

# **Frigatebird census on Aldabra in 2013**

Report from the third annual survey

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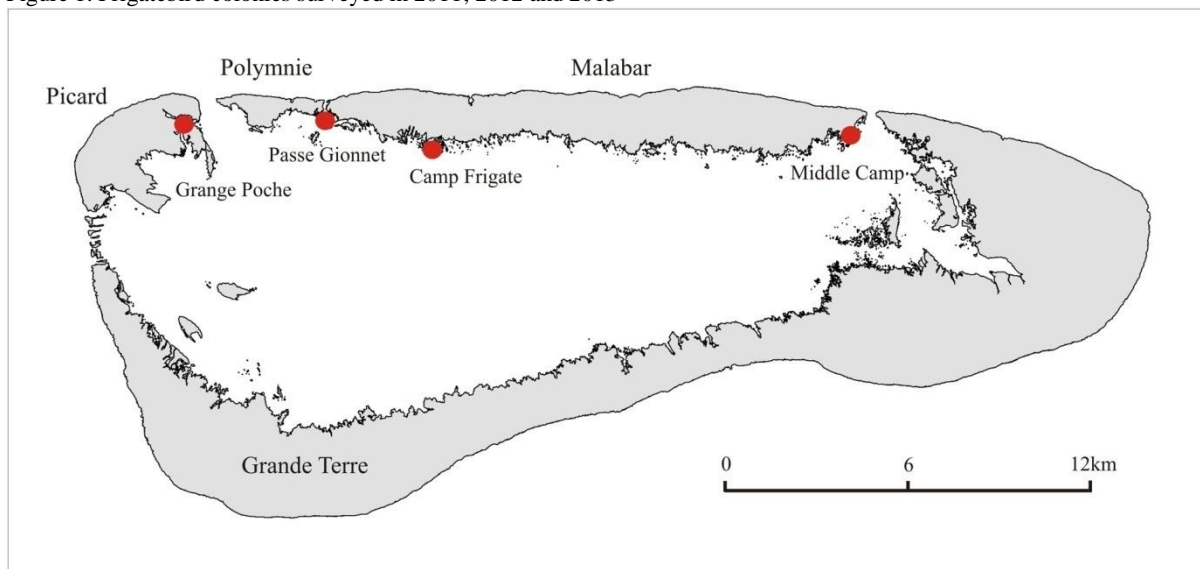
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# 1. Context and aims

Aldabra holds the largest frigatebird colony in Indian Ocean with at least 4400 pairs of greater frigatebirds *Fregata minor* and 6600 pairs of lesser frigatebirds *F. ariel* breeding annually (Sur *et al.* in press). There have been several studies on frigatebirds done on Aldabra (Diamond 1967–68, Reville 1976–77, Burger & Betts 2000) and in January 2011 an SIF initiated survey was performed which has been repeated in 2012 and 2013. Since 2011 the four known frigatebird colonies – Grande Poche, Passe Gionnet, Camp Frigate and Middle Camp (Figure 1.) – were annually surveyed using a simple, easily repeatable methodology that gives basic information about the number of nesting pairs and population development.

Figure 1. Frigatebird colonies surveyed in 2011, 2012 and 2013



The 2011 and 2012 surveys showed that there were at least 9891 (2011) and 5708 (2012) pairs of frigatebirds breeding on Aldabra. The numbers found in the 2011 survey were 10% higher than found in any of the surveys conducted before. The 2012 survey showed a 42% decrease in number of breeding frigatebirds compared to 2011 (see 2011 and 2012 report, Šur *et al.* (in press) for the calculation). These large fluctuations were not understood and additional surveys were needed in order to try and ascertain whether this constitutes a trend or not. Due to the complex breeding cycle of frigatebirds and simplified approach of the survey it was not possible to count the exact number of each species, only estimates on species composition were possible. Frigatebirds have a long breeding cycle and neither species breeds in an annual cycle. It takes 12–19 months for a pair to fully raise one chick. Due to this long breeding cycle the survey was repeated in 2012 and 2013 in order to get a more complete picture of the current population size, distribution and development. The previously published breeding cycle of both species is summarized in Tables 1 and 2. The figures are taken from Reville (1980).

Table 1. Breeding cycle of lesser frigatebirds (372–564 days), peak of egg-laying is marked with X

Period	Length (d)	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
laying/courting	14 d courting				X	X	X															
incubation	41 d																					
chick on nest	145–179 d																					
post-fledging	141–349 d																					

Table 2. Breeding cycle of greater frigatebirds (341–583 days), peak of egg-laying is marked with X

Period	Length (d)	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
laying/courting	15 d courting					X	X	X														
incubation	55 d																					
chick on nest	148–202 d																					
post-fledging	154–292 d																					

## 2. Methods used in 2013 survey

The 2013 survey was conducted between 29<sup>th</sup> January and 11<sup>th</sup> February. The survey was done mainly from boat at high tide. A small part of Middle Camp was surveyed by walking at spring low tide. Just over 24 hours were spent doing the complete survey (17.5 hours in 2011 and 2012). The longer time spent on performing the 2013 survey is partly due to more subcolonies being occupied by breeding frigatebirds and partly by some subcolonies being inaccessible by boat which required the team to walk into very shallow channels to count frigatebirds on foot. This time does not include travelling to the colonies and back. For more information on the biology of the species, details of previous censuses on Aldabra and the survey methodology used during the annual surveys see the 2011 and 2012 reports.

The survey in 2013 was conducted by a team of five people:

Janske van de Crommenacker – Aldabra Scientific Coordinator, navigation, mapping, counter (greater frigatebirds on nest)

Cathrina Onezia – Senior Ranger, counter (lesser frigatebirds on nests)

Arjan de Groene – Volunteer, counter (chicks on nest)

Murvin Green – boatman (*Caspian*)

Jude Brice – boatman (*Drongo*)

Two similar aluminium boats were used to survey the colonies. *Drongo* – 16 feet long with 25hp engine was used to survey Middle Camp colony. *Caspian* – also 16 feet long with 25hp engine was used to survey all other colonies. *Bizou* – 27 feet long boat with two 140hp engines was used for logistical support. All colonies were surveyed during spring high tide (High tide of 3.2m or more). Tide information and timing of survey can be found in Table 3.

*Camp Frigate, Grande Poche and Passe Gionnet (29<sup>th</sup> January – 2<sup>nd</sup> February)*

Due to severe fuel restrictions, it was decided to camp on Polymnie at the site of the old hut. All forays were done from that camp using *Caspian*, which was brought over from Picard through the lagoon. The rest of the team and supplies were shipped to the camp by *Bizou* via the outside of the lagoon.

*Middle Camp (10<sup>th</sup>–11<sup>th</sup> February)*

The camp was used as a base for the surveying team. The team and supplies were brought by *Bizou* via the outside of the lagoon. *Drongo*, already present at Middle Camp was used for the survey and was left there after completion of the survey.

Bras Takamaka, a colony active in 1960s, was not visited during the course of this survey since there were no frigatebirds observed during other monthly monitoring conducted in the area.

