Supplementary information

Desperate times call for desperate measures: non-food ingestion by starving seabirds

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Text S1. Extended methods.

Seabird sampling

Deceased short-tailed shearwaters, *Ardenna tenuirostris*, were collected from the Eastern Australian coastline between 10th October and 4th of November 2013, during a short-tailed shearwater "wreck" (large mortality event). Beach-wrecked dead birds were collected from Stradbroke and Fraser Island, Queensland, Australia and birds that died in care or were euthanized for veterinary purposes were donated by Currumbin Wildlife Sanctuary Hospital, Queensland, Australia. Deceased birds were immediately frozen and stored at the Moreton Bay Research Station, Dunwich, Queensland.

Birds were defrosted and air-dried over 24 hours; weighed, measured and necropsied from the 8-11th December 2013. Age and sex were determined by examination of the gonads following van Franeker's collection and dissection procedures manual for northern fulmars [1]. Gut contents were removed and washed with distilled water. Non-food items, both natural (pumice) and synthetic (plastic) were separated from organic items and air dried, before being counted and weighed using electronic scales.

The total number of pumice pieces per bird were recorded along with the total weight of each pumice sample and the length/width/heigh measurements of the largest piece of pumice. The pumice was inspected with optical microscopes and pumice mineralogy and textures compared with separate collections of Havre pumice collected from beach strandings [2] that were ongoing along the Queensland and New South Wales coastlines since March 2013.

The known migratory path of the short-tailed shearwaters [3] and the known distribution of sea-rafted pumice from the 2012 Havre eruption [4] prior to the 2013 seabird wreck event were overlayed to determine the location of interaction of the migrating seabirds with the sea-rafted pumice. Estimating timing of pumice ingestion was calculated based on date and location of bird stranding and the published average southern migration velocity of ~ 694 km day^{-1} for the species [3]. Through these factors we were able to correlate the probable geographical location of where the deceased short-tailed shearwaters first interacted with the sea-rafted pumice and estimated the length of time before wrecking.

Statistical analysis was conducted using R version 3.5.1 [5]. Total number and mass of synthetic and natural items ingested across the group were compared using a non-parametric Mann-Whitney U test. Individual non-food ingesting behaviour was investigated by using Pearson's correlation to compare the relationship between the count and mass of items ingested.

Deceased seabird and gut content sampling

A total of 172 adult short-tailed shearwaters were collected (f=79 female, m=89, unknown=4). All birds were in a starving body condition with no significant subcutaneous or intestinal fat and atrophied pectoral muscles (*min weight*=282, *median weight*=333g, *max weight*=415g). The majority of individuals (*n*=166, 96.5%) had non-nutritive items in their gut at the time of death, including synthetic items (*n*=152 88.4% of individuals, *median*=4, *max*=23, Fig. 2.), predominantly hard plastic (97% of synthetic items), and natural pumice (*n*=152, 88.4% of individuals, *median*=3, *max*=27, Fig. 2.).

Short-tailed shearwater tracking from global location sensors

Short-tailed shearwater were tracked from Wedge Island, southeast Tasmania, Australia (43° 07' S, 147° 40' E). Global location sensor (GLS) devices, were deployed as part of a larger study concerning breeding movements during 2012 - 2015 (Bool 2019). Only data collected from the 2013 return migration to the Southern Hemisphere is presented here as it corresponded with the timing of the Havre eruption. Shearwater movements and distribution during the non-breeding season were estimated with global location sensing (GLS) devices. The devices used in this study were deployed throughout the breeding season from October to April. Two types of GLS devices were used over the course of the study: (1) MK19 GLS tags (British Antarctic Survey, Cambridge, UK; 16x14x6 mm, 2.5 g) were deployed during the 2011 breeding season; (2) MK3005 GLS tags (Biotrack Ltd., Wareham, UK; 2.5 g) were deployed in the 2012 breeding season (Table S1). All the tags collected ambient light, activity (wet/dry events) and sea surface temperature data (SST; -0.125°C resolution). The GLS tags sampled ambient light every minute and recorded the maximum light level every five minutes, which was used to estimate the birds' location (Sumner, Wotherspoon, & Hindell, 2009; Wotherspoon, Sumner, & Lisovski, 2013).Water temperature ± 0.5°C was recorded when the device was continuously wet for 20 minutes. The MK19 and MK3005 tags provided temperature data when devices were submerged for 25 minutes, but when the sensor was dry for six seconds or longer they stopped recording.

