The following supplement accompanies the article

Population biology of *Porites astreoides* and *Diploria strigosa* on a shallow Caribbean reef

Peter J. Edmunds*

Department of Biology, California State University, 18111 Nordhoff Street, Northridge, California 91330-8303, USA

*Email: peter.edmunds@csun.edu

Marine Ecology Progress Series 418:87–104 (2010)

Supplement. The study site, calculations serving to justify size classes, and transition probabilities in support of size-based matrix models of coral populations

Fig. S1. Map of study sites on the south coast of St. John, US Virgin Islands. Colonies of *Porites astreoides* were tagged and censused at Yawzi Point, Tektite and Cabritte Horn, and colonies of *Diploria strigosa* were tagged and censused at Yawzi Point and Tektite. Juvenile corals have been censused annually at 6 additional sites within this area since 1994 (see Edmunds 2000). *Virgin Islands Ecological Resource Station (VIERS). Dotted line marks the boundary of the Virgin Islands National Park

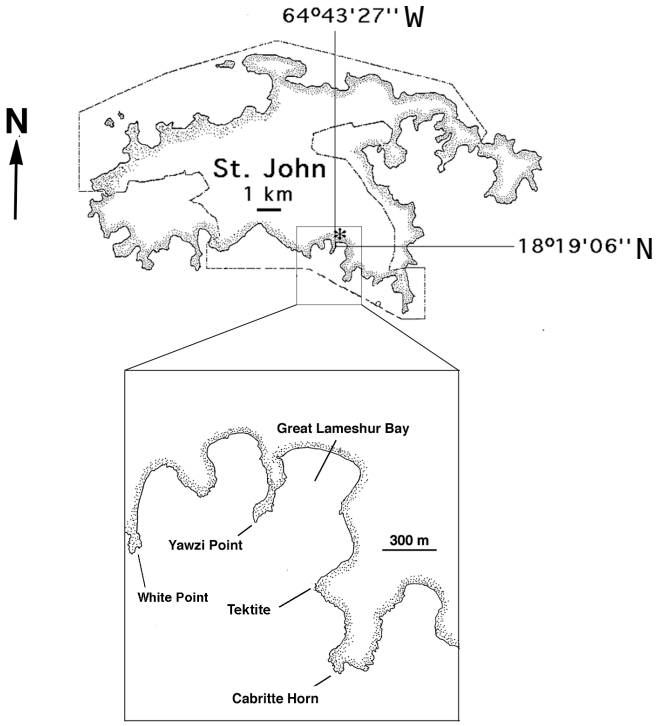

Fig. S2. Line plots displaying errors (ψ: left ordinate, φ: right ordinate) arising from variation in size classes used in size-based population matrices. Errors were calculated according to Vandermeer (1978) for size class I (top panels), II (middle panels) and III (lower panels) (≤40 mm, 41–80 mm and ≥81 mm, respectively), in the primary demographic analysis using data from 2004 to 2005, which was about half way through the study (sample sizes in Tables S1, S2). Note scales differ among panels. ψ describes the 'errors of estimation' that are inversely proportional to the width of the size class and caused by too few individuals in the size classes. φ describes 'errors of distribution' that arise from the distribution of individuals within the size class; individuals near the lower end of the size class have a reduced probability of transitioning out of the size class in one time interval, whereas those near the upper end of the size class have an elevated probability of transitioning out of the size class. ψ should decrease with increasing width of size classes, φ should increase with increasing width of size classes, and the intersection of the functions indicates the optimal size of each size class (after Vandermeer 1978). Although the behavior of the errors becomes erratic at small sample sizes for size classes II and III (as predicted, Vandermeer 1978), the analyses generally reveal optimized (i.e. low) errors for the width of the size classes chosen for the comparative demographic analyses of these species

