

Supporting Information. Souza, J. A., and A. Flores. 2021. Abundance and active patch selection modulate reproductive connectivity and fitness of pea crabs living on sand dollars.

Supplementary Tables

Table S1. Spatial distribution estimates for each site based on the average nearest neighbor distance for all sand dollar patches and for only occupied patches. *N*: number of sand dollars; *p*: number of sand dollar/m²; *L*: perimeter; *A*: total area; *R_o*: observed average nearest neighbor distance; *R_e*: expected average nearest neighbor distance; *R_{ec}*: corrected *R_e* for the absence of boundary strips; *S_R*: standard error; *Z*: distribution estimates.

	Armação N		Armação S		Barreiros		B. Velha N		B. Velha S		Araçá		Praia Preta		Saco Grande		Praia Grande	
	All	Occ.	All	Occ.	All	Occ.	All	Occ.	All	Occ.	All	Occ.	All	Occ.	All	Occ.	All	Occ.
N	411	142	466	75	63	29	391	23	297	35	124	73	102	39	94	34	115	63
P	1.827	0.631	2.071	0.333	0.280	0.129	1.738	0.102	1.320	0.156	0.551	0.324	0.453	0.173	0.418	0.151	0.511	0.280
L	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
A	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225
<i>R_o</i>	0.349	0.371	0.363	0.379	0.985	1.101	0.398	0.480	0.426	0.481	0.606	0.650	0.722	0.812	0.848	0.935	0.748	0.777
<i>R_e</i>	0.378	0.652	0.354	0.911	0.998	1.514	0.387	1.719	0.446	1.367	0.700	0.924	0.775	1.290	0.809	1.389	0.728	0.998
<i>R_{ec}</i>	0.370	0.629	0.347	0.866	0.945	1.393	0.379	1.564	0.435	1.268	0.674	0.878	0.743	1.201	0.774	1.286	0.699	0.945
<i>R_e/R_o</i>	1.083	1.760	0.976	2.403	1.014	1.376	0.974	3.579	1.048	2.843	1.155	1.422	1.073	1.588	0.954	1.485	0.973	1.284
<i>S_{RC}</i>	0.010	0.030	0.009	0.059	0.071	0.161	0.011	0.207	0.014	0.132	0.035	0.061	0.043	0.118	0.047	0.136	0.038	0.071
<i>Z</i>	-2.847	-9.286	0.970	-9.007	-0.188	-2.560	0.983	-5.981	-1.432	-6.708	-2.683	-4.512	-1.236	-4.055	0.841	-3.329	0.538	-3.118
<i>P</i>	0.002	0.000	0.166	0.000	0.426	0.005	0.163	0.000	0.076	0.000	0.004	0.000	0.108	0.000	0.200	0.000	0.295	0.001

Table S2. Dependent and independent variables used in stepwise backward multiple regression analyses to test overall relationships of host and crab population parameters on connectivity and its effects on individual fitness. $(R_e/R_o)_{occ}$: aggregation index of occupied sand dollars; Z_{Cocc} : reproductive connectivity of occupied sand dollars; b_f : effects of female connectivity, as their access to searching males, on individual fitness.

Site	Dependent variables			Independent variables				
	$(R_e/R_o)_{occ}$	Z_{Cocc}	b_f	Host abundance	Occupancy ratio	Crab abundance	Prop. females	N.crabs/sand-dollar
Armação North	1.760	2.068	-20.41	124	0.59	183	0.51	0.445
Armação South	2.403	0.422	6.30	466	0.16	84	0.30	0.180
Barreiros	1.376	-0.905	7.55	411	0.35	39	0.59	0.619
Barra Velha North	3.579	-0.877	12.12	297	0.12	25	0.64	0.064
Barra Velha South	2.843	-0.454	-0.60	391	0.06	42	0.57	0.146
Araçá	1.422	0.376	5.63	63	0.46	103	0.33	0.831
Praia Preta	1.588	-0.453	-5.80	115	0.55	47	0.51	0.461
Saco Grande	1.485	-0.922	1.53	102	0.38	41	0.41	0.436
Praia Grande	1.284	0.746	8.28	94	0.36	84	0.39	0.750
Average	1.971	0.493	1.62	229.2	0.34	72.0	0.47	0.437

Table S3. Summary statistics for size vs. fecundity relationships at all sampling sites. *F*: fecundity (= number of eggs); CW: carapace width.

Site	<i>fecundity</i> = $a \times (\text{body size})^b$	R^2	p
Armação North	$F = 3.45 \times (CW)^{2.7}$	0.38	< 0.0001
Armação South	$F = 34.5 \times (CW)^{1.2}$	0.16	0.14
Barreiros	$F = 3.12 \times (CW)^{2.5}$	0.67	< 0.0001
Barra Velha North	$F = 26.06 \times (CW)^{1.6}$	0.65	0.004
Barra Velha South	$F = 3.29 \times (CW)^{2.7}$	0.88	< 0.0001
Araçá	$F = 13.18 \times (CW)^{1.8}$	0.35	0.001
Praia Preta	$F = 6.15 \times (CW)^{2.3}$	0.71	0.004
Saco Grande	$F = 5.79 \times (CW)^{2.8}$	0.88	0.0003
Praia Grande	$F = 0.84 \times (CW)^{3.3}$	0.56	< 0.0001

Table S4. Summary statistics of linear relationships between female connectivity (as the potential for interactions with searching males) and fitness (as percent departure from expected egg production). *Ft*: fitness; *C*: connectivity.

