S1 Supporting Information

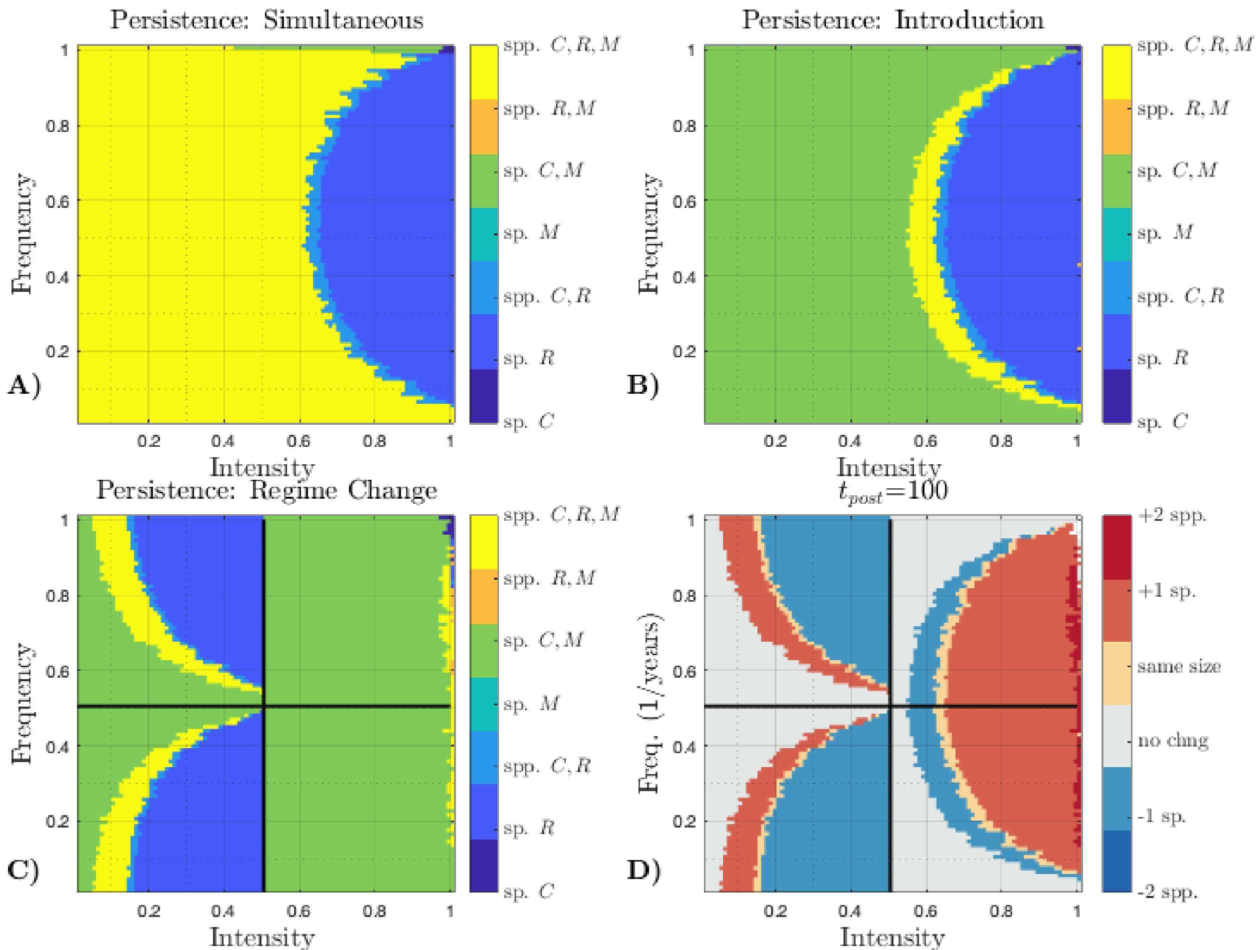
Our results from the main text show how historical disturbance regimes can alter future communities and invasibility long after the regime has changed. Here we present a variety of further results figures to highlight that this holds true for many situations other than the experiments described in the main text. We alter several features of the experiments on the same community of three species presented in the main text, including letting each species act as invader, altering the shift of the regime change, altering the random initialization (i.e. the "seed" of the pseudorandom number generator), changing the time periods, changing the number of introduced seeds and changing the threshold required for species persistence. Additionally, we perform multiple sets of experiments for two additional communities that have very different species parameters from the those in the main text. We use generic labels for species in this appendix (i.e. sp. 1, sp. 2, sp. 3), except where species C,R,M are used exactly as in the main text, in which case we also retain those names for them. In this way, results can be more easily compared both between the SI and main text, and within the SI.

Parameters for additional species and communities were selected with two goals: to sample a broad variety of distinct life history parameters and competitive interactions, and to avoid "tuning" or "cherry picking" to see a desired effect. Thus, species have seed yields ranging from 900 to 2100, germination rates ranging from 0.3 to 0.6, seedbank survival rates ranging from 0.3 to 0.7, and competition weights ranging from 0.5 to 1.09. Species were randomly grouped into new communities, and species were permuted so that each one plays the role of invader in one suite of results. Thus, we roughly sample the huge life-history parameter space to examine how widely representative the results presented in the main text are. Overall, every community we have analyzed shows strong effects of disturbance history on community composition in regime change experiments, for at least one species acting as invader. We have also shown that in some configurations such effects of historical regime change are minimal. Thus, while these effects are clearly not universal, our work suggest they are not rare. Determining *a priori* when to expect strong effects of past disturbance regimes on future communities and invasions will be a fascinating challenge for future research.

MATLAB code that implements the model of the main text and generates the these comparison plots is freely accessible under license (CC-BY-NC-SA) at the Zenodo repository:
`https://zenodo.org/record/4429199` , `DOI:10.5281/zenodo.4429199`

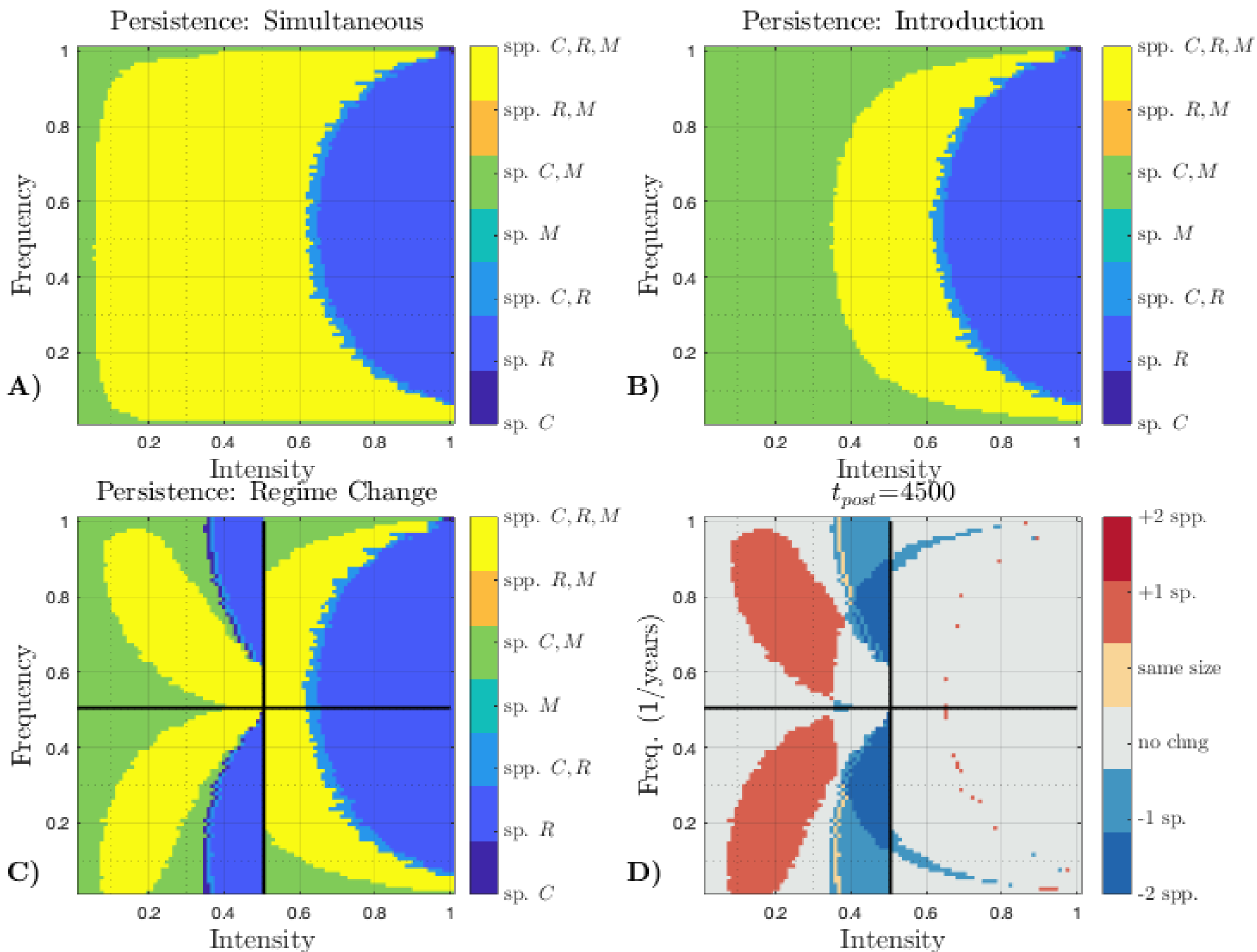
	Yield (Y)	Germ. (G)	surv. (s)	$\alpha_{\cdot,C}$	$\alpha_{\cdot,R}$	$\alpha_{\cdot,M}$	note
Sp. 1 (C)	900	0.6	0.4	1	0.9	0.5	Outcompetes R, with lower yield
Sp. 2 (R)	1100	0.4	0.6	1.1	1	0.5	Ruderal, high yield, large seedbank
Sp. 3 (M, invader)	1000	0.5	0.5	0.6	1.1	1	Moderate compared to R,C

Table S1: For ease of comparison with supplementary figures, Table S1 provides the parameter set discussed in the main text. For the matrix $[\alpha_{ij}]$, each column is the weights for the other species' competitive effects on the focal species. Species C excludes R with no disturbance. R indirectly benefits from disturbance because it has higher seedbank survival and lower germination than C, causing disturbance to be relatively more damaging to C.