Tags were attached to the tarsus after Cleeland, Lea, and Hindell (2014). The maximum weight of the tag and attachment was 4.5 g, < 1% of the mean mass (597.1 ± 57.3 g, n = 421) of the birds at Wedge Island. Tags were calibrated at the deployment site by placing them under the open sky for 2 to 7 days prior to deployment to provide light recordings at a known location allowing for accurate estimation of sun elevation (Lisovski et al., 2012). A subset of non-tagged birds (n = 74) were weighed using a 1 kg (± 5 g) Salter spring balance (Super Samson models, Salter Australia Pty Ltd, Melbourne, Australia) and compared with those of tagged birds to check for device effects at the end of the return migration in October of each year. A total of 141 GLS tags were deployed on adults during the breeding season and 93 GLS tags were retrieved during subsequent breeding seasons. All birds were recaptured at the colony, either in their burrows or on the surface near their burrows, except for one individual which was found dead on a beach in South Australia in 2013 (post-migration, cause of death unknown). The 2013 short-tailed shearwater wreck is suspected to be a factor in the low recovery rate of GLS devices in 2013 relative to 2012.

Location processing

Daily positions were estimated from the raw light and sea surface temperature (SST) values recorded by the GLS devices in the R package SGAT (Sumner et al., 2009; Wotherspoon et al., 2013). This package uses a curve method (Ekstrom, 2002; Sumner et al., 2009), where location estimates are computed using a likelihood function calibrated with solar zenith angles calibrated at a known site. Because the tags deployed on these birds were attached to their leg the sensor can sometimes be shaded by the bird when it is in flight or when it is sitting on the surface at the colony. Shading can considerably affect the estimation of latitude positions. Therefore, where shading of the tag's sensor prevented accurate estimation of the twilight curve, individual twilights were manually adjusted to match the overall trend in the light level prior to twilight, based on the set light threshold identified during the pre-processing stage. In addition, sometimes when birds sit on the surface at the colony or when nesting, wet/and or muddy and sufficiently salty feathers can result in false SST readings. These readings are typically anomalously higher than the median SST temperature, so this data was identified and removed using the SSTfilter and selectData functions in SGAT.

SGAT is based on a Bayesian framework that uses Markov Chain Monte Carlo (MCMC) to estimate the posterior distribution of locations (Sumner et al., 2009). Each birds' locations were estimated (and 95% CI) using a set of priors that include: 1) a spatial probability mask, to exclude locations on land, 2) a movement model where the average speed of travel between successive locations was assumed to be Gamma distributed, the probability of distribution of speeds is estimated using the mean time intervals between twilights (in hours), limiting the distance between locations, and, 3) to improve accuracy of location data, SST was used to constrain the location estimation. The final estimated track was calculated using a Metropolis algorithm to burn in 12 000 iterations. The posterior distribution of the filtered mean temperature data recorded by the device was compared to remote satellite derived SST data, obtained from the Earth System Research Laboratory http://www.esrl.noaa.gov/psd/repository/entry/show?entryid=12159560-ab82-48a1-b3e4-88ace20475cd) and, 4) to account for twilight errors associated with tag shading, a log-normal probability distribution was applied to twilights, providing more accurate location estimation (Wotherspoon et al., 2013).

Spatial analysis of foraging data

To identify the Austral winter foraging distribution of the shearwaters, we considered the migration phase to have commenced when a bird moved north of 40°S, while the end of the northern migration was taken to be when a bird arrived at 40°N. From this, the total time spent in their non-breeding foraging areas, the highest latitude reached and the time taken to migrate for each bird was determined.

Carrying a GLS device did not influence the return body masses of tracked birds (567.8 ± 51.6 g) when compared with those of control birds (572.0 ± 49.3 g, t = -0.46, df = 113.3 p = 0.65).

