Supplementary Material:

Ocean acidification affects competition for space:

Projections of community structure using cellular automata

Sophie J. McCoy, Stefano Allesina, and Catherine A. Pfister

Section A: Experimental data

Supplement table S1.
Experimentally-derived pairwise competitive overgrowth probabilities. Historical data (1980s) from Paine (1984), modern data (2010s) from McCoy & Pfister (2014). Winners are listed in the row and losers in the column.

(a) Scenario H1: Survey data from the 1980s, grazers present

	space	Pm	Lp	Pw	Li	Art
space	0.00	0.00	0.00	0.00	0.00	0.00
Pm	1.00	0.00	1.00	1.00	1.00	1.00
Lp	1.00	0.00	0.00	0.34	0.41	1.00
Pw	1.00	0.00	0.66	0.00	0.31	1.00
Li	1.00	0.00	0.59	0.69	0.00	1.00
Art	1.00	0.00	0.00	0.00	0.00	0.00

(b) Scenario H2: Experimental data from the 1980s, grazers absent

	space	Pm	Lp	Pw	Li	Art
space	0.00	0.00	0.00	0.00	0.00	0.00
Pm	1.00	0.00	0.96	1.00	1.00	1.00
Lp	1.00	0.04	0.00	0.95	1.00	1.00
Pw	1.00	0.00	0.05	0.00	0.80	1.00
Li	1.00	0.00	0.00	0.02	0.00	1.00
Art	1.00	0.00	0.00	0.00	0.00	0.00

(c) Scenario M1: Survey data from the 2010s, grazers present

	space	Pm	Lp	Pw	Li	Art
space	0.00	0.00	0.00	0.00	0.00	0.00
Pm	1.00	0.00	0.72	1.00	1.00	1.00
Lp	1.00	0.28	0.00	0.72	0.56	0.91
Pw	1.00	0.00	0.28	0.00	0.04	0.70
Li	1.00	0.00	0.44	0.96	0.00	1.00
Art	1.00	0.00	0.09	0.30	0.00	0.00

(d) Scenario M2: Experimental data from the 2010s, grazers absent

	space	*Pm*	*Lp*	*Pw*	*Li*	*Art*
space	0.00	0.00	0.00	0.00	0.00	0.00
Pm	1.00	0.00	0.00	0.29	0.14	1.00
Lp	1.00	1.00	0.00	0.92	0.73	0.75
Pw	1.00	0.71	0.08	0.00	0.17	0.45
Li	1.00	0.86	0.27	0.83	0.00	0.89
Art	1.00	0.00	0.25	0.55	0.11	0.00