	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (C)	900	0.6	0.4	1	0.9	0.5
Sp. 2 (R)	1100	0.4	0.6	1.1	1	0.5
Sp. 3 (M, invader)	1000	0.5	0.5	0.6	1.1	1

Fig. S1: Same results as Fig. 2 in main text, but with a regime change shift of $(I_1, F_1) = (I_0 + 0.5, F_0 + 0.5)$, so that equal areas of parameter space experience increase and decrease in disturbance.



	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (C)	900	0.6	0.4	1	0.9	0.5
Sp. 2 (R)	1100	0.4	0.6	1.1	1	0.5
Sp. 3 (M, invader)	1000	0.5	0.5	0.6	1.1	1

Fig. S2: Same results as in Fig. S1, but $t_{post} = 4,500$ years after species introduction. Here and above (and main text Fig. 5) we can see that the regimes experiencing decreases in disturbance intensity (left of black line) appear to have longer lasting effects of historical regimes, but the increases (right of black line) affect more of parameter space initially.

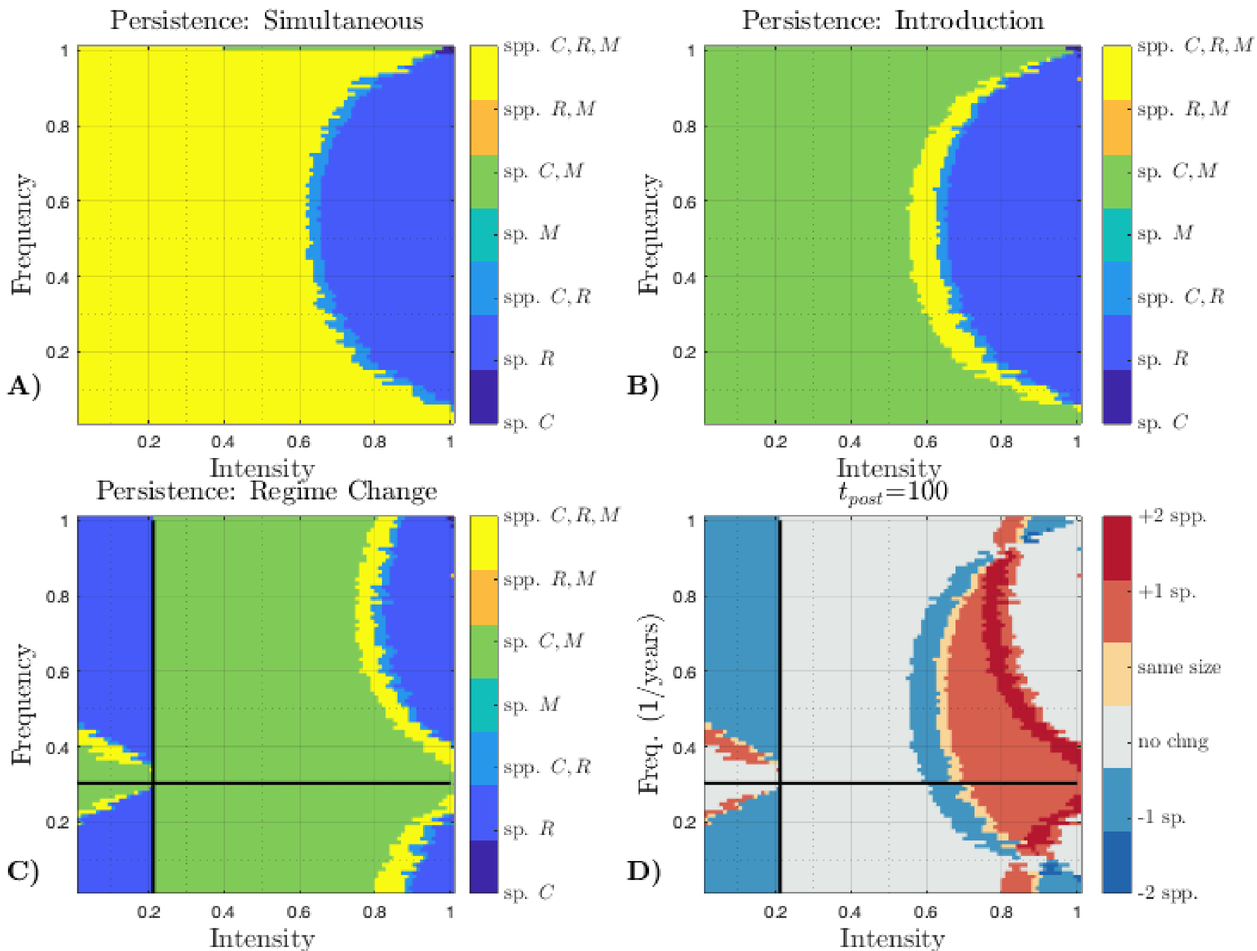


Fig. S3: Same results as Fig. 2 in main text, but using a different initialization of the pseudorandom process. As results only differ in a few boundary points, we conclude our results using single realizations of each disturbance process are qualitatively robust.

