

Supplementary Materials

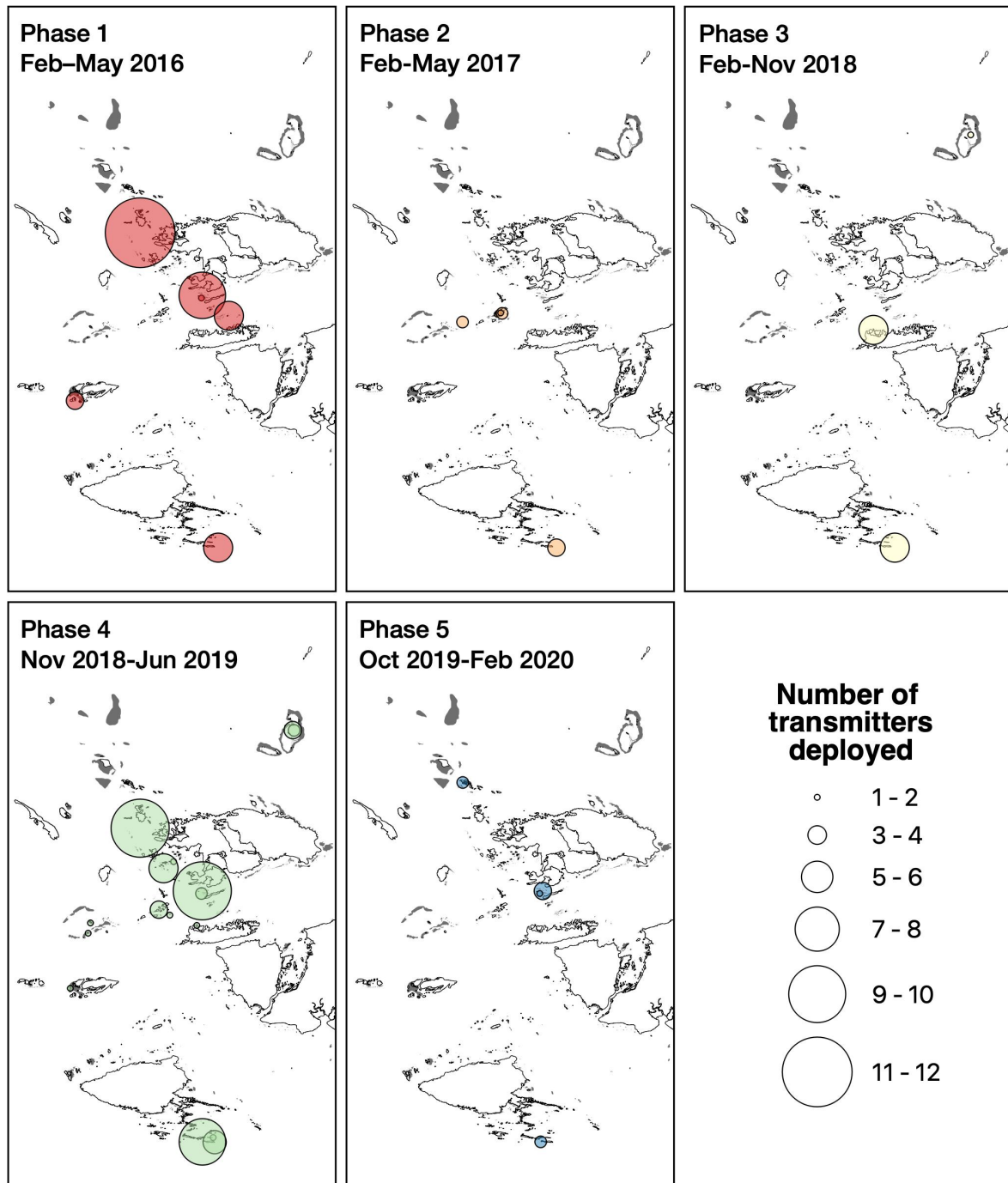


Figure S1. The number of acoustic transmitters deployed on *M. alfredi* during five tagging phases in Raja Ampat between February 2016 and February 2020. The size of the bubbles represents the number of transmitters deployed.

