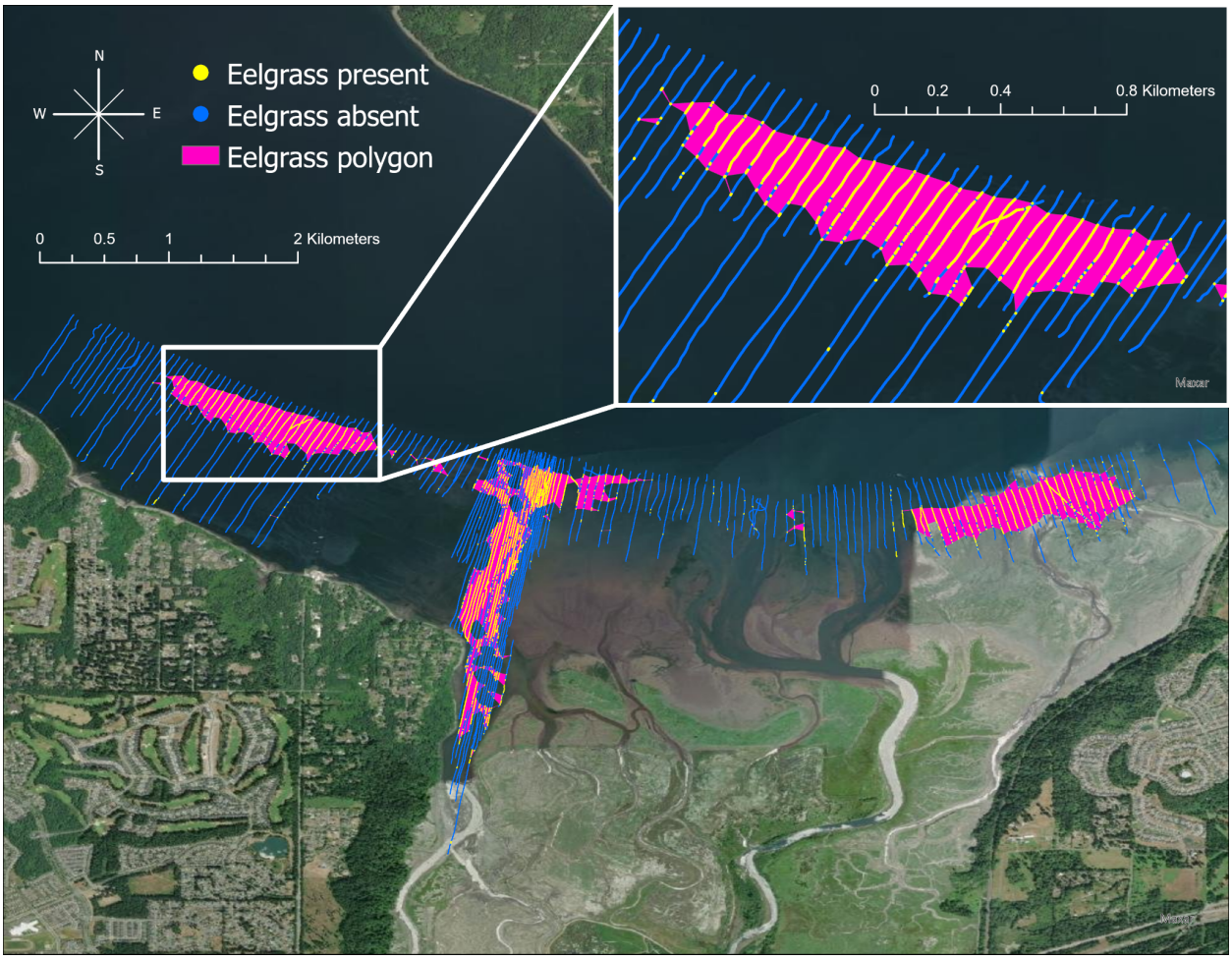

Figure S1. From surveys in the Nisqually River delta, we converted data describing the presence and absence of eelgrass along transects into a polygon by using the aggregate points function in ArcGIS Pro.