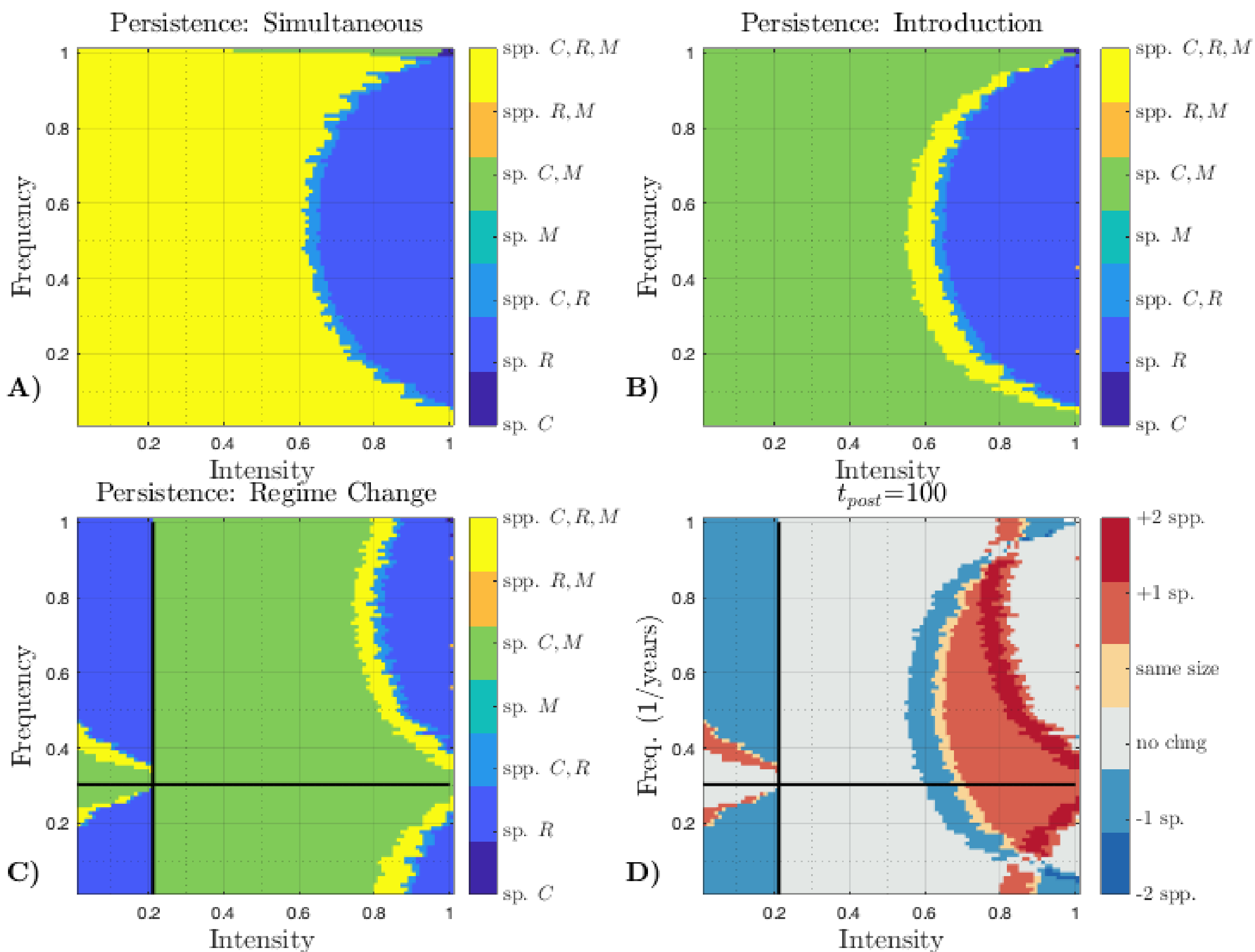
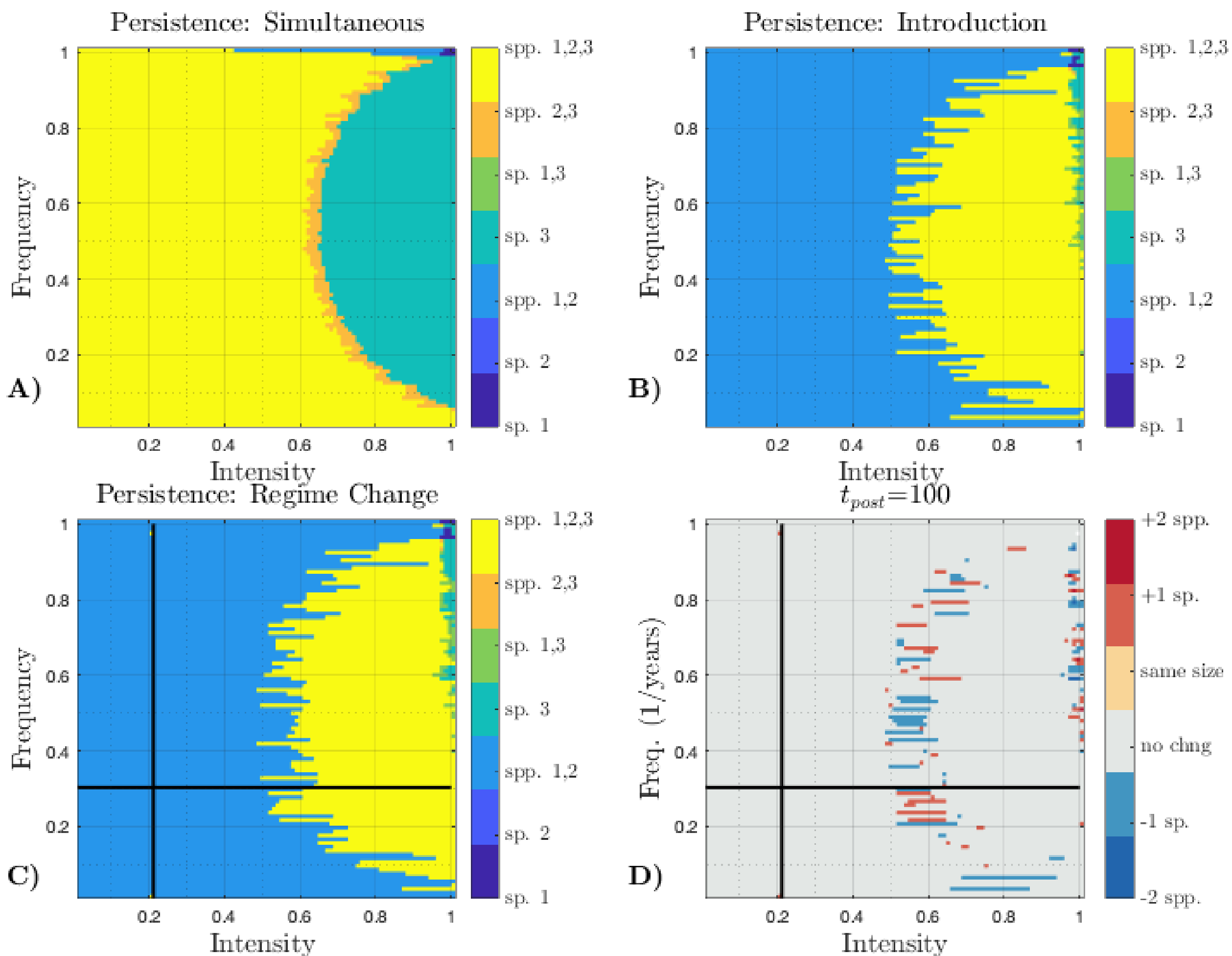
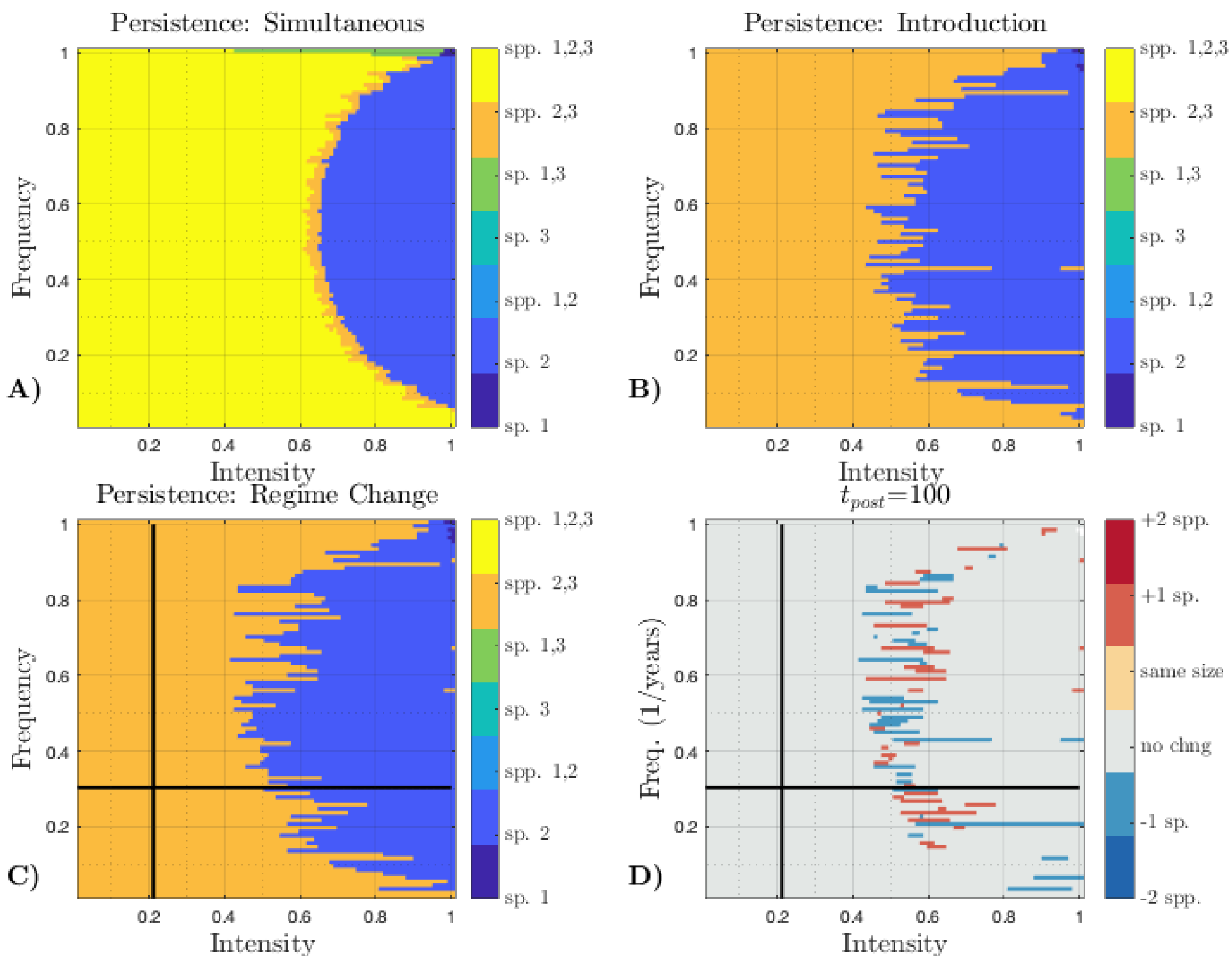


Fig. S4: Same results as Fig. 2 in main text, but longer interim time period, $(t_{pre}, t_{intm}, t_{post}) = (1800, 100, 100)$. As results show only minor differences compared to Fig. 2, we conclude our results using a 20 year interim period are not strongly sensitive to occurrence of disturbance events in that interim period.



