Supplementary Materials

1. Study Site Coordinates and Bathymetry

Our sampling site coordinates and mean elevation relative to mean sea level (MSL) are shown in Table S1.

Table S1. Longitude, latitude, and elevation of study sites.

Habitat	Site ID	Latitude	Longitude	Elevation (m)
Historical Seagrass HS	HS1	-41.08765	174.8888	-0.3
	HS2	-41.08881	174.8926	x
	HS3	-41.09862	174.9096	-0.2
	HS4	-41.09912	174.9111	-0.2
	HS5	-41.09918	174.9112	-0.2
Existing Seagrass ES	ES2	-41.09702	174.8771	-0.3
	ES3	-41.09851	174.8763	-0.4
	ES4	-41.09842	174.8761	-0.4
	ES5	-41.09883	174.8759	-0.2
	ES6	-41.10039	174.8721	-0.3
Potential Seagrass PS	PS1	-41.09908	174.8725	-0.4
	PS2	-41.09866	174.8723	-0.4
	PS3	-41.09851	174.8722	-0.4
	PS4	-41.09827	174.8721	-0.4
	PS5	-41.09814	174.8721	-0.4

* ES1 was discarded due to field difficulties and depth. HS2 could not be surveyed.

2. Google Earth Imagery of Pāuatahanui Inlet, Potential Habitat (PS) (2002–2019)

The objective of this timeseries is to show the dynamism of the seagrass patches nearby and at potential seagrass habitat (PS) since 2002–2019. South PS habitat has been intermittently colonized by seagrasses during some years (2016, 2017, 2018, and 2019) but this did not happen previously (2002–2014) (Figure S1).


11/03/2005
06/02/2006
25/11/2009
12/12/2012
18/08/2013
14/01/2014
14/01/2014
11/05/2015
Google Earth
200 m
N

Figure S1. Timeseries imagery of potential seagrass (PS) habitat (blue circle) since 2002–2019.

3. Light Monitoring

Row light monitoring and water level data from 23/8/18 to 3/10/18 (winter) and from 8/2/19 to 21/3/19 (summer) are shown in Figures S2–7. Calculations for each site are shown in Table S2.

Table S2. Light availability at historical seagrass (HS), existing seagrass (ES), and potential seagrass (PS) sites during winter and summer deployments. Values are daily mean photosynthetically available radiation (PAR) (±SE). Daily total PAR dose and PAR dose when submerged and emerged are shown as well as the number of days each site was under compensation irradiance (CI) during deployments (x = loss of device).

Site	Season	PAR When Submerged (mol m^{-2} d^{-1})	PAR When Emerged (mol m^{-2} d^{-1})	Total PAR (mol m^{-2} d^{-1})	Number of Days Where Total PAR Was below Compensation Irradiance (Days)
HS1	Winter	2.3 ± 0.2	25.2 ± 2.3	27.5	6 (2)
	Summer	x	x	x	x
HS2	Winter	x	x	x	x
	Summer	5.1 ± 0.2	59.6 ± 2.4	64.7	3 (0)
HS3	Winter	1.8 ± 0.2	46 ± 1.5	47.8	0 (0)
	Summer	4.8 ± 0.2	56.1± 2.8	60.9	3 (0)
HS4	Winter	0.8 ± 0.1	27.3 ± 3.2	28.1	11 (4)
	Summer	5.8 ± 0.2	66.6 ± 2.6	72.4	3 (0)
HS5	Winter	3.9 ± 0.2	25.2 ± 1	29.2	7 (2)
	Summer	5 ± 0.2	57.9 ± 2.2	62.9	5 (2)
ES2	Winter	4 ± 0.3	52.7 ± 2.4	56.7	3 (0)
	Summer	4.4 ± 0.2	51.4 ± 2	55.8	1 (0)
ES3	Winter	x	x	x	x
	Summer	5.1 ± 0.2	58.5 ± 2.7	63.6	1 (0)
ES4	Winter	4.5 ± 0.3	30 ± 1.5	34.5	4 (2)
	Summer	5 ± 0.2	57.9 ± 2.3	62.9	2 (0)
ES5	Winter	4.8 ± 0.3	47.8 ± 2.3	52.6	4 (2)
	Summer	3 ± 0.2	34.4 ± 1.8	37.4	2 (0)
ES6	Winter	4.3 ± 0.3	46.8 ± 2.1	51.1	3 (0)
	Summer	2.5 ± 0.1	28.5 ± 1.5	31	2 (0)
PS1	Winter	5.1 ± 0.3	36.7 ± 2	41.8	4 (0)
	Summer	5.5 ± 0.2	63.3 ± 2.6	68.8	1 (0)
PS2	Winter	2 ± 0.2	30 ± 2	32	5 (0)
	Summer	x	x	x	x
PS3	Winter	x	x	x	x
	Summer	4.6 ± 0.2	53.4 ± 2.9	58	0 (0)
PS4	Winter	x	x	x	x
	Summer	3.7 ± 0.2	42.6 ± 1.8	46.3	0 (0)
PS5	Winter	x	x	x	x
	Summer	x	x	x	x