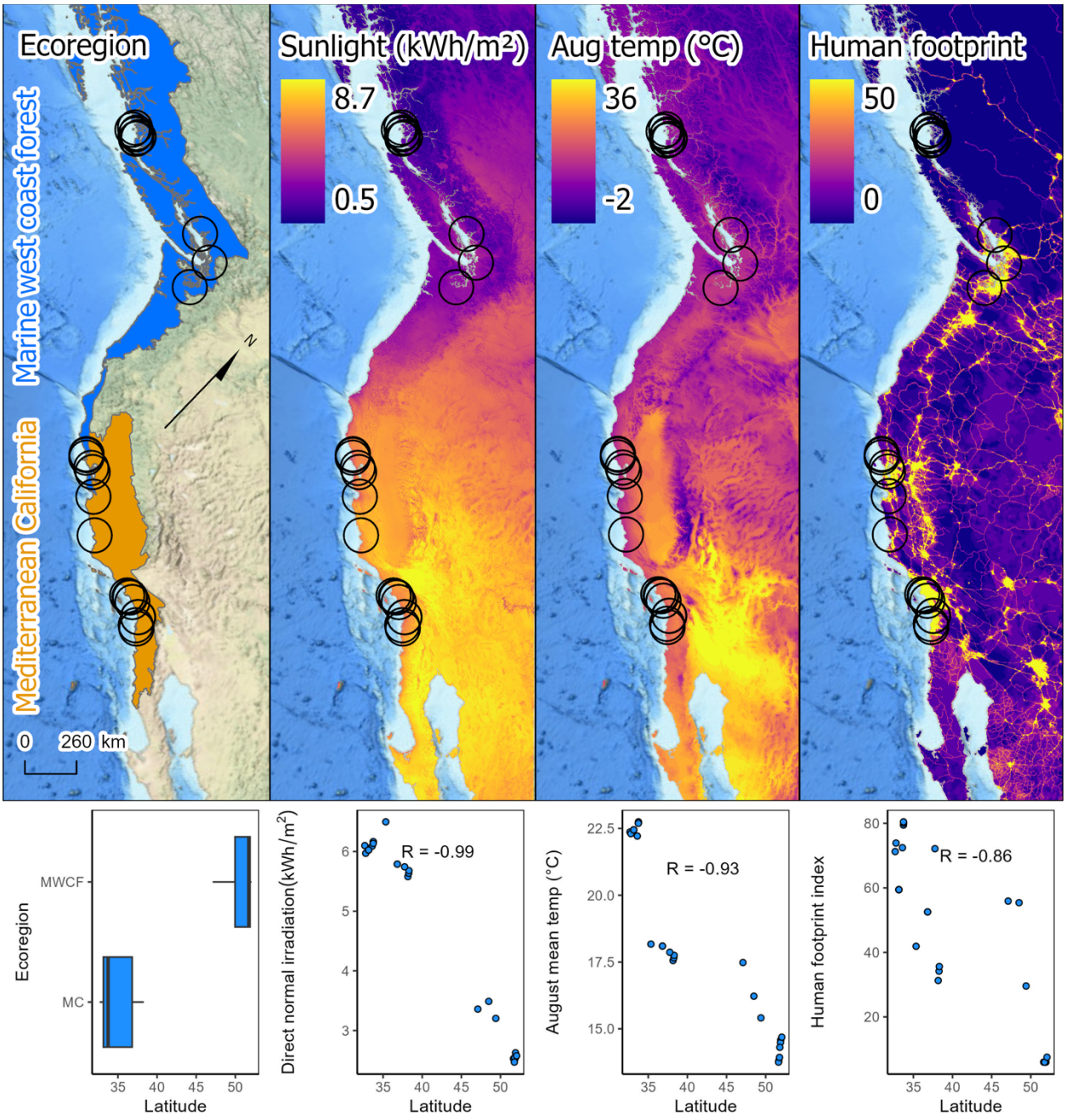

Figure S2. Relationships between sites' environmental variables and latitude, mapped above and plotted below. R: Pearson correlation coefficient. Ecoregion abbreviations: marine west coast forest (MWCF) and Mediterranean California (MC).

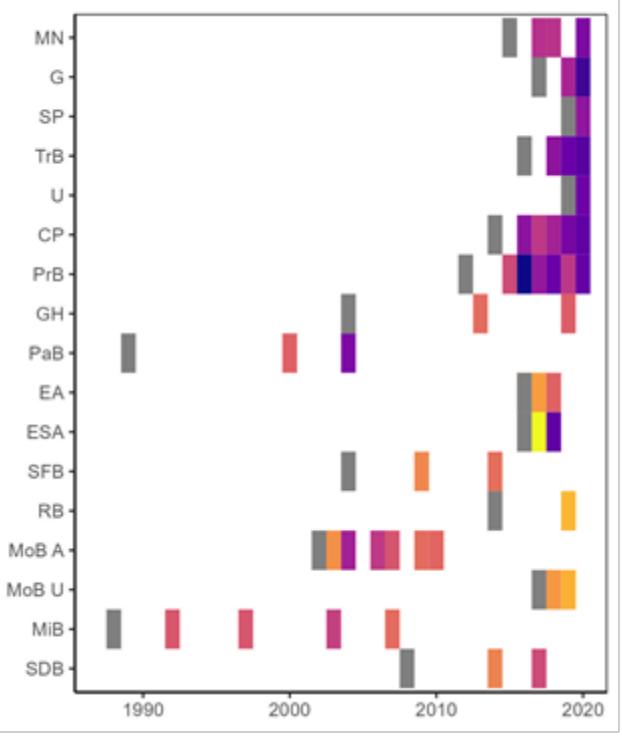

Figure S3. Figure 2, except all data are tier one. Additional abbreviations: Morro Bay UAV and Aerial (MoB U, MoB A).