Site	$fitness = a + b_f \times (connectivity)$	R^2	p
Armação North	$Ft = -0.89 - 20.41 \times C$	0.23	0.01
Armação South	$Ft = 0.03 + 6.30 \times C$	0.33	0.23
Barreiros	$Ft = -0.83 + 7.55 \times C$	0.17	0.15
Barra Velha North	$Ft = -1.14 + 12.12 \times C$	0.54	0.01
Barra Velha South	$Ft = -0.66 - 0.60 \times C$	0.00	0.87
Araçá	$Ft = -0.07 + 5.63 \times C$	0.10	0.10
Praia Preta	$Ft = -0.18 - 5.80 \times C$	0.06	0.36
Saco Grande	$Ft = 0.05 + 1.53 \times C$	0.01	0.76
Praia Grande	$Ft = -0.39 + 8.28 \times C$	0.10	0.20

Supplementary Figures

Fig. S1. Distribution maps of sand dollars (*Encope emarginata*), with and without pea crabs (*Dissodactylus crinitichelis*), in 15 X15 m surveyed areas at study sites. M: males, F: females, N: empty.

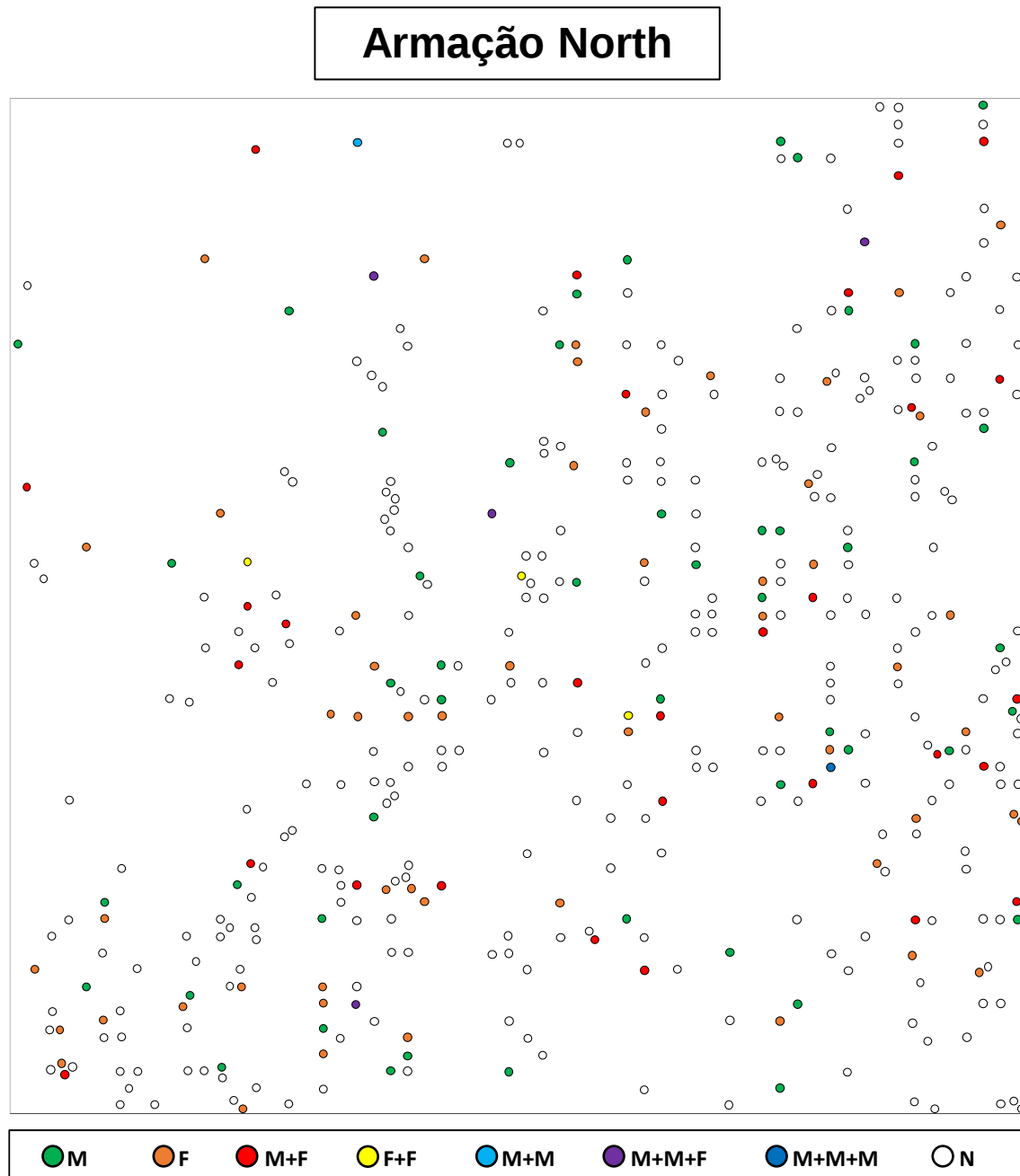


Fig. S1. Continued.

