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Environmental Management Division

St Helena Seabird Report

2004-2011

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Executive Summary

- St Helena's seabird monitoring programme was initially set up in 2005 thanks to an Overseas Territories Environment Programme (OTEP) funded project. This review concentrates on analysing all seabird data collected between 2004-2011.
- Colony and nest monitoring was conducted on an approximate monthly basis. A six monthly count was also conducted around the whole of St Helena's coast.
- Ad hock sightings of seabirds from members of the public were recorded using the Marine Sightings Scheme.
- The information gathered from placing an individually numbered metal ring on a bird's leg otherwise known as "Ringing" also fed into the seabird monitoring programme.
- In total the Marine Section went out in the boat 160 times conducted 168 nest searches and 125 land surveys from 2004-2011.
- A total of 1930 individual nests were monitored on three main sites; Egg Island, Thompson's Valley Island and Peaked Island.
- Black Noddies (*Anous minutus*) were the most abundant and brown boobies (*Sula leucogaster*) were the least abundant seabird species on St Helena.
- Breeding seasons and nesting and fledging success rates were calculated for fairy terns (*Gypis alba*), brown noddies (*Anous stolidus*), Madeiran storm petrels (*Oceanodroma castro*), masked boobies (*Sula dactylatra*) and red-billed tropicbirds (*Phaethon aethereus*) however the sample size for some species and years were very small.
- A total of 112 seabirds were ringed and there were 197 seabird sightings reported from 2004-2011.
- The black noddy and red-billed tropicbird populations are potentially internationally important.
- There is evidence to suggest St Helena's Madeiran storm petrel population warrants recognition as a separate species which would be St Helena's only endemic seabird and of international conservation importance.
- The re-colonisation of masked boobies onto St Helena's mainland despite the presence of cats is a very rare event and data from monitoring work clearly shows the size of the mainland colony is increasing. Understanding the reasons behind it, together with the successes and failures of the attempt is of global interest to seabird ecology.
- The data analysis has highlighted many data gaps, notably for sooty terns, red-billed tropicbirds and Madeiran storm petrels which pose difficulties in monitoring accurately using conventional methods. Species targeted approaches are needed to address these separately.

- Other data gaps include basic information about the offshore islands, specifically Speery, Shore and George Island which probably hold the highest abundance and diversity of breeding seabirds.
- Colonies that have been identified as of high importance for continued monitoring are Speery Island, Thompson Valley Island, Peaked Island and the mainland cliffs opposite Peaked Island, Egg Island, Shore and George Island, Great Stone Top, James Bay to Rupert's Bay, Lots' Wife and Blue Point.
- St Helena's future seabird monitoring programme should be scheduled a minimum of a year in advance and include detailed contingency plans. It should set precise recording codes and procedures to maintain consistency and use specific species targeted approaches to address identified data gaps.
- The establishment of the St Helena Ringing Scheme and continued use of the Marine Sightings Scheme should form important elements to the revised monitoring programme.

1 Background

St Helena's unique position in the South Atlantic is potentially home to significant populations of some seabird species and therefore of global conservation importance. Seabirds are often used as an indicator of the health of the marine environment but despite the potential importance St Helena's seabirds had been poorly studied prior to 2004. Research had mainly concentrated on a few species within a short time frame (Rowlands *et al.* 1998, Stonehouse, 1963). No constant monitoring had been conducted to establish baseline data on the seabird populations which is essential to be able to effectively protect and conserve species. St Helena's Seabird Monitoring Programme was set up in 2005 thanks to an Overseas Territories Environment Programme (OTEP) funded project (STH001) "A Monitoring Scheme and Awareness Programme for Seabirds and Turtles at St Helena". A series of preliminary surveys were conducted in 2004 to establish the extent of the seabird colonies and access the feasibility of establishing a monitoring programme for seabirds and turtles on St Helena (George, 2005). It was hoped that the monitoring programme would collect essential baseline data on the seabird populations to determine their breeding seasons and population status. The monitoring programme continued throughout the two year project by the Marine Section and continued until the "Pause and Review" in the New Environmental Management Division in March 2012. This review concentrates on analysing all seabird data collected between 2004-2011 to identify breeding seasons and population trends. Assessment of the effectiveness of the methods used, identifying data gaps and priorities for future monitoring will also be highlighted.

2 Methods

2.1 Colony Monitoring

Colony counts were conducted on an approximately monthly basis. Colonies were either observed from a boat or from set land observation points. Two observers counted the number of birds independently using a clicker if in large numbers, then a mean of the two counts were recorded on specific recording sheets for the colonies. One species at a time was counted and birds were observed using Fujinon 7x50 binoculars or through a Nikon 30x60 field scope to determine their activity on the colony e.g. nesting, roosting etc. A full list of activity codes and their description are given in Appendix 1. If adverse weather conditions were encountered, where possible the count was postponed until the weather did not impede the observations. A map of all the main monitoring locations are given in Appendix 2.

2.2 Nest Monitoring

Nest monitoring started in 2004 on three main offshore islands; Thompson's Valley Island, Peaked Island and Egg Island. West Rocks Red-billed Tropicbird colony was also briefly monitored in 2004/05. Lot's Wife nest monitoring started in 2009 and Blue Point started in 2010. Nest monitoring was conducted on an approximately monthly basis throughout the year.

Each individual nest was given a laminated numbered tag that was secured to a nearby rock or vegetation. Each new nest was given a new number. The content of each nest was evaluated and the number of adults from the incubating pair present, number of eggs and chicks present and the approximate stage of chick growth defined by the coding system (Appendix 1) were then recorded on a record sheet using the appropriate code. Where possible a GPS reading was taken of the nest location. However if, for example, nests were close together several nest locations were grouped in one GPS location. Egg Island was divided up into four quadrants to help in separating out nest locations and to assist in relocating nests each visit. Each nest was then revisited approximately on a monthly basis until the hatching/fledging success was known. On Thompson's Valley Island, Peaked Island and Egg Island the whole island was searched for nests each time nest monitoring was conducted.