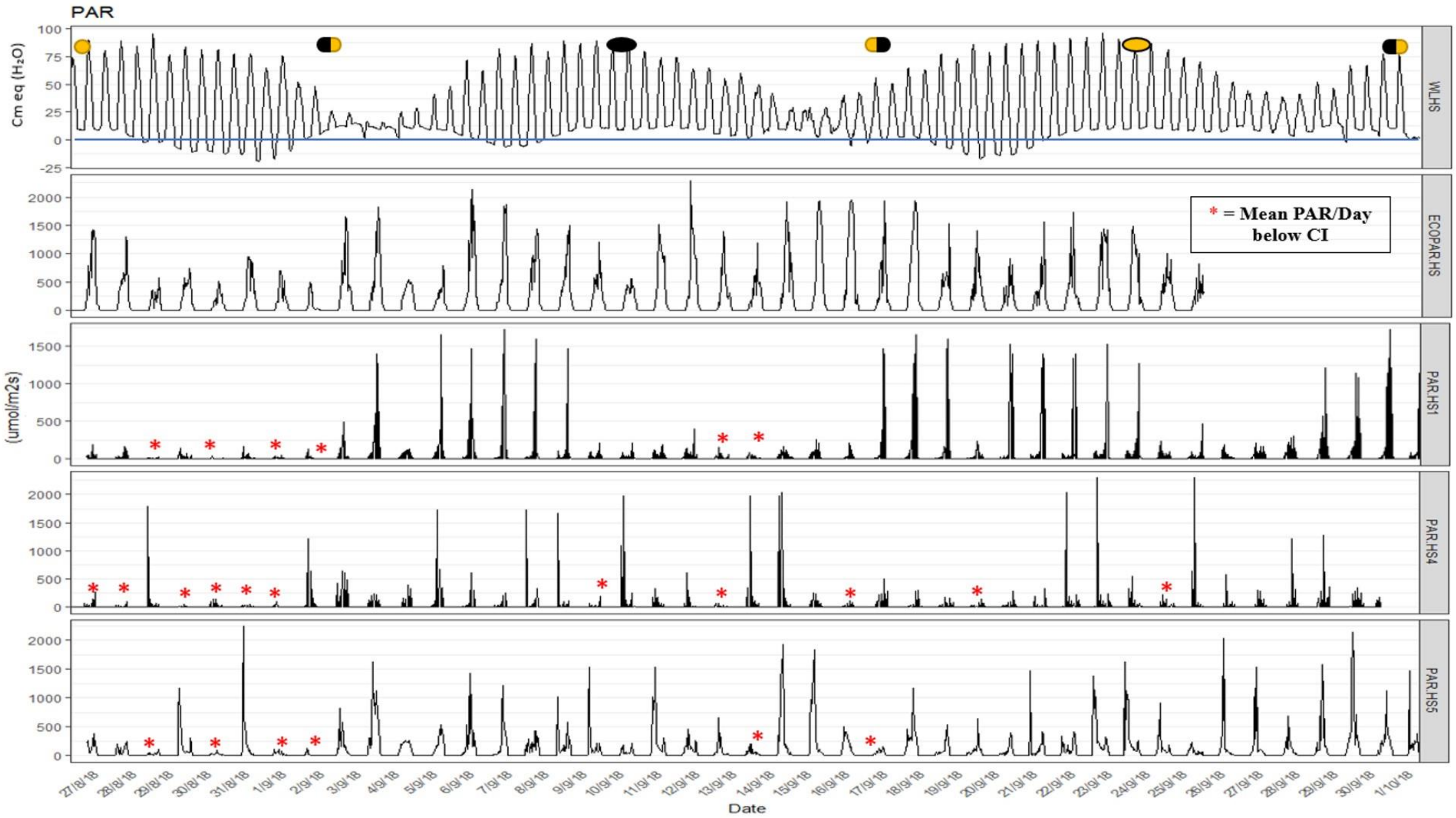
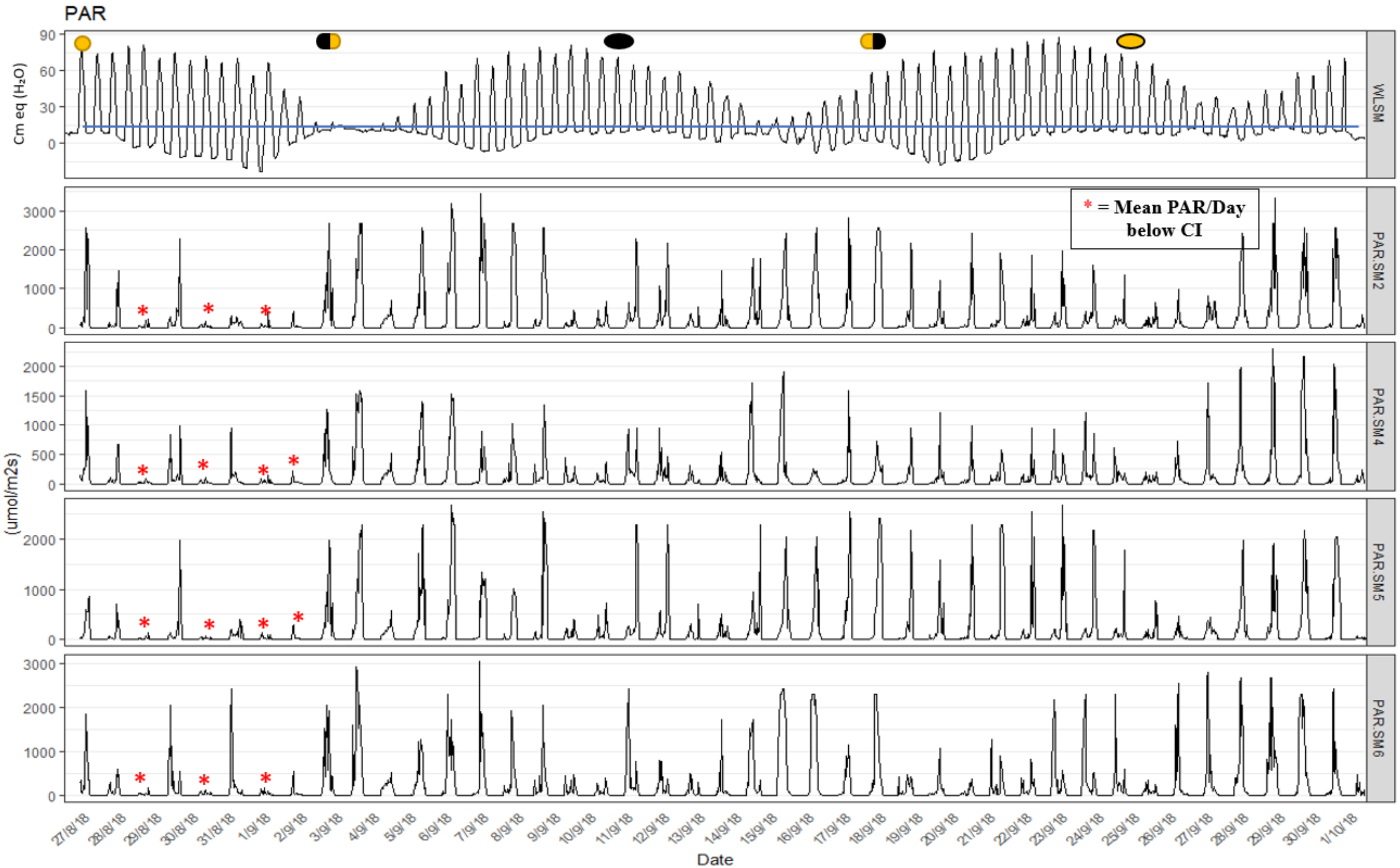