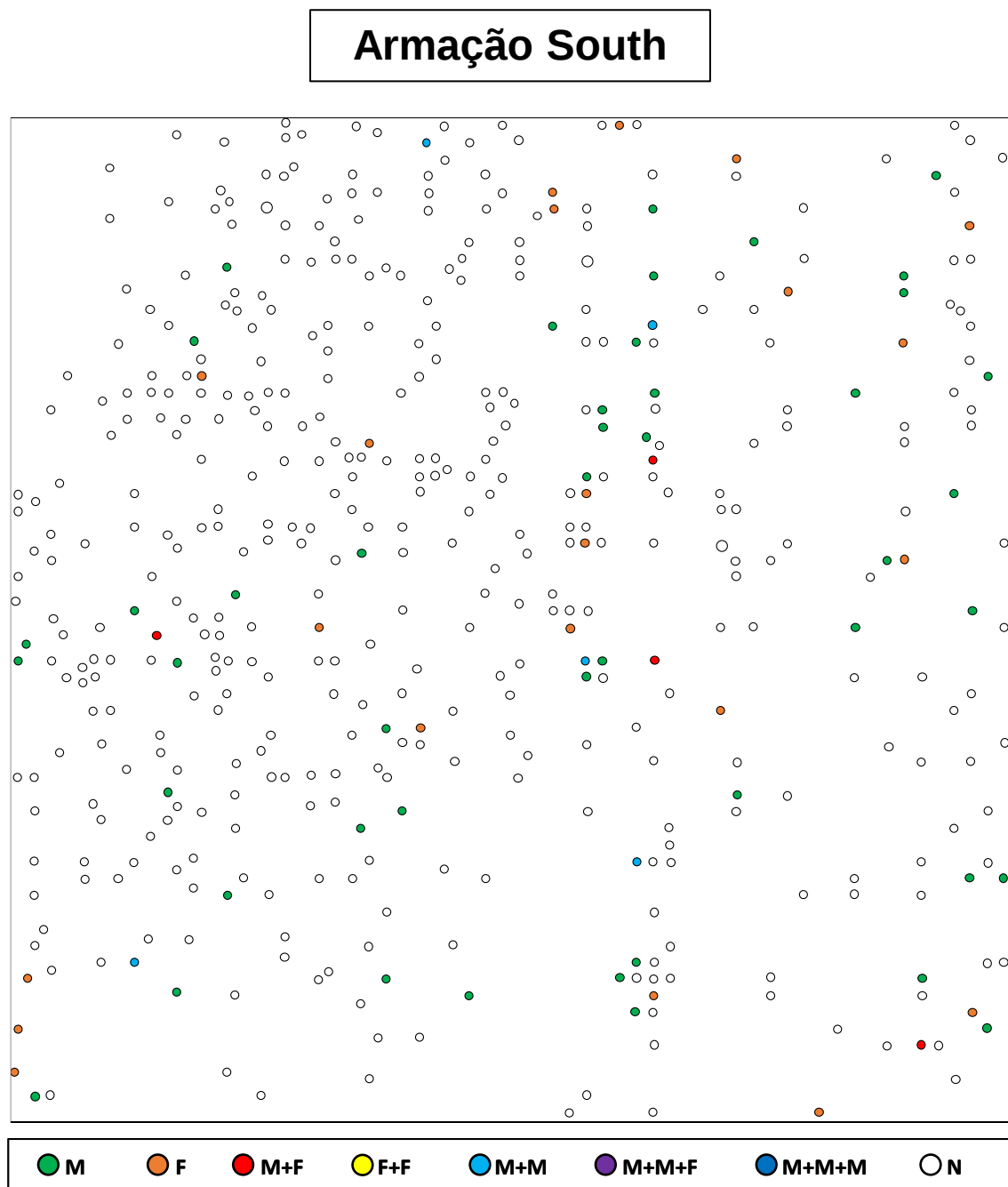


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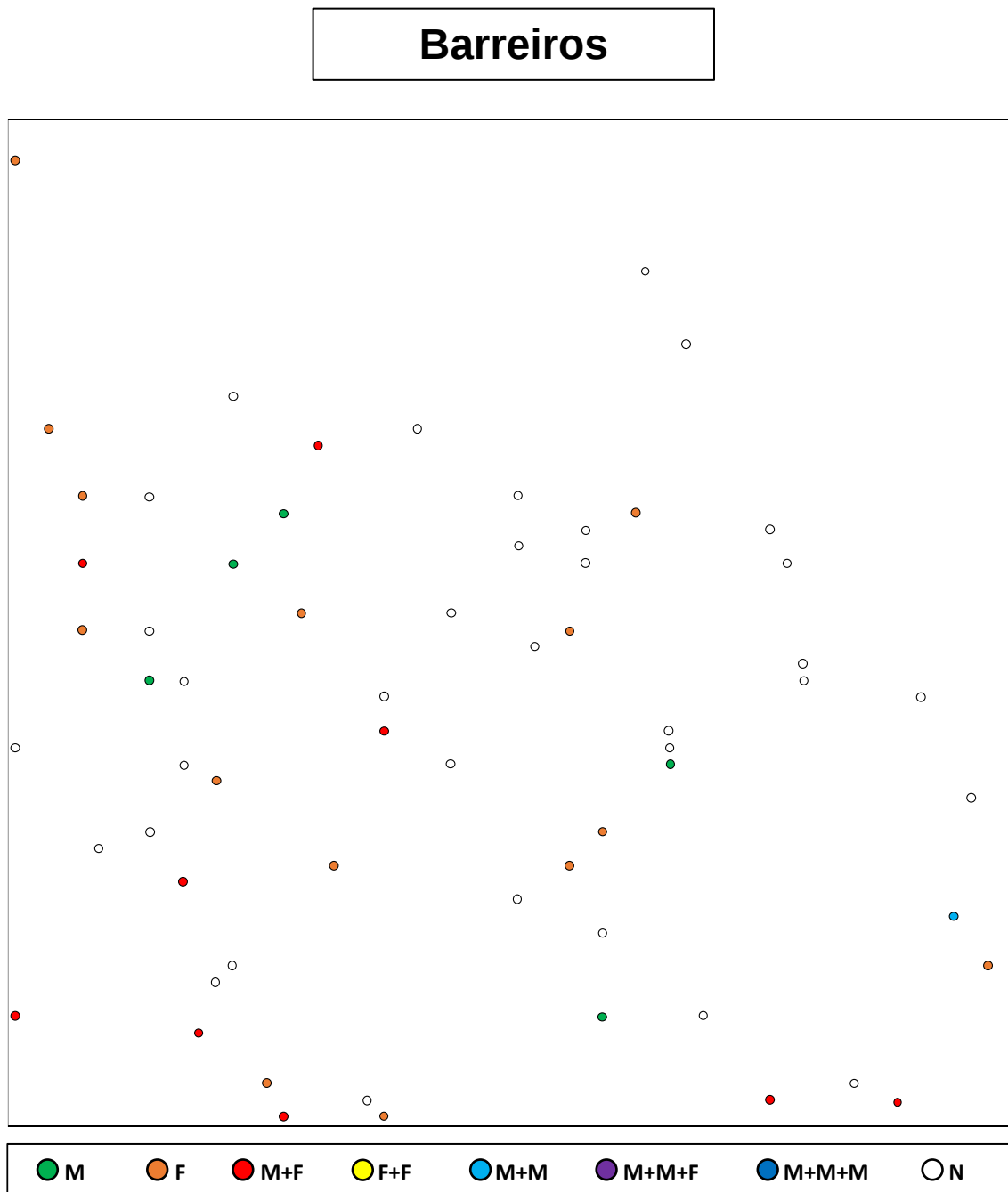