Due to poor access at West Rock, trial photographic nest monitoring was conducted by photographing the nesting colonies at certain set locations. Potential nest locations were labelled on the photographs then each nest was checked monthly to assess the activity using a Nikon 30x60 field scope from sea level. In 2011 a similar method was also used at Lot's Wife and Blue Point in conjunction with the traditional nest recording method. The results of the two methods were compared month by month to assess the accuracy of the photographic trial and to give an estimate of the number of nesting birds using the area.

2.3 Six Monthly Counts

All seabirds seen during an 'around the island' boat trip were recorded by the nearest coastal location using the same methods as colony monitoring. Specifically for Madeiran

Storm Petrels, a dusk count was conducted by boat at Egg Island; the numbers of birds in flight around the island were estimated every 15 minutes until it was deemed too dark to continue. The maximum numbers of Madeiran storm petrels seen were then used as a gauge of the population size on Egg Island. All of these counts for the whole of St Helena's coastline were added together including nest monitoring data for that particular month, usually in October/November and May of each year based on the original start date. This gave an estimate of the total population size of all seabird species twice a year.

2.4 Seabird Ringing

Placing an individually numbered metal ring on a bird's leg otherwise known as "Ringing" is an established mark, recapture method that allows birds to be individually identified for their lifespan. This can be used in many ways for example to differentiate between breeding birds, allowing nesting attempts to be monitored more accurately. The process of ringing also allows other important parameters such as moult and condition to be monitored which can provide important information on the relationship between body condition and survival. In 2004 in conjunction with the OTEP project the Marine Scientific Officer Mrs Emma Bennett was successful in gaining training on Ascension Island to attain a British Trust for Ornithology (BTO) seabird ringing permit. In 2010 Mrs Elizabeth Clingham the new Marine Scientific Officer was also successful in gaining her BTO seabird ringing permit. It was hoped that seabird ringing on St Helena would feed into the seabird monitoring programme to provide valuable information on species longevity.

2.5 The Marine Sightings Scheme

The Marine Sightings Scheme was set up alongside the Seabird Monitoring Programme during the OTEP project. The scheme was designed to record all unusual marine sightings received from the general public such as cetaceans, fish and seabirds. Members of the public could report their sightings verbally, by phone or in person to a member of the Marine Section who would record all the details on a set record sheet. Some commercial and recreational fishermen were given a record book to note all sightings whilst they were at sea which was collected at regular intervals to retrieve the data. It was hoped this information would be able to be used in conjunction with the other seabird monitoring to establish long term trends of occurrence and abundance of rare or seasonal species that are known to frequent St Helena's waters.

2.6 Data Management

All data collected was recorded on predetermined recording sheets. After each survey was conducted the sheets were double checked for errors and means calculated where appropriate. The hard copy of the data was then either entered into a customised Microsoft Access database designed by Alan Mills, Alan Mills Consulting Ltd, UK., or an excel spreadsheet by members of the Marine Section. The hard copies were then archived systematically in lever arch files.

3 Data Analysis

The results of the analyses are grouped per species.

3.1 Species Abundance

The mean numbers of adults per location were calculated for each species excluding occasions where no birds were observed. A preliminary analysis of the nesting data was undertaken to identify the main breeding seasons. For these species the mean numbers of adults per location were calculated separately to take into account seasonality. These means were then ranked to give an implication of location importance for the species. To estimate the seasonal abundance of species at different locations the maximum number of adults per species at up to four of the largest colonies was calculated. Where data allowed, the maximum number of adults over winter and over summer (i.e. 6 month periods) were calculated. None of the census methods were designed to account for imperfect detection and estimate the error associated with counts; therefore a state-space model was used to estimate trends and associated observation errors. State-space models are hierarchical models that decompose an observed time series of bird counts into a process variation (i.e. actual population fluctuation) and an observation error component (Kery and Schaub 2012). State-space models were fit using WinBUGS (Lunn *et al.* 2000) and the posterior distributions of the estimated population growth parameter lambda were used to infer whether populations had changed over time. Results are reported as the mean plus the 95% credible interval limits for each parameter.

3.2 Breeding Cycles

Breeding seasons were estimated from the nest recording data, by calculating the mean number of incubating adults per month per location and species. Usually numbers were markedly higher over part of the year, which made it possible to evaluate the 'breeding season' by eye. Peak egg laying and chick rearing periods were estimated by averaging the total number of clutches/chicks per month per species and colony.

3.3 Nesting and Fledging Success

Only nests with repeat visits were used in the analysis. Birds were only considered hatched if a chick (naked, downy, downy with feathers, near fledged, fledged) was observed at the nest. Birds were considered fledged if a 'near fledged' or 'fledged' chick was observed at the nest because the chances of failure in near fledged chicks was considered to be very low. Nest visits where the nest was not re-found, there was an unknown outcome or that were empty were discounted from the analysis as these visits did not give any reliable information about the status of the nesting attempt for success rate calculations. Nesting and fledging success rates were calculated using a customised procedure written by Dr Steffen Oppel (pers. comm.) for each species per year and location and also the mean success rates across years for each species and location.

3.4 Other

Summary descriptive statistics have been employed to describe the results of the seabird sightings from the Marine Sightings Scheme and an overview of all seabird ringing that has been carried out up to 2011.

4 Results Summary

4.1 Colony Monitoring Effort

In total the Marine Section went out in the boat 160 times from 2004-2011(including 6 month surveys) conducted 168 nest searches and 125 land surveys (Table 1). Egg Island had the highest number of boat surveys (83) and nest searches (47) conducted. Shore Island had the highest number of surveys conducted from the mainland (45) (Table 2).

Table 1. Summary of surveying methods per year.