(e) Scenario M3: Experimental data from the 2010s, grazers present

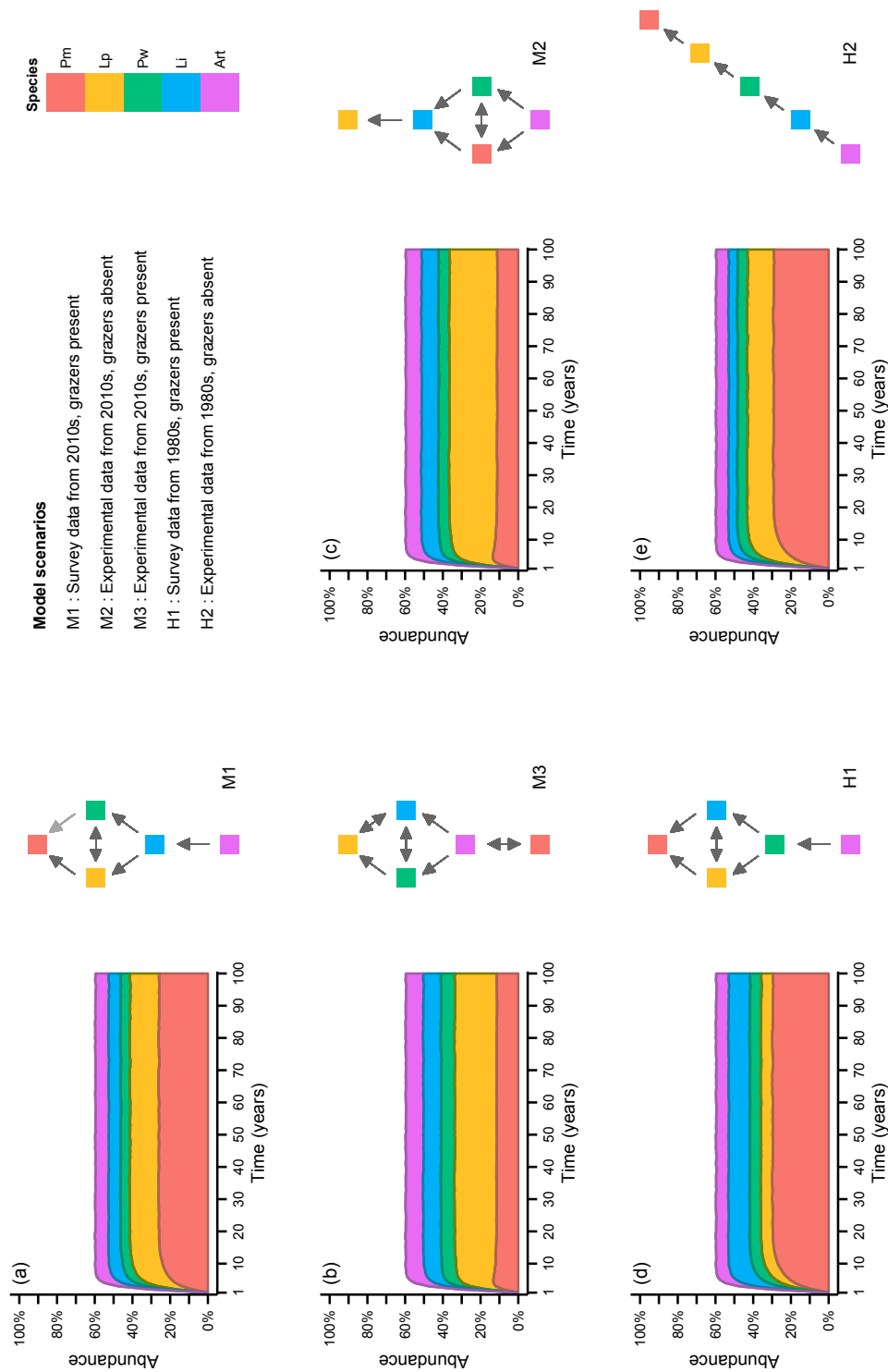|	space	*Pm*	*Lp*	*Pw*	*Li*	*Art*
space	0.00	0.00	0.00	0.00	0.00	0.00
Pm	1.00	0.00	0.09	0.30	0.29	0.60
Lp	1.00	0.91	0.00	0.77	0.60	0.69
Pw	1.00	0.70	0.23	0.00	0.50	0.60
Li	1.00	0.71	0.40	0.50	0.00	1.00
Art	1.00	0.40	0.31	0.40	0.00	0.00