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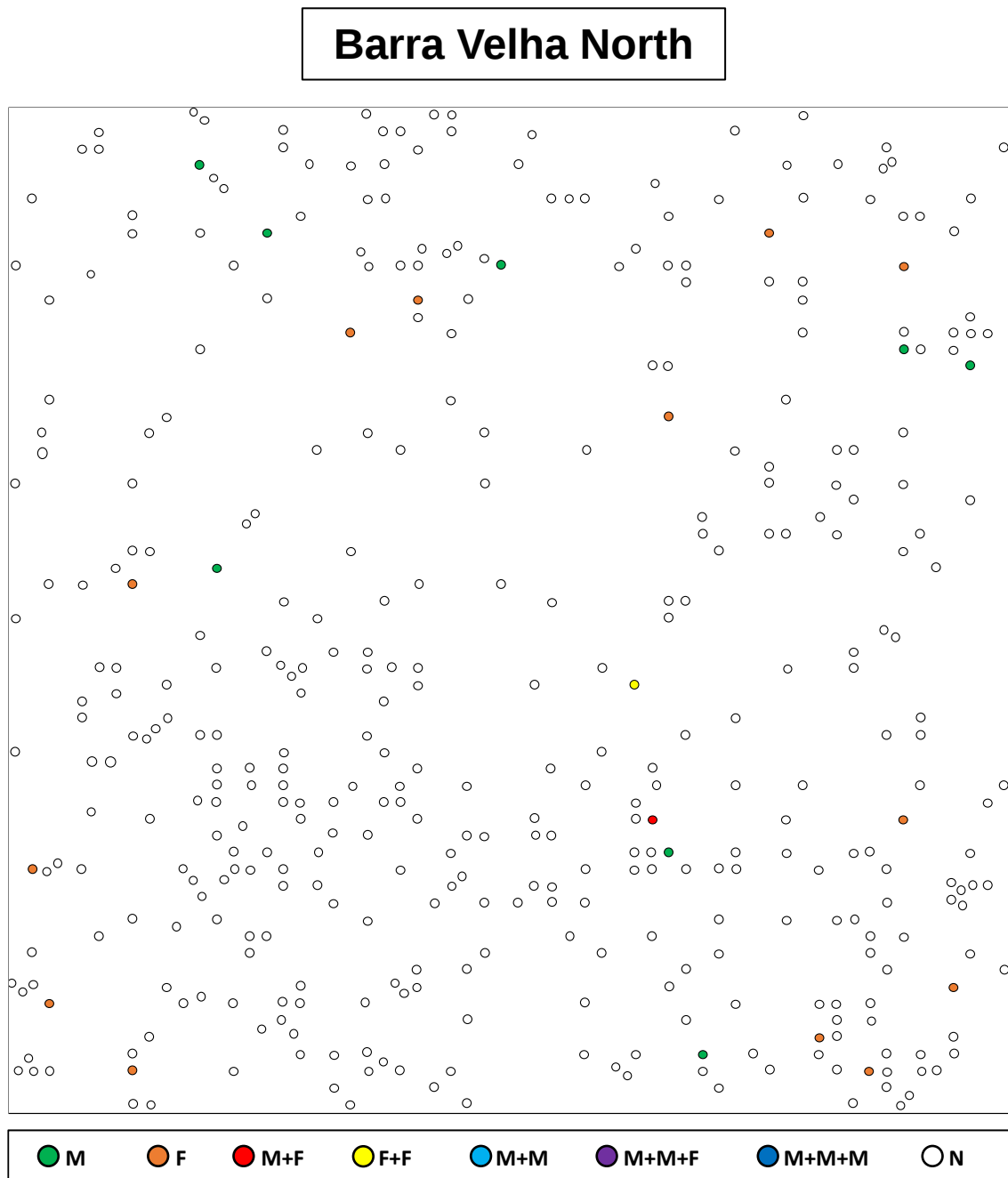