	Year								
Survey Method	2004	2005	2006	2007	2008	2009	2010	2011	Total
Number of Boat Trips	12	33	32	20	21	14	17	11	**160**
Number of Land Surveys	7	18	24	16	1	6	24	29	**125**
Number of Nest Searches	10	35	36	21	13	14	25	14	**168**

Table 2. Summary of colony total count surveys and nest searches conducted during 2004 to 2011 (inc. six monthly counts and times none were seen). NS= nest searches by land BS= boat surveys, MS= mainland surveys.

		Year								
Colony	**Method**	2004	2005	2006	2007	2008	2009	2010	2011	**Total**
Speery Island and Camel Rock (Salt Rock)	BS	4	12	12	8	10	5	9	7	**67**
James Bay-Rupert's Bay	BS	-	10	12	11	9	5	9	8	**64**
George Island	BS	1	2	2	-	1	1	-	2	**9**
	MS		-	-	1	-	-	-	-	**1**
Shore Island	BS	1	2	2	-	1	1	-	2	**9**
	MS	4	12	12	7	-	-	2	8	**45**
Peaked Island	BS	4	13	12	10	10	6	8	7	**70**
	NS	3	12	12	7	5	2	1	1	**43**
Mainland Opposite Peaked Island	BS	3	12	12	10	11	6	8	7	**71**
Thompson's Valley Island	BS	3	14	12	10	10	5	9	7	**70**
	NS	4	12	12	7	4	3	7	-	**45**
Egg Island	BS	5	17	16	10	11	7	7	10	**83**
	NS	3	11	12	7	4	4	5	1	**47**
Great Stone Top	MS	1	6	12	8	1	-	3	4	**35**
Lot's Wife	MS	-	-	-	-	-	2	4	10	**16**
	NS	-	-	-	-	-	5	12	11	**28**
Blue Point	MS	-	-	-	-	-	-	4	10	**14**
	NS	-	-	-	-	-	-	-	1	**1**

4.2 Six Month Surveys Summary

In total nine six month around the island surveys were conducted between 2004-2011 (Table 3). These were at intervals of every six months until 2008 when the surveying became sporadic. Black noddies and fairy terns respectively are the most abundant species on St Helena.

Table 3. The total number of adults counted during six monthly surveys around St Helena (* includes birds in flight, - indicates no counts were completed).

	Survey Date									
Species	Oct/Nov 2004	May 2005	Oct/Nov 2005	May 2006	Oct/Nov 2006	May 2008	May/Jun 2009	Mar 2011	Nov 2011	**Max Number of Adults**
Sooty Tern*	50	28	8	3	141	-	-	62	-	**141**
Fairy Tern	246	453	467	422	535	510	462	295	214	**535**
Red-billed Tropicbird*	51	41	101	39	57	2	61	42	65	**101**
Brown Noddy	207	517	314	435	96	225	52	261	57	**517**
Black Noddy	2477	1035	4240	259	3216	771	555	495	189	**4240**
Brown Booby	12	4	10	10	6	17	7	3	5	**17**
Masked Booby	52	173	138	130	115	139	63	289	266	**266**
Madeiran Storm Petrel*	201	417	124	52	504	-	-	-	1	**504**

4.3 Nest Recording Summary

Throughout the monitoring period (2004-2011) a total of 1930 individual nests were monitored on three main sites; Egg Island, Thompson's Valley Island and Peaked Island. 73% (1417) of the nest records were for brown noddies and 70% of the nest records (1344) were from Egg Island. The masked boobies at Lot's Wife started to be monitored in 2009 and to date 115 nests have been monitored.

5 Species Specific Results

5.1 Sooty Tern (*Sterna fuscata*)

Species Abundance

Sooty terns were recorded very rarely during the seabird monitoring programme, Table 4 shows they were most frequently observed at Speery Island. There are also <5 records of sooty terns flying around Egg Island. Figure 1 shows the abundance of sooty terns per month from 2004-2011.

Table 4. Sooty tern mean adult abundance on St Helena 2004-2011 (including birds in flight, ± standard deviation (SD), n = number of occasions birds were recorded in each colony).

	Throughout the Year		
Colony	**Mean Number of Adults**	**n**	**Rank**
Speery Island	44 ± 58	46	1
George Island	17 ± 22	7	2
Shore Island	9 ± 9	19	3
Egg Island	2 ± 1	6	4

Nest Records

There were two nest records in 2005 and four in 2008 on Egg Island, all clutches consisted of one egg; however there are not enough data to accurately access their success. In July 2006 there was a report of sooty terns nesting on Castle Rock Plain by Mr Woodrow Stevens and Mr Guy Bailey. Upon investigation 20 adults were seen flying and sitting in the area with eight fledged chicks.

Discussion

Sooty terns appear to have the highest abundance on Speery Island; this is concurrent with historical records where in 1948 1200-1400 birds have been recorded (Rowlands *et al.* 1998). From the monthly monitoring it is clear they are present all year around. The seasonal abundance of sooty terns at first glance appears to be greatly reduced from the start of the monitoring programme however the majority of this is due to data gaps from the irregularity of monitoring after mid-2007. Unfortunately it was not possible to infer how they move around within the vicinity of St Helena between the breeding and non-breeding season.

Sooty terns are known to have a fairly short incubation period (28-30 days) and chicks can fly at around 60 days (Ashmole 1963). This is a relatively short space of time to record and monitor nesting attempts, especially when monitoring is only conducted on an approximate monthly basis. For nesting and fledging success to be accurately assessed monitoring intervals would ideally need to be a lot shorter. Stonehouse (1963) reported breeding intervals of nine to ten months on St Helena which also makes nest monitoring difficult to initiate if the timing of the last season was not known. Rowlands *et al.* (1998) however suggests that breeding may depend on the timing of the arrival of warm water.