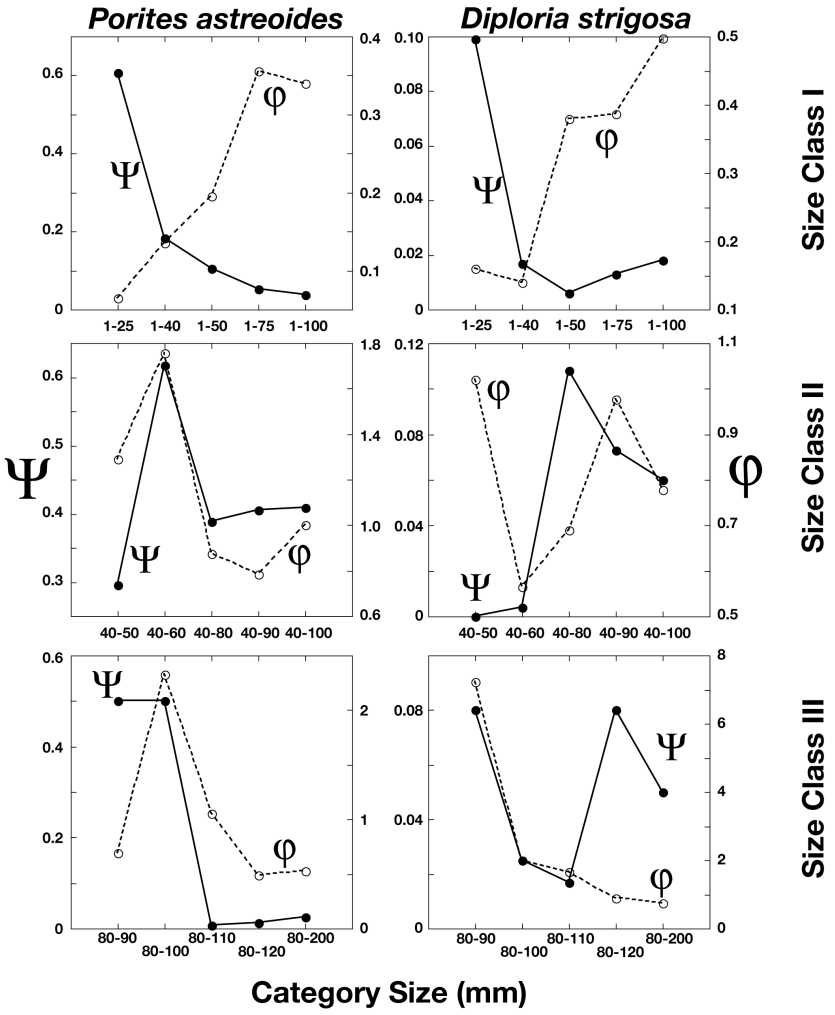

Fig. S3. Mean transition probabilities (± SE) for the size-based population matrices for (A) *Porites astreoides* (determined from 8 matrices for the years between 1999 and 2007, Table S1), and (B) *Diploria strigosa* (determined from 5 matrices for the years between 2002 and 2007, Table S2). Values display the probability of a colony transitioning from an initial size (abscissa) to a final size (categories) over 1 yr using the size classes I (≤40 mm), II (41–80 mm), and III (≥81 mm). Sample sizes (no. of colonies) for each year range from 89 to 259 (mean = 172) for *P. astreoides*, and from 91 to 122 (mean = 92) for *D. strigosa*