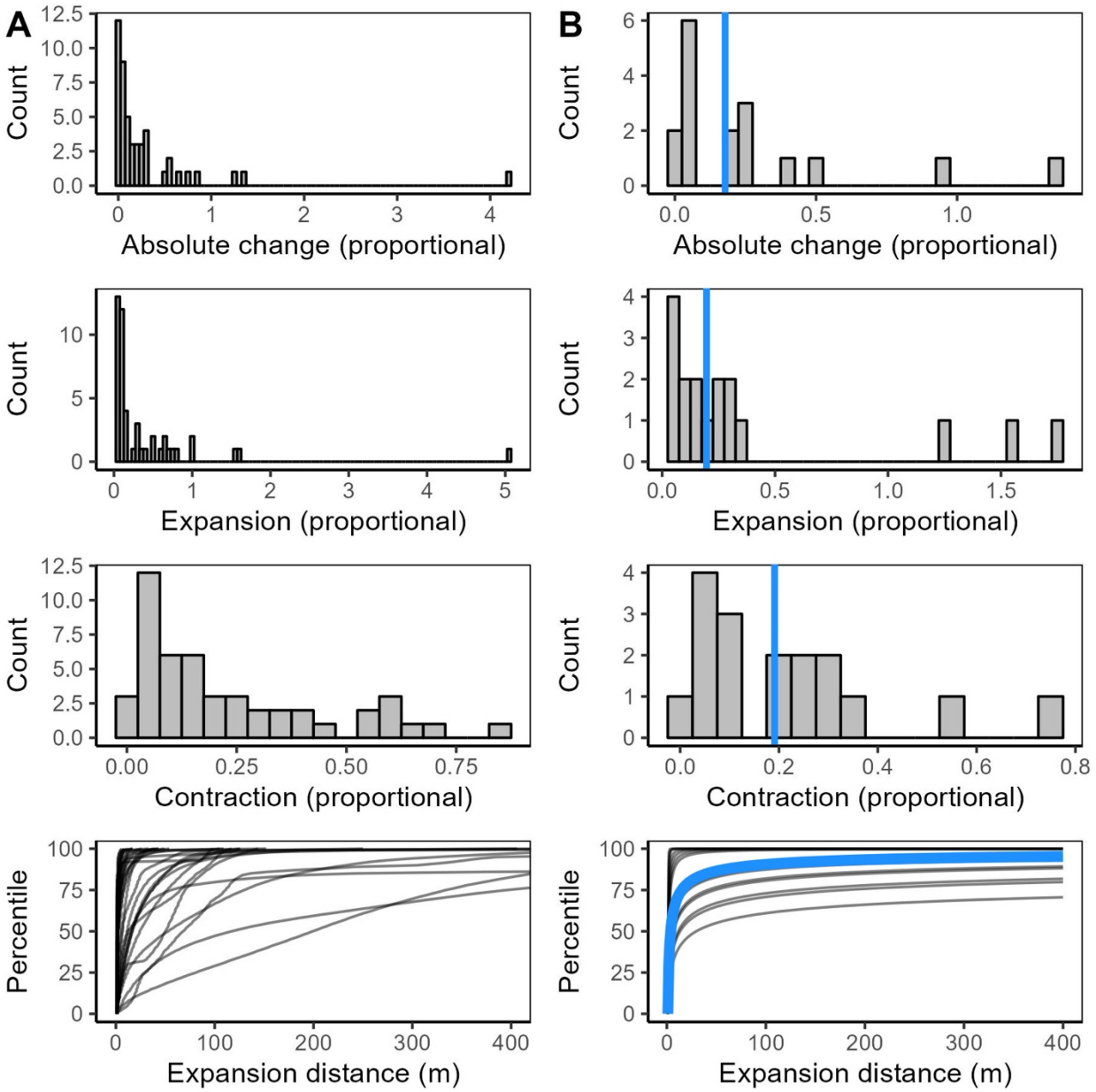

Figure S4. Figure 3, except all data are tier one and no models detected increased changes with increasing time between observations, so no model predictions are made using years between observations as a covariate. A: raw observations. B: model predictions.