Figure S2. PAR across a complete tidal cycle in winter at historical seagrass (HS) sites. The top panel indicates relative water level and the second PAR collected with ECOPAR (http://www.seabird.com/ecopar) loggers is indicated. The other series show data collected with HOBO loggers.



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5 **Figure S3.** PAR across a complete tidal cycle in winter at existing seagrass (ES) sites. The top panel indicates relative water level. The other series show data collected with
6 HOBO loggers.

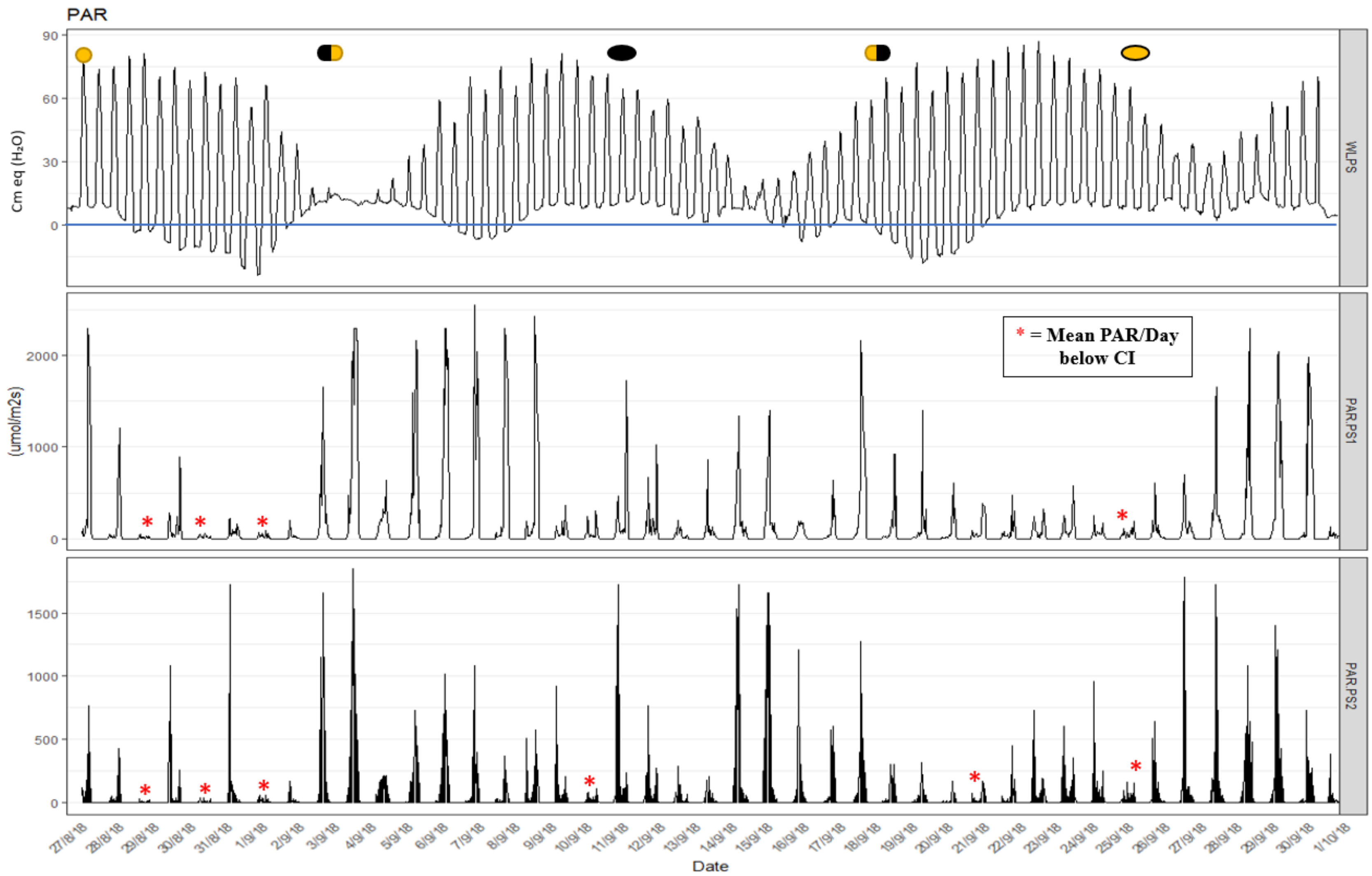


Figure S4. PAR across a complete tidal cycle in winter at potential seagrass (PS) sites. The top panel indicates relative water level. The other series show data collected with HOBO loggers.