Table 3. Tides and timing of the survey in 2013

Date	Colony	Start of survey	Finish of survey	Relevant tides (Ile de Mayotte)*
29-1-2013	Camp Frigate	8:21	10:08	05:29 +3.7 H 11:44 +0.4 L
	Grande Poche	15:46 16:55	16:49 18:41	17:49 +3.5 H 23:52 +0.5 L
30-1-2013	Camp Frigate	7:25	10:25	05:58 +3.7 H 12:12 +0.4 L
	Grande Poche	16:40	18:55	18:19 +3.5 H
31-1-2013	Camp Frigate	7:33	10:44	06:29 +3.6 H 12:42 +0.5 L
	Passe Gionnet	17:23	19:15	18:50 +3.5 H
1-2-2013	Passe Gionnet	7:39	10:20	07:01 +3.4 H
	Camp Frigate	10:29	11:33	13:14 +0.6 L
2-2-2013	Camp Frigate	8:08	9:10	07:37 +3.2 H 13:50 +0.8 L
10-2-2013	Middle Camp	6:54	10:04	04:15 +3.8 H
	Middle Camp low tide	11:50	12:48	10:30 +0.3 L 16:38 +3.6 H
	Middle Camp	17:33	18:30	22:41 +0.3 L
11-2-2013	Middle Camp	17:26	17:40	17:14 +3.8 H 23:19 +0.3 L

\* Ile de Mayotte tides are 50 minutes earlier than the tides outside Aldabra Atoll

### 3. Results

A summary of the 2011, 2012 and 2013 survey is provided in Tables 4 and 5. For a full comparison of counted breeding pairs within the individual sub-colonies in the 2011, 2012 and 2013 surveys and maps see the Appendices.

It was unclear which exact calculation steps were used to divide chicks into greater or lesser frigatebirds in 2011 and 2012. According to previous reports the number of non-breeding adult frigatebirds on a subcolony was utilized to determine chick species, but as these were not surveyed in 2013 these numbers could not be used for this assessment. Therefore the 2013 chick species ratio was calculated based on the following data, in order of importance:

- 1: Comments on chick species composition documented during the survey
- 2: If no comment was made: ratio of adult breeding frigatebirds in the subcolony where the chicks were observed was used
- 3: If no comment was made and no adult breeding frigatebirds were observed, for the 2011 and 2012 surveys the ratio of non-breeding adult frigatebirds on the subcolony was used. For the 2013 survey the published ratio of species composition 60/40 (Lesser/Greater) was used (Reville 1983).

This method has its limitations as does not allow for temporal shifts in the breeding cycle between greater and lesser frigatebirds. Possibly one of the species is further along the breeding cycle with more lone chicks on nests compared to the other species where the parent, being earlier in the breeding cycle, may still be present and breeding on the nest. Also, in predominantly lesser frigatebird colonies the number of greater frigatebirds may be overestimated and vice versa.

However, to be able to compare 2013 figures with the numbers from 2011 and 2012 we recalculated the old data using the 2013 methodology. Table 5 shows the 2011 and 2012 numbers obtained by abovementioned calculation methodology.

Table 4. Comparison of counts and percentage of counts for the last three frigatebird surveys on Aldabra; 2011 and 2012 numbers based on previous calculations made for 2011 and 2012 reports (differences highlighted in yellow). The 2011 and 2012 calculations could not be repeated over the 2013 data.

		2011				2012				2013			
		Greater	Lesser	Chicks	Total	Greater	Lesser	Chicks	Total	Greater	Lesser	Chicks	Total
(A) <i>Estimated total population</i>	Adults	370	3034		3404 34.4%	384	2498		2882 50.5%	369	3999		4368 39.6%
	Chicks	2367	2005		4372 44.2%	1427	179		1606 28.1%	1570	2725		4295 39.0%
	Feeding	1461	654		2115 21.4%	843	377		1220 21.4%	1628	728		2356 21.4%
	Total	4198	5693		9891	2654	3054		5708	4400	6619		11019
(B) <i>Actual counts for individual colonies</i>	Grand Poche	136	520	779	1435 18.4%	74	413	381	868 19.3%	157	237	884	1278 14.8%
	Passe Gionnet	15	6	498	519 6.7%	14	57	221	292 6.5%	56	443	689	1188 13.7%
	Camp Frigate	125	1374	1160	2659 34.2%	151	1521	235	1907 42.5%	118	2829	739	3686 42.5%
	Middle Camp	94	1134	1935	3163 40.7%	145	507	769	1421 31.7%	38	490	1983	2511 29.0%
	Total	370	3034	4372	7776	384	2498	1606	4488	369	3999	4295	8663

Table 5. Comparison of counts and percentage of counts for the last three frigatebird surveys on Aldabra based on 2013 calculation method applied to 2011, 2012 and 2013 survey data (changes highlighted in yellow)

		2011				2012				2013			
		Greater	Lesser	Chicks	Total	Greater	Lesser	Chicks	Total	Greater	Lesser	Chicks	Total
(A) <i>Estimated total population</i>	Adults	370	3034		3404 34.4%	384	2498		2882 50.5%	369	3999		4368 39.6%
	Chicks	1844	2528		4372 44.2%	801	805		1606 28.1%	1570	2725		4295 39.0%
	Feeding	1461	654		2115 21.4%	843	377		1220 21.4%	1628	728		2356 21.4%
	Total	3675	6216		9891	2028	3680		5708	4400	6619		11019
(B) <i>Actual counts for individual colonies</i>	Grand Poche	136	520	779	1435 18.4%	74	413	381	868 19.3%	157	237	884	1278 14.8%
	Passe Gionnet	15	6	498	519 6.7%	14	57	221	292 6.5%	56	443	689	1188 13.7%
	Camp Frigate	125	1374	1160	2659 34.2%	151	1521	235	1907 42.5%	118	2829	739	3686 42.5%
	Middle Camp	94	1134	1935	3163 40.7%	145	507	769	1421 31.7%	38	490	1983	2511 29.0%
	Total	370	3034	4372	7776	384	2498	1606	4488	369	3999	4295	8663

Table 6. Overview and comparison of counted nests and estimated species composition per colony for the last three frigatebird surveys based on 2013 method for calculating ratio of greater vs lesser chicks.

		2011			2012			2013		
		Adult on nest	Chick on nest	Total nests	Breeding adults	Chick on nest	Total nests	Adult on nest	Chick on nest	Total nests
Lesser frigatebirds	Grand Poche	520	575	1095	413	221	634	237	417	654
	Passe Gionnet	6	166	172	57	76	133	443	362	805
	Camp Frigate	1374	663	2037	1521	94	1615	2829	580	3409
	Middle Camp	1134	1124	2258	507	410	917	490	1366	1856
	Total	3034	2528	<b>5562</b>	2498	801	<b>3299</b>	3999	2725	<b>6724</b>
Greater frigatebirds	Grand Poche	136	204	340	74	160	234	157	467	624
	Passe Gionnet	15	332	347	14	145	159	56	327	383
	Camp Frigate	125	497	622	151	141	292	118	159	277
	Middle Camp	94	811	905	145	359	504	38	617	655
	Total	370	1844	<b>2214</b>	384	805	<b>1189</b>	369	1570	<b>1939</b>

The 2013 spatial distribution of nesting birds was similar to the distribution found in 2011 and 2012 with one exception: A large shift of both greater and lesser breeding frigatebirds to Passe Gionnet was seen compared to earlier surveys. It was necessary to split up what used to be subcolony 9 in Passe Gionnet during the 2011 and 2012 surveys into six different subcolonies and add 18 new subcolonies which previously did not contain any birds.