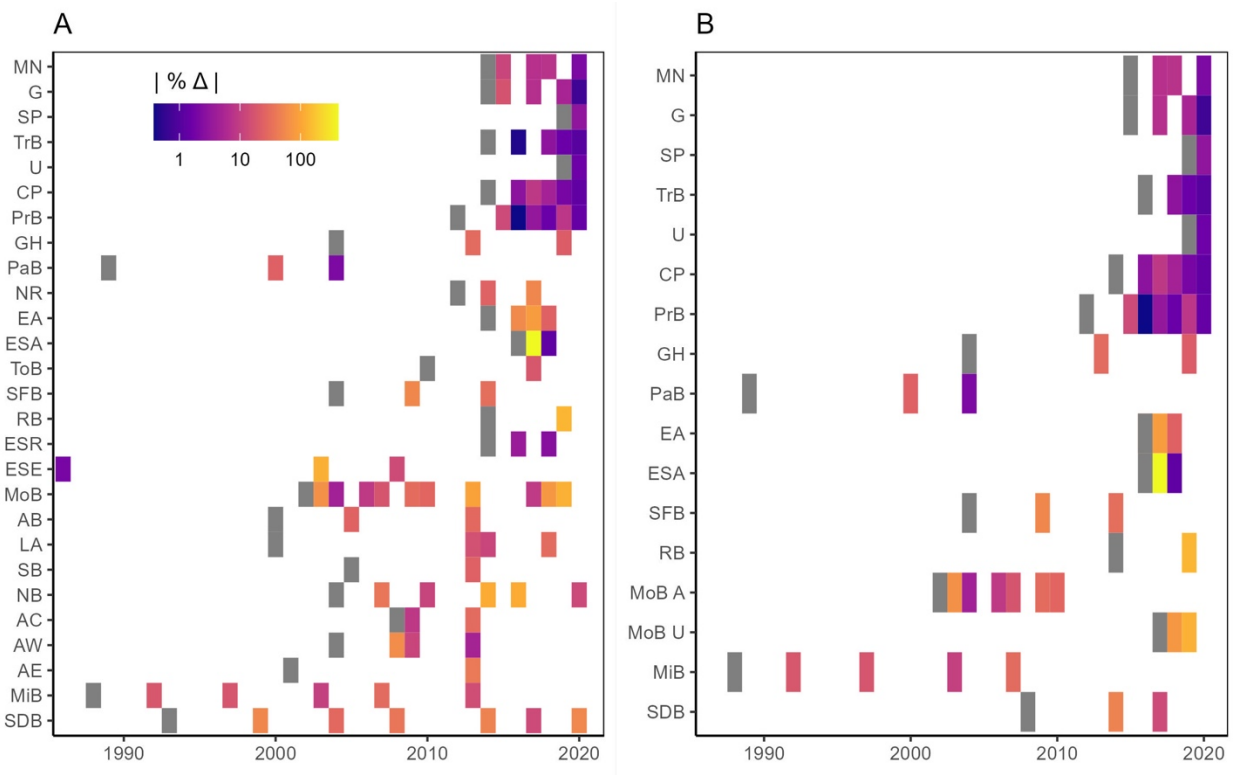

Figure S5. Figure 2, except percent change is divided by the length of time between observations describing all (A) and tier one (B) data.

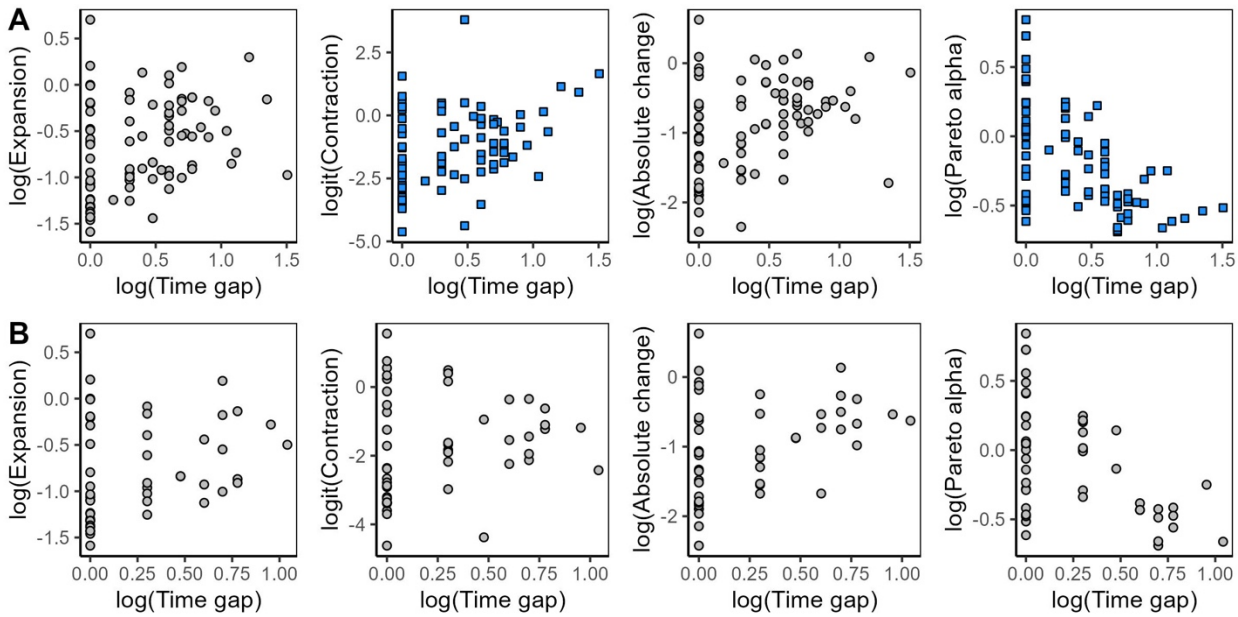

Figure S6. Examining for effects of time gaps between observations (in years) on eelgrass dynamics in all (A) and tier one (B) data. Blue squares indicate data supporting important relationships (determined via AICc) between eelgrass dynamics metrics and time gaps in models that also accounted for site effects.