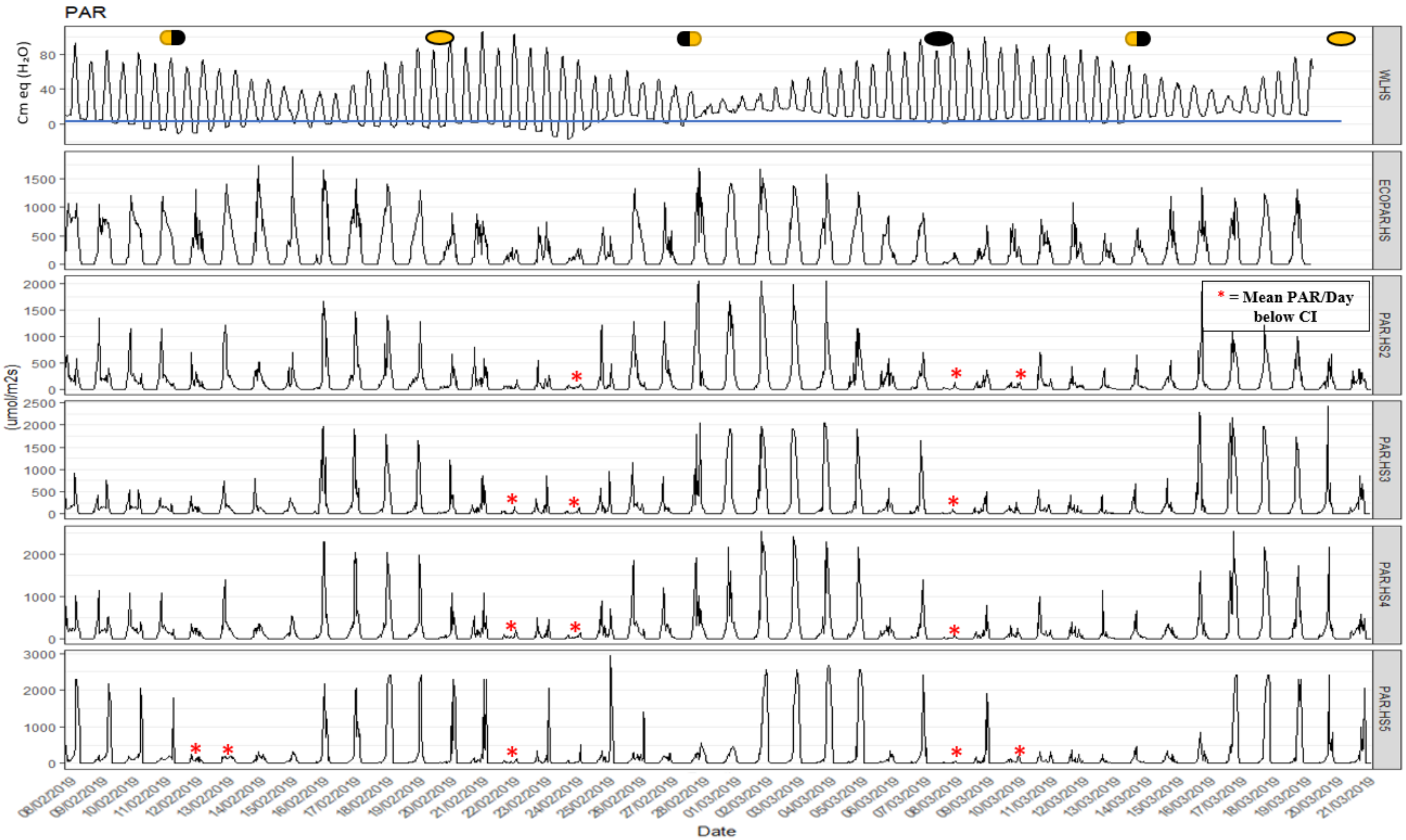


Figure S5. PAR across a complete tidal cycle in summer at historical seagrass (HS) sites. The top panel indicates relative water level, and the second PAR collected with ECOPAR (http://www.seabird.com/ecopar) loggers is indicated. The other series show data collected with HOBO loggers.