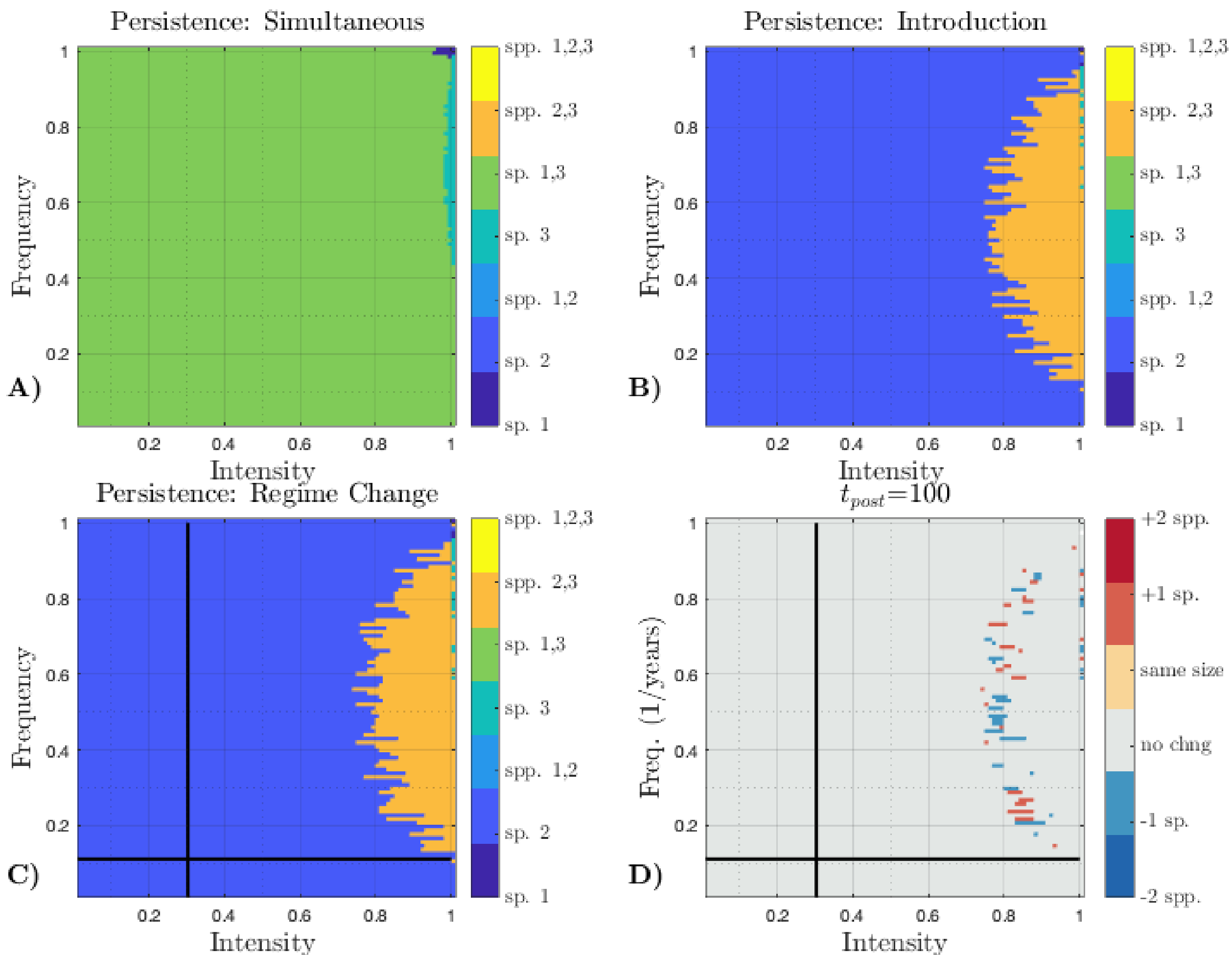
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (M)	1000	0.5	0.5	1	0.6	1.1
Sp. 2 (C)	900	0.6	0.4	0.5	1	0.9
Sp. 3 (R, invader)	1100	0.4	0.6	0.5	1.1	1

Fig. S5: Same results as Fig. 2 in main text, but with species R as the introduced species (here labeled 3). Historical regime change causes little change in communities in this case.



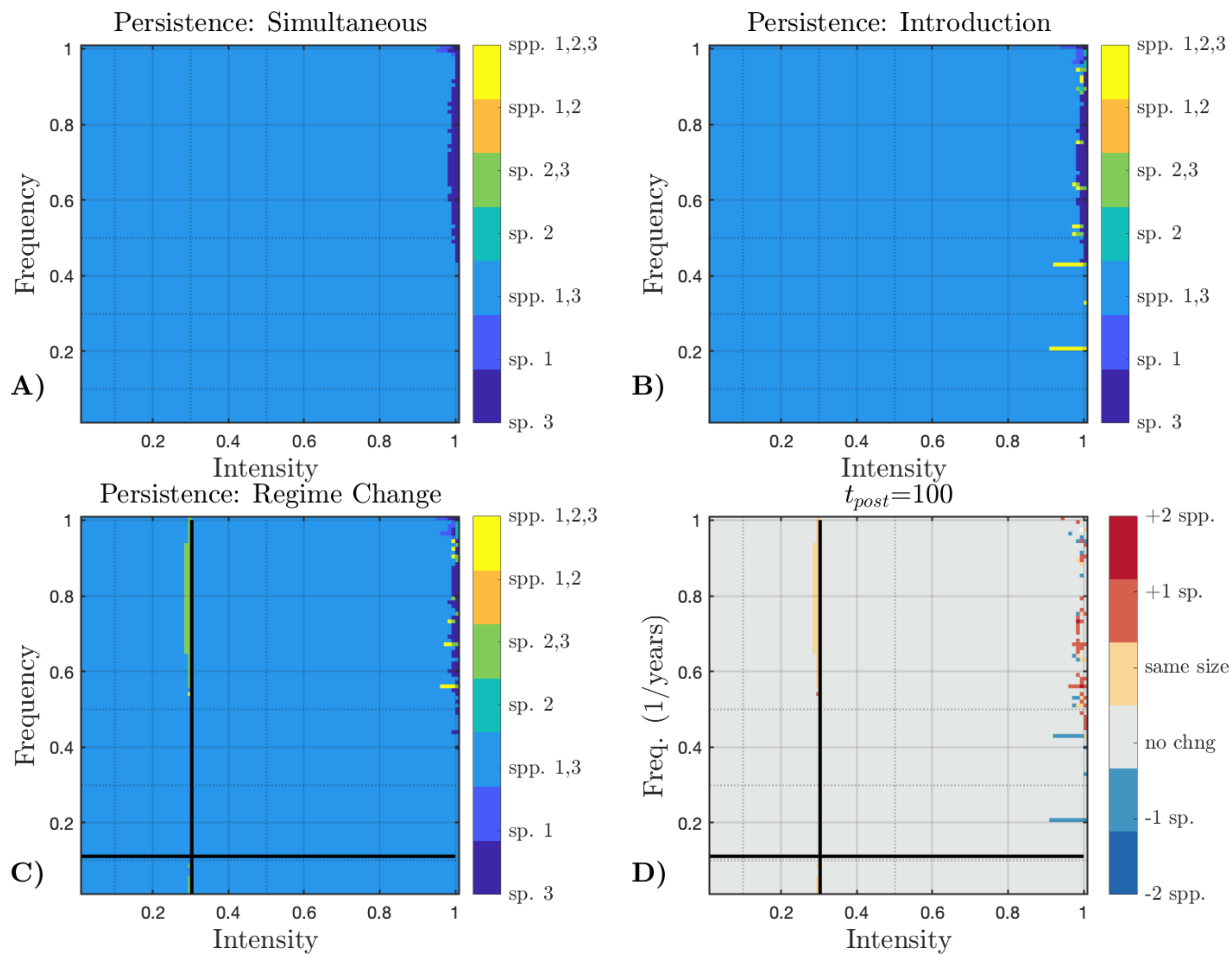
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (M)	1000	0.5	0.5	1	1.1	0.6
Sp. 2 (R)	1100	0.4	0.6	0.5	1	1.1
Sp. 3 (C, invader)	900	0.6	0.4	0.5	0.9	1

Fig. S6: Same results as Fig. 2 in main text, but with species C as the introduced species (here labeled 3).