Supplement figure S1.
Historical and modern species abundances derived from community surveys. 1980s data
from Paine, unpublished data. 2010s data from McCoy & Pfister (2014). See also Table 1.
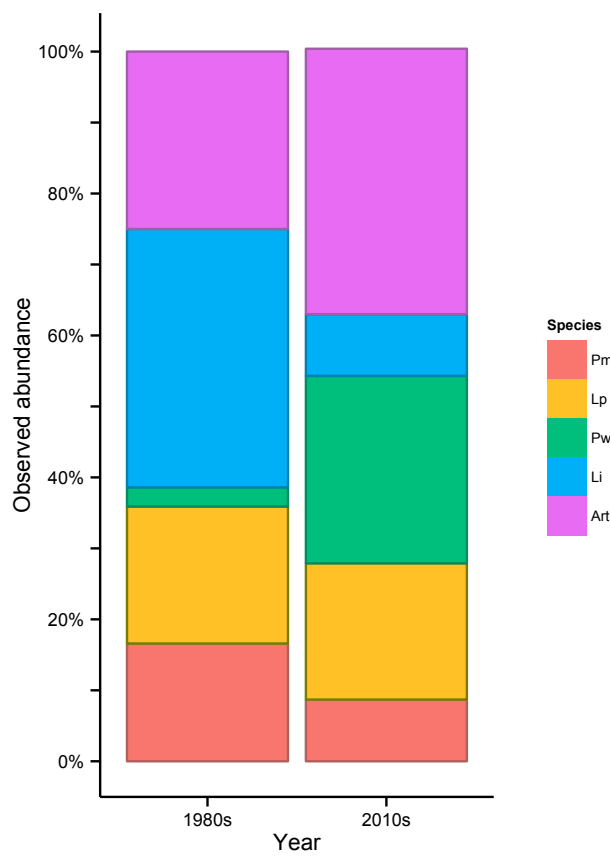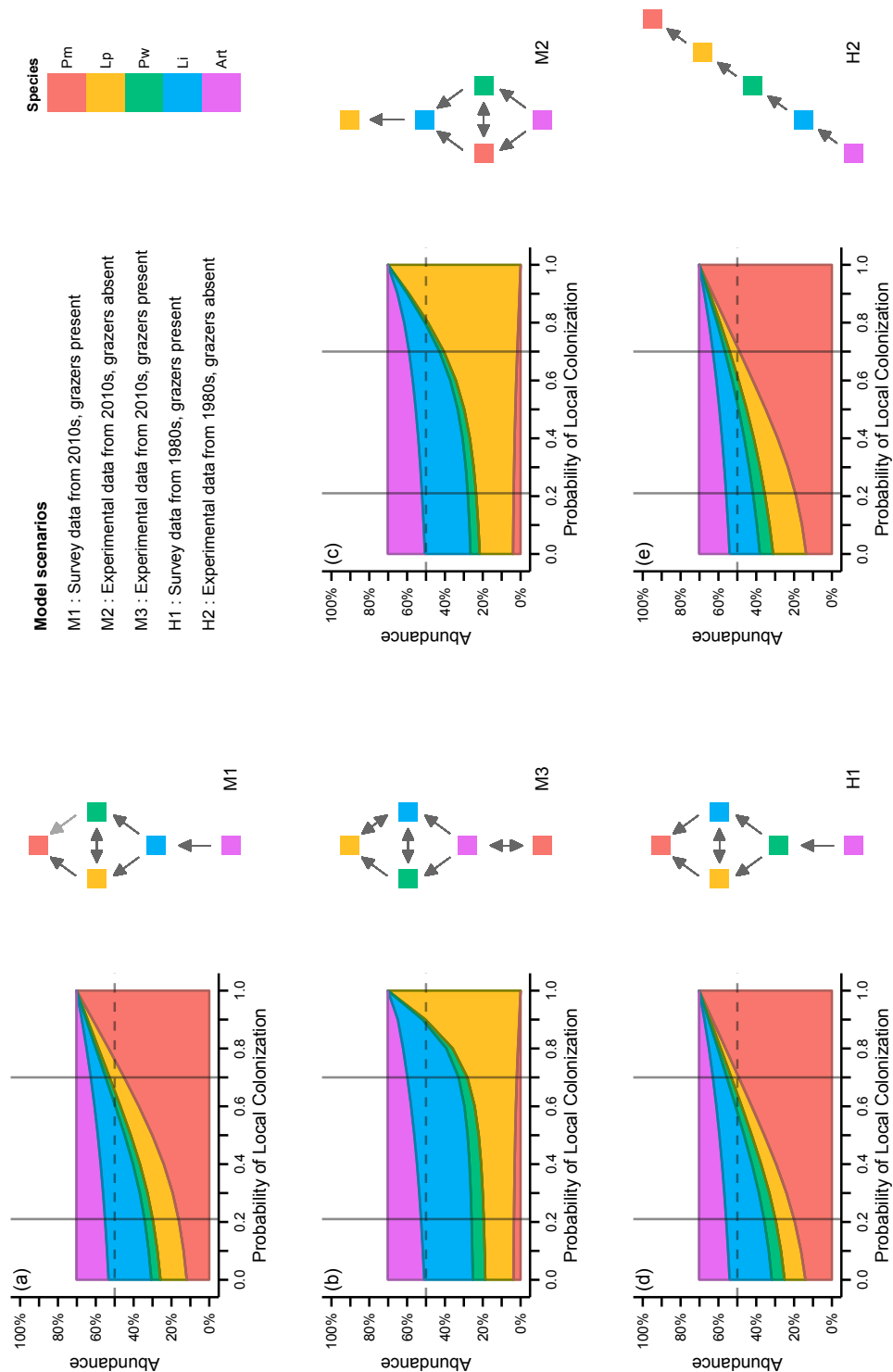
Section B: Model outputs

Supplement figure S2.

Outputs of species abundances over time from model scenarios (*a*) M1, (*b*) M3, (*c*) M2, (*d*) H1, and (*e*) H2 averaged over 1000 simulations. Different species are shown by color.

Species

Pm, Lp, Pw, Li, Art

Model scenarios

M1 : Survey data from 2010s, grazers present
M2 : Experimental data from 2010s, grazers absent
M3 : Experimental data from 2010s, grazers present
H1 : Survey data from 1980s, grazers present
H2 : Experimental data from 1980s, grazers absent

Supplement figure S3.

Effect of varying the proportion of local colonization on equilibrium species abundance from model scenarios (*a*) M1, (*b*) M3, (*c*) M2, (*d*) H1, and (*e*) H2 averaged over 1000 simulations. Horizontal dashed grey lines mark 50% space occupancy. Vertical grey lines mark the threshold probability of local colonization at which the competitive dominant first becomes dominant and at which the competitive dominant reaches 50% space occupancy.