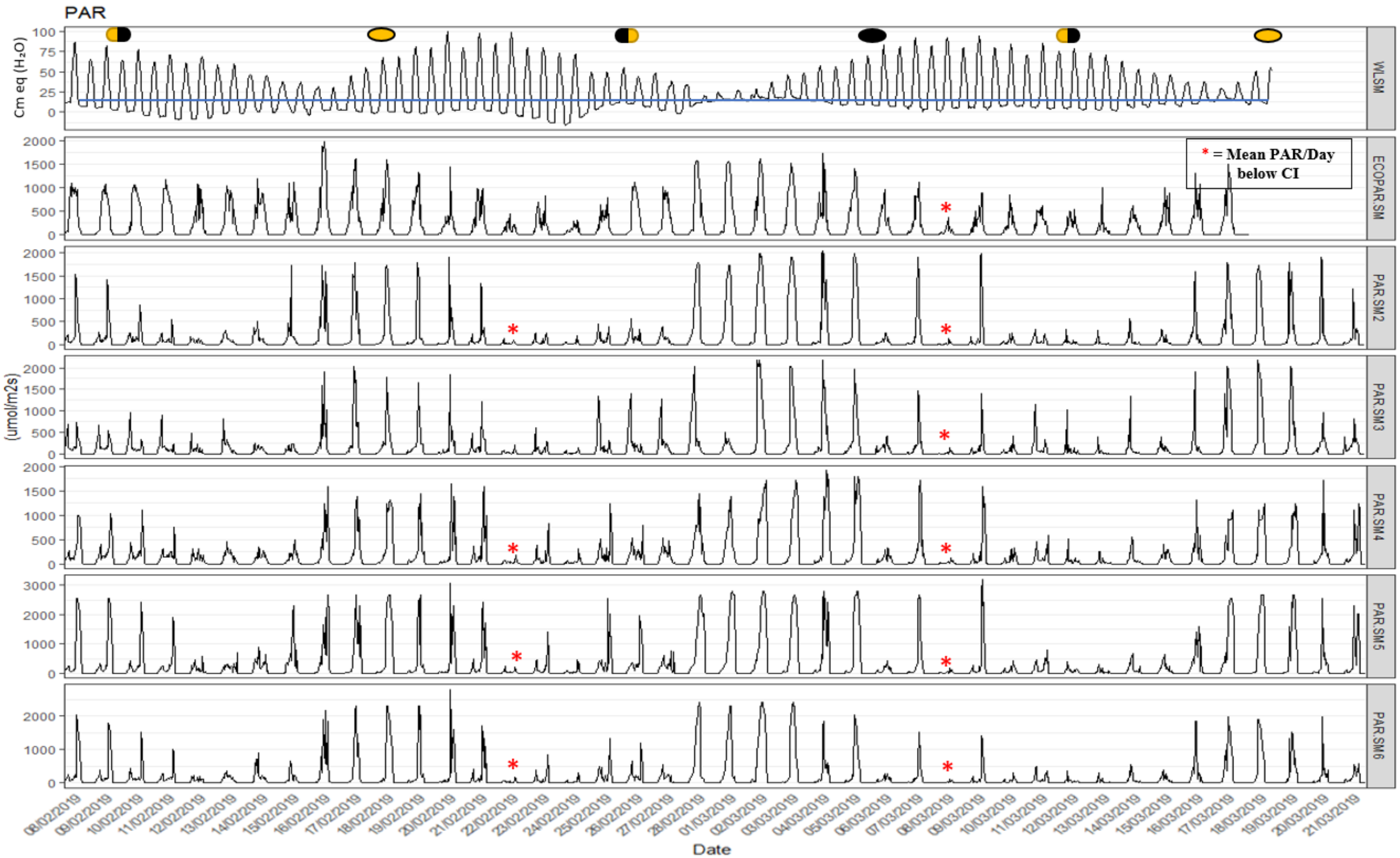


Figure S6. PAR across a complete tidal cycle in summer at existing seagrass (ES) sites. The top panel indicates relative water level, and the second PAR collected with ECOPAR (http://www.seabird.com/ecopar) loggers is indicated. The other series show data collected with HOBO loggers.

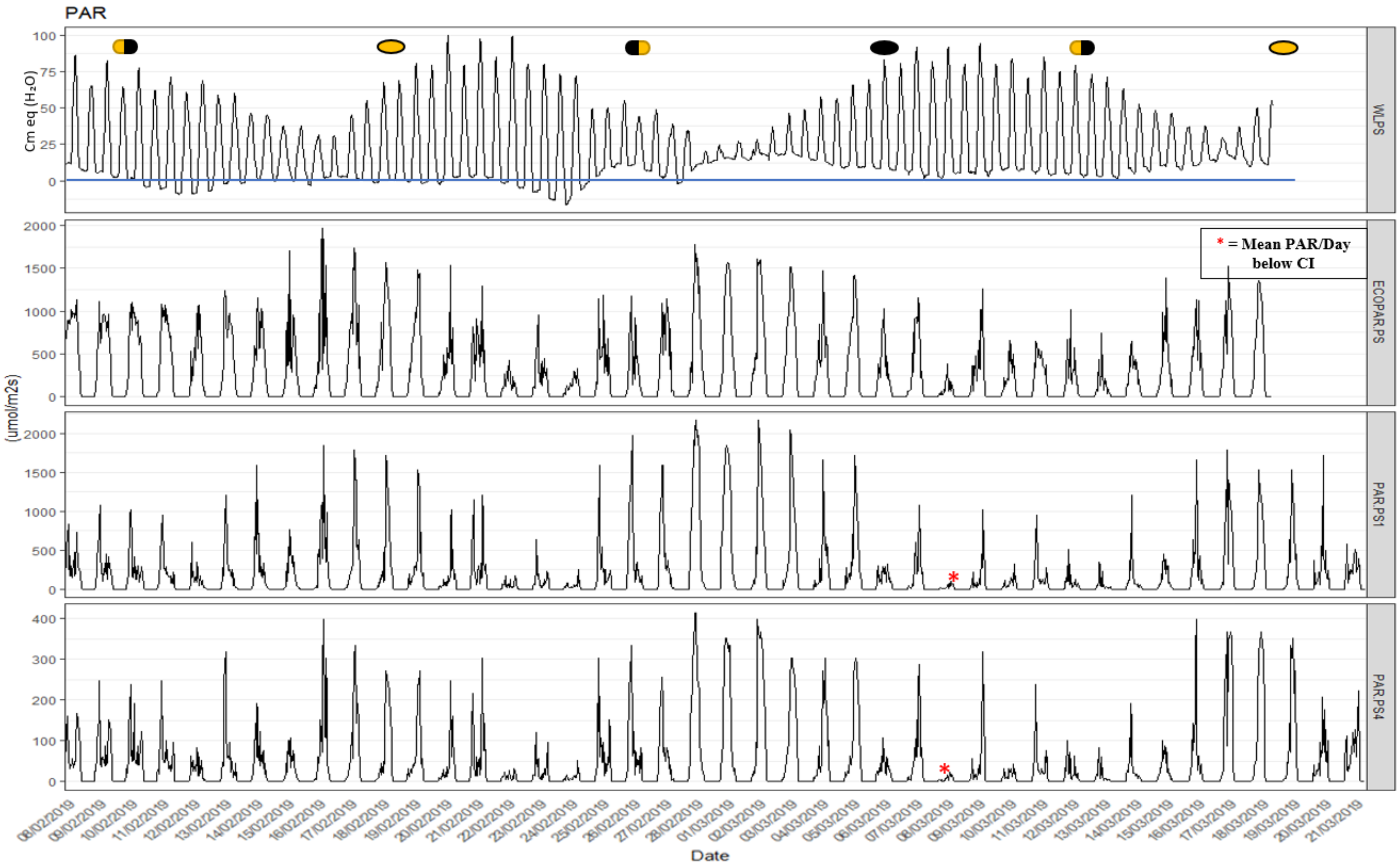


Figure S7. PAR across a complete tidal cycle in summer at potential seagrass (PS) sites. The top panel indicates relative water level, and the second PAR collected with ECOPAR (http://www.seabird.com/ecopar) loggers is indicated. The other series show data collected with HOBO loggers.