Providence of non-food items

The ingested pumice was uniform in its intrinsic characteristics, being white to light grey, highly vesicular and relatively crystal-poor with observed phenocrysts of plagioclase and rare pyroxene. Pumice clasts were typically rounded, which is typical of sea-rafted pumice [6,7]. Stranded Havre pumice was repeatedly collected from SE Queensland beaches from May 2013 to February 2014 [8], recording numerous stranding events and confirming pumice was present in offshore regions at the time of shearwater migrations. Plastic was mostly featureless hard fragments.

Relationship between count and mass of ingested non-food items

We found no significant difference in total count (U = 13464, P = 0.148) of ingested plastic or pumice, but a significant difference existed between the ingested mass across the group (Pumice 1st Q = 0.028g, med = 0.060g, 3rd Q = 0.117g, max = 0.746g, Plastic 1st Q = 0.040g, med = 0.087g, 3rd Q = 0.176g, max = 1.160g, U = 8054, P = 0.002).

When individual ingestion is assessed, we see a positive relationship between the number of ingested synthetic to natural items (r = 0.248, P = 0.001), but no significant difference between ingested item mass (r = 0.023, P = 0.798) (Figure 2).

Location of pumice and bird interactions

Based upon time-based distribution patterns of the sea-rafted pumice from the Havre eruption, the date of seabird stranding and mean length of time taken by short-tailed shearwaters on their southward migration from the northern hemisphere to South-East Queensland, a predicted area of where seabirds ingested the pumice was mapped (Figure 1). The majority of the 172 individuals appear to have interacted with the sea-rafted pumice from between ~17.5°S and 165°E during September through to October 2013.

Estimated time between pumice interaction and final wrecking

Shearwaters found wrecked on Fraser Island had flown a straight line distance of approximately 958 km since having interacted with the northern edge of the pumice raft located NW of New Caledonia (17°50'S, 158°52'E), while those that wrecked on North Stradbroke Island had flown approximately 1180 km. The birds were found wrecked between October and November, which correlated with a second concentration of pumice recorded NE of Rockhampton (22°02'S, 151°13'E) in September of the same year, a distance of 355 km from Fraser Island and 642 km from North Stradbroke Island (Figure 1). Based on these distances and assuming uninterrupted mean southern flight velocity [3], we calculated that the birds wrecked between ~12 to ~ 42 hours after having interacted with the northern edge of pumice raft (Table 1).

Authors' contributions.

S.B. and L.R. initiated the study; L.R. collected the carcasses; K.A.T provided the laboratory materials, facilitated storage and disposal of carcasses. L.R., L.G and K.A.T. performed the necropsies, L.R and L.G. collected and measured the pumice and plastic. L.G analyzed the ingested pumice. S.B., L.R. and K.A.T. analyzed the data; N.B. undertook shearwater tracking and associated field work, provided shearwater information and migration path data; all authors wrote the paper. All authors approve the final version of the manuscript and they agree to be held accountable for the work performed.

Competing interests.

We declare we have no competing interests.

Permits.

Queensland Government Scientific purposes permit no.WISP12620313

Ethics Statement.

All animal handling and instrumentation were carried-out under Research Permits (DPIPWE: FA10212, FA13009, FA14063, FA15083, FA16077) and University of Tasmania Animal Ethics Committee permits (A11338, A128942, A15572).

Funding.

This pumice and short-tailed shearwater research was financially supported by a QUT Vacation Research Experience Scholarship to LG.

Acknowledgements.

We would like to acknowledge those that assisted in the collection of short-tailed shearwaters used in this study from beaches in Eastern Australia. We would like to thank Queensland Parks and Wildlife Service, Linda Behrendorff, Queensland Department of Environment and Science, David Stewart and Currumbin Wildlife Sanctuary Hospital, Chief Veterinarian Dr. Mic Pyne for donation of seabird carcasses. We would also like to thank the University of Queensland's Moreton Bay Research Station where necropsies took place.

Supplementary tables.

Table S1. Year, model, and the number of GLS devices deployed and retrieved from short-tailed shearwaters at Wedge Island. Including tags that were deployed for multiple years and the number of tracks.

Year	Model	GLS deployed[a]	GLS recovered	Tracks included in analyses[b]
2012	MK19	15	10	
2013	MK3005	30	13	8*

a) Excluding birds tracked only for the breeding season.

b) Some tags failed during deployment and consequently did not provide data for the entire non-breeding stage. Data was only included if it included where available for the return migration.