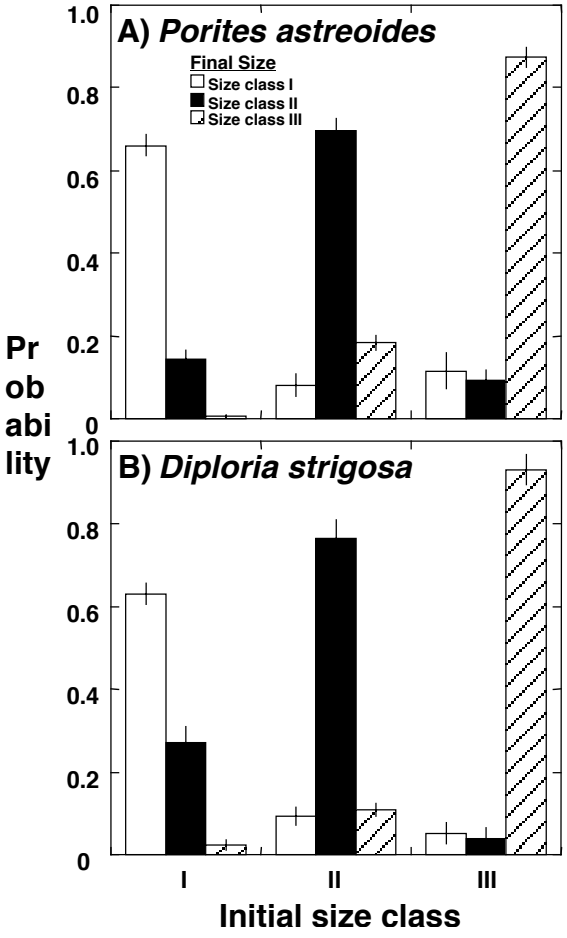

Table S1. Demographic characteristics of *Porites astreoides* on the reefs of St. John for annual intervals between 1999 and 2007. Transition probabilities for the 3 x 3 size-based matrices are shown for colonies in sizes classes I (≤40 mm diameter, which probably includes some congenerics as described in 'Materials and methods' in the main paper), II (41–80 mm) and III (≥81 mm), with the values listed by row for each of the nine cells (I,I = the probability of a coral starting the interval in size class I, and ending the interval in size class I, etc.). Mortality = proportion dying in each size class; matrix statistics refer to λ, the intrinsic rate of population change, and ρ, the damping ratio (λ and ρ were calculated from the transition probabilities for each interval); sample sizes (n) = the number of colonies censused for each size class over each interval. Shaded column displays values used in the 100 yr population projections (Fig. 5)

		Sampling Interval							
	Property	2006–07	2005–06	2004–05	2003–04	2002–03	2001–02	2000–01	1999–00
Transition probabilities	I,I	0.658	0.673	0.702	0.750	0.704	0.650	0.500	0.650
	I,II	0.126	0.093	0.119	0.086	0.157	0.150	0.265	0.175
	I,III	0.000	0.019	0.000	0.009	0.009	0.000	0.000	0.000
	II,I	0.140	0.000	0.152	0.196	0.043	0.114	0.000	0.000
	II,II	0.674	0.800	0.667	0.647	0.725	0.600	0.841	0.625
	II,III	0.163	0.143	0.182	0.196	0.159	0.171	0.159	0.300
	III,I	0.200	0.367	0.152	0.113	0.012	0.000	0.000	0.080
	III,II	0.089	0.122	0.174	0.032	0.049	0.029	0.195	0.060
	III,III	0.911	0.816	0.870	0.887	0.902	0.971	0.756	0.880
Mortality	I	0.225	0.224	0.190	0.164	0.139	0.200	0.235	0.175
	II	0.047	0.057	0.000	0.039	0.072	0.114	0.000	0.075
	III	0.000	0.020	0.000	0.016	0.037	0.000	0.049	0.020
Matrix statistics	λ	1.005	1.000	1.015	0.960	0.949	0.986	0.980	0.970
	ρ	1.500	1.550	1.455	1.269	1.254	1.315	1.587	1.638
Sample sizes (n)	I	111	107	77	115	115	18	23	36
	II	43	35	34	53	61	30	44	27
	III	45	49	52	61	83	41	52	67

Table S2. Demographic characteristics of *Diploria strigosa* on the reefs of St. John for annual intervals between 2002 and 2007. Transition probabilities for the 3 x 3 size-based matrices are shown for colonies in sizes classes I (≤40 mm diameter, which probably includes some congenerics as described in 'Materials and methods' in the main paper), II (41–80 mm) and III (≥81 mm), with the values listed by row for each of the nine cells (I,I = the probability of a coral starting the interval in size class I, and ending the interval in size class I, etc.). Mortality = proportion dying in each size class; matrix statistics refer to λ, the intrinsic rate of population change, and ρ, the damping ratio (λ and ρ were calculated from the transition probabilities for each interval); sample sizes (n) = the number of colonies censused for each size class over each interval. Shaded column displays values used in the 100 yr population projections (Fig. 5)

		Sampling Interval				
	Property	2006–07	2005–06	2004–05	2003–04	2002–03
Transition probabilities	I,I	0.647	0.636	0.696	0.541	0.635
	I,II	0.353	0.182	0.217	0.378	0.231
	I,III	0.059	0.045	0.000	0.000	0.019
	II,I	0.143	0.070	0.023	0.105	0.130
	II,II	0.857	0.674	0.860	0.658	0.783
	II,III	0.107	0.116	0.070	0.158	0.087
	III,I	0.038	0.000	0.095	0.125	0.000
	III,II	0.000	0.077	0.000	0.125	0.000
	III,III	1.000	0.885	0.952	0.813	1.000
Mortality	I	0.059	0.227	0.130	0.108	0.135
	II	0.000	0.140	0.047	0.079	0.022
	III	0.000	0.038	0.000	0.000	0.000
Matrix statistics	λ	1.058	0.931	0.994	0.976	0.999
	ρ	1.127	1.272	1.220	1.603	1.113
Sample sizes (n)	I	17	22	19	32	47
	II	28	43	48	42	52
	III	26	26	20	17	23