It is interesting to note that there are historical breeding records for George, Shore and Speery Island as well as Egg Island. The report of the sooty terns potentially breeding on Castle Rock Plain is not the first: Rowlands *et al.* (1998) provides accounts of sooty terns breeding there around 1900 and also on Castle Rock Point around 1930. The flattish area on Gill Point known as 'Bird Ground' used to be a principle source of sooty tern eggs as late as 1955 before cats ravaged the area. Dry Gut to the east was also once a known breeding ground for sooty terns, soon to be lost under the airport development. If a colony does form on the mainland again in the future this is a conservation priority and extra monitoring should be considered at that area.

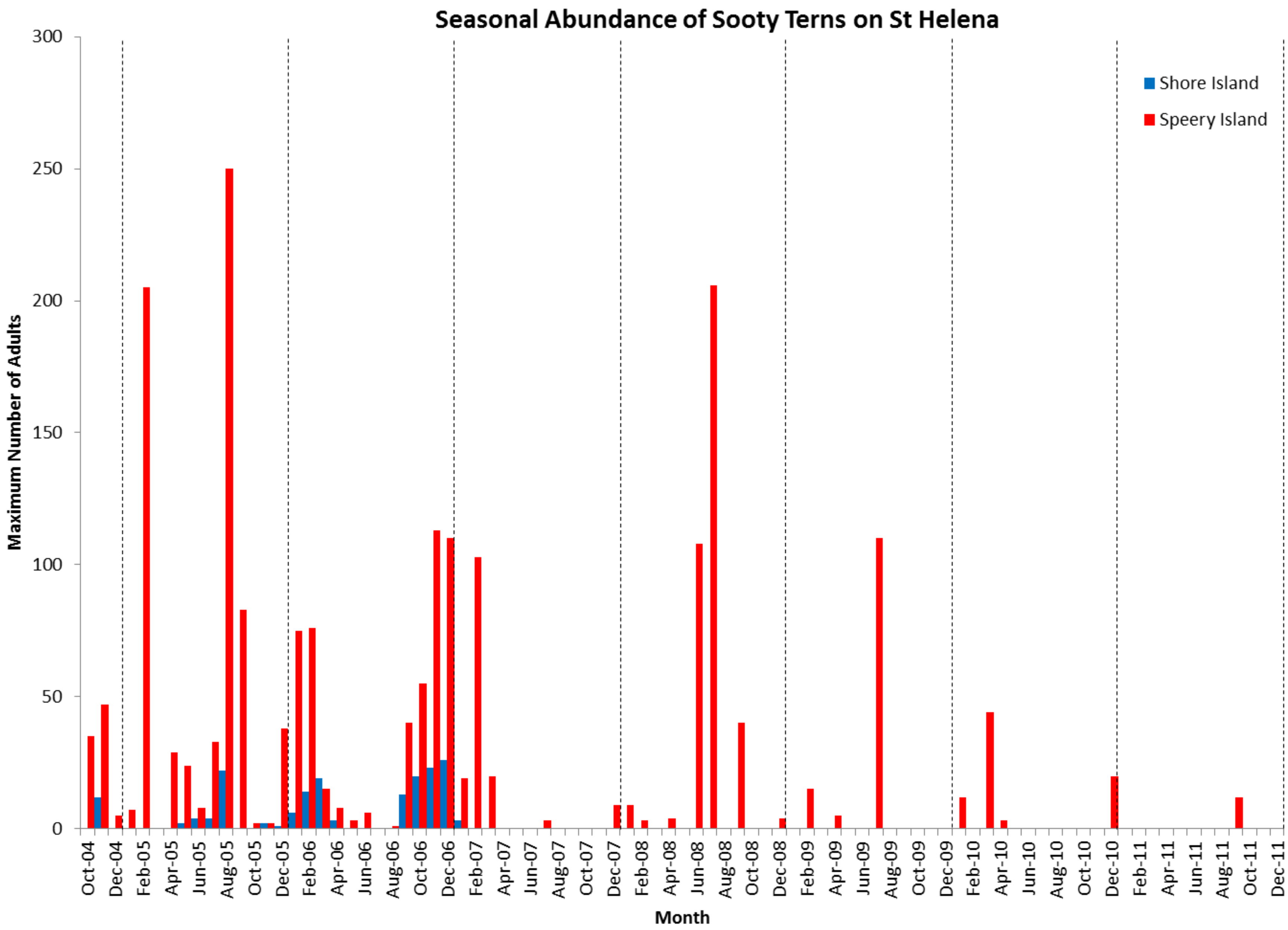

Figure 1 Seasonal abundance of sooty terns on St Helena Island (a dashed line indicates the start of a new year).

5.2 Fairy Tern (*Gygis alba*)

Species Abundance

Fairy terns were most abundant at the colony surveyed along the cliff faces from James Bay to Rupert's Bay throughout the year (Table 5). During their peak breeding season Thompson's Valley Island is second colony where adults are most abundant and during the lowest period of their breeding season Speery Island is the second colony where adults are most abundant. Figure 2 shows the seasonal abundance of fairy terns in the most abundant colonies.

Table 5. Fairy tern mean adult abundance (±SD) during their peak breeding season and low breeding season on St Helena 2004-2011 (* includes Camel Rock, n = number of occasions birds were recorded in each colony).

	Peak Breeding Season (May-November)			**Low breeding Season (November-May)**		
Colony	**Mean Number of Adults**	**n**	**Rank**	**Mean Number of Adults**	**n**	**Rank**
James Bay-Rupert's Bay	63 ± 37	29	1	53 ± 30	35	1
Thompson's Valley Island	38 ± 13	32	2	16 ± 12	38	3
Speery Island*	31 ± 17	29	3	27 ± 14	37	2
Great Stone Top	13 ± 5	19	4	6 ± 5	13	4
Mainland Opposite Peaked Island	6 ± 5	27	5	3 ± 2	31	6
Peaked Island	3 ± 2	25	6	2 ± 1	20	8
Egg Island	3 ± 2	18	7	1 ± 1	11	9
Blue Point	3 ± 2	6	8	3 ± 1	4	7
Shore Island	1 ± 1	3	9	5 ± 5	2	5

The population trend models (Figure 3) indicate that there was a steady decline in fairy tern numbers from the James Bay to Rupert's Bay area from 2004-2011 however the mean trend estimate indicates an annual decline of 3% from James Bay-Rupert's Bay area, but this was not significant at the 5% confidence level (test of model parameter estimates, lambda = 0.97, 95%CI: 0.93 - 1.0). The data for Thompson's Valley Island, Speery Island and Great Stone Top are insufficient to reliably estimate a trend.