*Includes data from 2 devices retrieved in 2013 that were deployed during 2012.

Table S2: Raw data collected. 172 adult short-tailed shearwaters were collected from the Eastern Australian coastline between 10th October and 4th of November 2013, during a short-tailed shearwater "wreck", frozen, and then air dried and necropsied the 8-11th December 2013. Age and sex were determined by examination of the gonads following van Franeker's collection and dissection procedures manual for northern fulmars [1]. Note: ID max is 176 (not 172) as four birds from original 176 collected were excluded due to incomplete or missing data.

ID	*Collection location*	*Bird Mass (g)*	*Sex*	*Number ingested pumice*	*Mass ingested pumice*	*Number ingested plastic*	*Mass ingested plastic*
1	Stradbroke	393	m	3	0.072	8	0.5985
2	Fraser Island Poyungan Oaks East Beach	315	m	4	0.02	12	0.19887
3	Fraser Island Poyungan Oaks East Beach	366	f	7	0.054	4	0.0888
4	Fraser Island Poyungan Oaks East Beach	322	f	0	NA	8	0.1055
5	Fraser Island Poyungan Oaks East Beach	353	m	2	0.008	0	NA
6	Fraser Island Poyungan Oaks	373	m	4	0.018	14	0.3859

	East Beach						
7	Fraser Island Poyungan Oaks East Beach	379	f	6	0.0462	23	0.1778
8	Fraser Island Poyungan Oaks East Beach	357	f	4	NA	4	0.0894
9	Fraser Island Poyungan Oaks East Beach	356	m	5	0.0871	1	NA
10	Fraser Island Poyungan Oaks East Beach	335	m	3	0.0143	2	0.024
11	Fraser Island Poyungan Oaks East Beach	348	m	1	0.0385	13	0.2613
12	Fraser Island Poyungan Oaks East Beach	306	f	3	0.0286	6	0.074
13	Fraser Island Poyungan Oaks East Beach	343	m	2	0.0321	0	NA
14	Fraser Island Poyungan Oaks East Beach	343	m	0	NA	0	NA
15	Fraser Island Poyungan Oaks East Beach	387	m	23	0.247	5	0.0734
16	Fraser Island Poyungan Oaks East Beach	392	f	1	0.0032	3	0.008
17	Fraser Island Poyungan Oaks East Beach	360	m	2	0.0288	1	0.0031
18	Fraser Island Poyungan Oaks East Beach	375	f	5	0.077	3	0.0455
19	Fraser Island Poyungan Oaks East Beach	375	m	25	0.5346	0	NA
20	Fraser Island Poyungan Oaks East Beach	388	NA	0	NA	17	0.6147
21	Fraser Island Poyungan Oaks East Beach	415	m	5	0.0568	3	0.0546
22	Fraser Island Poyungan Oaks East Beach	336	m	3	0.0336	10	0.0898
25	Fraser Island	358	m	8	0.073	6	0.0389

	Poyungan Oaks East Beach						
26	Fraser Island Poyungan Oaks East Beach	350	f	5	0.0405	4	0.0155
27	Fraser Island Poyungan Oaks East Beach	347	f	2	0.0294	11	0.1514
28	Fraser Island Poyungan Oaks East Beach	361	m	1	0.0068	3	NA
29	Fraser Island Poyungan Oaks East Beach	317	m	3	0.043	6	0.1743
30	Fraser Island Poyungan Oaks East Beach	319	m	7	0.1642	3	0.0534
31	Fraser Island Poyungan Oaks East Beach	355	m	27	0.1306	23	0.219
32	Fraser Island Poyungan Oaks East Beach	380	m	4	0.0569	13	0.348
33	Fraser Island Poyungan Oaks East Beach	333	m	7	0.1558	19	0.2943
34	Fraser Island Poyungan Oaks East Beach	323	m	4	0.0358	4	0.3707
35	Fraser Island Poyungan Oaks East Beach	350	m	1	0.0474	5	0.0844
36	Fraser Island Poyungan Oaks East Beach	328	f	9	0.096	4	0.0632
37	Fraser Island Poyungan Oaks East Beach	358	f	27	0.5775	6	0.0665
38	Fraser Island 500m north - Cornwell Rd	328	f	10	0.0693	12	0.2828
39	Fraser Island 500m north - Cornwell Rd	383	f	1	0.0016	0	NA
40	Fraser Island 500m north - Cornwell Rd	316	m	4	0.0483	2	0.5425
41	Fraser Island 500m north - Cornwell Rd	343	f	4	0.0611	2	0.0343