Table S3. Elasticity analyses for *Porites astreoides* and *Diploria strigosa* on the reefs of St. John between 1999 and 2007, and 2002 and 2007, respectively; *D. strigosa* were not tagged and censused before 2002. Elasticity matrices were calculated using the equation $e_{ij} = a_{ij}/\lambda \times \partial\lambda/\partial a_{ij}$ (where e_{ij} is the elasticity of the (i,j) entry of the size-based matrix, a_{ij} is the (i,j) transition probability in the matrix, and λ is population growth), and the values indicate which transitions (bold, as in Tables S1 & S2) had the greatest effect on population growth (λ). Data refer to size classes I (≤40 mm diameter), II (41–80 mm) and III (≥81 mm), for transitions from the start of the interval (columns) to the end of the interval (rows)

		Porites astreoides Size class			*Diploria strigosa* Size class		
Period	Size class	I	II	III	I	II	III
1999–2000	I	0.058	0.000	0.028			
	II	0.028	0.220	0.039			
	III	0.000	0.067	**0.657**			
2000–2001	I	0.000	0.000	0.000			
	II	0.000	0.530	0.087			
	III	0.000	0.087	**0.295**			
2001–2002	I	0.004	0.002	0.000			
	II	0.002	0.026	0.014			
	III	0.000	0.014	**0.937**			
2002–2003	I	0.032	0.006	0.006	0.000	0.000	0.000
	II	0.011	0.140	0.033	0.000	0.000	0.000
	III	0.001	0.038	**0.736**	0.000	0.000	**1.000**
2003–2004	I	0.163	0.167	0.029	0.088	0.105	0.038
	II	0.041	0.121	0.018	0.071	0.237	0.044
	III	0.005	0.042	**0.565**	0.000	0.082	**0.408**
2004–2005	I	0.084	0.017	0.021	0.074	0.004	0.028
	II	0.119	0.192	0.063	0.032	0.203	0.000
	III	0.000	0.084	**0.502**	0.000	0.028	**0.632**
2005–2006	I	0.094	0.000	0.046	0.024	0.011	0.000
	II	0.036	0.309	0.042	0.008	0.123	0.039
	III	0.010	0.077	**0.387**	0.003	0.036	**0.756**
2006–2007	I	0.074	0.011	0.028	0.109	0.042	0.027
	II	0.039	0.149	0.034	0.062	0.268	0.000
	III	0.000	0.062	**0.602**	0.007	0.021	**0.464**

Table S4. Population structure for *Porites astreoides* and *Diploria strigosa* in 100 m^2 of reef at the end of 100 yr projections. The projections began with the 2007 population vectors, which for *P. astreoides* consisted of 113 colonies in size class I (≤40 mm), 81 in size class II (41–80 mm), and 56 in size class III (≥81 mm), and for *D. strigosa* consisted of 17 colonies in size class I, 33 in size class II, and 50 in size class III. Results are shown for the number of colonies in each size class, as well as the percentage cover under scenarios A–C (described in 'Materials and methods. Population projections' in the main paper, Fig. 5); 95% CI in parentheses. The CI were generated from the transition matrices corresponding to the λ values at the 2.5^{th} and 97.5^{th} percentiles of the 1000 λ values derived by bootstrap resampling. Population growth was limited by attainment of 100% cover in <100 yr in all cases

Scenario	Features	*Porites astreoides*	*Diploria strigosa*
Scenario A	I	10208 (2533–11509)	7929 (61–17418)
	II	6556 (1122–5787)	13901 (77–10975)
	III	10458 (495–17816)	33095 (2184–33524)
	Cover %	100 (<2–100)	100 (<1–100)
Scenario B	I	4451(2075–11333)	2555 (51–17161)
	II	2509 (834–5649)	4465 (58–10810)
	III	3619 (295–17527)	10499 (679–33038)
	Cover %	37 (<2–100)	100 (<1–100)
Scenario C	I	1122 (253–10662)	5787 (6–17993)
	II	728 (112–5361)	10146 (8–11337)
	III	1171 (50–18548)	24420 (315–34794)
	Cover %	12 (<1–100)	100 (<1–100)