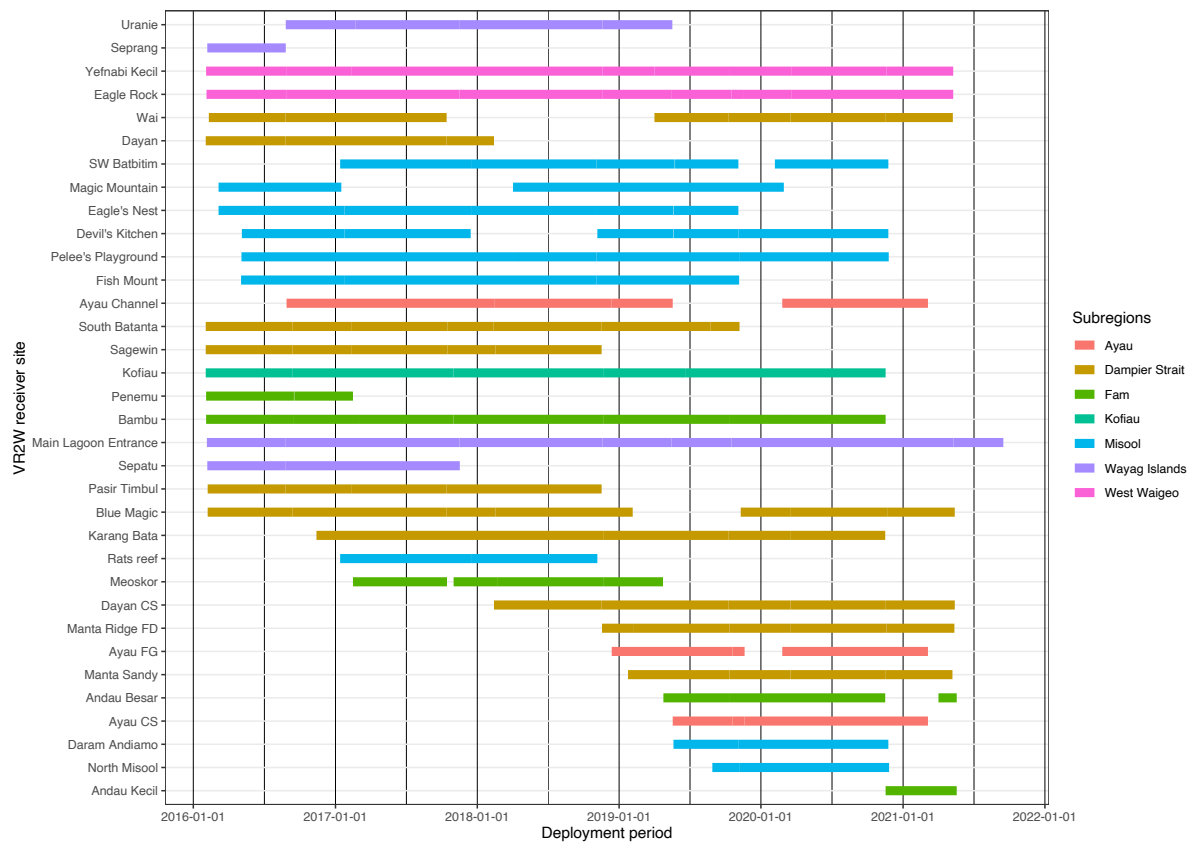


Figure S2. VR2W acoustic receiver deployment periods between February 2016 and September 2021 in Raja Ampat.



Figure S3. The detection patterns of 94 tagged *M. alfredi* recorded by receivers across the Raja Ampat archipelago between February 2016 and September 2021. Black vertical lines represent deployment dates of each transmitter.