42	Fraser Island - Unknown	324	m	3	0.046	4	0.1658
43	Fraser Island 500m north - Cornwell Rd	338	f	2	0.12	0	NA
44	Fraser Island 500m north - Cornwell Rd	323	f	4	0.0866	9	0.493
45	Fraser Island - Unknown	345	f	0	NA	11	0.2931
46	Fraser Island - Unknown	370	m	7	0.1159	8	NA
47	Fraser Island - Unknown	332	m	6	0.0545	2	0.0149
48	Fraser Island 500m south - Cornwell Rd	364	f	4	0.2128	4	0.137
49	Fraser Island 500m south - Cornwell Rd	347	f	10	0.0925	6	0.0823
50	Fraser Island South Eurong	339	m	1	0.0121	3	0.0579
51	Fraser Island - Unknown	339	f	6	0.1509	6	0.1919
52	Fraser Island 500m south - Cornwell Rd	382	f	1	0.0076	7	0.2853
53	Fraser Island 500m south - Cornwell Rd	373	f	4	0.0515	5	0.1229
54	Fraser Island 500m south - Cornwell Rd	321	m	10	0.1561	1	0.0996
55	Fraser Island 500m south - Cornwell Rd	336	f	8	0.0975	2	0.0531
56	Fraser Island South Eurong	332	m	6	0.0557	5	0.146
57	Fraser Island South Eurong	321	m	13	0.0939	6	0.0577
58	Fraser Island South Eurong	321	f	6	0.089	0	NA
59	Fraser Island South Eurong	345	m	12	0.2014	3	0.037
60	Fraser Island South Eurong	322	f	2	0.0139	0	NA
61	Fraser Island South Eurong	304	f	5	0.0911	2	0.0226
62	Fraser Island South Eurong	345	m	2	0.0084	1	0.0211

63	Fraser Island South Eurong	323	f	0	NA	0	NA
64	Fraser Island South Eurong	342	m	2	0.0272	4	0.0524
65	Fraser Island Garrowea Creek	350	m	3	0.042	5	0.153
66	Fraser Island Garrowea Creek	303	m	5	0.0855	3	0.0441
67	Fraser Island Garrowea Creek	316	m	2	0.0067	5	0.5087
68	Fraser Island Garrowea Creek	350	m	1	0.0929	0	NA
69	Fraser Island North of Dili Village	320	m	0	NA	4	0.0874
70	Fraser Island North of Dili Village	298	m	2	0.0549	0	NA
71	Fraser Island Garrowea Creek	367	m	3	0.0284	11	0.1798
72	Fraser Island Garrowea Creek	321	f	1	0.059	5	0.0356
73	Fraser Island Garrowea Creek	325	m	0	NA	2	0.0463
74	Fraser Island Garrowea Creek	368	m	2	0.0283	3	0.0601
75	Fraser Island Garrowea Creek	338	f	2	0.0221	4	0.0856
76	Fraser Island Garrowea Creek	352	m	1	0.0693	2	0.035
77	Fraser Island Garrowea Creek	315	f	2	0.0113	3	0.035
78	Fraser Island Garrowea Creek	327	m	16	0.1737	3	0.0928
79	Fraser Island Garrowea Creek	370	m	2	0.0176	2	0.7509
80	Fraser Island North of Dili Village	330	f	6	0.044	13	NA
81	Fraser Island North of Dili Village	352	f	2	0.0209	1	0.0126
82	Fraser Island North of Dili Village	325	m	5	0.0337	1	0.0147
83	Fraser Island North of Dili Village	315	NA	2	0.1617	2	0.1103
85	Fraser Island Yidney Rocks	308	f	1	0.0214	6	NA