Table 7. Changes in numbers of counts between the last three frigatebird surveys.

		% change 2011-2012	% change 2012-2013	% change 2011-2013
(A) <i>Estimated total population</i>	Adults	-15%	52%	28%
	Chicks	-63%	167%	-2%
	Feeding	-42%	104%	17%
	Total	-42%	95%	13%
(B) <i>Actual counts for individual colonies</i>	Grand Poche	-40%	47%	-11%
	Passe Gionnet	-44%	307%	129%
	Camp Frigate	-28%	93%	39%
	Middle Camp	-55%	77%	-21%
	Total	-42%	93%	11%

The same conversion factors were used to estimate the number of breeding pairs as in the 2011 and 2012 survey (Table 8). In line with the 2011 survey, the calculation is largely simplified and only total number of nests found was used to obtain the number of fledglings being fed. This calculation also assumes that the nesting species composition remained the same as in 1970s.

Table 8. Total breeding population based on 2011, 2012 and 2013 surveys.

	Species	pairs with eggs*	pairs feeding fledglings**	Total
2011	Lesser	5288	654	5942
	Greater	2488	1461	3949
	Total	7776	2115	<b>9891</b>
2012	Lesser	3052	377	3429
	Greater	1436	843	2279
	Total	4488	1220	<b>5708</b>
2013	Lesser	5891	728	6619
	Greater	2772	1628	4400
	Total	8663	2356	<b>11019</b>

\* Ratio of pairs on eggs was taken from Reville (1983), 68:32 (lesser:greater);

\*\* No. fledglings calculated using Reville's figures (assuming 11% of all breeding pairs of lesser were feeding fledglings and 37% of all breeding pairs of greater were feeding fledglings).  
(See 2011 report p10 for detailed explanation)

The conservatively estimated number of breeding frigatebirds on Aldabra in the 2011 survey was at least 11,000 pairs of frigatebirds (6,600 lesser and 4,400 greater) based on 7776 counted nests and 2115 pairs feeding fledglings, which is comparable to earlier surveys by Reville, Burger and Betts and Diamond. The actual total was considered to be even higher because it was based on Reville's numbers that did not include the birds hidden by vegetation and those undergoing post-nuptial moult during the laying season. This higher number may still be an underestimate because Reville's numbers represent breeding pairs at the peak of breeding season and the latest three surveys may not have been done in that peak. In 2012 the number of nests dropped by 42% compared to the 2011 figures.

Table 8 shows a total of 8663 counted nests and 2356 pairs feeding fledglings in the 2013 survey which would result in a conservative estimate of at least 12,200 pairs of breeding frigatebirds in 2013. This is higher than any of the surveys previously done on Aldabra.



## 4. Discussion

### 4.1 Yearly differences in overall number of nests

In the past only Reville in the 1970s conducted a frigatebird census on the whole of the atoll in two consecutive years. A summary of his field count (all pairs) conducted between August and November 1976 and 1977 is shown in Table 9. From detailed observations of sections of colonies Reville concluded that both species had an extended but fixed annual laying period, starting in April with lesser and in July with greater. 90% of greater eggs were laid between August and October, thus most of the eggs of greater were laid about four months after the lesser.

Table 9. Comparison of two consecutive counts of pairs done by Reville in 1976 and 1977.

Colony	Lesser frigatebird			Greater frigatebird		
	1976	1977	% change	1976	1977	% change
Middle Camp	57	291	+ 410%	1508	1315	- 13%
Camp Frigate	2817	2369	- 17%	204	190	- 7%
Passe Gionnet	131	101	- 23%	49	113	+ 131%
<b>Total*</b>	<b>3005</b>	<b>2761</b>	<b>- 8%</b>	<b>1761</b>	<b>1618</b>	<b>- 8%</b>

\* As opposed to the 2011-2013 surveys Reville included courting pairs in his counts

During Reville's study, the number of pairs breeding on Aldabra in 1976 was similar to the number in 1977. The overall decrease in his count from 1976 to 1977 was only 8% but species numbers in the individual colonies between these years changed by up to 410%. Substantial annual variability in the colonies on Aldabra was also recorded in the 2012 and 2013 survey.

A study done in four consecutive years on Europa Island in Mozambique Channel (Le Corre 2001) found both species of frigatebirds in all breeding stages all year round. Only two distinct periods with higher incubation activity were observed (highlighted in green in Table 10). Europa Island is located 22° S of the equator. Its climate is sub-arid but, similarly to Aldabra, dominated by two seasons – with a cool dry season from June to October and a warm humid season from November to May (Délépine, Mauge & Padovani, 1976 in Le Corre 2001).

Table 10. Frigatebird (G: greater; L: lesser) breeding activity on Europa Island (yellow – periods with all breeding stages, green – higher incubation activity)

Green = higher incubation activity																																																
Species	1993												1994												1995												1996											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D												
G																																																
L																																																

A reduction in nest numbers was recorded during the 2012 survey followed by an increase in numbers in the 2013 survey comparable to 2011 figures. This periodic fluctuation in breeding populations on Aldabra may be caused by food availability, but alternatively by leap-years in breeding due to a single breeding cycle spanning more than one year. Long term monitoring is required to confirm if a specific periodicity in the breeding cycle of frigatebirds exists on Aldabra and if so, what the time frame of this periodicity is.

### 4.2. Individual colonies

#### *Grande Poche*

This colony did not exist at the time of the last whole atoll survey done by Burger & Betts in 2000 or for any of the previous surveys. The first nests in the area were noticed in 2008 (C. Onezia, pers.

comm.). Breeding of greater frigatebirds at this colony was recorded for the first time in 2009 (survey results taken from Aldabra fileserver). Establishment of a breeding colony at Grande Poche was speculated to have been caused by the increased disturbance of Passe Gionnet colony by relatively large numbers of tourists in recent years. This may have resulted in shifting of part of the colony to Grande Poche area (comments of long term staff), which could have eventually attracted more birds from other colonies. In 2011 lesser frigatebirds were recorded breeding here for the first time and the total number of nests increased five times between 2010 and 2011. In 2012 the number of nests in Grande Poche dropped similarly as in other colonies on the atoll. In the 2013 survey the number of breeding frigatebirds dropped slightly compared to 2011, but only by a small margin.

