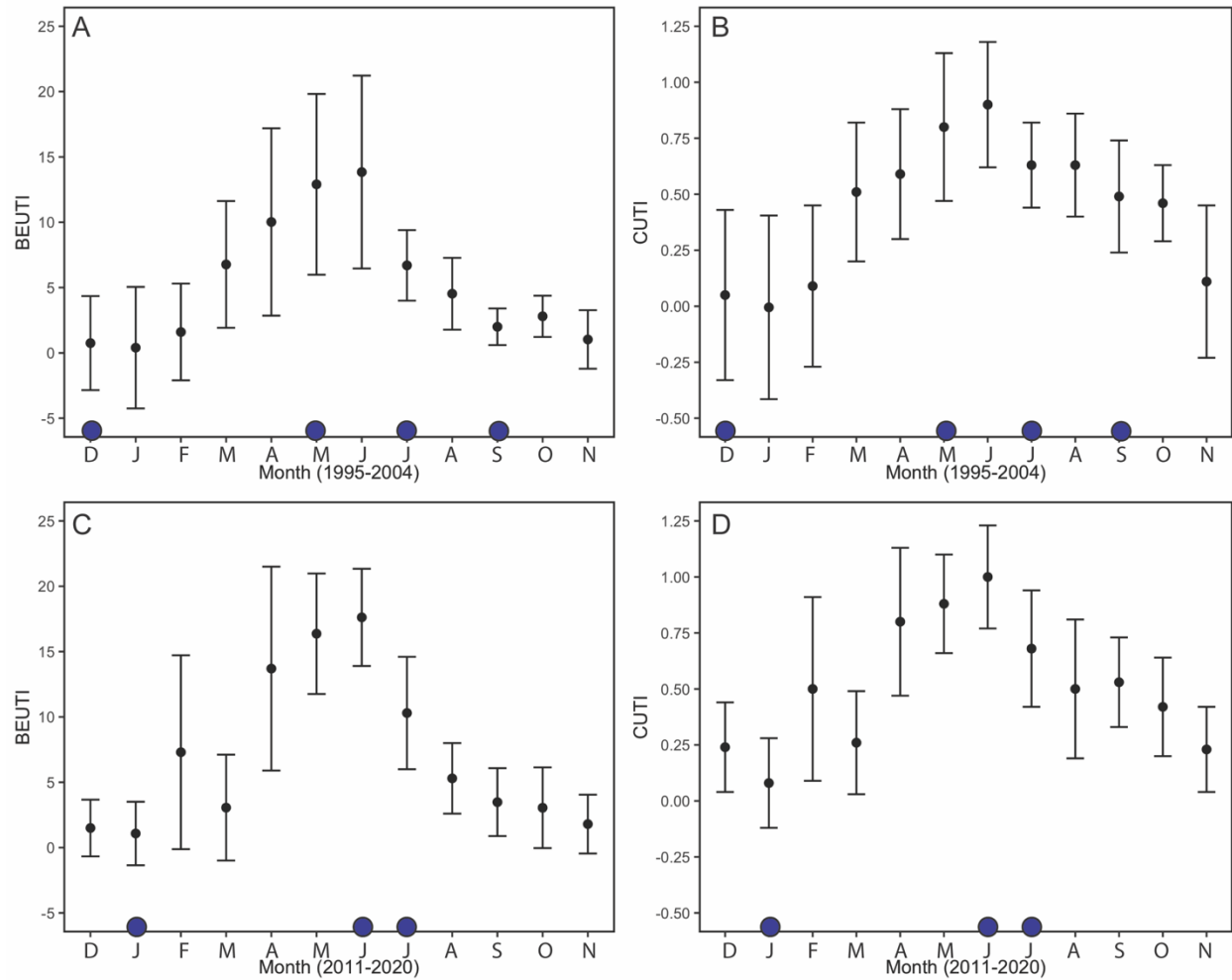
Figure S8. Aggregated monthly upwelling indices for both study periods to identify monthly and seasonal trends. Blue circles on x-axes represent months during which mussels were collected. (a) BEUTI averaged for all months 1995-2004 (e.g., Jan = mean BEUTI of all January months from 1994-2005). (b) CUTI averaged for all months 1995-2004 (e.g., Jan = mean CUTI of all January months from 2011-2020). (c) BEUTI averaged for all months 2011-2020 (e.g., Jan = mean BEUTI of all January months from 1994-2005). (d) CUTI averaged for all months 2011-2020 (e.g., Jan = mean CUTI of all January months from 2011-2020).