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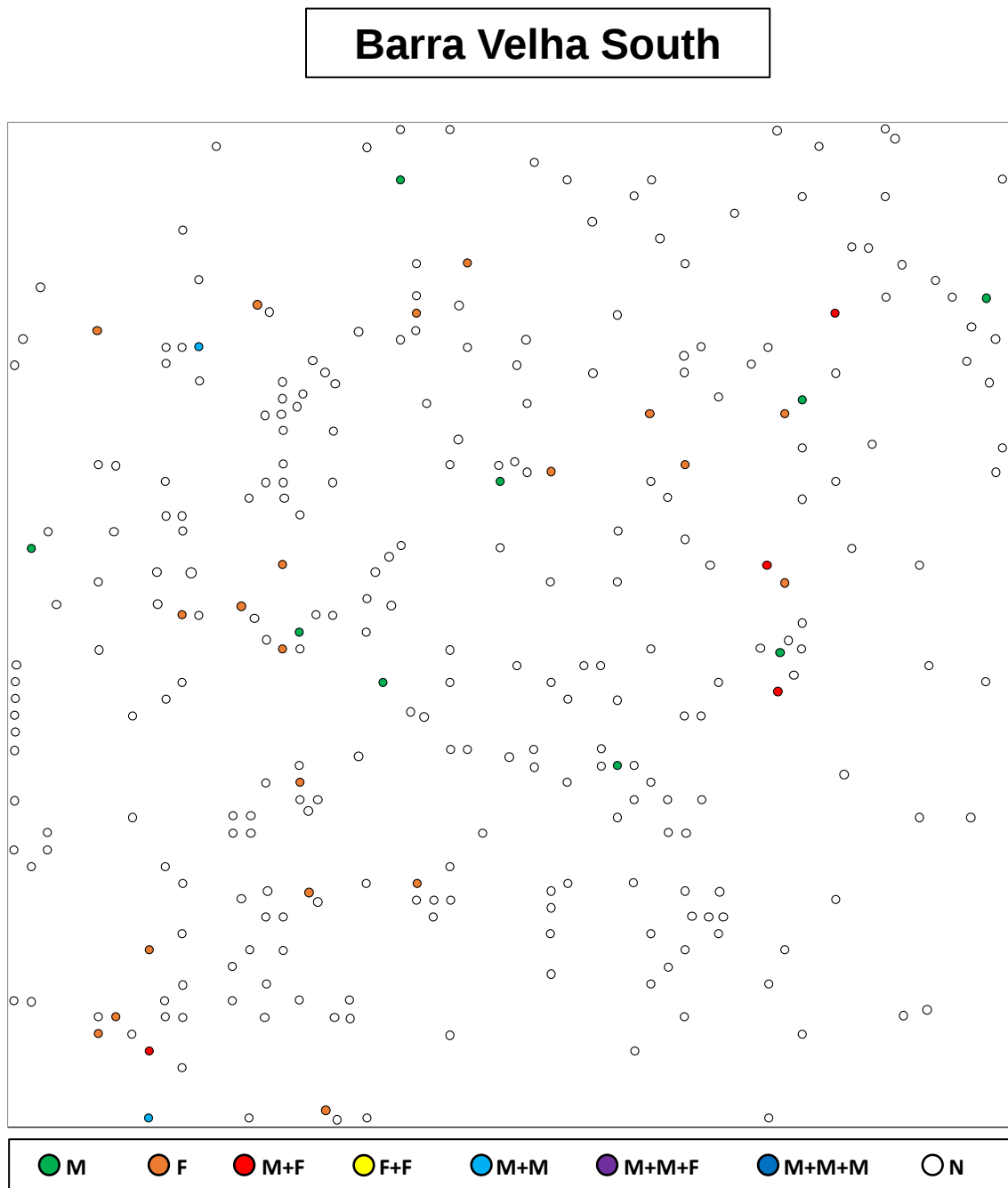


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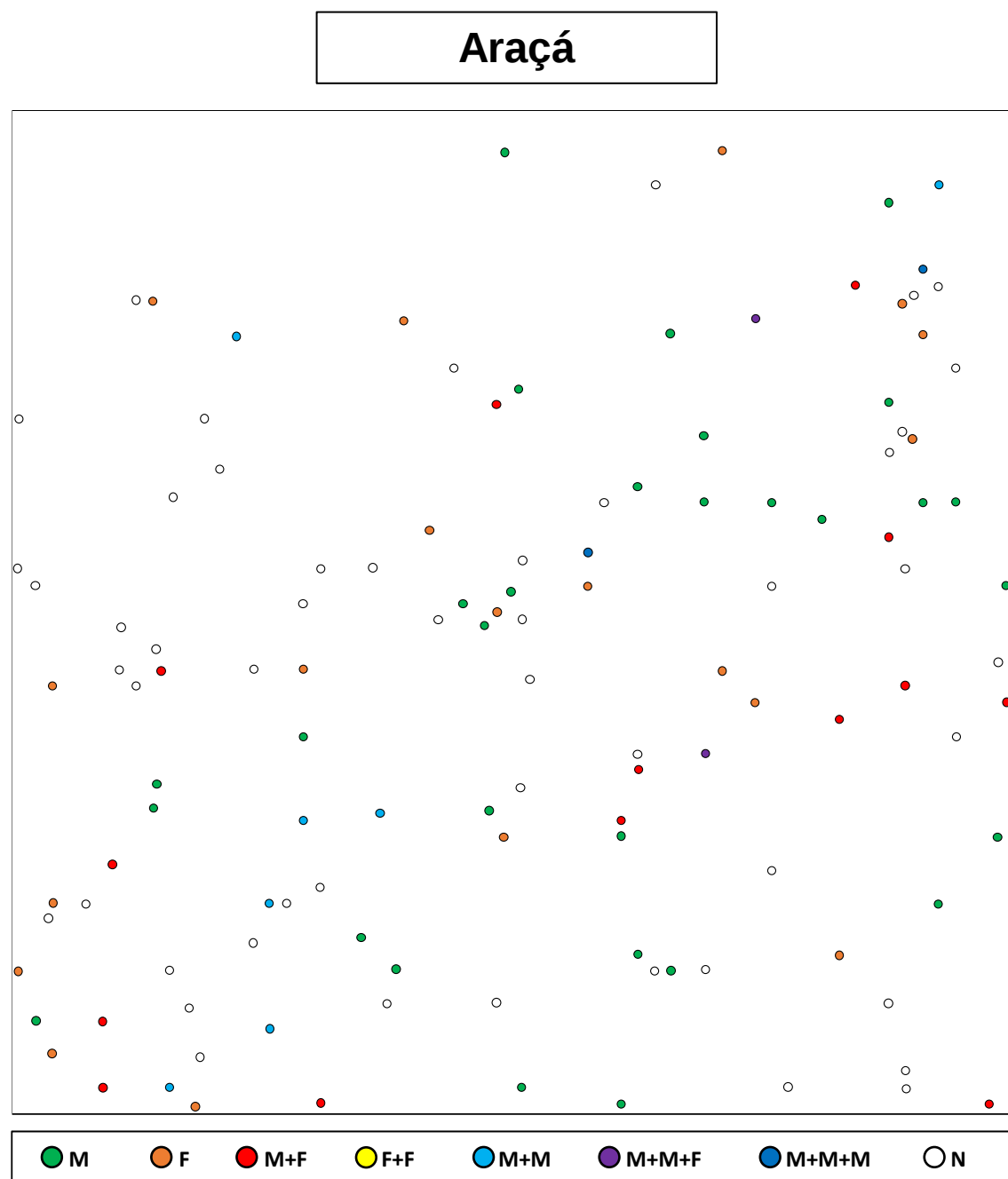