#### *Passe Gionnet*

In 1967 there were more than 300 pairs of greater frigatebirds recorded breeding and no lesser frigatebirds at Passe Gionnet (Diamond 1975b). In the 1970s Reville recorded about 200 pairs of greater and 130 pairs of lesser breeding in this colony. In December 2009 there were no nesting lesser frigatebirds recorded here and only about 100 chicks were found which were probably all greater (data taken from Aldabra server). In 2011 six lesser adults on nests were recorded with potentially more nests that were recorded as “chicks”. In 2012 the number of lesser frigatebirds in this colony visibly increased but the overall number of nests (especially notable on number of chicks) dropped by 43%. The most noticeable change in the 2013 survey was the recolonisation of Passe Gionnet where the number of breeding frigatebirds increased by 307% compared to 2012 and 129% compared to 2011. This increase was mostly driven by the large number of chicks in that colony, but the increase of breeding adults was most pronounced for lesser frigatebirds: in 2011 only six lesser adults were seen breeding, in 2012 57 were seen and in 2013 this number had increased to 443 breeding lesser adult frigatebirds. It is possible that the combination of the low number of visitors over the last few years due to piracy threat and the change of viewing area from Passe Gionnet to Grand Poche had a major impact on the number of breeding frigatebirds in Passe Gionnet but other factors should not be discounted. Monitoring the colony for several more years would ascertain whether this increase is a long-term one.

#### *Camp Frigate*

After the Passe Gionnet colony the biggest increase in number of nesting frigatebirds was seen at Camp Frigate. Although the number of adult greater frigatebirds did not change over the years, the number of adult lesser frigatebirds increased from 1374 in 2011 to 1521 in 2012 and to 2829 in 2013. Typically, as shown in table 6, the number of estimated lesser chicks did not follow this trend, dropping from 663 in 2011 to 94 in 2012 and almost reaching 2011 numbers again in 2013 with 580 chicks estimated to be lesser frigatebirds. Although the number of lesser frigatebird chicks is a very rough estimate, it is clear that the trend differs from the adult numbers. This dissimilarity suggests that many of the breeding lesser frigatebirds were in a different stage of the breeding cycle in the Camp Frigate colony compared to previous years.

During the survey of Camp Frigate in 2012 it had also been noticed that, compared to 2011, lesser frigatebirds were at very early stages of nesting. At least one lesser nest was observed having an egg in it. Reville (1980) stated in his thesis that lesser frigatebirds on Aldabra have an extended but fixed annual laying period starting in April till the end of October. This, together with new nests found in March 2011, suggests that frigatebirds on Aldabra may be breeding all year round.

#### *Middle Camp*

Apart from the survey in 2011 the colony was surveyed in September 2006 by Weimerskirch *et al.* (2010) and in December 2009 by SIF staff. Despite different timing of the surveys it is possible to compare the numbers in this colony. A comparison of the last five Middle Camp survey results is provided in Table 9.

The total nest numbers suggest that the Middle Camp colony might have followed roughly a two year cycle. This could have been the case in all colonies on Aldabra in the recent years. Due to the shift in number of chicks vs number of breeding adult lesser frigatebirds and the limited number of surveys performed at the same time of year it is not possible to confirm this hypothesis for Middle Camp.

Table 11. Comparison of the five most recent frigatebird survey results done at Middle Camp.

Species	2006 (Sep)	2009 (Dec)	2011 (Jan)	2012 (Jan)	2013 (Feb)
Lesser	1364	700	1134	507	490
Greater	1027	328	94	145	38
Chicks	908	515	1953	769	1983
<b>Total</b>	<b>3299</b>	<b>1543</b>	<b>3163</b>	<b>1421</b>	<b>2511</b>

## 8. Recommendations

### 8.1. Annual Monitoring

Over the last three years the frigatebird colonies on Aldabra have been monitored annually using the same methodology. However, the reasons for the fluctuations in numbers of nesting frigatebirds between the years and the shift in nesting locations are not understood. To be able to identify any long term patterns or trends in breeding frigatebird distribution and to assess whether the recent shift to Passe Gionnet is related to prior visitor disturbance (which currently is virtually non-existent), this survey needs to be continued for at least several years.

For part of this survey the team camped on Polymnie for several days which saved a lot of time, fuel and manpower as opposed to travelling back and forth from Picard every day and should be considered in future surveys.

Additionally, in future surveys the methodology used for estimating chick species composition needs to be harmonised. The calculation methods used in the recent surveys require the surveyors to identify the difference between chick species and document that during the survey, but this is near impossible for untrained staff, (staff specifically trained in frigatebird chick identification is not routinely available on Aldabra). In addition, there will most likely be an observer bias based on individual identification expertise. It should be recognised that the most important goal of these surveys is being able to compare results over the years using identical and repeatable methodologies and if changes to methodology are proposed SIF should consider (and if needed test) long term feasibility of that proposal before discontinuing previous methods.

### 8.2. Study of breeding cycle of Aldabra frigatebirds

The outcome of the recent surveys raises a question about the breeding cycle of frigatebirds on Aldabra. In the 1970s Reville proposed that the breeding cycle of lesser frigatebirds is long but with a fixed start at the beginning of April. Finding new nests in early March 2011 and the very early breeding stage of most of the Camp Frigate colony in January 2012 strongly suggests that frigatebirds on Aldabra breed all year round. Additionally, the 33% increase in total number of adult breeding lesser frigatebirds still on nests compared to 2011 (62.5% increase compared to 2012) where the number of adult greater frigatebirds seems to be reasonably stable over the years might indicate that the breeding cycle of frigatebirds may not be as fixed as previously suggested. The establishment of the Grande Poche Colony in recent years, and its size, makes it possible to study Aldabra frigatebirds more closely, because it is fairly close to the Station and thus easier to monitor. A study that would record all breeding stages for the whole colony on a monthly basis and spanning at least two years would provide data that would result in a better understanding of the breeding cycle of frigatebirds on Aldabra. The counts should be done once a month for the whole colony using a kayak to minimise disturbance with mapping and recording of all breeding stages for each species (number of displaying males, incubating adults, adults feeding chicks, dependent juveniles, independent juveniles). Such a study could be made a personal project of one or two rangers who show keen interest. Alternatively, several smaller, representative sections of the colony could be selected and specific nests could be monitored on a monthly basis. In addition to assessing the successful breeding cycle of individual birds this will also give an indication of number of failed nests.

## 8.5. Tourism recommendations

Since frigatebirds started breeding in Grande Poche area in 2009 we concur with the previous report and Sur *et al.* (in press) that it would be wise to use only this colony for tourism purposes and avoid Passe Gionnet. Grande Poche colony is more convenient for tourist visits not only because it is closer to the Station but due to its location and shape there are no narrow channels and strong currents and it is easier to keep a reasonable distance from nesting birds. Although not definitive, the results of the 2013 survey support this by showing that the number of breeding frigatebirds in Passe Gionnet colony increased substantially after a period of very low tourist activity. It is important to realise that the wildlife and nature conservation comes first on Aldabra. As long as the revised rules proposed in the 2012 report and in Sur *et al.* (in press) are strictly followed, colony viewing can continue to be part of the full Aldabra experience for the visitors.

As a means of generating understanding of the severity of frigatebird disturbance consider showing visitors and new staff a video of a breeding frigate being chased off her nest by human disturbance and the resulting destruction of her nest within seconds by unpaired males stealing nest material, if at all possible using existing footage.