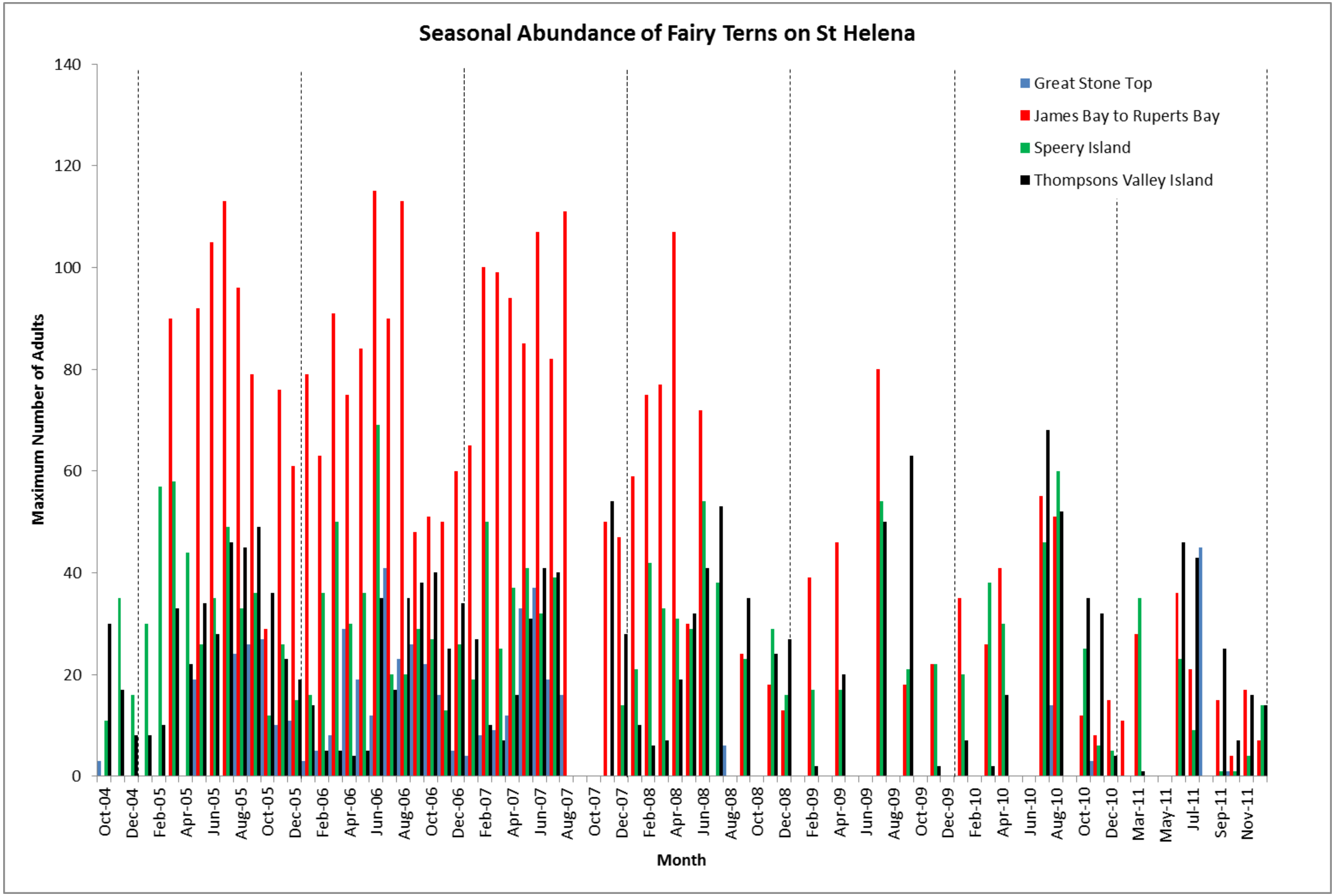

Figure 2 Seasonal Abundance of fairy terns on St Helena Island (a dashed line indicates the start of a new year).