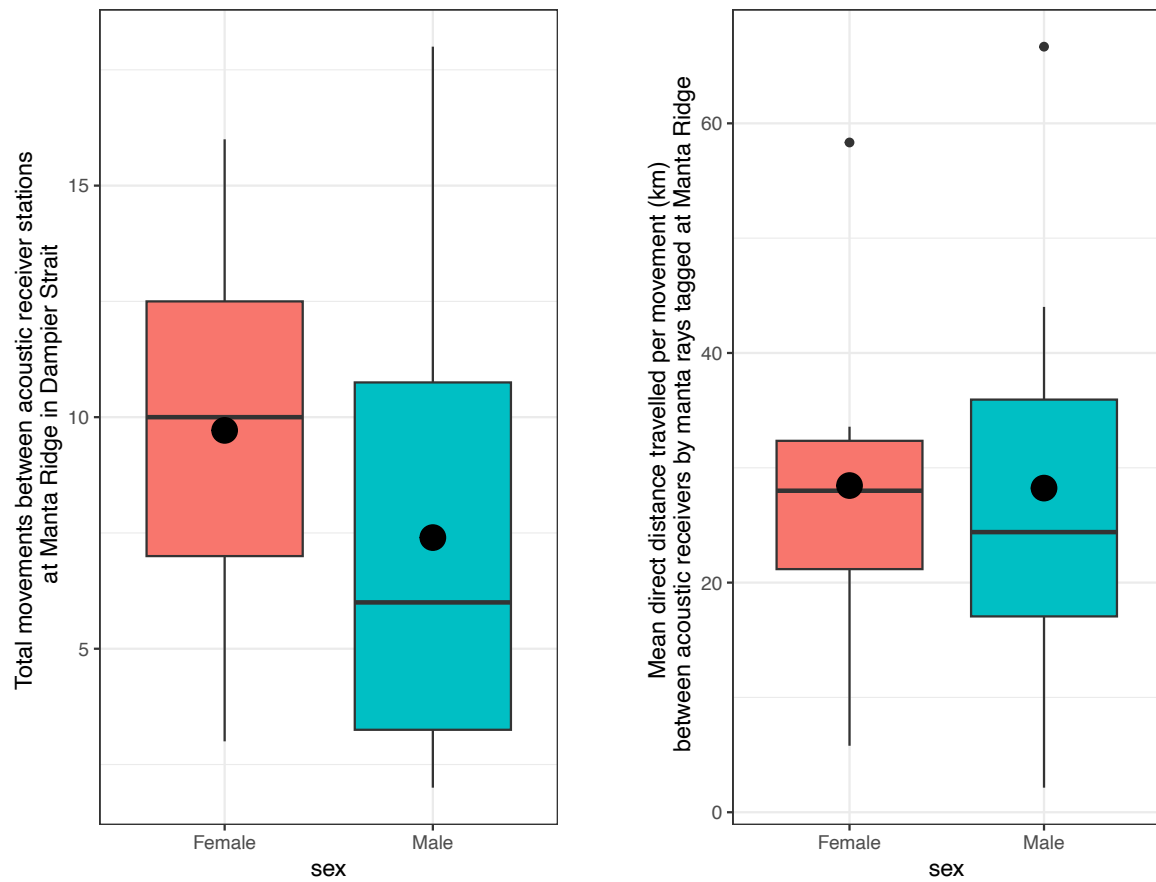


Figure S4. Boxplots for the total number of *M. alfredi* movements recorded between two sites (left panel) and for the mean direct distance travelled by tagged *M. alfredi* (right panel) based on sex. Black dots represents the average of each measure for each sex.