## 9. Conclusions

- There are four frigatebird colonies on Aldabra at present – Passe Gionnet, Camp Frigate, Middle Camp and a new colony at Grande Poche, with *ca.* 1400 nests recorded, which was established in the last five years. The Bras Takamaka colony has not been active since the 1960s.
- At least 12,200 pairs of frigatebirds bred on Aldabra in the 2012/2013 season. The species ratio was estimated to be roughly the same as the previous years (60% lesser and 40% greater) amounting to *ca.* 7300 lesser and 4900 greater breeding pairs of frigatebird. This is 11% more than found during the previous surveys and affirms Aldabra's position as the biggest frigatebird breeding colony in the Indian Ocean.
- There is considerable yearly variability in the number of nesting birds, possibly depending on food availability in the region. This was reflected in the 42% decrease in number of nests from 2011 to 2012 followed by an increase of 93% in nests from 2012 to 2013.
- Aldabra's frigatebirds do not seem to have a fixed start of breeding as found in the previous surveys but are likely to breed year-round with pronounced peaks of egg-laying. A more detailed study is needed to confirm this.
- The 2013 survey shows that the number of nests in the Passe Gionnet colony has increased significantly. Since it has been proposed that the increase is the result of decreased tourist activity it is important to monitor this colony to verify the longevity and extent of this increased nesting activity, and provide evidence that Aldabra's nesting frigatebirds are vulnerable to human disturbance and the colonies should be treated as sensitive.

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## Appendices

### *Appendix 1. Survey results per colony*

#### 1. 2013 Survey results from Grande Poche colony compared with 2012 and 2011 survey

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
GP1	14	0	7	GP1	79	0	0	GP4	101	33	51
GP2	13	0	1	GP2	37	0	0				
GP3	26	6	32	GP3	25	0	14	GP5	42	6	56
GP4	6	0	8	GP4	13	0	5				
GP5	31	0	33	GP5	13	0	0				
GP6	4	0	8	GP6	3	0	12	GP6	5	3	60
GP6A	11	1	32								
GP6B	21	4	75	GP7	14	2	30				
GP6C	0	0	1	GP8	6	0	0				
GP8	1	0	0								
GP7	0	0	3	N/A	0	0	0	N/A	0	0	0
GP9	34	95	17	GP9	11	12	75	GP7	24	10	125
GP9A	1	0	0								
GP9B	7	0	15	N/A	0	0	0	N/A	0	0	0
GP10	7	11	48	GP10	12	3	26	GP8	34	16	95
GP11	2	4	39	GP11	0	0	27				
GP11A	0	0	6	N/A	0	0	0	N/A	0	0	0
GP12	0	1	15	GP12	0	1	3	N/A	0	0	0
GP11C	0	0	1	GP13	11	0	12	GP9	28	1	30
GP12A	1	0	0								
GP13	0	0	24								
GP13A	0	0	2								

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
GP14A	1	0	1								
GP14	6	8	130	GP14	35	17	23	GP10	56	6	112
GP15	12	0	60	GP15	8	2	20				
GP15A	0	0	0	N/A	0	0	0	N/A	0	0	0
GP15B	0	0	2								
GP16	20	4	127	GP16	17	5	56	GP11	64	16	102
GP16A	0	0	1	N/A	0	0	0	N/A	0	0	0
GP16B	0	0	2								
GP16C	0	0	1								
GP17	15	0	5	GP17	48	0	0	GP3	14	13	10
GP18	1	0	1	GP18	24	0	1	N/A	0	0	0
GP19	0	0	3	GP19	9	0	0				
GP20	0	1	11	GP20	34	11	36	GP1	86	11	112
GP20B	0	0	8								
GP20C	0	0	7								
GP20D	1	2	60								
GP20A	0	0	1	N/A	0	0	0	N/A	0	0	0
GP21	2	20	97	GP21	14	21	41	GP2	66	21	26
<b>Total</b>	<b>237</b>	<b>157</b>	<b>884</b>	<b>Total</b>	<b>413</b>	<b>74</b>	<b>381</b>	<b>Total</b>	<b>520</b>	<b>136</b>	<b>779</b>
Total nests			<b>1278</b>	Total nests			<b>868</b>	Total nests			<b>1435</b>

## 2. 2013 Survey results from Passe Gionnet colony compared with 2012 and 2011 survey

Subcolony No. in 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
PG1	1	0	3	PG1	0	0	1	GF2	0	12	225
PG2	3	8	31	PG2	0	4	22				
PG3	12	13	83	PG3	0	2	12				
PG4	61	11	124	PG4	3	3	68				
PG4B	8	2	19	N/A	0	0	0	N/A	0	0	0
PG5	30	0	25	PG5	5	0	8	GF3	6	3	90
PG6	16	0	0	PG6	4	0	0				
PG7	3	0	14	PG7	0	0	5	GF1	0	0	11
PG8A	37	1	53	PG8	45	5	55	PG2	0	0	104
PG8B	121	10	144								
PG13	0	0	6	PG9	0	0	50	PG1	0	0	68
PG14	0	0	11								
PG15	0	0	5								
PG16	1	7	23								
PG22	12	1	42								
PG26	0	0	2								
PG10	112	0	23	N/A	0	0	0	N/A	0	0	0
PG11	0	0	1								
PG12	0	0	4								
PG17	0	0	3								
PG18	0	0	1								
PG19	0	1	2								
PG20	0	0	2								
PG21	0	0	5								
PG23	0	0	3								
PG24	2	0	18								
PG25	0	0	2								



Subcolony No. in 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
PG27	6	0	0								
PG28	0	0	20								
PG29	1	0	1								
PG30	8	0	0								
PG31	1	0	0								
PG46	8	2	19								
<b>Total</b>	<b>443</b>	<b>56</b>	<b>689</b>	<b>Total</b>	<b>57</b>	<b>14</b>	<b>221</b>	<b>Total</b>	<b>6</b>	<b>15</b>	<b>498</b>
Total nests			<b>1188</b>	Total nests			<b>292</b>	Total nests			<b>519</b>

### 3. 2013 Survey results from Camp Frigate colony compared with 2012 and 2011 survey

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
CF1	0	1	2	CF1	0	1	1	CF1	0	0	3
CF1A	3	0	8	CF2	1	1	1	CF2	0	0	4
CF3	6	2	36	CF3	0	8	14	CF3	0	0	6
CF4	2	0	0	CF4	5	0	0	CF9	1	4	42
CF4A	1	0	0	N/A	0	0	0	N/A	0	0	0
CF5	6	0	15	CF5	0	3	10	CF10	0	5	73
CF6	2	0	61	CF6	0	2	6				
CF5A	3	0	0	N/A	0	0	0	N/A	0	0	0
CF7	42	0	12	CF7	14	9	14	CF11	4	5	60
CF8	57	0	0	CF8	36	0	0	CF43	14	0	0
CF8A	3	0	0	N/A	0	0	0	N/A	0	0	0
CF9	11	0	0	CF9	8	0	0	N/A	1	0	0
CF9A	41	0	0	N/A	0	0	0	N/A	0	0	0
CF10	107	0	22	CF10	20	0	0	N/A	0	0	0
CF12	3	0	16	CF11	6	7	6	CF12	1	2	19
				CF12	7	0	0				
CF13	9	0	20	CF13	0	5	5	CF13	1	12	120
CF14	15	0	0	CF14	6	16	28				
CF15	22	0	0	CF15	10	0	0	N/A	0	0	0
CF15A	0	0	82					N/A	0	0	0
CF16	10	0	0	CF16	3	0	0	N/A	0	0	0
CF17	24	0	1	CF17	2	3	9	CF14	0	1	33
CF18	5	0	21	CF18	0	2	5				
CF17A	5	0	0	N/A	0	0	0	N/A	0	0	0
CF17B	1	0	0	N/A	0	0	0	N/A	0	0	0
CF17C	3	0	0	N/A	0	0	0	N/A	0	0	0
CF19	7	0	0	CF19	44	0	0	CF15	115	0	0