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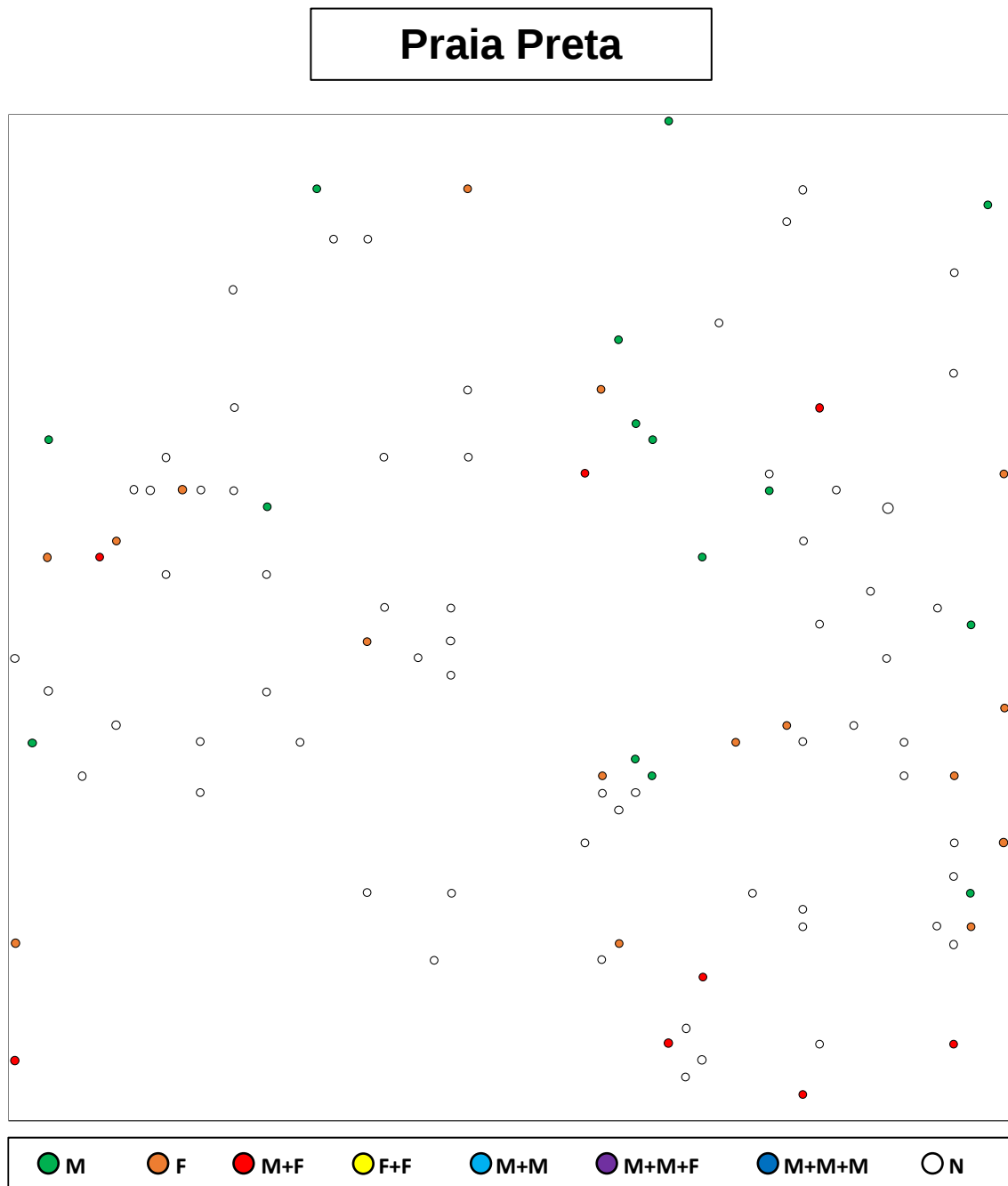