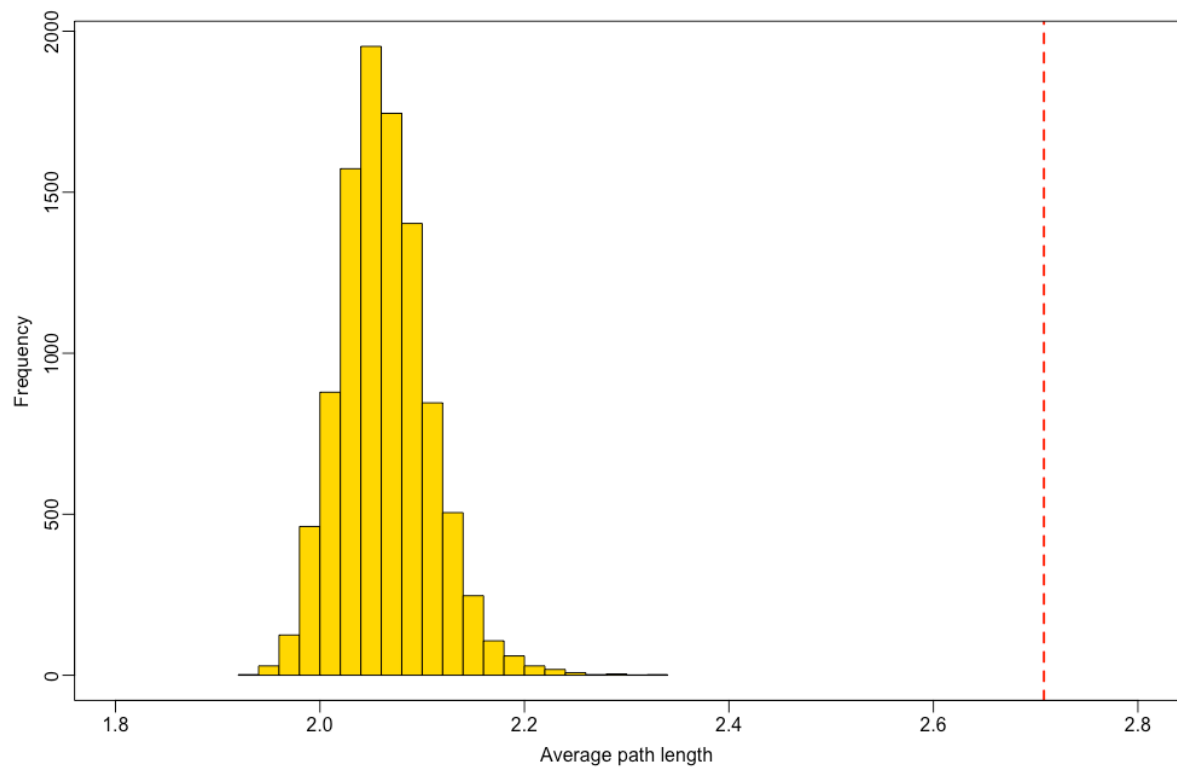


Figure S5. Distribution of average path length values obtained from permuted random networks (10,000 iterations) compared to the observed value of average path length (red vertical dashed line) of the receiver-based network in Raja Ampat.

Table S1. The number of acoustic transmitters deployed on *M. alfredi* in February 2016–February 2020, detected by at least one acoustic receiver, and detected by two or more acoustic receivers in each tagging region in Raja Ampat.

Tagging region	Number of acoustic transmitters deployed	Number of acoustic transmitters detected by one or more receiver stations	Number of acoustic transmitters detected by two or more receiver stations
Ayau	6	5	4
Dampier Strait	36	31	29
Fam & Bambu	13	6	3
Kofiau & Boo	4	3	1
Misool	28	25	24
Wayag	2	1	1
West Waigeo	28	23	10
TOTAL	117	94	72

Table S2. The total number of acoustically tagged *M. alfredi* movements (N movements) between receiver stations from February 2016 to September 2021 in the Raja Ampat archipelago. The movements occurred from Receiver Station 1 (in Region 1) to Receiver Station 2 (in Region 2).

No.	Receiver Station 1	Receiver Station 2	Region 1	Region 2	N movements
1	Magic Mountain	Eagle's Nest	Misool	Misool	93
2	Eagle's Nest	Magic Mountain	Misool	Misool	73
3	Eagle's Nest	Southwest Batbitim	Misool	Misool	65
4	Ayau Besar Feeding Ground	Ayau Besar Cleaning Station	Ayau	Ayau	60
5	Ayau Besar Cleaning Station	Ayau Besar Feeding Ground	Ayau	Ayau	59
6	Southwest Batbitim	Eagle's Nest	Misool	Misool	57
7	Manta Ridge	Manta Sandy	Dampier Strait	Dampier Strait	38
8	Manta Sandy	Manta Ridge	Dampier Strait	Dampier Strait	37
9	Southwest Batbitim	Magic Mountain	Misool	Misool	32
10	Devil's Kitchen	Magic Mountain	Misool	Misool	28
11	Magic Mountain	Devil's Kitchen	Misool	Misool	25
12	Magic Mountain	Southwest Batbitim	Misool	Misool	23
13	Southwest Batbitim	Fish Mount	Misool	Misool	18
14	Devil's Kitchen	Daram Andiamo	Misool	Misool	17
15	Eagle's Nest	Devil's Kitchen	Misool	Misool	16
16	Daram Andiamo	Devil's Kitchen	Misool	Misool	15
17	Eagle's Nest	Fish Mount	Misool	Misool	15
18	Dayan Cleaning Station	Manta Ridge	Dampier Strait	Dampier Strait	14
19	Devil's Kitchen	Eagle's Nest	Misool	Misool	14
20	Manta Sandy	Dayan Cleaning Station	Dampier Strait	Dampier Strait	12
21	Manta Ridge	Wai	Dampier Strait	Dampier Strait	12
22	Fish Mount	Devil's Kitchen	Misool	Misool	11
23	Fish Mount	Magic Mountain	Misool	Misool	11
24	Fish Mount	Southwest Batbitim	Misool	Misool	11
25	Rats Reef	Southwest Batbitim	Misool	Misool	11
26	Yefnabi Kecil	Eagle Rock	West Waigeo	West Waigeo	11
27	Manta Ridge	Dayan Cleaning Station	Dampier Strait	Dampier Strait	10
28	Dayan Cleaning Station	Wai	Dampier Strait	Dampier Strait	10
29	Magic Mountain	Daram Andiamo	Misool	Misool	10
30	Southwest Batbitim	Devil's Kitchen	Misool	Misool	10
31	Fish Mount	Eagle's Nest	Misool	Misool	10
32	Ayau Besar Feeding Ground	Ayau Besar Lagoon Entrance	Ayau	Ayau	8