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
CF19A	1	0	0								
CF20	17	0	0	CF20	10	0	0	CF16	12	0	7
CF21	70	0	14	CF21	23	0	1		7	1	7
CF21A	18	0	0	N/A	0	0	0	N/A	0	0	0
CF22	17	0	0	CF22	21	1	0	CF17	2	0	6
CF22A	22	0	0	N/A	0	0	0	N/A	0	0	0
CF23	12	0	0	CF23	11	0	0	CF19	17	0	0
CF24	12	0	1	CF24	2	0	0	CF18	23	4	61
CF25	114	5	41	CF25	51	8	1				
CF26	75	0	1	CF26	58	0	0				
CF26A	11	0	0	N/A	0	0	0	N/A	0	0	0
CF27A	38	0	2	CF27	5	0	1	N/A	0	0	0
CF28	102	1	63	CF28	99	6	14	CF21	171	9	73
CF27	98	0	10	CF29	78	2	4	CF20	72	4	23
CF27C	35	0	0	N/A	0	0	0	N/A	0	0	0
CF30	44	1	56	CF30	0	13	1	CF22	33	8	76
CF31	32	0	0	CF31	15	0	0				
CF32	124	0	2	CF32	54	0	1	CF25	129	8	59
CF33	21	0	25	CF33	0	4	6				
CF34	38	0	0	CF34	92	0	0				
CF35	38	45	6	CF35+CF36	44	25	16	CF24	51	14	72
CF36	33	0	4								
CF37	47	0	2	CF37	67	0	1	CF26	28	0	0
CF38	13	0	0	CF38	22	0	0	N/A	0	0	0
CF38A	2	0	0	N/A	0	0	0	N/A	0	0	0
CF38B	1	0	0	N/A	0	0	0	N/A	0	0	0
CF39	36	0	8	CF39	21	0	0	CF36	27	1	8
CF40	24	0	0	CF40	3	0	0	CF34	3	0	0
CF40A	7	0	0	N/A	0	0	0	N/A	0	0	0

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
CF41	22	0	0	CF41	12	0	0	CF35	1	0	0
CF42	123	0	11	CF42	29	0	3	CF32	19	4	27
CF43	21	0	15	CF43	14	0	1	CF30	22	6	15
CF44	7	0	11	CF44	4	3	2	CF31	34	7	60
CF44A	5	0	0	N/A	0	0	0	N/A	0	0	0
CF44B	7	0	0	N/A	0	0	0	N/A	0	0	0
CF45	109	0	15	CF45	146	4	3	CF29	142	2	32
CF45A	84	0	6								
CF46	91	0	6	CF46	73	0	0	CF28	159	3	24
CF47A	47	0	1	CF47	127	1	0	CF27 + CF33	118	2	34
CF47B	132	0	20								
CF47C	4	0	0	N/A	0	0	0	N/A	0	0	0
CF48	0	0	0	CF48	1	0	0	N/A	0	0	0
CF49	18	0	19	CF49	23	2	8	CF23	32	3	27
CF50	6	0	0	CF50	4	0	0	N/A	0	0	0
CF51	27	0	0	CF51	22	0	0	N/A	0	0	0
CF52	3	0	0	CF52	3	0	0	N/A	0	0	0
CF53	4	0	0	CF53	1	0	0	N/A	0	0	0
CF54	0	1	7	CF54	0	0	3	CF38 + CF37	0	2	3
CF54A	0	0	1	N/A	0	0	0	N/A	0	0	0
CF55	12	0	0	CF55	16	0	0	CF39	1	0	0
CF56	18	0	0	CF56	18	0	0	CF40	79	0	0
CF57	6	0	8	CF57	8	10	30	CF41	4	6	74
CF57A	37	0	2								
CF57B	1	55	5								
CF58	9	0	0	CF58	3	0	0	CF42	1	0	13
CF59	108	0	4	CF59	52	0	0	CF8	23	0	0
CF60	49	0	3	CF60	20	0	0				

Subcolony No. In 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
CF61	39	0	0	CF61	12	0	1	N/A	0	0	0
CF62	14	0	0	CF62	15	0	0	CF6	9	0	0
CF63	23	0	0	CF63	12	0	0				
CF64	203	7	61	CF64	45	11	38	CF7	13	8	80
CF65	78	0	7	CF65	23	4	1	CF5	5	4	19
CF66	31	0	0	N/A	0	0	0	N/A	0	0	0
CF67	1	0	6	N/A	0	0	0	N/A	0	0	0
<b>Total</b>	<b>2829</b>	<b>118</b>	<b>739</b>	<b>Total</b>	<b>1521</b>	<b>151</b>	<b>235</b>	<b>Total</b>	<b>1374</b>	<b>125</b>	<b>1160</b>
Total nests			<b>3686</b>	Total nests			<b>1907</b>	Total nests			<b>2659</b>

