

Electronic supplementary material for:

Castorani, M. C. N., Reed, D. C., Raimondi, P. T., Alberto, F., Bell, T. W., Cavanaugh, K. C., Siegel, D. A., & Simons, R. D. Fluctuations in population fecundity drive variation in demographic connectivity and metapopulation dynamics. *Proc. R. Soc. B Biol. Sci.* (doi:10.1098/rspb.2016.2086)

Appendix S2: Supplementary results

Uncertainty analysis for fecundity-biomass relationship. All results were extremely robust to the method of fecundity estimation (i.e., zero intercept vs. non-zero intercept generalized least squares linear regressions; see electronic supplementary material, appendix S1 and table S1). Moreover, all results were highly robust to uncertainty in the parameter used to estimate fecundity (i.e., the density of spore-bearing sorus tissue) from giant kelp canopy biomass density (see electronic supplementary material, appendix S1). Using a zero intercept model, the relationship was fit as *sorus area density* = $a \times \sqrt{\text{canopy biomass density}}$, where $a = 1463$ for the estimated parameter, $a = 1234$ for the lower bound of the 95% confidence interval (CI), and $a = 1895$ for upper bound of the 95% CI. Varying the value of a resulted in changes of AIC values less than 0.1 for all models, indicating no measureable difference in model fit. Similarly, for all models the estimates of coefficients and standard errors of fixed terms differed by less than 0.0001 and there was no measureable change in their significance by the Wald likelihood-ratio χ^2 test.

Uncertainty analysis for spore loss rate. For all tested values of the daily proportional spore loss rate ($\mu = 0.5$ to 0.99 d^{-1}), increases in the temporal complexity of fecundity and dispersal estimates were associated with improvements to model fit and increases in the standardized effect of connectivity on patch occupancy. In all cases, the temporal complexity of fecundity was more important than that of dispersal. When holding

the method of dispersal estimation constant, models with time-varying fecundity estimates fit the data much better (compare models 1–4 vs. 5–6 in electronic supplementary material, figure S1) and had 22–206% larger connectivity effect sizes than models with time-averaged fecundity estimates with or without occupancy data. On the other hand, when holding the method of fecundity estimation constant, models with time-varying dispersal estimates saw relatively modest improvements to fit (compare models 1 vs. 2, 3 vs. 4, and 5 vs. 6 in electronic supplementary material, figure S1) and no appreciable improvement in connectivity effect sizes (< 9%) compared to models with time-averaged dispersal estimates. Adding patch occupancy data to time-averaged fecundity estimates consistently improved model fit (compare models 1 vs. 3 and 2 vs. 4 in electronic supplementary material, figure S1) and increased connectivity effect sizes by 7–104%. For all values of μ , the best model used a connectivity measure with time-varying fecundity and dispersal (model 6; $\Delta_i > 2.2$; electronic supplementary material, figure S1). Applying this model across all values of μ , demographic connectivity, patch size, and occupancy in the prior semester were positively related to likelihoods of patch persistence and colonization (likelihood-ratio $\chi^2 > 85$, $p < 0.001$; electronic supplementary material, figure S2). Coefficients for all model terms were highly consistent across all values of μ (electronic supplementary material, figure S2).