No.	Receiver Station 1	Receiver Station 2	Region 1	Region 2	N movements
33	Wai	Dayan Cleaning Station	Dampier Strait	Dampier Strait	8
34	Wai	Manta Ridge	Dampier Strait	Dampier Strait	8
35	Daram Andiamo	Magic Mountain	Misool	Misool	8
36	Eagle's Nest	Rats Reef	Misool	Misool	8
37	Devil's Kitchen	Southwest Batbitim	Misool	Misool	8
38	Eagle Rock	Yefnabi Kecil	West Waigeo	West Waigeo	8
39	Eagle Rock	Wai	West Waigeo	Dampier Strait	8
40	Ayau Besar Lagoon Entrance	Ayau Besar Feeding Ground	Ayau	Ayau	7
41	Wai	Manta Sandy	Dampier Strait	Dampier Strait	7
42	Dayan Cleaning Station	Manta Sandy	Dampier Strait	Dampier Strait	6
43	Devil's Kitchen	Fish Mount	Misool	Misool	6
44	Magic Mountain	Fish Mount	Misool	Misool	6
45	Wai	Dayan	Dampier Strait	Dampier Strait	5
46	Wai	Pasir Timbul	Dampier Strait	Dampier Strait	5
47	Dayan	Wai	Dampier Strait	Dampier Strait	5
48	Pasir Timbul	Wai	Dampier Strait	Dampier Strait	5
49	Southwest Batbitim	Rats Reef	Misool	Misool	5
50	Ayau Besar Lagoon Entrance	Ayau Besar Cleaning Station	Ayau	Ayau	4
51	Ayau Besar Cleaning Station	Ayau Besar Lagoon Entrance	Ayau	Ayau	4
52	Manta Ridge	Yefnabi Kecil	Dampier Strait	West Waigeo	4
53	Pasir Timbul	Yefnabi Kecil	Dampier Strait	West Waigeo	4
54	Wai	Yefnabi Kecil	Dampier Strait	West Waigeo	4
55	Wai	Blue Magic	Dampier Strait	Dampier Strait	4
56	Blue Magic	Wai	Dampier Strait	Dampier Strait	4
57	Manta Sandy	Wai	Dampier Strait	Dampier Strait	4
58	Rats Reef	Eagle's Nest	Misool	Misool	4
59	Yefnabi Kecil	Pasir Timbul	West Waigeo	Dampier Strait	4
60	Wai	Eagle Rock	Dampier Strait	West Waigeo	3
61	Pasir Timbul	Dayan	Dampier Strait	Dampier Strait	3
62	Dayan Cleaning Station	Karang Bata	Dampier Strait	Dampier Strait	3
63	Blue Magic	Pasir Timbul	Dampier Strait	Dampier Strait	3
64	Manta Ridge	Pasir Timbul	Dampier Strait	Dampier Strait	3
65	Penemu	Yefnabi Kecil	Fam & Bambu	West Waigeo	3
66	Eagle's Nest	Daram Andiamo	Misool	Misool	3
67	Eagle Rock	Manta Sandy	West Waigeo	Dampier Strait	3
68	Eagle Rock	Pasir Timbul	West Waigeo	Dampier Strait	3
69	Manta Ridge	Eagle Rock	Dampier Strait	West Waigeo	2
70	Manta Sandy	Eagle Rock	Dampier Strait	West Waigeo	2