4. Seagrass substrate and porewater correlations

Seagrass and substrate Pearson correlation matrix is shown in Table S3. Seagrass % cover relationship with % mud, % organic matter, porewater PO_4^{3-}, and NH_4^+ from 0 to 5 cm are shown in (Equations 1,2,3,4). Relationship of other seagrass traits with substrate are also shown in Figure S8.

$$\% \text{ Cover} = \frac{89.8184}{1+e^{(-(-3.0134+0.307Mud))}} \tag{1}$$

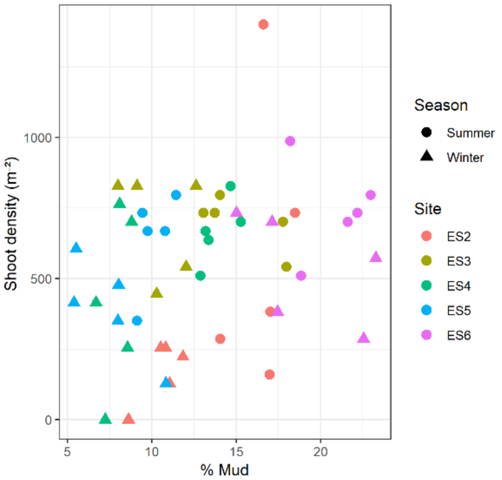
$$\% \text{ Cover} = \frac{77.647}{1+e^{(-(-7.668+6.683Sed.OM))}} \tag{2}$$

$$\% \text{ Cover} = 18.241 \ln (PO_4^{3-}) + 60.184;\ R^2 = 0.3619 \tag{3}$$

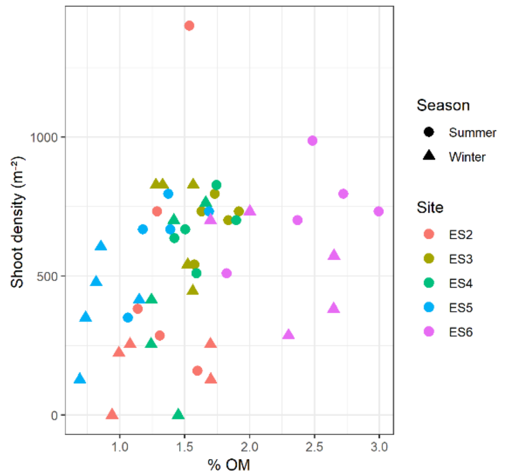
$$\% \text{ Cover} = 21.451 \ln (NH_4^+) + 20.475;\ R^2 = 0.2964 \tag{4}$$

Table S3. A variable by variable matrix of Pearson correlation coefficients based on observations from Pāuatahanui Inlet, New Zealand. Significant correlations are indicated in bold type, (probability > |r| under H_o: Rho = 0; n = 30 observations).

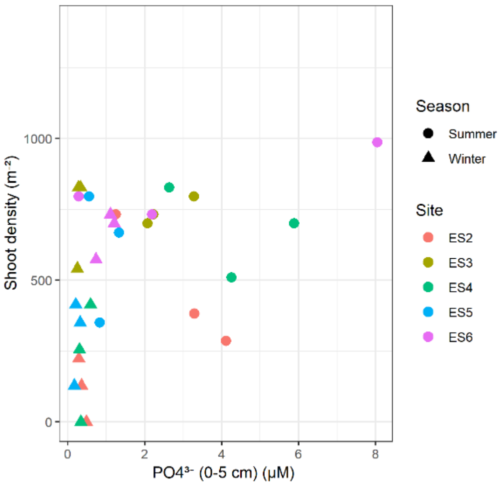
	%Cover	**Shoot d.**	**AGB**	**BGB**	**Biomass**	**Mud**	**Sand**	**Bulk d.**	**OM**	**PAR**	**Eh**	**H_2S0.5**	**H_2S5.10**	**PO_4^{3-}**	**PO_4^{3-}510**	**NH_4^+05**	**NH_4^+510**
%Cover	1	**0.73**	**0.77**	**0.54**	**0.58**	**0.65**	**-0.65**	0.18	**0.62**	-0.00	**0.64**	0.20	0.22	**0.52**	0.26	**0.46**	-0.11
Shoot d.	**0.73**	1	**0.70**	**0.67**	**0.70**	**0.54**	**-0.52**	0.06	**0.55**	0.22	**0.58**	0.23	0.18	**0.39**	0.18	**0.37**	-0.01
AGB	**0.77**	**0.70**	1	**0.53**	**0.57**	**0.49**	**-0.49**	0.19	**0.52**	0.16	**0.55**	0.08	0.23	0.27	**0.27**	0.26	**0.29**
BGB	**0.54**	**0.67**	**0.53**	1	**0.99**	**0.44**	**-0.43**	0.03	**0.62**	0.07	**0.39**	0.28	0.17	**0.55**	0.14	0.20	0.00
Biomass	**0.58**	**0.70**	**0.57**	**0.99**	1	**0.46**	**-0.45**	0.04	**0.63**	0.07	**0.41**	0.28	0.18	**0.55**	0.16	0.21	0.02
Mud	**0.65**	**0.54**	**0.49**	**0.44**	**0.46**	1	**-0.99**	0.03	**0.79**	-0.16	**0.64**	0.33	0.09	**0.37**	**0.51**	0.21	0.18
Sand	**-0.65**	**-0.52**	**-0.49**	**-0.43**	**-0.45**	**-0.99**	1	-0.03	**-0.81**	0.19	**-0.64**	-0.33	-0.1	-0.36	**-0.53**	-0.19	-0.19
Bulk d.	0.18	0.06	0.19	0.03	0.04	0.03	-0.03	1	-0.02	-0.18	0.34	**0.57**	-0.01	0.31	0.09	0.26	-0.20
OM	**0.62**	**0.55**	**0.52**	**0.62**	**0.63**	**0.79**	**-0.81**	-0.02	1	-0.14	**0.51**	0.22	-0.02	**0.36**	**0.58**	0.08	0.21
PAR	-0.00	0.22	0.13	0.07	0.07	-0.16	0.19	-0.18	-0.14	1	-0.06	-0.29	0.12	0.22	-0.27	-0.02	-0.08
Eh	**0.64**	**0.58**	**0.55**	**0.39**	**0.41**	**0.64**	**-0.64**	0.34	**0.51**	-0.06	1	0.5	0.17	**0.54**	0.27	**0.38**	0.09
H_2S0.5	0.20	0.23	0.08	0.28	0.28	0.33	-0.33	**0.57**	0.22	-0.29	**0.50**	1	0.22	**0.47**	-0.05	0.33	-0.17
H_2S5.10	0.22	0.18	0.23	0.17	0.18	0.09	-0.10	-0.01	-0.02	0.12	0.17	0.22	1	0.1	-0.23	0.25	-0.14
PO_4^{3-}	**0.52**	**0.39**	0.27	**0.55**	**0.55**	**0.37**	-0.36	0.31	**0.36**	-0.22	**0.54**	**0.47**	0.10	1	0.03	0.32	-0.11
PO_4^{3-}510	0.26	0.18	**0.27**	**0.14**	0.16	**0.51**	**-0.53**	-0.09	**0.58**	-0.27	0.27	-0.05	-0.23	0.03	1	-0.00	**0.66**
NH_4^+05	**0.46**	**0.37**	0.26	0.20	0.21	0.21	-0.19	0.26	0.08	-0.02	**0.38**	0.33	0.25	0.32	-0.00	1	-0.21
NH_4^+510	-0.11	0.01	**0.29**	0.00	0.02	0.18	-0.19	-0.20	0.21	-0.08	0.09	-0.17	-0.14	-0.11	**0.66**	-0.21	1