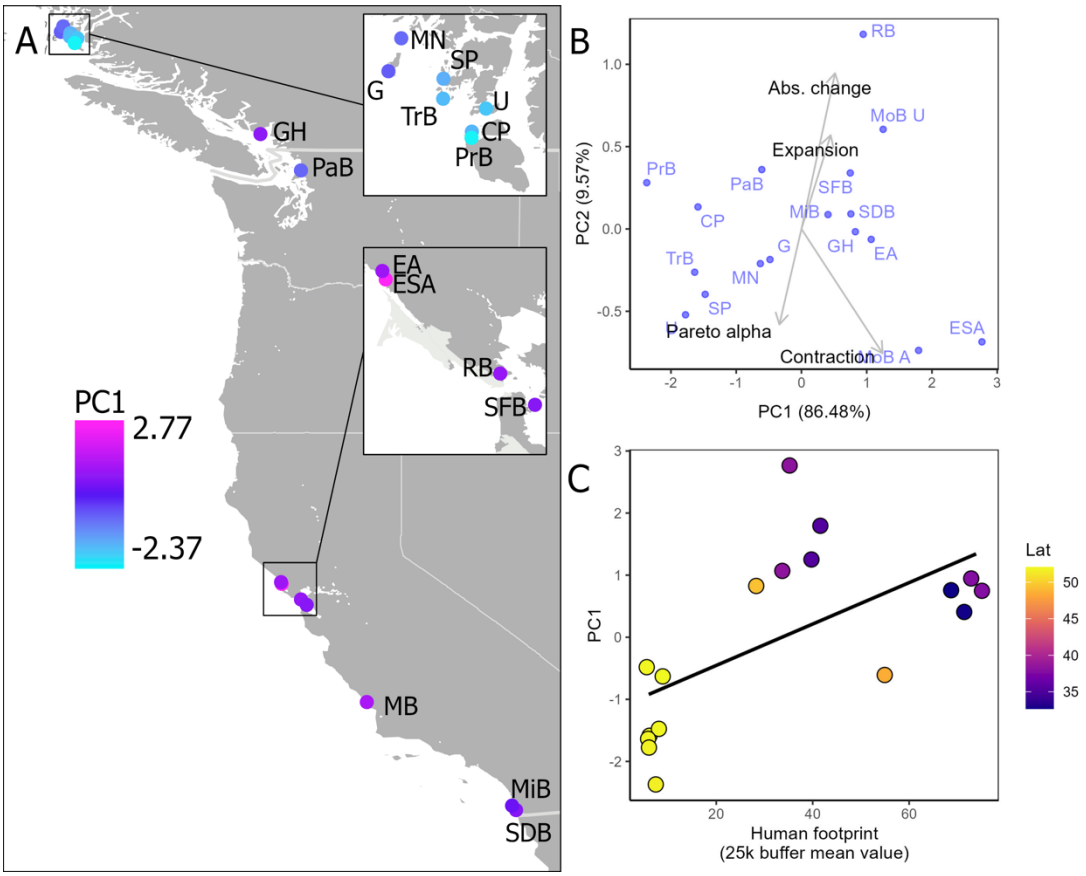

Figure S7. Figure 4, except all data are tier one.

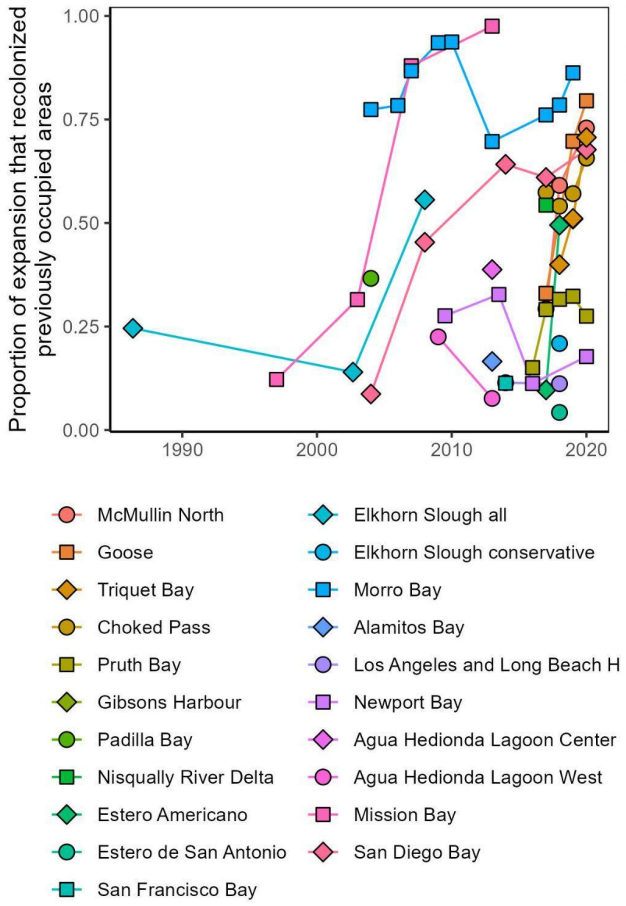

Figure S8. Figure 5, except all data are tier one.