No.	Receiver Station 1	Receiver Station 2	Region 1	Region 2	N movements
71	Pasir Timbul	Eagle Rock	Dampier Strait	West Waigeo	2
72	Dayan	Yefnabi Kecil	Dampier Strait	West Waigeo	2
73	Manta Ridge	Blue Magic	Dampier Strait	Dampier Strait	2
74	Pasir Timbul	Blue Magic	Dampier Strait	Dampier Strait	2
75	Karang Bata	Dayan Cleaning Station	Dampier Strait	Dampier Strait	2
76	Manta Ridge	Karang Bata	Dampier Strait	Dampier Strait	2
77	Karang Bata	Manta Sandy	Dampier Strait	Dampier Strait	2
78	Bambu	Andau Besar	Fam & Bambu	Fam & Bambu	2
79	Southwest Batbitim	Pelee's Playground	Misool	Misool	2
80	Fish Mount	Rats Reef	Misool	Misool	2
81	Magic Mountain	Eagle Rock	Misool	West Waigeo	2
82	Eagle Rock	Dayan Cleaning Station	West Waigeo	Dampier Strait	2
83	Yefnabi Kecil	Wai	West Waigeo	Dampier Strait	2
84	Dayan	Eagle Rock	Dampier Strait	West Waigeo	1
85	Dayan Cleaning Station	Eagle Rock	Dampier Strait	West Waigeo	1
86	Dayan Cleaning Station	Yefnabi Kecil	Dampier Strait	West Waigeo	1
87	Dayan	Devil's Kitchen	Dampier Strait	Misool	1
88	Wai	Kofiau	Dampier Strait	Kofiau & Boo	1
89	Dayan Cleaning Station	Bambu	Dampier Strait	Fam & Bambu	1
90	Karang Bata	Bambu	Dampier Strait	Fam & Bambu	1
91	Dayan Cleaning Station	Meoskor	Dampier Strait	Fam & Bambu	1
92	Manta Sandy	Meoskor	Dampier Strait	Fam & Bambu	1
93	Dayan	Penemu	Dampier Strait	Fam & Bambu	1
94	Wai	Ayau Besar Lagoon Entrance	Dampier Strait	Ayau	1
95	South Batanta	Dayan	Dampier Strait	Dampier Strait	1
96	Blue Magic	Manta Ridge	Dampier Strait	Dampier Strait	1
97	Wai	Sagawin	Dampier Strait	Dampier Strait	1
98	Sagawin	South Batanta	Dampier Strait	Dampier Strait	1
99	Bambu	Dayan Cleaning Station	Fam & Bambu	Dampier Strait	1
100	Meoskor	Dayan Cleaning Station	Fam & Bambu	Dampier Strait	1
101	Meoskor	Manta Ridge	Fam & Bambu	Dampier Strait	1
102	Meoskor	Southwest Batbitim	Fam & Bambu	Misool	1
103	Bambu	Eagle Rock	Fam & Bambu	West Waigeo	1
104	Andau Besar	Yefnabi Kecil	Fam & Bambu	West Waigeo	1
105	Andau Kecil	Andau Besar	Fam & Bambu	Fam & Bambu	1
106	Andau Besar	Bambu	Fam & Bambu	Fam & Bambu	1

No.	Receiver Station 1	Receiver Station 2	Region 1	Region 2	N movements
107	Andau Besar	Meoskor	Fam & Bambu	Fam & Bambu	1
108	Kofiau	Wai	Kofiau & Boo	Dampier Strait	1
109	Magic Mountain	Sepatu	Misool	Wayag	1
110	Southwest Batbitim	Daram Andiamo	Misool	Misool	1
111	Daram Andiamo	Eagle's Nest	Misool	Misool	1
112	Pelee's Playground	Eagle's Nest	Misool	Misool	1
113	Rats Reef	Fish Mount	Misool	Misool	1
114	Pelee's Playground	Magic Mountain	Misool	Misool	1
115	Eagle's Nest	Pelee's Playground	Misool	Misool	1
116	Magic Mountain	Rats Reef	Misool	Misool	1
117	Daram Andiamo	Southwest Batbitim	Misool	Misool	1
118	Pelee's Playground	Southwest Batbitim	Misool	Misool	1
119	Sepatu	Eagle Rock	Wayag	West Waigeo	1
120	Seprang	Eagle Rock	Wayag	West Waigeo	1
121	Main Lagoon Entrance	Yefnabi Kecil	Wayag	West Waigeo	1
122	Yefnabi Kecil	Ayau Besar Cleaning Station	West Waigeo	Ayau	1
123	Yefnabi Kecil	Dayan	West Waigeo	Dampier Strait	1
124	Yefnabi Kecil	Manta Ridge	West Waigeo	Dampier Strait	1
125	Yefnabi Kecil	Manta Sandy	West Waigeo	Dampier Strait	1
126	Yefnabi Kecil	Andau Kecil	West Waigeo	Fam & Bambu	1
127	Eagle Rock	Penemu	West Waigeo	Fam & Bambu	1
128	Yefnabi Kecil	Penemu	West Waigeo	Fam & Bambu	1
129	Eagle Rock	Magic Mountain	West Waigeo	Misool	1
130	Eagle Rock	Sepatu	West Waigeo	Wayag	1
131	Eagle Rock	Seprang	West Waigeo	Wayag	1