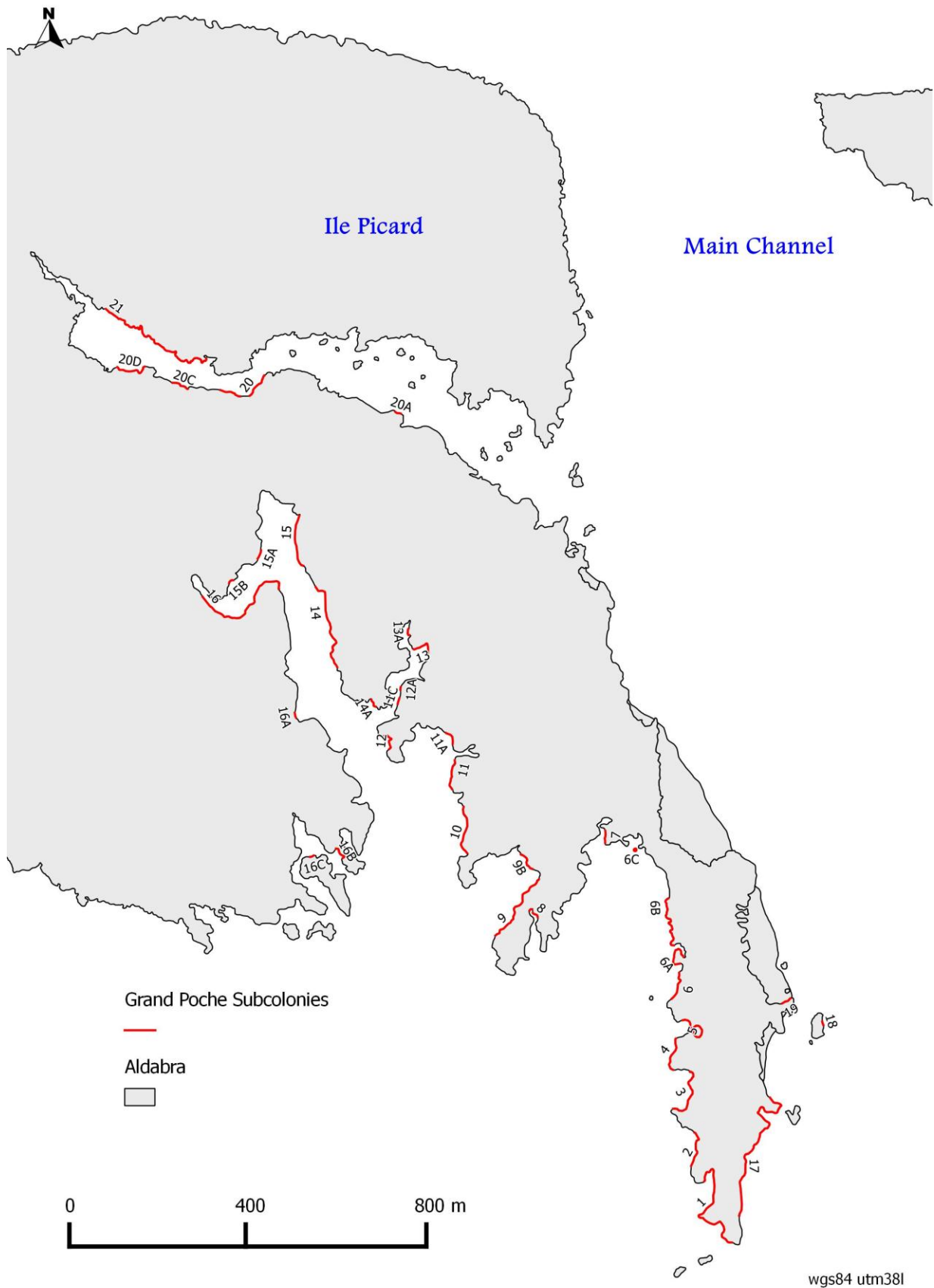
#### 4. 2013 Survey results from Middle Camp colony compared with 2012 and 2011 survey

Subcolony No. in 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
MC1	0	0	10	MC1	0	1	8	MC20	0	5	29
MC2	0	0	14	MC2	0	1	11	MC21	0	0	20
MC3	0	0	3	MC3	0	0	5	MC22	0	0	11
MC4	5	1	40	MC4	0	1	24	MC23	0	3	39
MC5	13	5	64	MC5	0	4	27	MC5	2	1	122
MC6	0	1	8	MC6	0	5	5	MC5.1			
MC5,5	0	0	1	N/A	0	0	0	N/A	0	0	0
MC7	11	1	47	MC7	2	7	20	MC24	0	5	78
MC7A	0	0	1								
MC7,5	0	0	3	N/A	0	0	0	N/A	0	0	0
MC8	3	0	11	MC8	0	2	2	MC25	3	1	21
MC6,5	0	0	15	MC9	0	0	2	N/A	0	0	0
MC10	16	2	138	MC10	0	13	29	MC6	0	5	105
MC11	16	1	49	MC11	0	2	17	MC28	4	2	39
MC12	20	8	81	MC12	0	10	20	MC27	0	6	68
MC13	3	0	16	MC13	0	0	1	MC7	0	1	26
MC14	141	0	261	MC14	0	3	18	MC8	7	7	62
MC15	26	3	31	MC15	16	9	13	MC29	3	5	24
MC16	0	0	16	MC16	2	9	11	MC30	0	6	39
MC17	35	4	103	MC17	36	16	46	MC31	37	7	101
MC18	6	0	8	MC18	10	2	11	N/A	0	0	0
MC18,5	1	0	1	N/A	0	0	0	N/A	0	0	0
MC19	35	0	21	MC19	16	4	16	MC32	11	1	23
MC20	78	2	191	MC20	123	2	63	MC9	123	11	188
MC21	55	1	72	MC21	44	7	28				
MC22	0	0	6	MC22	5	0	3	MC10 - MC11	115	0	113
MC23	0	0	4	MC23	5	1	7				

Subcolony No. in 2013	Number of birds in 2013			Subcolony No. in 2012	Number of birds in 2012			Subcolony No. in 2011	Number of birds in 2011		
	Lesser	Greater	Chick		Lesser	Greater	Chick		Lesser	Greater	Chick
MC23A	0	0	5	N/A	0	0	0	N/A	0	0	0
MC24	1	0	35	MC24	2	1	9	MC34	59	0	54
MC25	1	0	48	MC25	44	3	23	MC10 - MC11	0	0	0
MC25A	0	0	14	N/A	0	0	0	N/A	0	0	0
MC26	0	1	94	MC26	11	5	54	MC1	14	2	89
MC27	19	1	53	MC27	41	8	42	MC2	39	3	49
MC28	0	0	8	MC28	0	2	15	MC3	18	2	22
MC28A	0	0	10								
MC28B	0	0	2	N/A	0	0	0	N/A	0	0	0
MC28C	0	0	11								
MC29	0	0	37	MC29	0	2	22	MC4	0	4	44
MC30	0	2	26	MC30	0	2	13	MC12	0	2	59
MC30A	0	0	1								
MC31	0	0	82	MC31	1	5	39	MC13	2	5	121
MC32	0	0	2	MC32	11	0	0	MC14 - MC15	97	2	45
MC33	0	0	46	MC33	10	4	27				
MC34	0	0	26	MC34	0	2	7				
N/A	0	0	0	MC35	0	0	1	MC17	0	0	10
MC36	1	2	85	MC36	78	2	42	MC33	343	0	103
MC37	4	3	168	MC37	44	6	76	MC18 - MC19	253	8	206
MC38	0	0	8	MC38	6	0	8	MC35	4	0	13
MC39	0	0	7	MC39	0	4	4	MC36	0	0	12
<b>Total</b>	<b>490</b>	<b>38</b>	<b>1983</b>	<b>Total</b>	<b>507</b>	<b>145</b>	<b>769</b>	<b>Total</b>	<b>1134</b>	<b>94</b>	<b>1935</b>
			<b>2511</b>	Total nests			<b>1421</b>	Total nests			<b>3163</b>