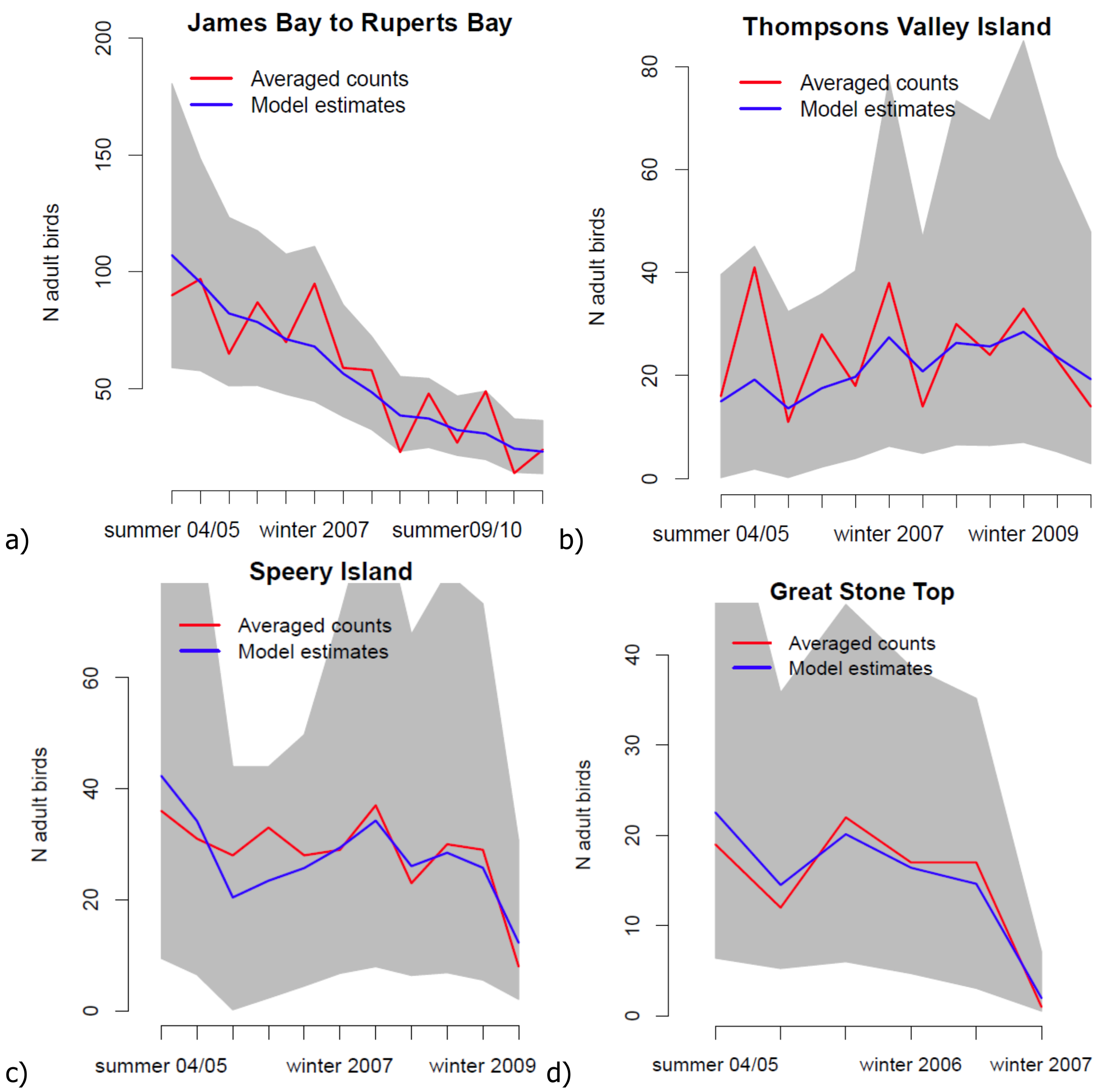

Figure 3. Population trend models of fairy terns at the four most abundant colony locations a) James Bay to Rupert's Bay 2004-2010, b) Thompson's Valley Island 2004-2009 and c) Speery Island 2004-2009 and d) Great Stone Top 2004-2007.

Nest Records

Thompson's Valley Island had a total of 191 nest records from 2004-2011, Peaked Island had only one nest record in 2005, 162 of those were identified as consisting of one egg clutches. Only 148 nest records were suitable for analysis given the criteria set (pg. 14). July-September on Thompson's Valley Island is the peak in adult abundance (Figure 4). Figure 5 shows the main egg laying period is from April-December with the peak in July. Chicks are mainly present from May-January with a peak in July and November. Table 6 shows the hatching and fledging success rate of fairy terns per year on Thompson's Valley Island. The mean hatching success rate was 0.36 and fledging success rate was 0.09 (n=148).

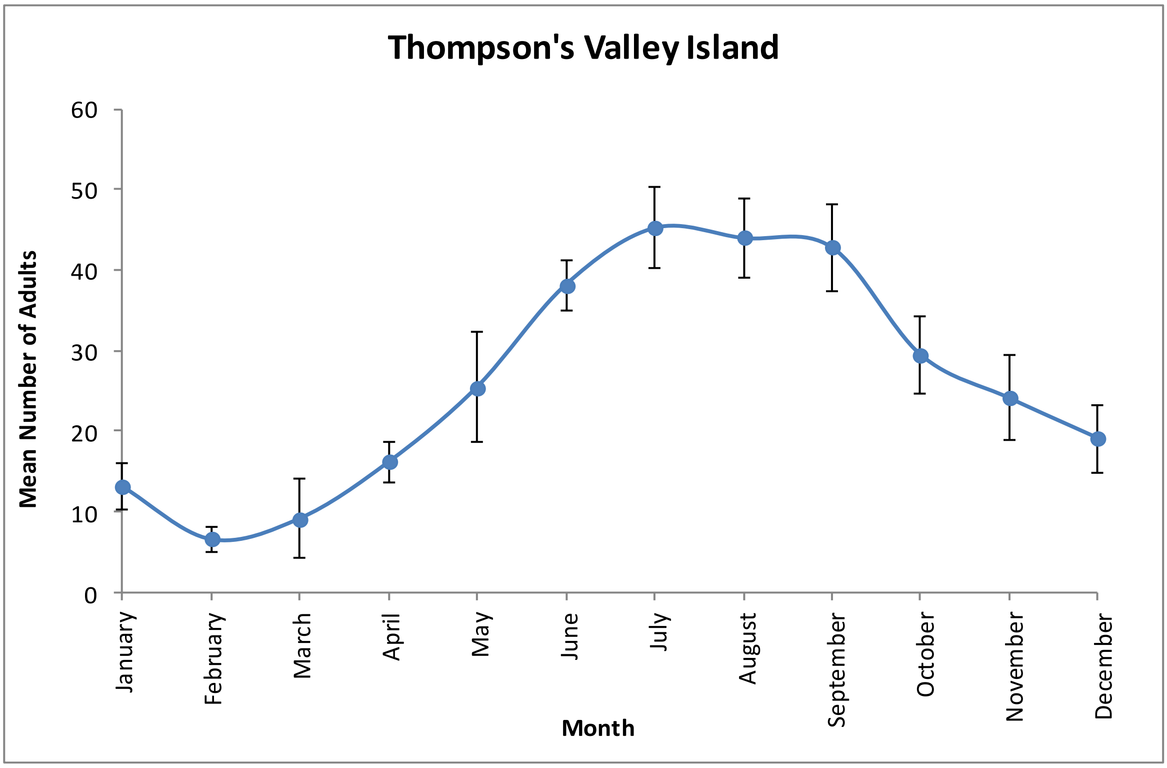

Figure 4. The mean number of fairy tern adults per month (± standard error of the mean (sem)) counted on Thompson's Valley Island 2004-2011.

