Spatial variability in recruitment of acroporid corals and predatory starfish along the Onna coast, Okinawa, Japan

Masako Nakamura*, Naoki H. Kumagai, Kazuhiko Sakai, Ken Okaji, Kei Ogasawara, Satoshi Mitarai

*Corresponding author: mnakamura@tsc.u-tokai.ac.jp

Ranking of site-grouping subsets

For each model, subset grouping sites, among which coral/*A. planci* density did not differ, were ranked using a paired-comparisons information-criterion approach (PCIC; Dayton 2003). To rank the subsets, Akaike information criteria (AIC), ΔAIC and Akaike weights (W_i) were used (Burnham & Anderson 2002). Generally, a value for ΔAIC larger than 2 is taken to be substantial. W_i of a model is used as a measure of the strength of the model among candidate models, and indicates the probability that the model is the best actual model. PCIC is analogous to multiple comparison tests using p-values, but unlike multiple comparison tests, the statistical power of PCIC does not decrease with the number of comparisons. These analyses were conducted with 'dredge' in the package, MuMIn, in the free statistical software, R (R Development Core Team 2014).

Table S1. Ranking of site-grouping subsets (S1 – S7) for the acroporid recruitment model. Sites sharing the same letter (A – G) do not differ in acroporid recruitment density. The best fitted subset is shown in bold face. Subsets within ΔAIC < 2 and the null subset, for which no site differed, are shown. Subsets were ranked by the Akaike model weight (W_i).

Ranking	S1	S2	S3	S4	S5	S6	S7	n.groups	AIC	ΔAIC	W_i
1	**A**	**B**	**C**	**D**	**E**	**E**	**F**	**6**	**2295**	**0**	**0.730**
2	A	B	C	D	E	F	G	7	2297	1.99	0.269
872	A	A	A	A	A	A	A	1	3615	1320	0.000

Table S2. Ranking of sites-grouping subset for crown-of-thorns starfish recruitment model. Sites sharing the same letter (A – D) do not differ in the recruitment density of crown-of-thorns. The best fitted subset is shown in bold face. Subsets within ΔAIC < 2 and the null subset, for which no site differed, are shown. Subsets were ranked by the Akaike model weight (W_i).

Ranking	S1	S2	S3	S4	S5	S6	S7	n.groups	AIC	ΔAIC	w
1	**A**	**B**	**B**	**C**	**C**	**C**	**B**	**3**	**100.7**	**0**	**0.02399**
2	A	A	A	B	B	B	A	2	101.1	0.3951	0.01969
3	A	A	A	B	B	B	B	2	101.2	0.524	0.01846
4	A	B	B	C	C	C	C	3	101.5	0.8561	0.01564
5	A	A	A	B	B	B	C	3	101.8	1.148	0.01352
6	A	B	A	C	C	C	B	3	102	1.277	0.01267
7	A	A	B	C	C	C	B	3	102	1.277	0.01267
8	A	B	B	C	C	C	D	4	102.2	1.48	0.01145
9	A	B	C	D	D	D	B	4	102.5	1.857	0.009482
10	A	B	C	D	D	D	C	4	102.5	1.857	0.009482
11	A	A	A	B	C	B	C	3	102.7	1.99	0.008868
384	A	A	A	A	A	A	A	1	108.3	7.668	0.0005186

Table S3. Ranking of site-grouing subsets for the acroporid abundance model. Sites sharing the same letter (A – F) do not differ in the abundance of acroporids. The best fitted subset is shown in bold face. Subsets within ΔAIC < 2 and the null subset, for which no site differed, are shown. Subsets were ranked by the Akaike model weight (W_i).

Ranking	S1	S2	S3	S4	S5	S6	S7	n.groups	AIC	ΔAIC	W_i
1	**A**	**B**	**C**	**D**	**E**	**B**	**D**	**5**	**1225**	**0**	**0.399**
2	A	B	C	D	E	B	F	6	1226	0.89	0.256
3	A	B	C	D	E	F	D	6	1227	1.90	0.155
853	A	A	A	A	A	A	A	1	1544	318.20	0.000

Table S4. Ranking of site-grouping subsets for the crown-of-thorns abundance model. Sites sharing the same letter (A – F) do not differ in the abundance of crown-of-thorns. The best fitted subset is shown in bold face. Subsets within ΔAIC < 2 and the null subset, for which no site differed, are shown. Subsets were ranked by the Akaike model weight (W_i).

Ranking	S1	S2	S3	S4	S5	S6	S7	n.groups	AIC	ΔAIC	W_i
1	**A**	**B**	**C**	**D**	**B**	**E**	**B**	**5**	**77.58**	**0**	**0.154**
2	A	B	C	D	E	F	B	6	78.55	0.97	0.095
3	A	B	C	D	A	E	B	5	78.57	0.99	0.094
4	A	B	C	D	B	E	F	6	78.61	1.03	0.092
836	A	A	A	A	A	A	A	1	170.1	92.49	0.000

Descriptions for trajectories of drifters

Among five drifters released on July 4th in 2013 (Fig. 7a), four (A to D) drifted offshore, or followed the coastline northeastward. The fifth was beached within three days of release (E, from the northernmost site). One of the remaining four was beached within 7 days (D). The other three drifted more than 30 days to the open ocean. They traveled 700 to 800 km in 30 days.

Three drifters released on July 23rd in 2013 (A, D, E; Fig. 7b) beached within three days of their release. The other one (B) beached along the coast after seven days, having traveled very little; therefore, we did not plot its course (Fig.7b).

Four drifters released from sites B to E on August 23rd in 2013, drifted northeastward along the coast (Fig. 7c). Two (D, E) beached within 7 days. The other two drifted to the open ocean (B, C). The signal from C was lost after 14 days and the other (B) beached within 30 days on the east coast of Okinawa Island. A fifth drifter released from the southernmost site (A), went to the open ocean and drifted northward more than 30 days (Fig 7c). This drifter traveled more than 900 km in 30 days.

One drifter released from the northernmost site on June 30th in 2014 followed the coastline and beached within 3 days (E, Fig. 7d). The one released from the southernmost site (A) followed the coastline northeastward, and then turned northwest. This beached on the Motobu peninsula within 7 days. Three other drifters drifted offshore after release, and then

went northeastward after passing the Motobu Peninsula. One of them (B) beached within 14 days on the east coast of Iheya Island, and the two others continued to the open ocean. Interestingly, one (D) went to mainland Japan, passing the south end of Kyushu Island and the south coast of Shikoku Island. This traveled 1358 km in 30 days and 2275 km altogether after just 42 days. Unexpectedly, the third (C) turned back southward in the offshore area of Okinawa Island, passing among the Kerama Islands, and travelling south of Okinawa Island.

All drifters released on July 12, 2014 followed the coastline northeastward, and then turned northwestward within 3 days (Fig. 7e). Two of them (B, C) beached during this time; B on the Motobu peninsula and C on Sesoko Island. Within 7 days, one other drifter beached (E). Two others went northeastward, and then turned to the east coast. The one beached within 14 days on the northeast end of Okinawa Island (A) and the other one went southeastward to the open ocean (D). This one traveled 517 km in 30 days.

LITERATURE CITED

Burnham KP, Anderson DR (2002) Model selection and multimodel inference: a practical information-theoretic approach. Springer Science & Business Media, New York, NY

Dayton CM (2003) Information criteria for pairwise comparisons. Psychol Methods 8:61–71

R Development Core Team (2014) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, www.R-project.org