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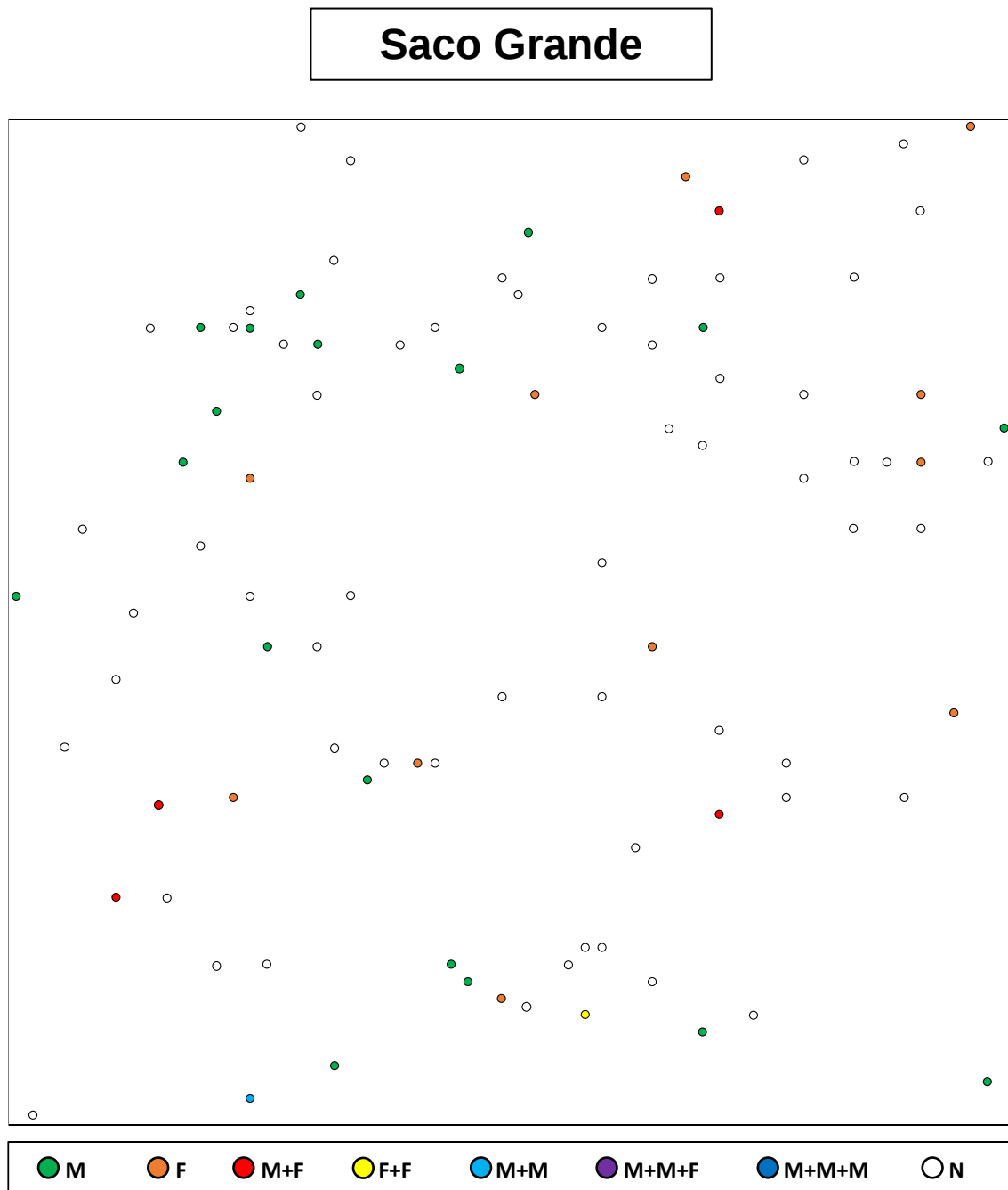


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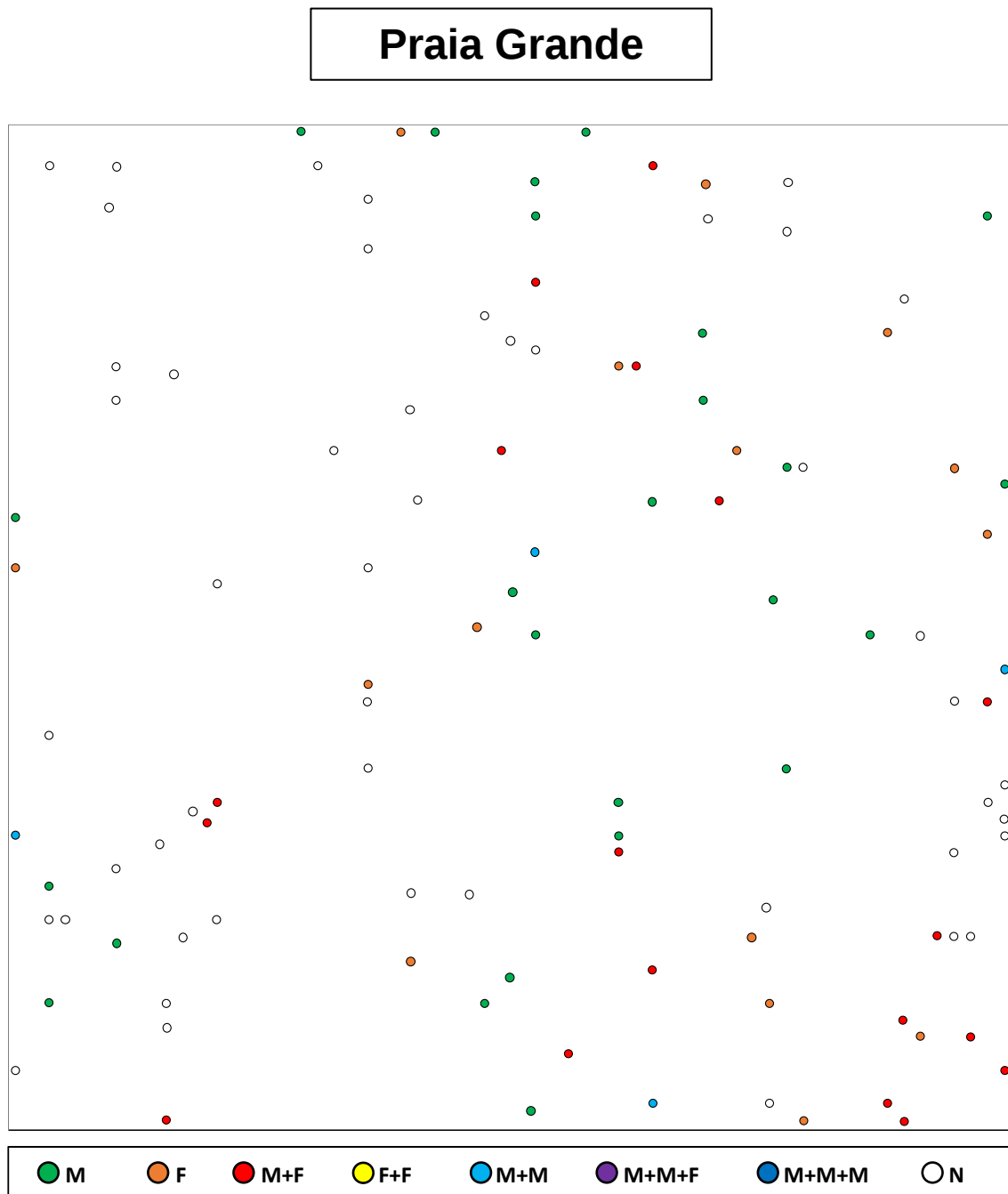