Text S1. The *M. californianus* individuals collected from Horseshoe Cove in June 2020 had been identified and tagged with gel nail polish in December 2019 to ensure that future collections occurred at the same micro-environment within the cove. We selected and tagged 10 shells that were > 30 mm long to minimize sample loss from dislodgement or predation of smaller juvenile shells. The eight remaining tagged individuals were collected in June 2020 with terminal shell lengths ranging from 32.3 to 41 mm (average estimated ventral margin growth rates of 6.5 mm over the course of six months, or ~ 1.1 mm per month). This supports our interpretation that an 80 mm long shell = one-year old *M. californianus* (Coe and Fox, 1942) is not applicable or reasonable for northern California mussels.

Table 1. Shell characteristics for all 40 specimens in the study (below).

Specimen ID	Collection date (dd/mm/yy)	Tidal pos.	Habitat	Shell length (mm)	Cross-sectional thickness (mm)	Inner calcite thickness (mm)	Std. gray value variance	Final growth band color
51002A	10/05/02	Mid	Open coast	60.00	2.36	1.81	-0.53	Dark
51002B	10/05/02	Mid	Open coast	60.50	2.94	2.37	0.19	Dark
PB51002	10/05/02	Mid	Open coast	73.70	4.30	2.63	-0.46	Dark
PB71902	19/07/02	Mid	Open coast	54.60	3.10	1.25	-0.92	Dark
71902B	19/07/02	Mid	Open coast	60.10	3.29	2.02	-0.15	Dark
71902A	19/07/02	Mid	Open coast	61.10	2.63	1.66	2.45	Dark
PB120102	01/12/02	Mid	Open coast	58.90	3.30	2.27	1.70	Dark
12102B	01/12/02	Mid	Open coast	59.20	3.30	1.96	2.88	Light
12102A	01/12/02	Mid	Open coast	60.10	3.09	1.93	0.98	Light
PB122302	23/12/02	Mid	Open coast	69.20	2.60	1.34	-0.78	Light
90703B	07/09/03	Mid	Open coast	54.70	2.56	1.19	2.17	Light
PB90703	07/09/03	Mid	Open coast	57.50	2.60	1.77	-0.97	Dark
90703A	07/09/03	Mid	Open coast	59.00	3.29	2.70	0.76	Dark
BBL119	18/01/19	Low	Cove	32.20	2.00	0.81	-0.26	Light
BBLX19	18/01/19	Low	Cove	39.60	2.30	0.90	-0.35	Light
BBLY19	18/01/19	Low	Cove	41.00	2.00	1.26	-0.88	Light
BBMX19	18/01/19	Mid	Cove	46.30	3.70	3.02	1.16	Light
BBH119	18/01/19	High	Cove	49.50	2.40	1.07	-1.03	Light
BBH219	18/01/19	High	Cove	54.20	3.40	2.05	0.59	Light
BBMY19	18/01/19	Mid	Cove	56.50	3.70	2.13	0.51	Light
BBM319	18/01/19	Mid	Cove	68.90	3.60	2.37	0.67	Dark
BBH319	18/01/19	High	Cove	70.10	3.60	1.50	-0.94	Dark
BB7114	11/07/19	Mid	Cove	72.10	2.51	1.92	-0.67	Dark
BB7116	11/07/19	Mid	Cove	73.10	2.85	2.15	-0.61	Dark
BB7113	11/07/19	Mid	Cove	76.60	3.20	3.59	0.22	Dark
BB7111	11/07/19	Mid	Cove	78.60	2.55	1.38	-0.54	Dark
BB7112	11/07/19	Mid	Cove	83.50	3.10	2.77	-0.47	Dark
BB7115	11/07/19	Mid	Cove	93.80	4.00	3.46	0.90	Dark
OCM220	06/06/20	Mid	Open coast	31.60	1.00	0.36	-0.69	Dark
OCM320	06/06/20	Mid	Open coast	32.10	1.30	0.44	-0.78	Dark
BBMB20	06/06/20	Mid	Cove	32.30	1.30	0.66	-0.29	Light
BBLB20	06/06/20	Low	Cove	33.50	1.00	0.38	-0.63	Dark
BBMA20	06/06/20	Mid	Cove	35.30	1.80	1.61	-0.93	Dark
BBMC20	06/06/20	Mid	Cove	35.50	1.80	0.80	-0.96	Light
BBHC20	06/06/20	High	Cove	36.20	1.80	0.63	-1.10	Dark
BBHA20	06/06/20	High	Cove	38.80	1.90	0.31	0.11	Dark
BBLA20	06/06/20	Low	Cove	38.90	1.50	0.90	-0.14	Dark

BBLC20	06/06/20	Low	Cove	41.00	1.20	0.66	-0.60	Dark
OCMM20	06/06/20	High	Open coast	71.60	2.70	1.88	0.39	Dark
OCLL20	06/06/20	Low	Open coast	73.70	3.50	2.42	0.00	Dark