Shoot density (m^{-2})
% Mud
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

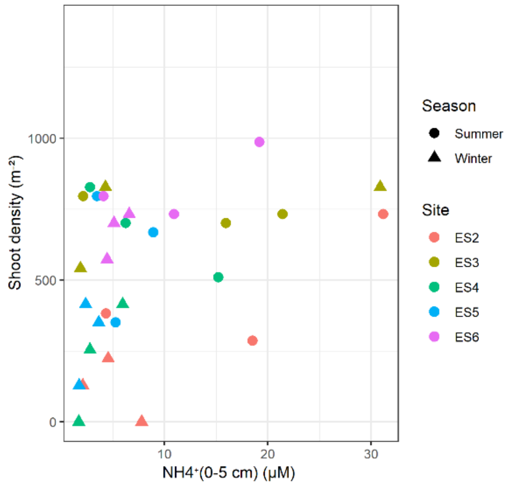
(**a**)


Shoot density (m^{-2})
% OM
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

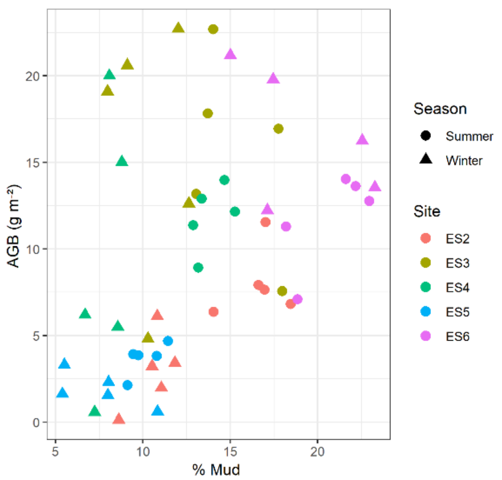
(**b**)


Shoot density (m^{-2})
PO_4^{3-} (0-5 cm) (µM)
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

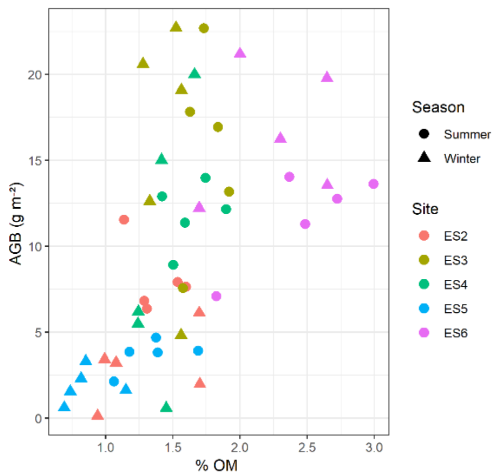
(**c**)


Shoot density (m^{-2})
NH_4^{+}(0-5 cm) (µM)
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

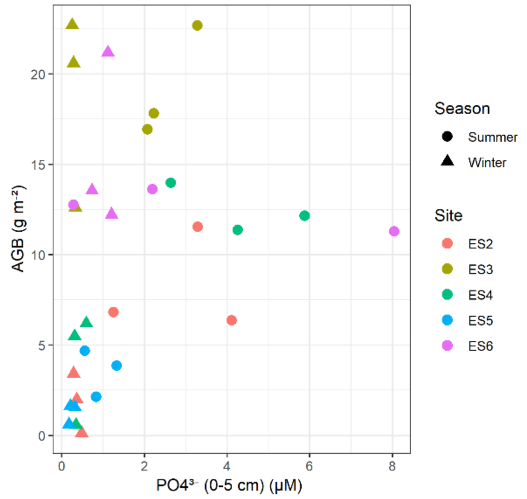
(**d**)