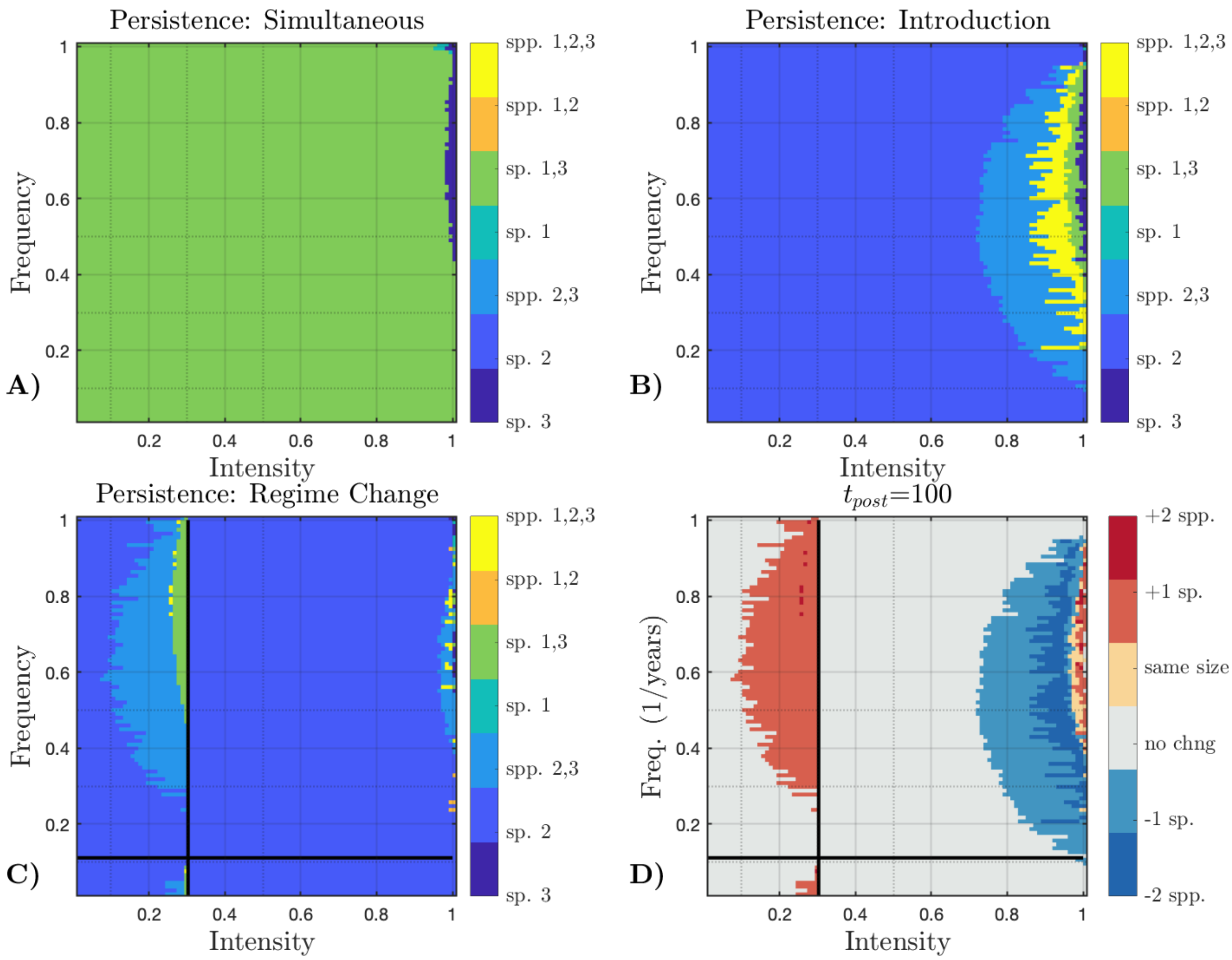
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1	1000	0.6	0.5	1	1.01	0.7
Sp. 2	2100	0.3	0.3	1.09	1	0.9
Sp. 3 (invader)	1000	0.3	0.7	0.7	0.8	1

Fig. S7: Results presented as in Fig. 2, for a different community. In this case there is a strong priority effect, evidenced by the large difference between Simultaneous and Introduction experiments. Note the extremely high seed yield of species 2.



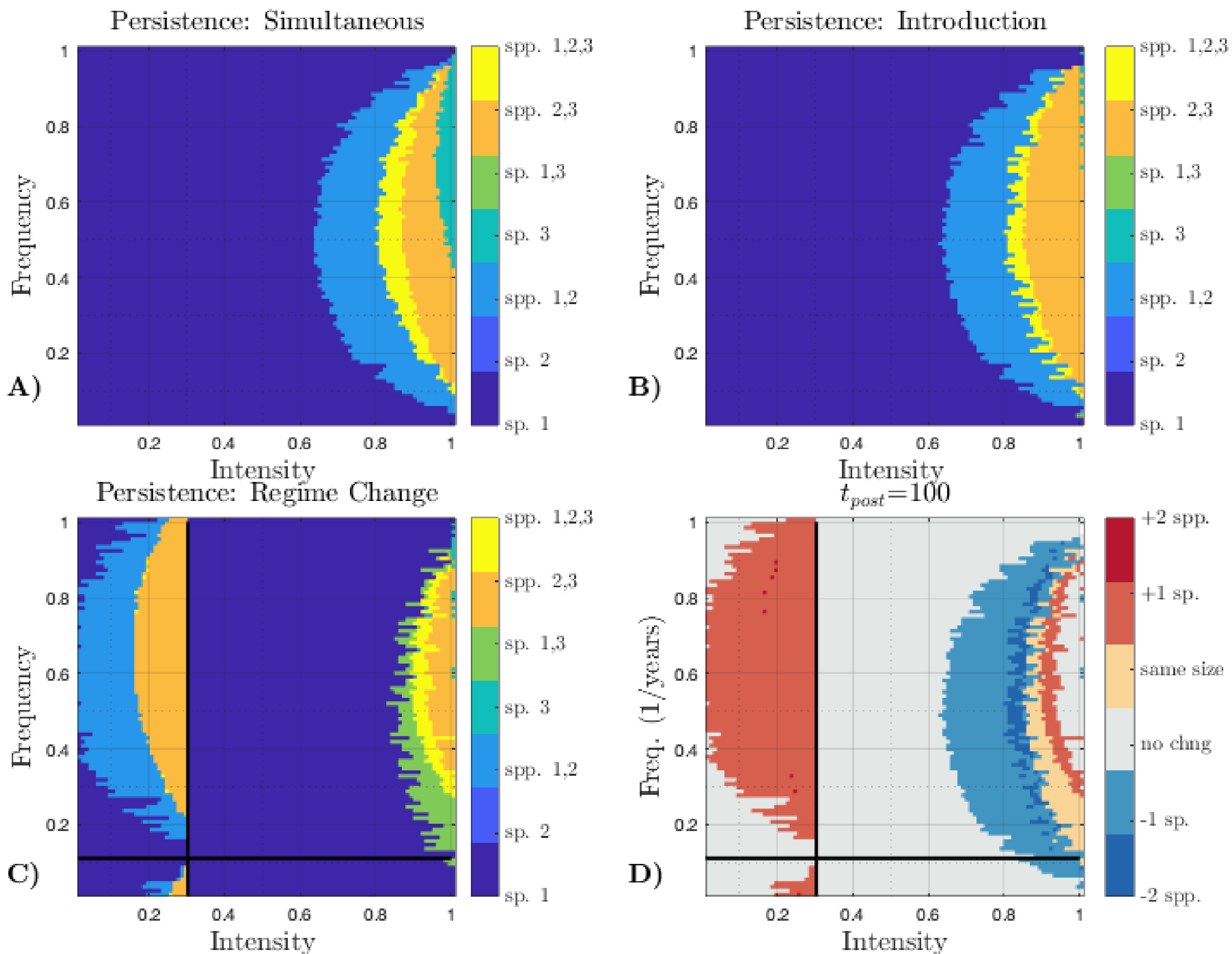
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1	1000	0.6	0.5	1	1.01	0.7
Sp. 2 (invader)	2100	0.3	0.3	1.09	1	0.9
Sp. 3	1000	0.3	0.7	0.7	0.8	1

Fig. S8: Same three-species community as above (Fig. S7), but here species 2 is the invader. In this scenario there is little difference between the community membership in any of the experimental treatments.



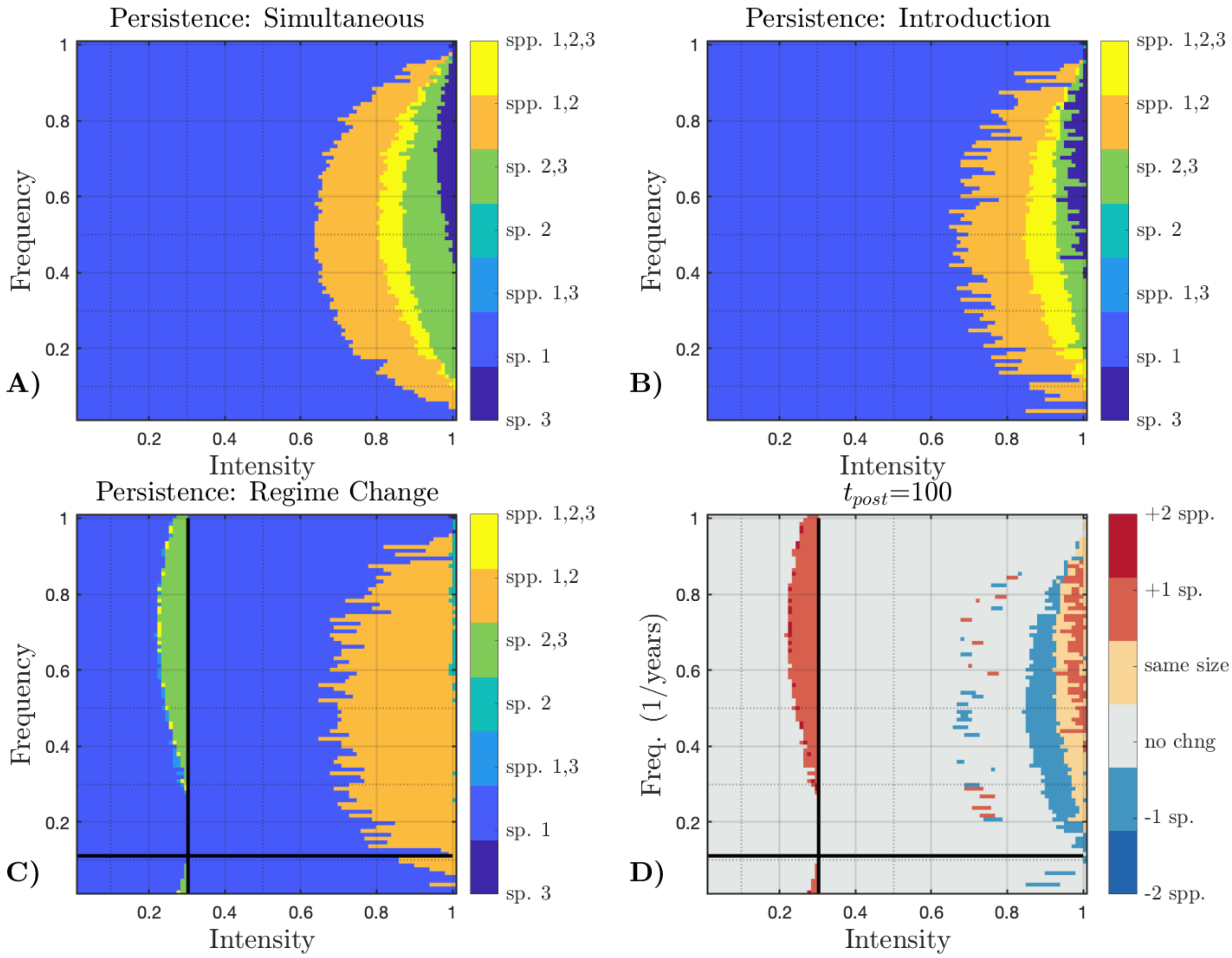
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (invader)	1000	0.6	0.5	1	1.01	0.7
Sp. 2	2100	0.3	0.3	1.09	1	0.9
Sp. 3	1000	0.3	0.7	0.7	0.8	1