Table S3. Centrality measures (node level metrics) of *M. alfredi* movement network in Raja Ampat between February 2016 and September 2021. The order of the receiver stations is based on the degree centrality (from largest to smallest).

No.	Receiver stations	Subpopulations	In-degree	Out-degree	Degree centrality	Betweenness	Closeness	Eigenvector
1	Wai	Dampier Strait	9	11	20	0.179	0.018	1.000
2	Eagle Rock	West Waigeo	11	9	20	0.324	0.020	0.967
3	Yefnabi Kecil	West Waigeo	9	9	18	0.167	0.018	0.861
4	Dayan Cleaning Station	Dampier Strait	7	8	15	0.086	0.016	0.799
5	Magic Mountain	Misool	7	8	15	0.215	0.015	0.476
6	Southwest Batbitim	Misool	8	7	15	0.049	0.013	0.372
7	Manta Ridge	Dampier Strait	6	8	14	0.031	0.016	0.817
8	Eagle's Nest	Misool	7	7	14	0.019	0.012	0.350
9	Manta Sandy	Dampier Strait	6	5	11	0.028	0.016	0.719
10	Devil's Kitchen	Misool	6	5	11	0.033	0.014	0.333
11	Pasir Timbul	Dampier Strait	5	5	10	0.017	0.016	0.651
12	Fish Mount	Misool	5	5	10	0.009	0.011	0.290
13	Dayan	Dampier Strait	4	5	9	0.079	0.017	0.500
14	Daram Andiamo	Misool	4	4	8	0.000	0.011	0.255
15	Rats Reef	Misool	4	3	7	0.000	0.011	0.209
16	Blue Magic	Dampier Strait	3	3	6	0.001	0.012	0.412
17	Bambu	Fam & Bambu	3	3	6	0.018	0.014	0.263
18	Meoskor	Fam & Bambu	3	3	6	0.034	0.014	0.305
19	Ayau Besar Cleaning Station	Ayau	3	2	5	0.017	0.012	0.095
20	Ayau Besar Lagoon Entrance	Ayau	3	2	5	0.015	0.012	0.105
21	Karang Bata	Dampier Strait	2	3	5	0.002	0.012	0.284
22	Andau Besar	Fam & Bambu	2	3	5	0.030	0.014	0.148

No.	Receiver stations	Subpopulations	In-degree	Out-degree	Degree centrality	Betweenness	Closeness	Eigenvector
23	Pelee's Playground	Misool	2	3	5	0.000	0.011	0.160
24	Ayau Besar Feeding Ground	Ayau	2	2	4	0.000	0.009	0.033
25	Penemu	Fam & Bambu	3	1	4	0.000	0.014	0.266
26	Sepatu	Wayag	2	1	3	0.000	0.014	0.201
27	Sagawin	Dampier Strait	1	1	2	0.026	0.012	0.088
28	South Batanta	Dampier Strait	1	1	2	0.027	0.011	0.049
29	Andau Kecil	Fam & Bambu	1	1	2	0.014	0.012	0.084
30	Kofiau	Kofiau & Boo	1	1	2	0.000	0.011	0.167
31	Seprang	Wayag	1	1	2	0.000	0.012	0.161
32	Main Lagoon Entrance	Wayag	0	1	1	0.000	0.012	0.072
33	North Misool	Misool	0	0	0	0.000	NA	0.000
34	Uranie	Wayag	0	0	0	0.000	NA	0.000