86	Fraser Island 200m North Poyungan Rocks	372	m	3	0.0439	12	NA
87	Fraser Island Yidney Rocks	344	m	3	0.0533	15	0.245
88	Fraser Island Yidney Rocks	326	f	25	0.3176	4	0.0408
89	Fraser Island Yidney Rocks	343	m	4	0.1065	2	NA
90	Fraser Island 200m North Poyungan Rocks	328	m	12	0.1289	3	NA
91	Fraser Island 200m North Poyungan Rocks	335	f	2	NA	6	0.0795
92	Fraser Island 200m North Poyungan Rocks	332	f	3	NA	1	NA
93	Fraser Island East Beach between Oak and Eurong	290	m	4	0.0709	6	0.1687
94	Fraser Island East Beach between Oak and Eurong	320	f	1	0.0219	1	0.018
95	Fraser Island East Beach between Oak and Eurong	358	m	1	0.012	3	0.757
96	Fraser Island East Beach between Oak and Eurong	328	f	1	0.0154	1	0.011
97	Fraser Island East Beach between Oak and Eurong	325	f	2	0.0668	0	NA
98	Fraser Island East Beach between Oak and Eurong	322	m	4	0.0281	3	NA
99	Fraser Island East Beach between Oak and Eurong	302	f	11	0.7458	2	NA
100	Fraser Island East Beach between Oak and Eurong	328	NA	0	NA	0	NA

101	Currumbin Wildlife Sanctuary	308	m	0	NA	1	0.027
102	Currumbin Wildlife Sanctuary	342	f	4	0.3095	5	0.1724
103	Currumbin Wildlife Sanctuary	308	m	2	0.0345	16	0.2105
104	Currumbin Wildlife Sanctuary	345	m	2	0.0917	0	NA
105	Currumbin Wildlife Sanctuary	302	f	5	0.0352	3	0.0321
106	Currumbin Wildlife Sanctuary	322	f	2	0.0161	6	0.0669
107	Currumbin Wildlife Sanctuary	311	f	3	0.0417	2	0.0431
108	Currumbin Wildlife Sanctuary	339	m	16	0.1483	15	NA
109	Currumbin Wildlife Sanctuary	359	m	0	NA	4	0.8592
110	Currumbin Wildlife Sanctuary	299	f	1	0.0252	4	0.068
111	Currumbin Wildlife Sanctuary	321	m	2	0.116	6	0.1301
112	Currumbin Wildlife Sanctuary	302	f	2	0.1692	1	0.0239
113	Currumbin Wildlife Sanctuary	333	m	0	NA	11	0.1724
114	Currumbin Wildlife Sanctuary	346	m	3	0.1069	2	0.02
115	Currumbin Wildlife Sanctuary	313	f	10	0.1411	0	NA
116	Currumbin Wildlife Sanctuary	311	f	3	0.0616	7	0.3934
117	Currumbin Wildlife	342	f	9	0.0626	7	0.143

	Sanctuary						
118	Currumbin Wildlife Sanctuary	315	m	9	0.0899	6	0.0519
119	Currumbin Wildlife Sanctuary	378	f	2	0.232	4	0.0786
120	Currumbin Wildlife Sanctuary	308	f	1	0.0093	4	0.054
121	Currumbin Wildlife Sanctuary	304	f	1	0.0033	13	0.2634
122	Currumbin Wildlife Sanctuary	352	m	20	0.2615	5	0.0408
123	Currumbin Wildlife Sanctuary	345	m	9	0.1668	10	0.11596
124	Currumbin Wildlife Sanctuary	365	m	13	0.1341	22	0.5485
125	Currumbin Wildlife Sanctuary	311	f	7	0.1352	7	0.133
126	Currumbin Wildlife Sanctuary	366	m	18	0.1412	14	0.144
127	Currumbin Wildlife Sanctuary	397	f	13	0.4001	14	0.3873
128	Currumbin Wildlife Sanctuary	367	m	0	NA	0	NA
130	Currumbin Wildlife Sanctuary	315	f	1	0.0261	1	0.0028
131	Currumbin Wildlife Sanctuary	352	m	6	0.2312	1	0.0479
132	Currumbin Wildlife Sanctuary	317	f	0	NA	3	0.1618
133	Currumbin Wildlife Sanctuary	338	f	5	0.0683	1	0.0128
134	Currumbin Wildlife Sanctuary	286	f	0	NA	2	0.0889
135	Currumbin	401	m	1	0.0063	5	0.259