Fig. S9: Same three-species community as above (Fig. S7), but here species 1 is the invader. Note the strong effect of history here and priority effects in this scenario (panel D), but not when either of the other species act as invader above (Figs. S7, S8).



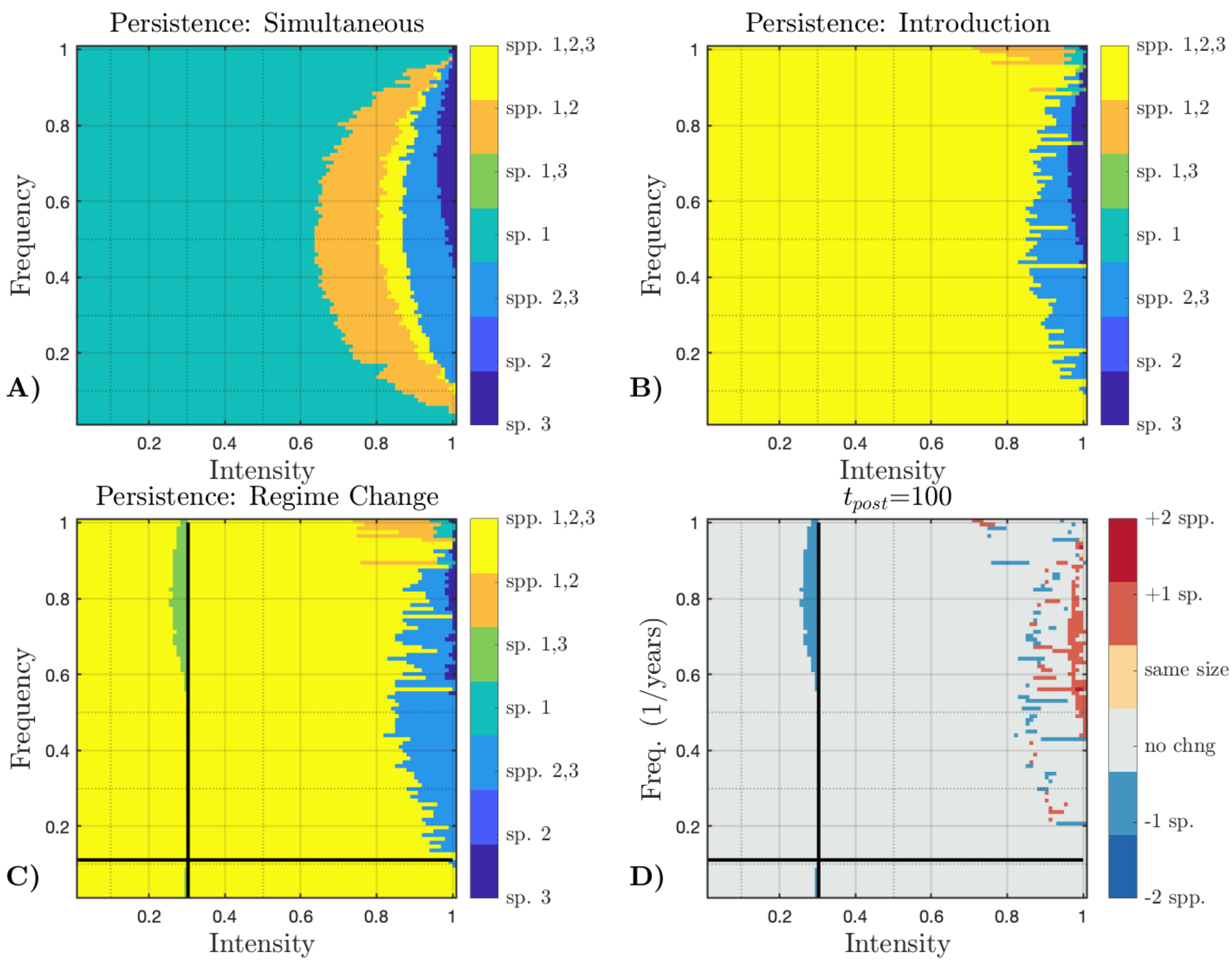
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1	2000	0.6	0.1	1	1.25	1.1
Sp. 2	1300	0.4	0.6	0.7	1	0.9
Sp. 3 (invader)	1000	0.3	0.8	0.8	0.8	1

Fig. S10: Results presented as in Fig. 2, for an additional distinct community. Note the rich interactions between disturbance regime and community membership, e.g. there are five distinct communities across the intensity range at high frequency in the Simultaneous experiment. Here, the reduction of disturbance tends to increase species richness (red, left of black line in panel D), while the increase can increase or decrease richness.



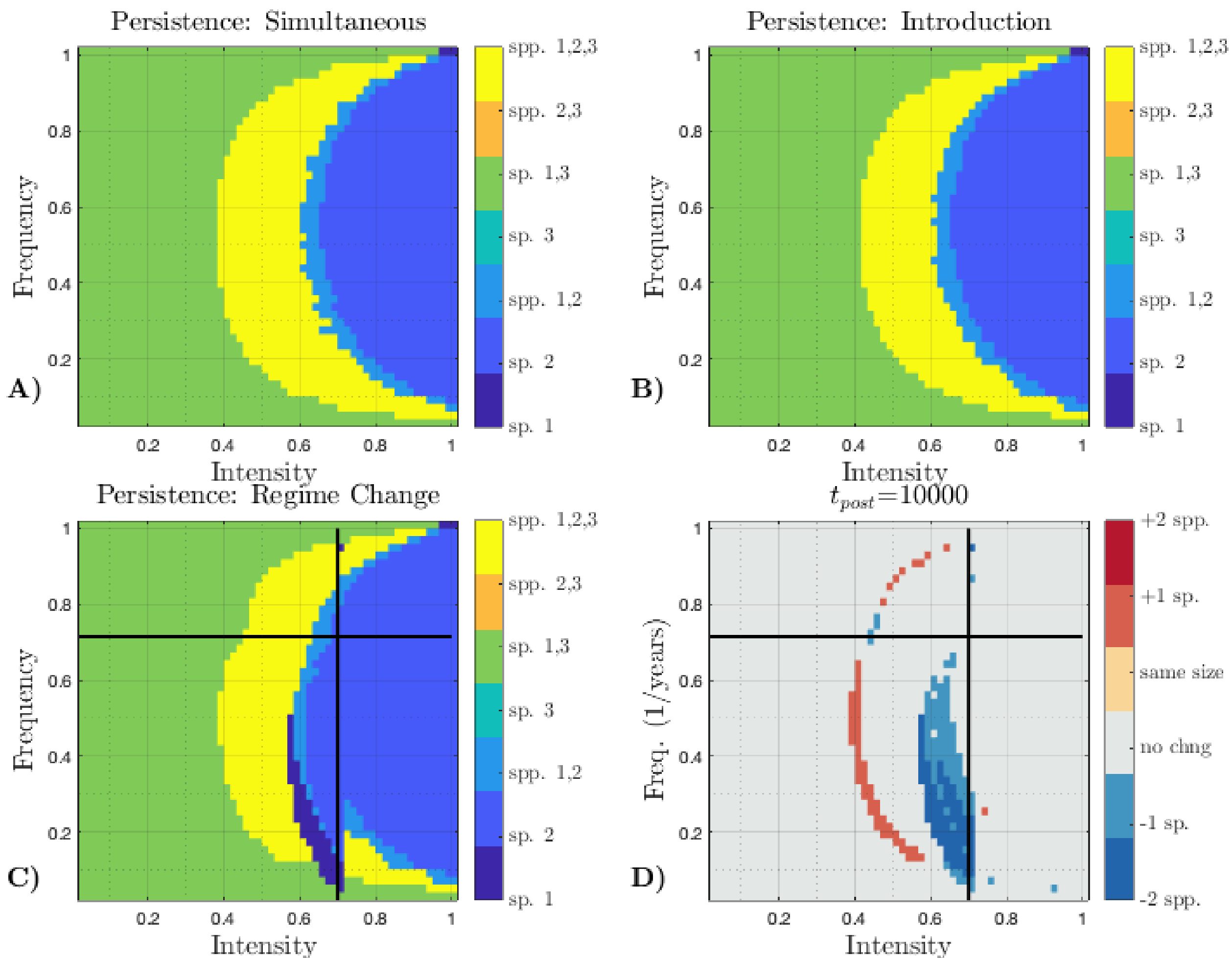
	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1	2000	0.6	0.1	1	1.25	1.1
Sp. 2 (invader)	1300	0.4	0.6	0.7	1	0.9
Sp. 3	1000	0.3	0.8	0.8	0.8	1

Fig. S11: Same three-species community as in Fig. S10 above, but here species 2 is the invader. This community has strong effects of historical regime change when either of two species is invader.