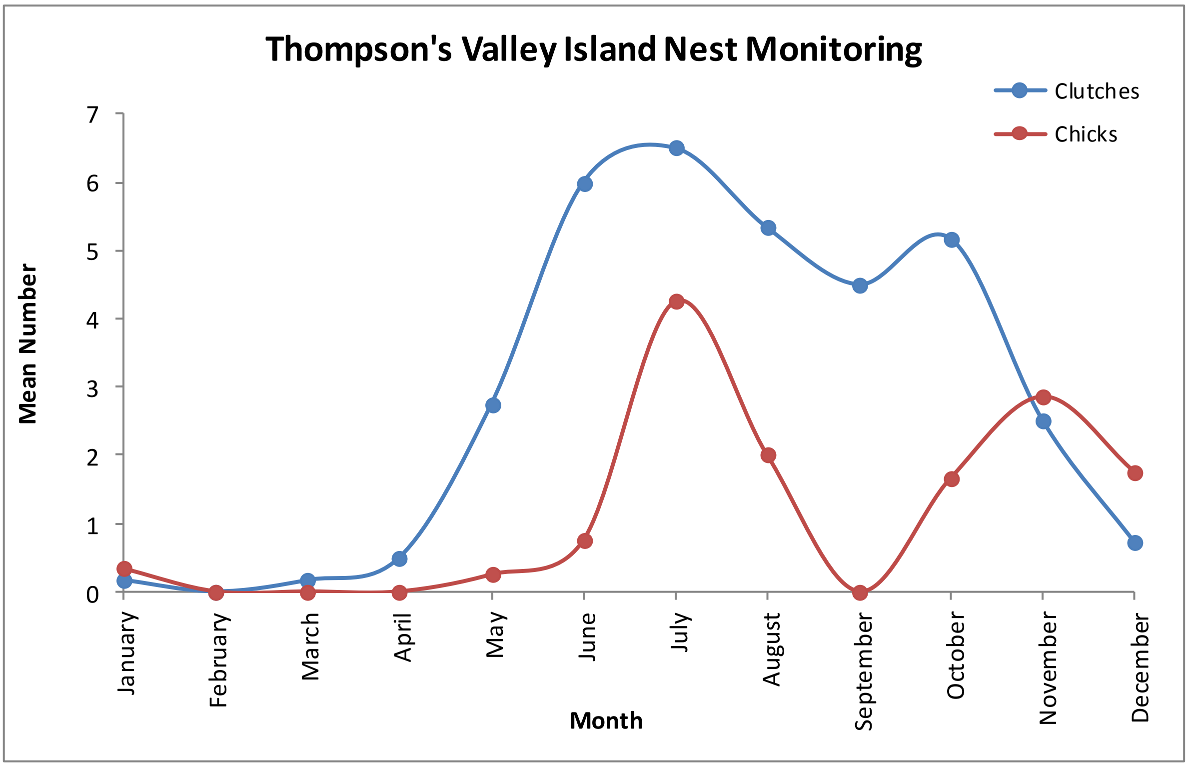

Figure 5. The mean number of fairy tern clutches and chicks present per month on Thompson's Valley Island from Nest Monitoring data 2004-2011.

Table 6. The hatching and fledging success of fairy terns on Thompson's Valley Island per year (n=number of nests).

Colony	Year	Hatching Success	Fledging Success	n
Thompson's Valley Island	2004	1	1	7
Thompson's Valley Island	2005	0.20	0.13	40
Thompson's Valley Island	2006	0.30	0.00	23
Thompson's Valley Island	2007	0.37	0.00	19
Thompson's Valley Island	2008	0.08	0.00	12
Thompson's Valley Island	2009	0.58	0.00	24
Thompson's Valley Island	2010	0.39	0.09	23

Discussion

Unfortunately the size of the population cannot be accurately estimated on St Helena as only coastal areas were surveyed during the monitoring programme and the large proportion of fairy terns that live and breed inland were not surveyed. The cliff areas from James Bay to Rupert's Bay are very important for fairy terns throughout the year. Although there appeared to be a decline in the number in this area, this may represent a redistribution rather than decline as many fairy terns also use Jamestown. This area should continue to be monitored as if the population declines further then it could become a cause for concern. Thompson's Valley Island is also clearly a very important offshore breeding colony for fairy terns which is free from the risks of predation. Given that a part of the population are known to breed inland including Jamestown where there is a large cat population it would be interesting to compare the breeding cycle and nesting success rates between the inland and offshore colonies. Fairy terns appear to breed all year on Thompson's Valley Island. However there were very few surveys conducted in February when the lull in the breeding seems to occur, so this cannot be confirmed. Their peak laying period was in July, which is different to Ascension Island where it was found to be in January by Dorward (1963).

5.3 Red-billed Tropicbird (*Phaethon aethereus*)

Species Abundance

Red-billed tropicbirds were most abundant at Great Stone Top throughout the year (Table 7). The colony at Blue Point near the Asses Ears was the second largest colony that was recorded from monthly total counts. Figure 6 shows the monthly occurrence of red-billed tropicbirds at the four largest colonies. From mid 2007-2011 very few surveys were conducted at Great Stone Top and Blue Point was excluded as colony monitoring only commenced in 2010. The population trend models are given in Figure 7, there appears to have been a substantial decline at Great Stone Top which is a cause for concern. However there was insufficient date to reliably estimate a long term trend.