Species
Pm
Lp
Pw
Li
Art

Model scenarios

M1 : Survey data from 2010s, grazers present
M2 : Experimental data from 2010s, grazers absent
M3 : Experimental data from 2010s, grazers present
H1 : Survey data from 1980s, grazers present
H2 : Experimental data from 1980s, grazers absent

**Section C: Computer code**

Supplement files.
Computer code and input files are provided in the .zip file `SupplementaryCodeFiles`.

Supplement table S2.
Best fit external colonization and disturbance rates, listed as cumulative vector
(input file for code: `bestCR.txt`).

Disturbance	*P. muricatum*	*L. phymatodeum*	*P. whidbeyense*	*L. impressum*	*Corallina* spp.
0.42495138	0.06881229	0.23032118	0.32700505	0.60916442	1.00000000

Supplement figure S4.
Flow chart of modelling steps within a time step.
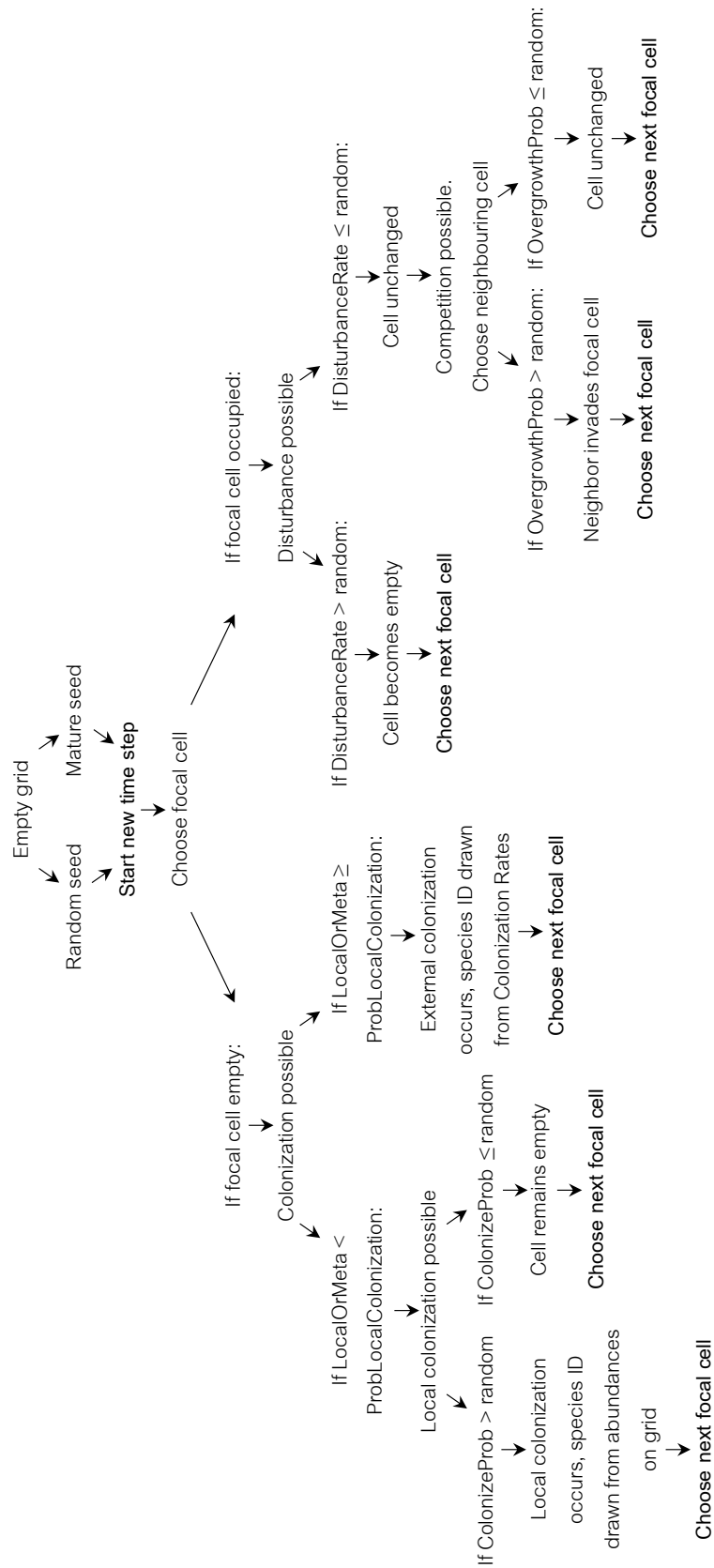
References cited.

Paine RT. 1984. Ecological determinism in the competition for space. *Ecology* **65**, 1339-1348.

McCoy SJ, Pfister CA. 2014. Historical comparisons reveal altered competitive interactions in a guild of crustose coralline algae. *Ecol. Lett.***1**7, 475-483.