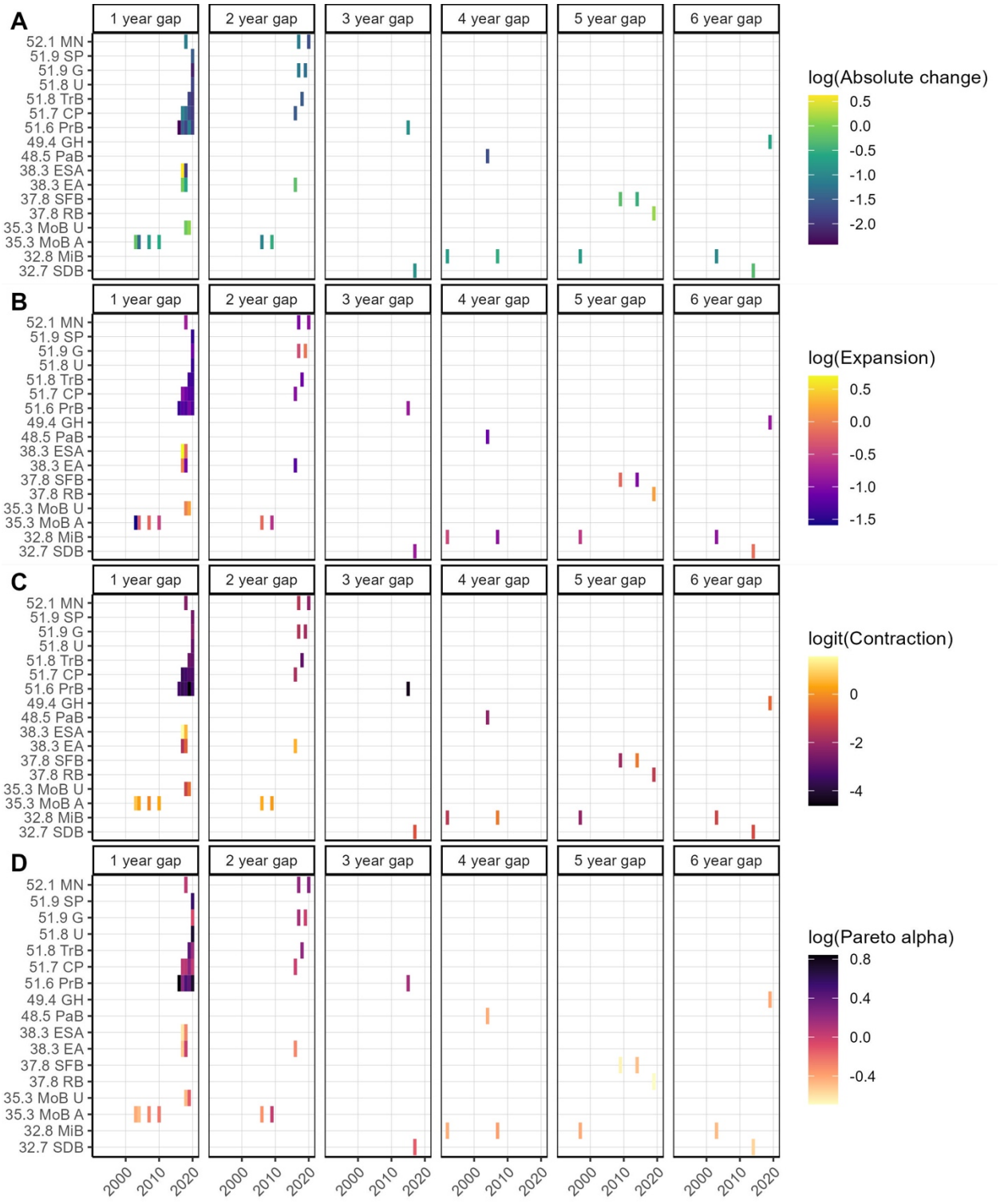
A
B
C
D
1 year gap
2 year gap
3 year gap
4 year gap
5 year gap
6 year gap
52.1 MN
51.9 SP
51.9 G
51.8 U
51.8 TrB
51.7 CP
51.6 PrB
49.4 GH
48.5 PaB
38.3 ESA
38.3 EA
37.8 SFB
37.8 RB
35.3 MoB U
35.3 MoB A
32.8 MiB
32.7 SDB
2000
2010
2020
log(Absolute change)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
log(Expansion)
0.5
0.0
-0.5
-1.0
-1.5
logit(Contraction)
0
-2
-4
log(Pareto alpha)
0.8
0.4
0.0
-0.4

Figure S9. Eelgrass meadow dynamics metrics (rows A-D) compared among sites, faceted by the number of years between surveys. Numbers indicate latitude and site abbreviations are the same as in Figs. 2 and S3. The dark-light color ramp scheme for estimates of Pareto alphas has been reversed because higher values indicate less dramatic eelgrass meadow boundary shifts, whereas higher values for other metrics indicate greater changes. These are tier one data and observations made between more than 6 intervening years have been excluded because there were only singular instances of these time gaps, precluding comparisons among sites.