	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (invader)	2000	0.6	0.1	1	1.25	1.1
Sp. 2	1300	0.4	0.6	0.7	1	0.9
Sp. 3	1000	0.3	0.8	0.8	0.8	1

Fig. S12: Same three-species community as in Fig. S10 above, but here species 1 is the invader. Effects of history are present in a relatively small region of parameter space, but more notable that e.g. Figs. S7, S8.



	Yld	Germ.	surv.	$\alpha_{\cdot,1}$	$\alpha_{\cdot,2}$	$\alpha_{\cdot,3}$
Sp. 1 (C)	900	0.6	0.4	1	0.9	0.5
Sp. 2 (R)	1100	0.4	0.6	1.1	1	0.5
Sp. 3 (invader)	1000	0.5	0.3	0.6	1.1	1

Fig. S13: Results as in Fig. 2 in main text, with the same residents but different invader species 3. This example has a negative shift in regime $(I_0, F_0) \rightarrow (I_1 = I_0 - 0.3, F_1 = F_0 - 0.3)$, and times $(t_{pre}, t_{intm}, t_{post})$=(1000, 1000, 10000). This demonstrates a very long duration of effects of disturbance history on community composition, and that a short interim time is not necessary. Also note this long duration of disturbance legacy occurs with a short-lived invader species.

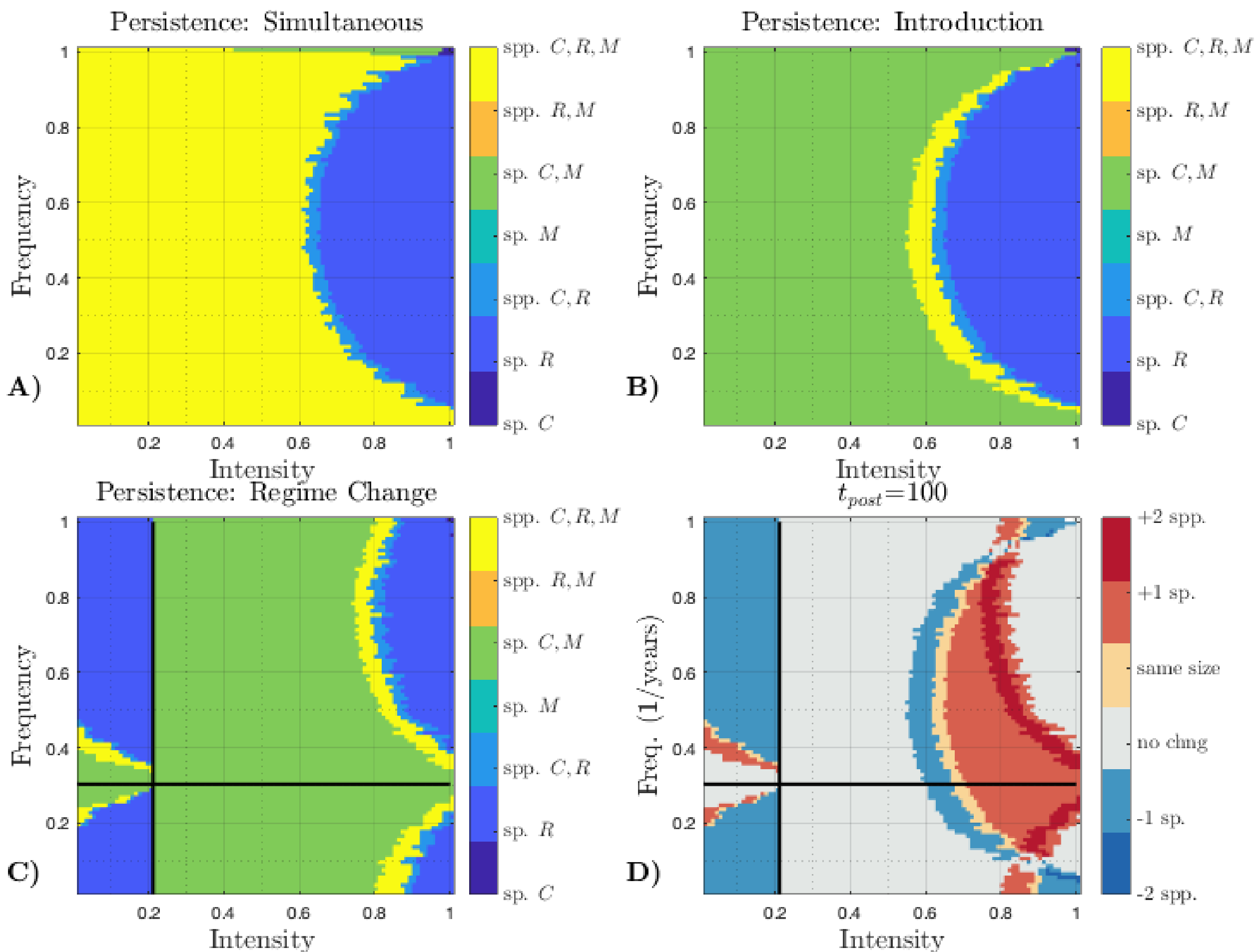


Fig. S14: All parameters as in Fig. 2 (main text), but with 1 seed introduced during invasion instead of 10.

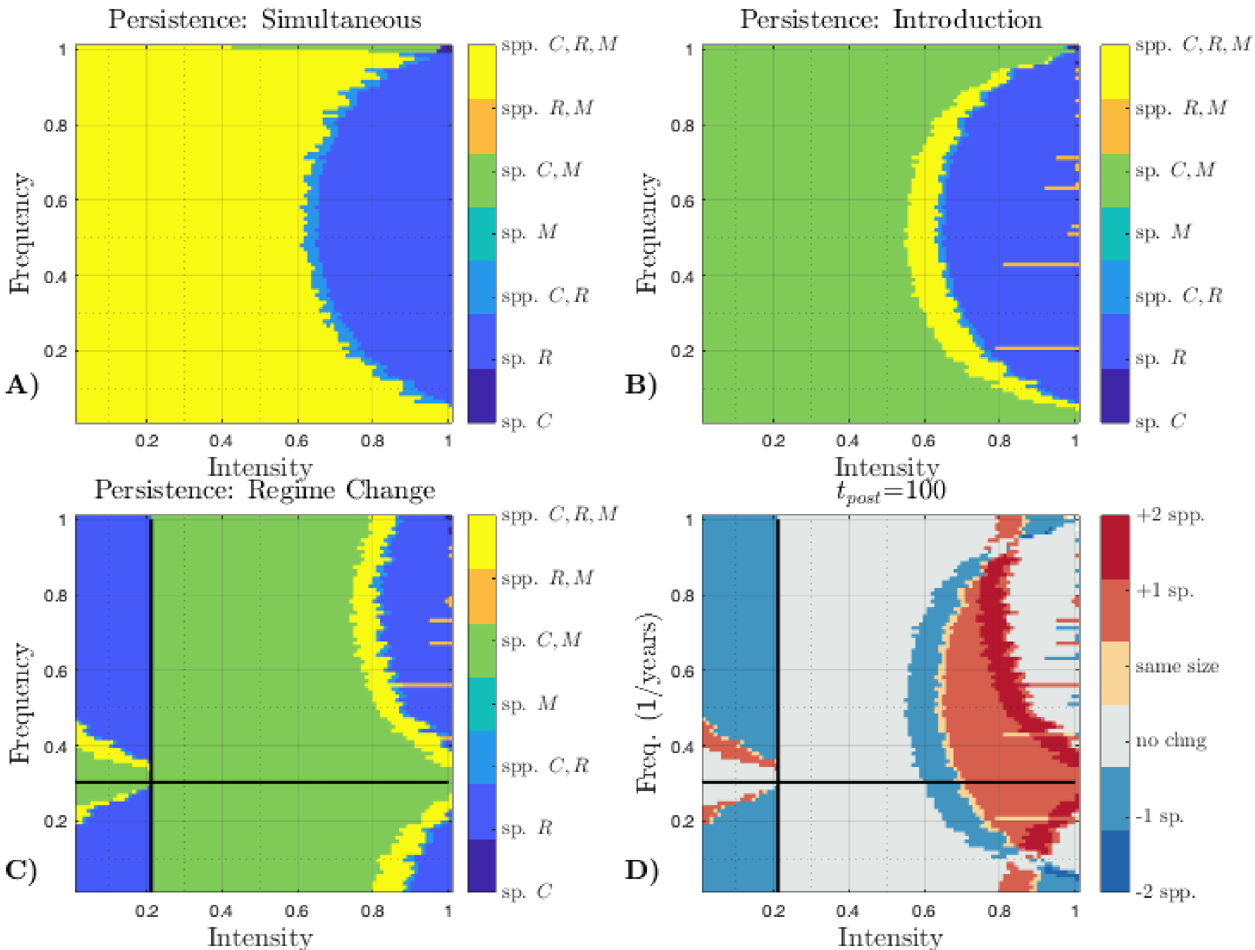


Fig. S15: All parameters as in Fig. 2 (main text), but with 100 seeds introduced instead of 10. Together with Fig. S14, this shows that our main-text results are qualitatively robust to a variation of two orders of magnitude in the number of seeds introduced during invasion.