AGB (g m^{-2})
% Mud
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

(**e**)


AGB (g m^{-2})
% OM
Season
Summer
Winter
Site
ES2
ES3
ES4
ES5
ES6

(**f**)



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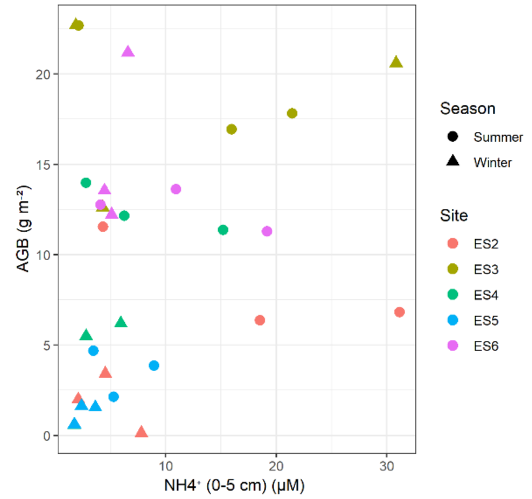
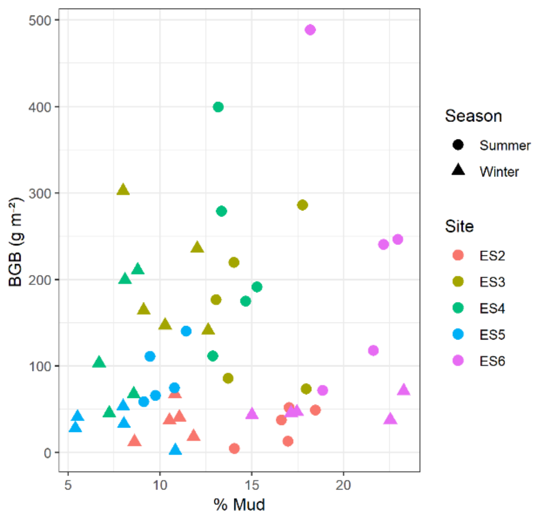
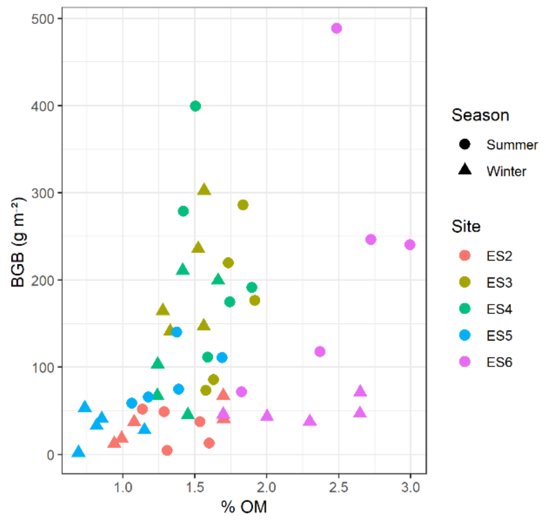


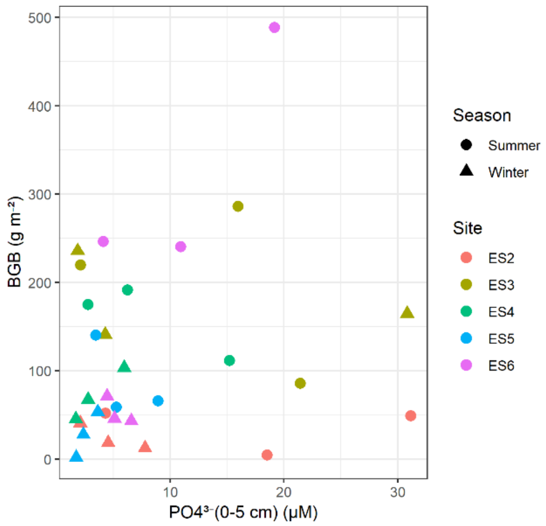
(**h**)



(**i**)



(**j**)



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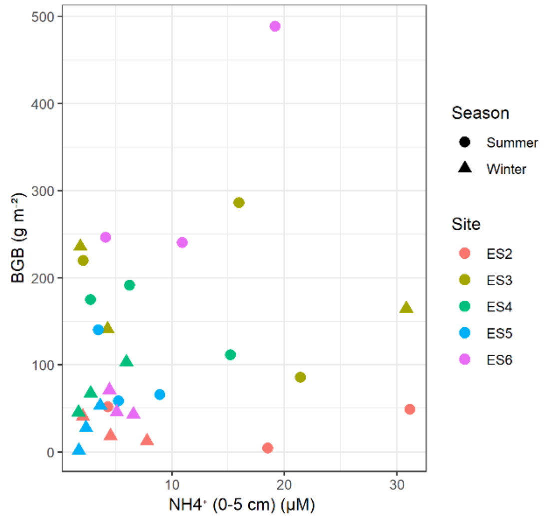

(**l**)

Figure S8. Scatter plots of seagrass biomass versus substrate conditions at existing seagrass (ES). (**a**) Seagrass shoot density vs. substrate % mud; (**b**) seagrass shoot density vs. substrate % organic matter;

(**c**) seagrass shoot density vs. porewater PO_4^{3-}; (**d**) seagrass shoot density vs. porewater NH_4^+; (**e**) seagrass above ground biomass (AGB) vs. substrate % mud; (**f**) seagrass AGB vs. substrate % organic matter; (**g**) seagrass AGB vs. porewater PO_4^{3-}; (**h**) seagrass AGB vs. porewater NH_4^+; (**i**) seagrass below ground biomass (BGB) vs. porewater % mud; (**j**) seagrass BGB vs. porewater % organic matter; (**k**) seagrass BGB vs. porewater PO_4^{3-}; and (**l**) seagrass AGB vs. porewater NH_4^+.