Table S1. Description of surveys used in this analysis. Tier one status is defined in terms of year pairs and is indexed in this table according to the second of the two years being compared. See Figure 5 in the main text for site locations.

Site	Year	Dates	Methods	Tier one
Agua Hedionda Lagoon Center	2008	11/26	Sonar, visual	NA
Agua Hedionda Lagoon Center	2009	4/22	Sonar, visual	no
Agua Hedionda Lagoon Center	2013	4/19, 7/15, 9/20	Aerial, sonar, visual	no
Agua Hedionda Lagoon East	2001	Oct	Sonar, visual	NA
Agua Hedionda Lagoon East	2013	4/19, 7/15, 9/20	Aerial, sonar, visual	no
Agua Hedionda Lagoon West	2004	9/13	Sonar, visual	NA
Agua Hedionda Lagoon West	2008	11/26	Sonar, visual	no

Agua Hedionda Lagoon West	2009	4/22	Sonar, visual	no
Agua Hedionda Lagoon West	2013	4/19, 7/15, 9/20	Aerial, sonar, visual	no
Alamitos Bay	2000	Unknown	Visual	no
Alamitos Bay	2005	Aug	Sonar, visual	no
Alamitos Bay	2013	4/3, 10/19, 10/29	Aerial, sonar	no
Choked Pass	2014	7/31	Aerial	NA
Choked Pass	2016	8/3	Aerial	yes
Choked Pass	2017	7/23	Aerial	yes
Choked Pass	2018	8/16	Aerial	yes
Choked Pass	2019	8/16	Aerial	yes
Choked Pass	2020	7/20	Aerial	yes
Elkhorn Slough all	1934	1931 & 1937 (composite)	Aerial	NA
Elkhorn Slough all	1966	1956, 1966, 1976 (composit	Aerial	no

		e)		
Elkhorn Slough all	1986.333	1980, 1987, 1992 (composite)	Aerial	no
Elkhorn Slough all	2002.667	2000, 2003, 2005	Aerial	no
Elkhorn Slough all	2008	2007, 2008, 2009	Aerial	no
Elkhorn Slough conservative	2014	Feb (GE), Jan 13 (aerial)	Aerial & Google Earth	NA
Elkhorn Slough conservative	2015.5	Mar 2015, Apr 2015, Apr 2016	Google Earth	no
Elkhorn Slough conservative	2018	Feb - Nov	Google Earth	no
Estero Americano	2014	Jun, Sep	Visual	NA
Estero Americano	2016	Jul	Visual	yes
Estero Americano	2017	Aug	Visual	yes
Estero Americano	2018	Aug	Visual	yes
Estero de San Antonio	2016	Aug	Visual	NA

Estero de San Antonio	2017	Aug	Visual	yes
Estero de San Antonio	2018	Aug	Visual	yes
Gibsons Harbour	2004	Sep	Underwater camera	NA
Gibsons Harbour	2013	Sep	Underwater camera	yes
Gibsons Harbour	2019	Sep	Underwater camera	yes
Goose	2014	8/16	Underwater camera	NA
Goose	2015	9/13	Aerial	no
Goose	2017	8/13	Aerial	yes
Goose	2019	8/2	Aerial	yes
Goose	2020	7/24	Aerial	yes
Los Angeles and Long Beach Harbors	2000	Mar 18 & August 2000 (sonar); Apr 3 & Sep 2000 (diver)	Sonar, visual	NA
Los Angeles and Long Beach Harbors	2013	Sep-Oct	Sonar, visual	no

Los Angeles and Long Beach Harbors	2014	May-Jun	Sonar, visual	no
Los Angeles and Long Beach Harbors	2018	Early Apr & mid-Sep	Sonar, visual	no
McMullin North	2014	8/15	Underwater camera	NA
McMullin North	2015	9/4	Aerial	no
McMullin North	2017	7/24	Aerial	yes
McMullin North	2018	7/4	Aerial	yes
McMullin North	2020	7/24	Aerial	yes
Mission Bay	1988	Oct	Sonar, visual	NA
Mission Bay	1992	Oct	Sonar, visual	yes
Mission Bay	1997	Oct	Sonar, visual	yes
Mission Bay	2003	Oct	Sonar, visual	yes
Mission Bay	2007	Oct	Sonar, visual	yes