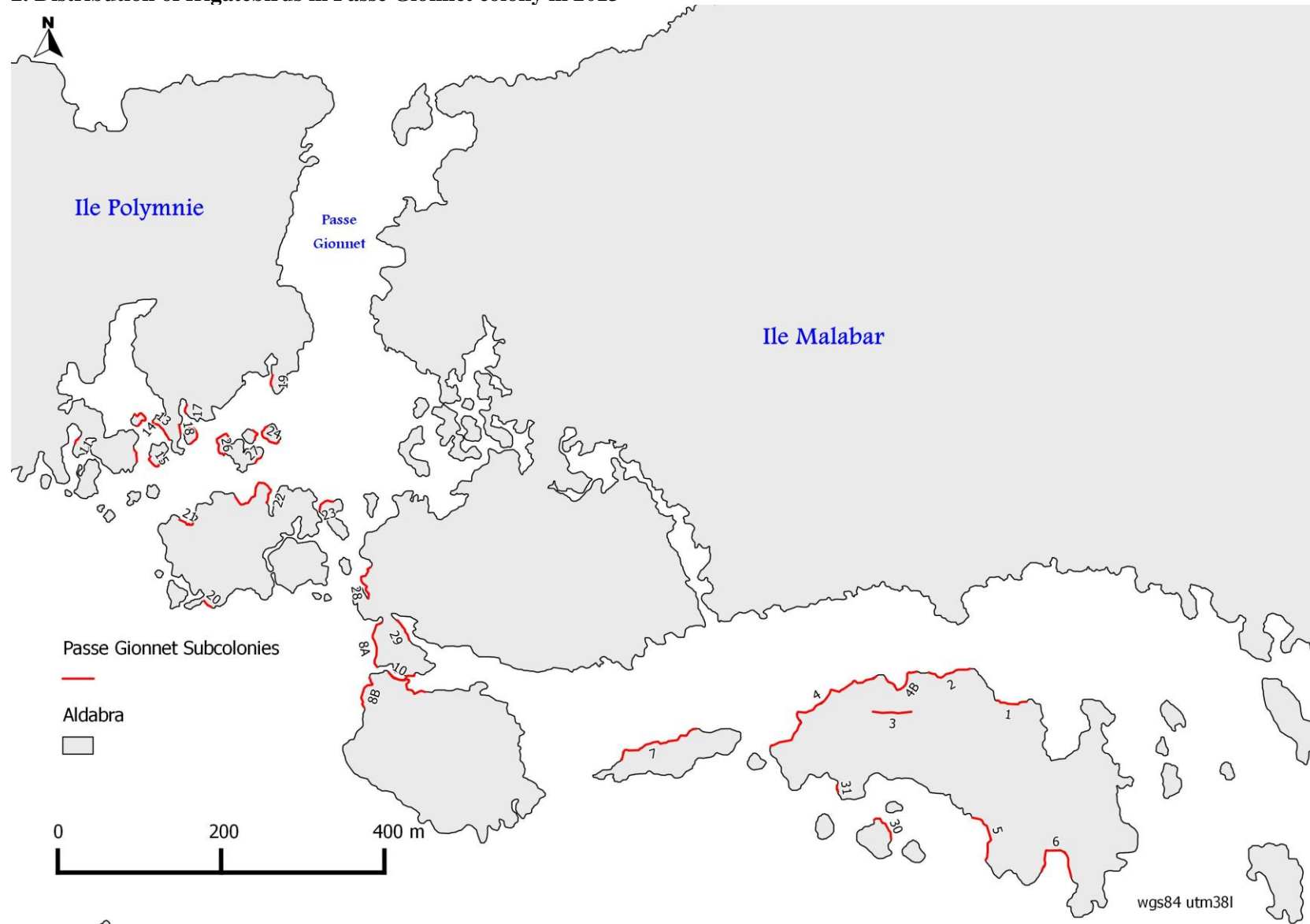
## Appendix 2. Colony maps

### 1. Distribution of frigatebirds in Grande Poche colony in 2013

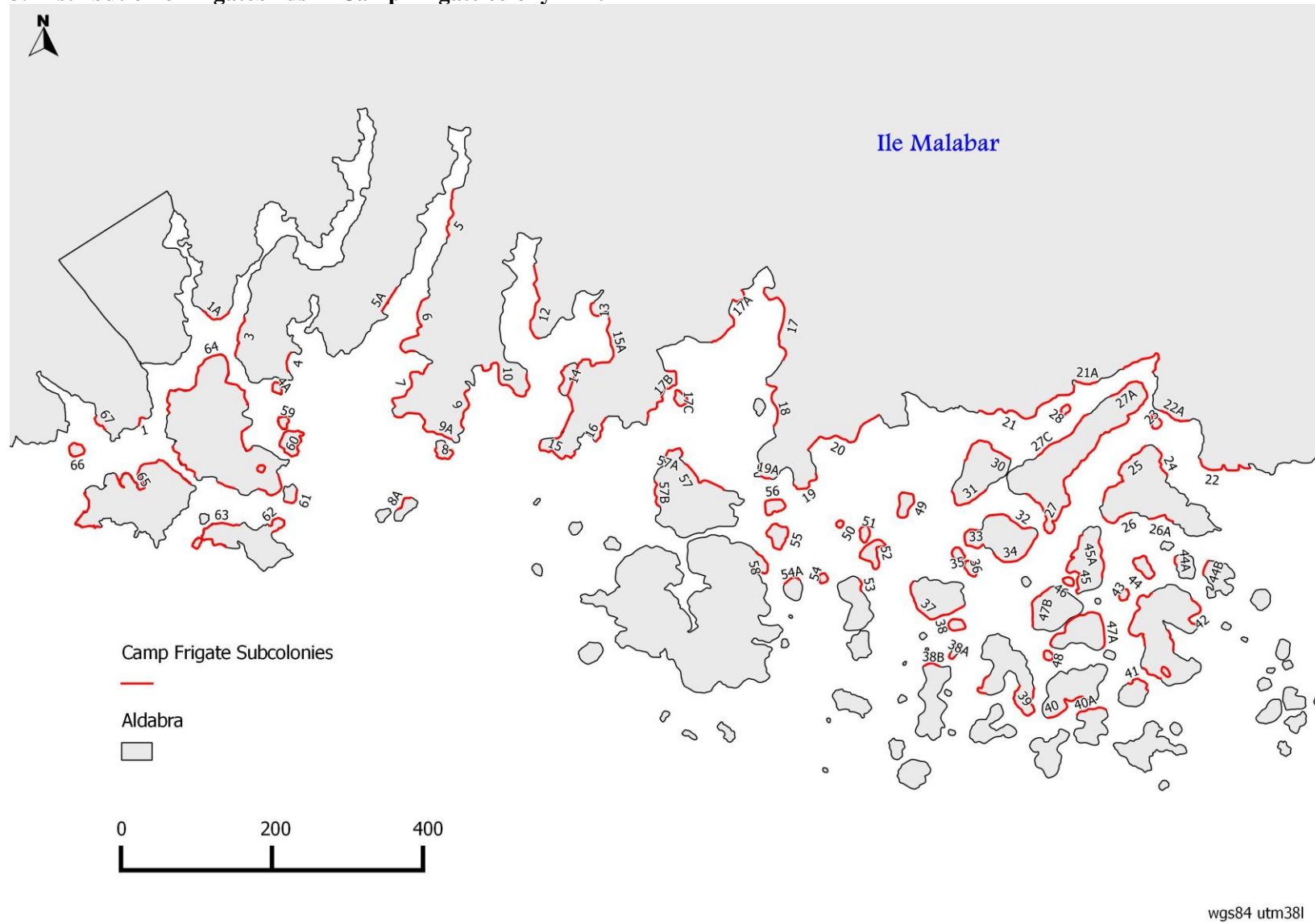




## 2. Distribution of frigatebirds in Passe Gionnet colony in 2013



### 3. Distribution of frigatebirds in Camp Frigate colony in 2012



#### 4. Distribution of frigatebirds in Middle Camp colony in 2012