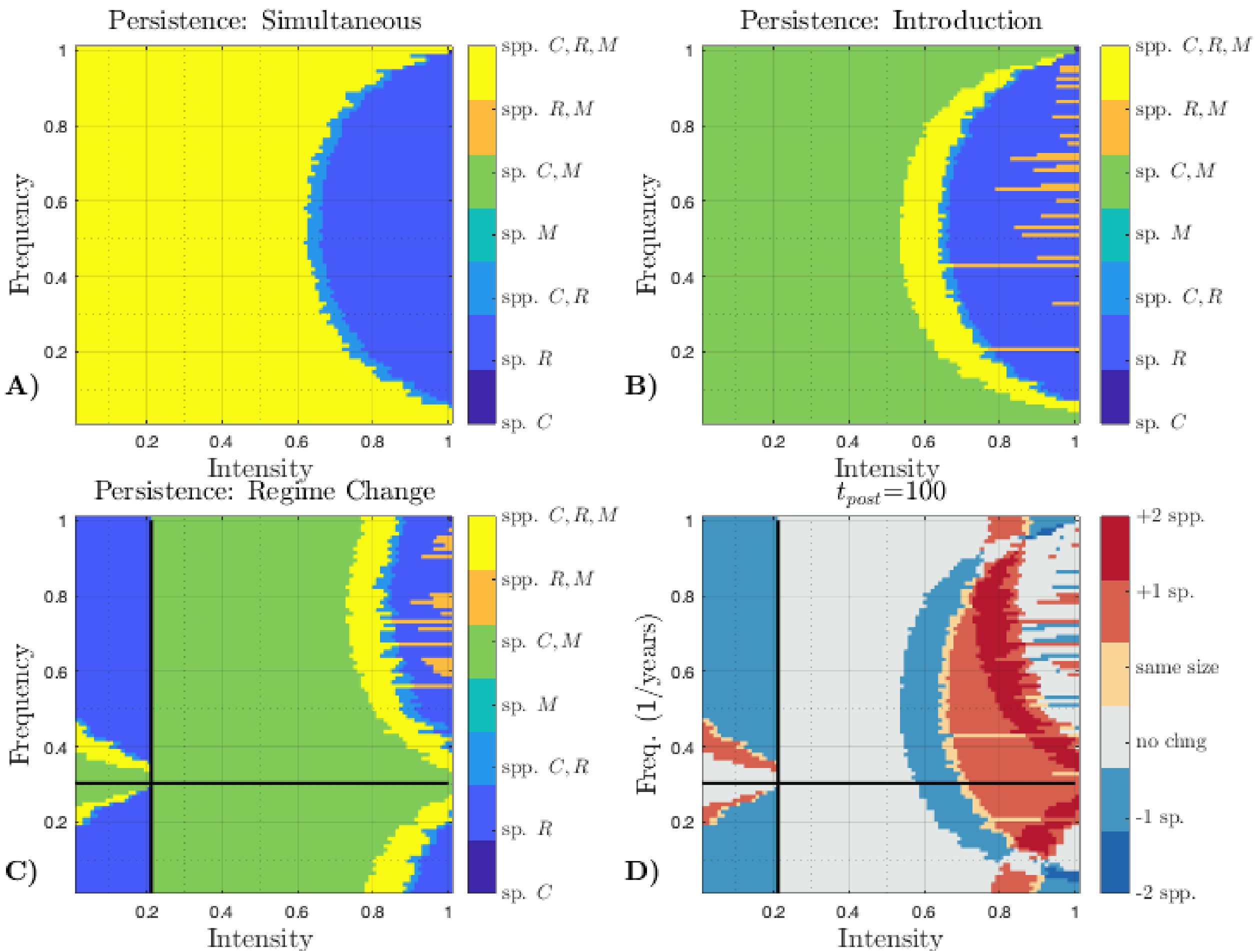


Fig. S16: All parameters as in Fig. 2 (main text), but with 2.5 seeds as the mean seed number for the threshold of species persistence (instead of 25).

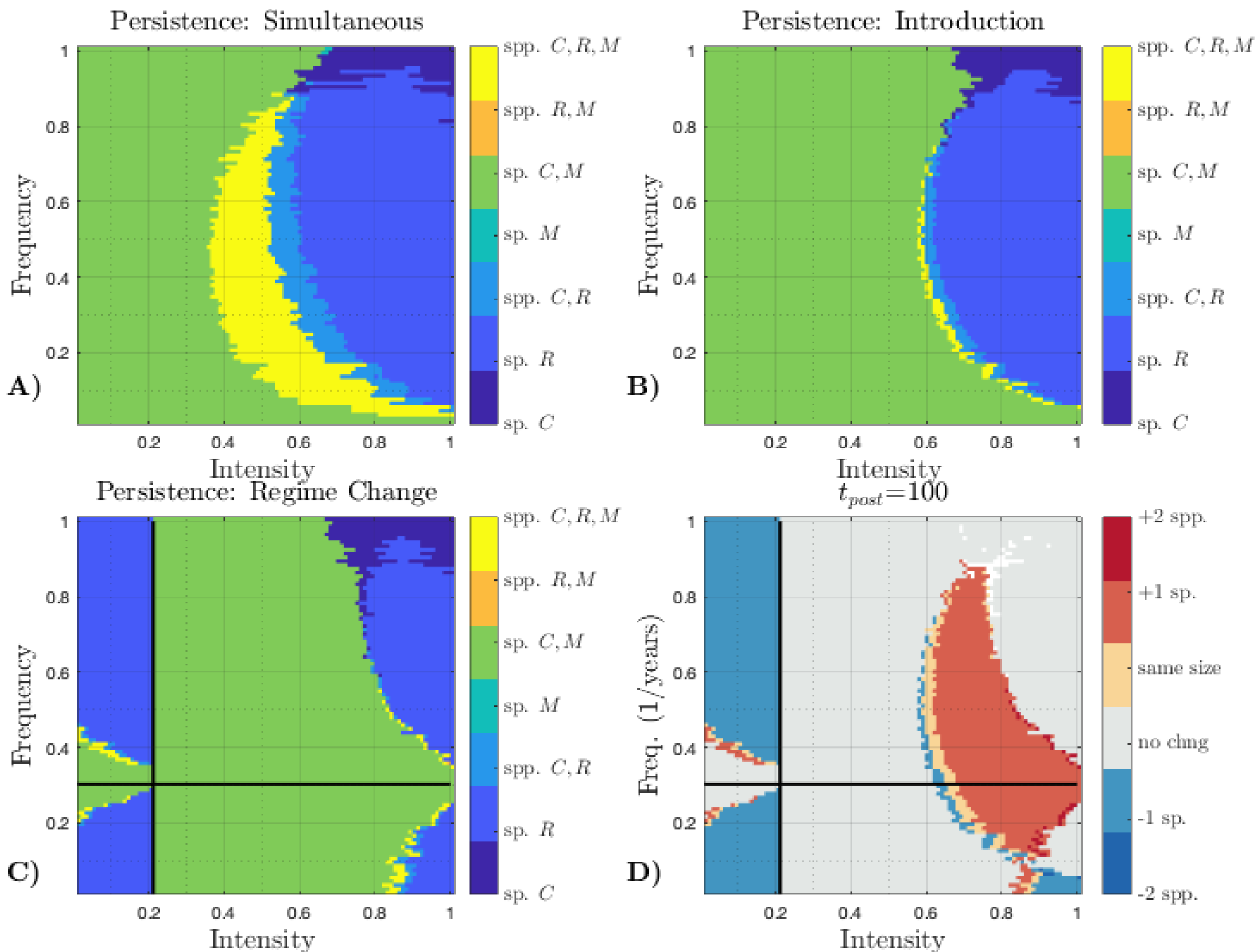


Fig. S17: All parameters as in Fig. 2 (main text), but with 250 seeds as the mean seed number for the threshold of species persistence (instead of 25). Together with Fig. S16, this shows that our main-text results are qualitatively robust to a variation of two orders of magnitude in the number of seeds considered as the threshold for species persistence.