Mission Bay	2013	May	Sonar, visual	no
Morro Bay	2002	11/25	Aerial	NA
Morro Bay	2003	11/21	Aerial	yes (grp. 1)
Morro Bay	2004	11/24	Aerial	yes (grp. 1)
Morro Bay	2006	11/6	Aerial	yes (grp. 1)
Morro Bay	2007	11/24	Aerial	yes (grp. 1)
Morro Bay	2009	11/13	Aerial	yes (grp. 1)
Morro Bay	2010	11/4	Aerial	yes (grp. 1)
Morro Bay	2013	5/28	Aerial	no
Morro Bay	2017	12/1 & 12/4	Aerial	no
Morro Bay	2018	Dec	Aerial	yes (grp. 2)
Morro Bay	2019	Dec	Aerial	yes (grp. 2)
Newport Bay	2003.5	Jan 2003 - Mar 2004	Visual	NA
Newport Bay	2007	Sep 2006 - Nov 2008	Sonar, visual	no
Newport Bay	2009.5	Aug 2009 - Oct 2010	Sonar, visual	no
Newport Bay	2013.5	Mar 2013 - Apr 2014	Sonar, visual	no

Newport Bay	2016	Jun-October (Dec for one portion)	Sonar, visual	no
Newport Bay	2020	6/19-11/9	Sonar, visual	yes
Nisqually River Delta	2012	2/15, 2/19	Sonar	NA
Nisqually River Delta	2014	2/22, 2/25	Sonar	no
Nisqually River Delta	2017	2/20, 2/ 23	Sonar	no
Padilla Bay	1989	6/3	Aerial	NA
Padilla Bay	2000	7/30	Aerial	yes
Padilla Bay	2004	6/4	Aerial	yes
Pruth Bay	2012	8/5	Aerial	NA
Pruth Bay	2015	8/1	Aerial	yes
Pruth Bay	2016	8/5	Aerial	yes
Pruth Bay	2017	6/26	Aerial	yes
Pruth Bay	2018	8/5	Aerial	yes
Pruth Bay	2019	7/30	Aerial	yes
Pruth Bay	2020	7/20	Aerial	yes

Richardson Bay	2014	Oct-Nov	Aerial, Sonar	NA
Richardson Bay	2019	Jun-Jul	Aerial, Sonar	yes
San Diego Bay	1993	Mar-Apr; Sep-Oct	Sonar, visual	NA
San Diego Bay	1999	Mar-Apr; Sep-Oct	Sonar, visual	no
San Diego Bay	2004	10/5, 7-8, 12-15, 18-19, 25-30, & 11/1-4	Sonar, visual	no
San Diego Bay	2008	Jun-Aug	Sonar, visual	no
San Diego Bay	2014	May-July	Sonar, visual	yes
San Diego Bay	2017	May-July	Sonar, visual	yes
San Diego Bay	2020	Aug-Oct	Sonar, visual	no
San Francisco Bay	2004	Jun-Oct	Aerial, Sonar	NA
San Francisco Bay	2009	Oct-Nov	Aerial, Sonar	yes
San Francisco Bay	2014	Oct-Nov	Aerial, Sonar	yes

Seal Beach	2005	Jun	Sonar, visual	NA
Seal Beach	2013	4/3, 8/1, 10/29	Aerial, Sonar	no
Superstition Pt	2019	8/3	Aerial	NA
Superstition Pt	2020	7/23	Aerial	yes
Tomales Bay	2010	7/29	Aerial	NA
Tomales Bay	2017	8/1-8/9	Aerial, Sonar	no
Triquet Bay	2014	9/16	Underwater camera	NA
Triquet Bay	2016	7/5	Aerial	no
Triquet Bay	2018	8/13	Aerial	yes
Triquet Bay	2019	8/1	Aerial	yes
Triquet Bay	2020	7/25	Aerial	yes
Underhill	2019	7/31	Aerial	NA
Underhill	2020	7/21	Aerial	yes

Table S2. Results of ground-truthing used in some studies to test the accuracy of remote sensing eelgrass.

Site	Year	Technique	Results	Comments	Source
Mission Bay	1988	254 diver transects 91.44 m long to evaluate side-scan sonar mapping	94% accuracy in classification of eelgrass and positional placement	Accuracy highest in expansive meadows, lower in sparse patches	Merkel & Associates (2014)
Alamitos Bay	2013	200 drop camera points to evaluate side-scan sonar mapping	100% accuracy (23 true positives, 177 true negatives)		Merkel & Associates (2014)
British Columbia: Gwaii Haanas, Haida Gwaii, north coast; Hakai Lúxvbálís, central	2017	12 sites, with 39-184 ground truth points per site depending on site size. Towed video camera used to evaluate UAS	True positive accuracy: 97.6% 91.3% 84.2% 70.0%, 91.7% (dense, moderate, sparse, very sparse, unvegetated, respectively)	Eelgrass density categories: very sparse (5–20% cover), sparse (20–60% cover), moderately dense (60–80% cover), and very dense (80–100% cover)	Nahirnick et al. (2019)

coast; Gulf Islands, south-east coast; Broken Group, Pacific Rim National Park and south-west coast		mapping.			