	Wildlife Sanctuary						
136	Currumbin Wildlife Sanctuary	330	m	0	NA	3	0.0772
137	Currumbin Wildlife Sanctuary	325	m	2	0.0131	3	0.0222
138	Currumbin Wildlife Sanctuary	312	f	2	0.0454	0	NA
139	Currumbin Wildlife Sanctuary	330	f	2	0.086	11	NA
140	Currumbin Wildlife Sanctuary	300	f	1	0.0194	2	0.1088
141	Currumbin Wildlife Sanctuary	352	m	2	0.0271	1	0.0111
142	Currumbin Wildlife Sanctuary	310	m	13	0.138	3	0.1312
143	Currumbin Wildlife Sanctuary	357	m	10	0.129	16	0.1308
144	Currumbin Wildlife Sanctuary	336	f	0	NA	11	0.2101
145	Currumbin Wildlife Sanctuary	327	f	2	0.0658	6	0.2027
146	Currumbin Wildlife Sanctuary	352	f	2	0.0473	4	0.0574
147	Currumbin Wildlife Sanctuary	332	f	8	0.1522	13	0.346
148	Currumbin Wildlife Sanctuary	310	f	10	0.3257	18	0.6322
149	Currumbin Wildlife Sanctuary	400	m	0	NA	2	0.18
150	Currumbin Wildlife Sanctuary	350	f	5	0.0787	1	0.014
151	Currumbin Wildlife Sanctuary	312	f	8	0.1045	0	NA

152	Currumbin Wildlife Sanctuary	282	f	1	0.0106	5	0.07368
153	Currumbin Wildlife Sanctuary	323	m	2	0.02	2	0.027
154	Currumbin Wildlife Sanctuary	337	m	1	0.0035	1	0.0104
155	Currumbin Wildlife Sanctuary	330	m	8	0.1023	8	0.1067
156	Currumbin Wildlife Sanctuary	298	f	1	NA	9	0.198
157	Currumbin Wildlife Sanctuary	341	f	4	0.1129	6	0.0328
158	Currumbin Wildlife Sanctuary	333	m	5	0.2063	5	0.066
159	Currumbin Wildlife Sanctuary	318	f	0	NA	3	0.056
160	Currumbin Wildlife Sanctuary	289	f	2	0.1319	2	0.0461
161	Currumbin Wildlife Sanctuary	314	m	9	0.1062	8	0.0985
162	Currumbin Wildlife Sanctuary	306	f	1	0.0075	2	0.0247
163	Currumbin Wildlife Sanctuary	323	m	3	0.0719	8	1.1595
164	Currumbin Wildlife Sanctuary	308	f	3	0.0212	7	0.1187
165	Currumbin Wildlife Sanctuary	335	m	3	0.0626	5	0.0578
166	Currumbin Wildlife Sanctuary	NA	NA	0	NA	0	NA
167	Currumbin Wildlife Sanctuary	324	f	4	0.0276	4	0.035
168	Currumbin Wildlife	336	m	2	0.0147	8	0.1652

	Sanctuary						
169	Currumbin Wildlife Sanctuary	310	f	1	0.0167	4	0.1146
170	Currumbin Wildlife Sanctuary	328	m	0	NA	0	NA
171	Currumbin Wildlife Sanctuary	344	m	16	0.1812	6	0.1382
172	Currumbin Wildlife Sanctuary	323	m	4	0.0444	2	0.039
173	Currumbin Wildlife Sanctuary	305	m	5	0.0318	3	0.1065
174	Currumbin Wildlife Sanctuary	334	f	4	0.0888	3	0.0219
175	Currumbin Wildlife Sanctuary	318	f	16	0.1837	2	0.0332
176	Currumbin Wildlife Sanctuary	360	m	12	0.1219	3	0.0372
	TOTALS	172 birds		824 pieces of pumice	13.5g of pumice	885 pieces of plastic	21.2g of plastic

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