Fig. S2. Maps of the northern and central coast of Brazil (A), the northern coast of São Paulo State (B) and the São Sebastião Channel (C), showing the position of sampling sites: Armação North (AM N), Armação South (AM S), Barreiros (BR), Barra Velha North (BV N), Barra Velha South (BV S), Araçá (AR), Praia Preta (PP), Saco Grande (SG) and Praia Grande (PG).



Fig. S3. Population structure of pea crabs *Dissodactylus crinitichelis* at each sampling site in single sand-dollar hosts *Encope emarginata*. Categories are grouped as to test whether females have lower chance than males to coexist in the same host (left), and whether the occurrence of heterosexual pairs is higher than expected by chance for sand dollars hosting two crabs or more (right). M: male; F: female; n_c : total number of crabs, f_{δ} : male relative frequency, f_{ϕ} : female relative frequency, ns: not significant, **: $p < 0.01$. Observed frequencies are shown in solid color and expected frequencies, assuming random distribution of crabs among occupied sand dollars and independent occurrence of males and females, are shown in white bars.

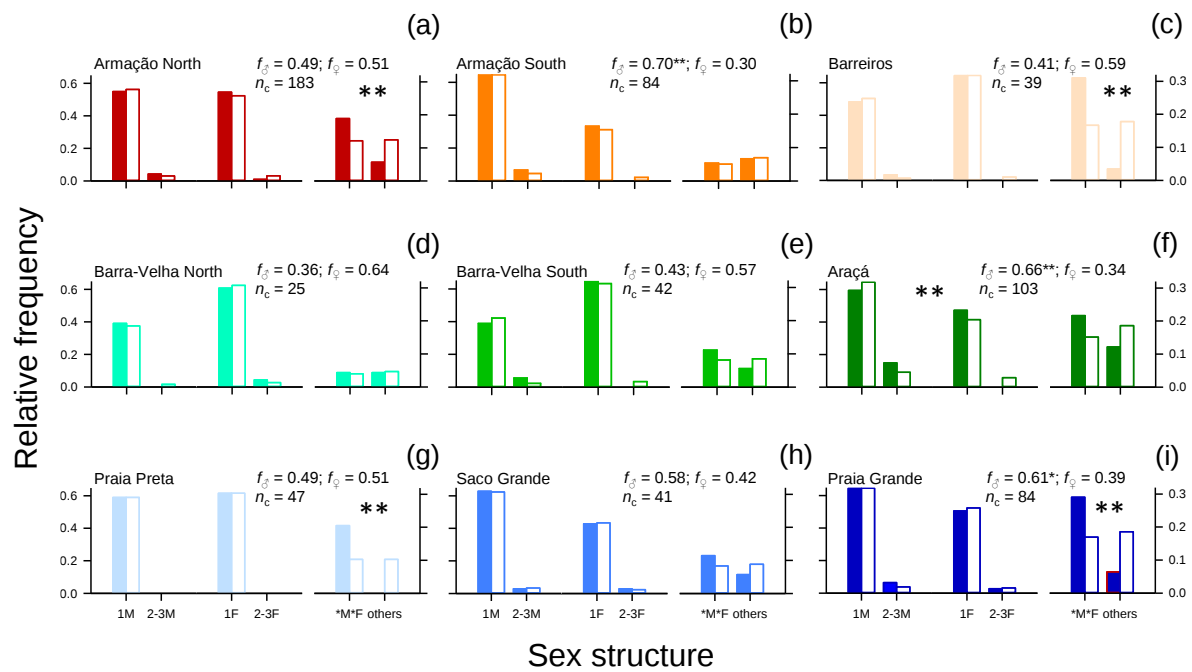


Fig. S4. *Dissodactylus crinitichelis* – Size vs. fecundity relationships in all sampling sites. In all cases, but Armação South (b), the allometric model fit the data ($0.35 < r^2 < 0.88$, $p < 0.004$ in all cases, average allometric coefficient $b = 2.1$, ranging from 1.8 and 3.3; more information on specific regression estimates is given in Table S2).