Table 7. Red-billed tropicbird mean adult abundance (±SD) during their peak breeding season and low breeding season on St Helena 2004-2011 (including birds in flight, n = number of occasions birds were recorded in each colony).

	Peak Breeding Season (July-December)			**Low Breeding Season (December-July)**		
Colony	**Mean Number of Adults**	**n**	**Rank**	**Mean Number of Adults**	**n**	**Rank**
Great Stone Top	40 ± 20	17	1	21 ± 10	18	1
Blue Point	12 ± 15	14	2	13 ± 10	10	2
Speery Island	8 ± 7	28	3	6 ± 4	37	3
Egg Island	4 ± 2	25	4	2 ± 2	25	4
James Bay-Rupert's Bay	2 ± 2	19	5	2 ± 1	18	5
Shore Island	1 ± 1	9	6	2 ± 1	10	5
Thompson's Valley Island	-	-	-	1	1	6

Nest Records

There were 49 nest records recorded for Red-billed tropicbirds on Egg Island from 2004-2010, nine of those were identified as consisting of one egg clutches and only 32 of the records were suitable for analysis. There were also 29 identified occupied nest cavities along West Rocks cliffs from 2004-2005 however none of these were suitable for analysis. Breeding adult red-billed tropicbirds were most abundant on Egg Island from July-January (Figure 8). The main incubating period on Egg Island was from July-December, with the peak number of incubating adults occurring in September (Figure 9). Table 8 gives the hatching and fledging success of red-billed tropicbirds on Egg Island per year. The mean hatching success of 0.28 and a fledging success of 0.19 (n=32) on Egg Island.

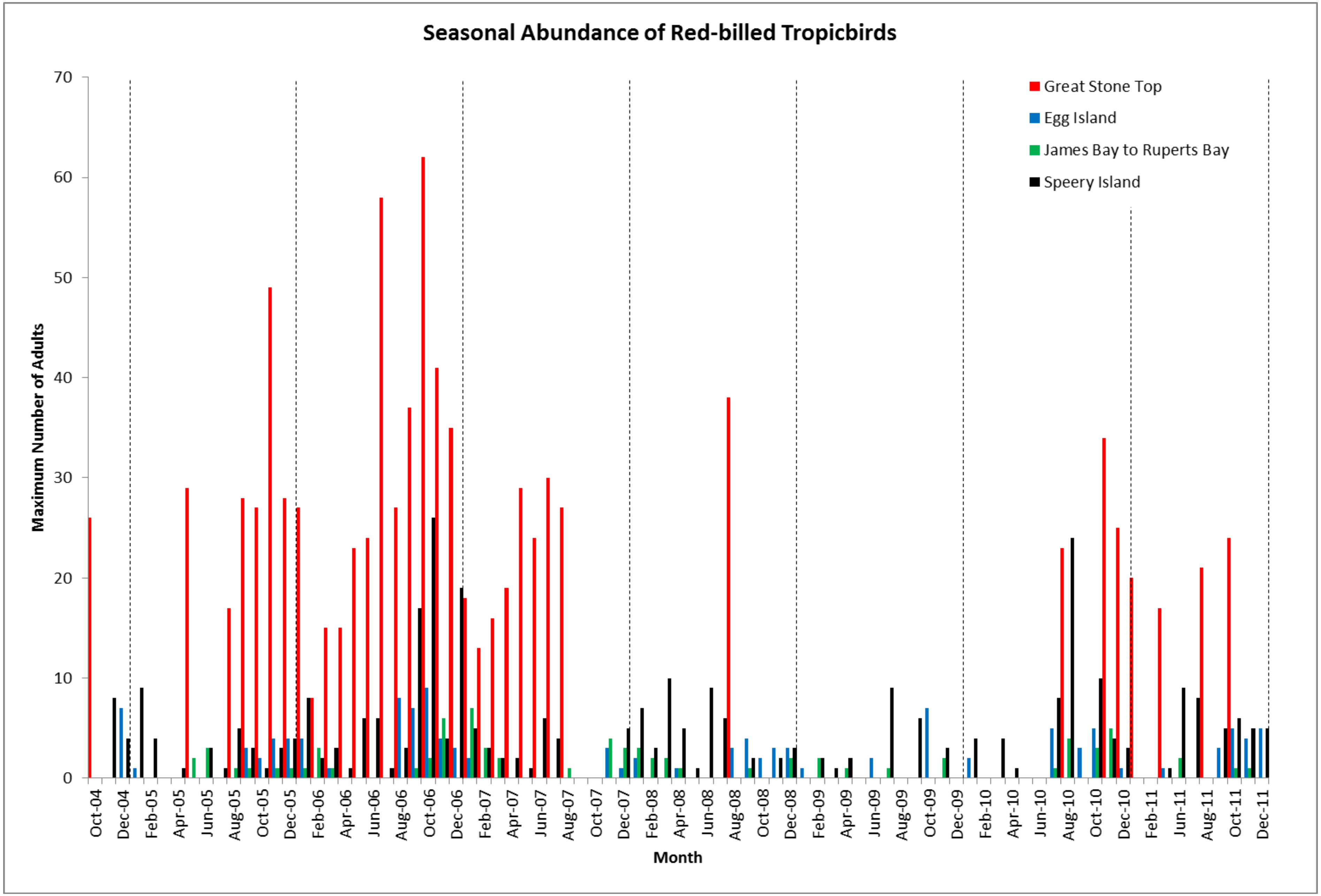

Figure 6 Seasonal abundance of red-billed tropicbirds on St Helena Island (a dashed line indicates the start of a new year).

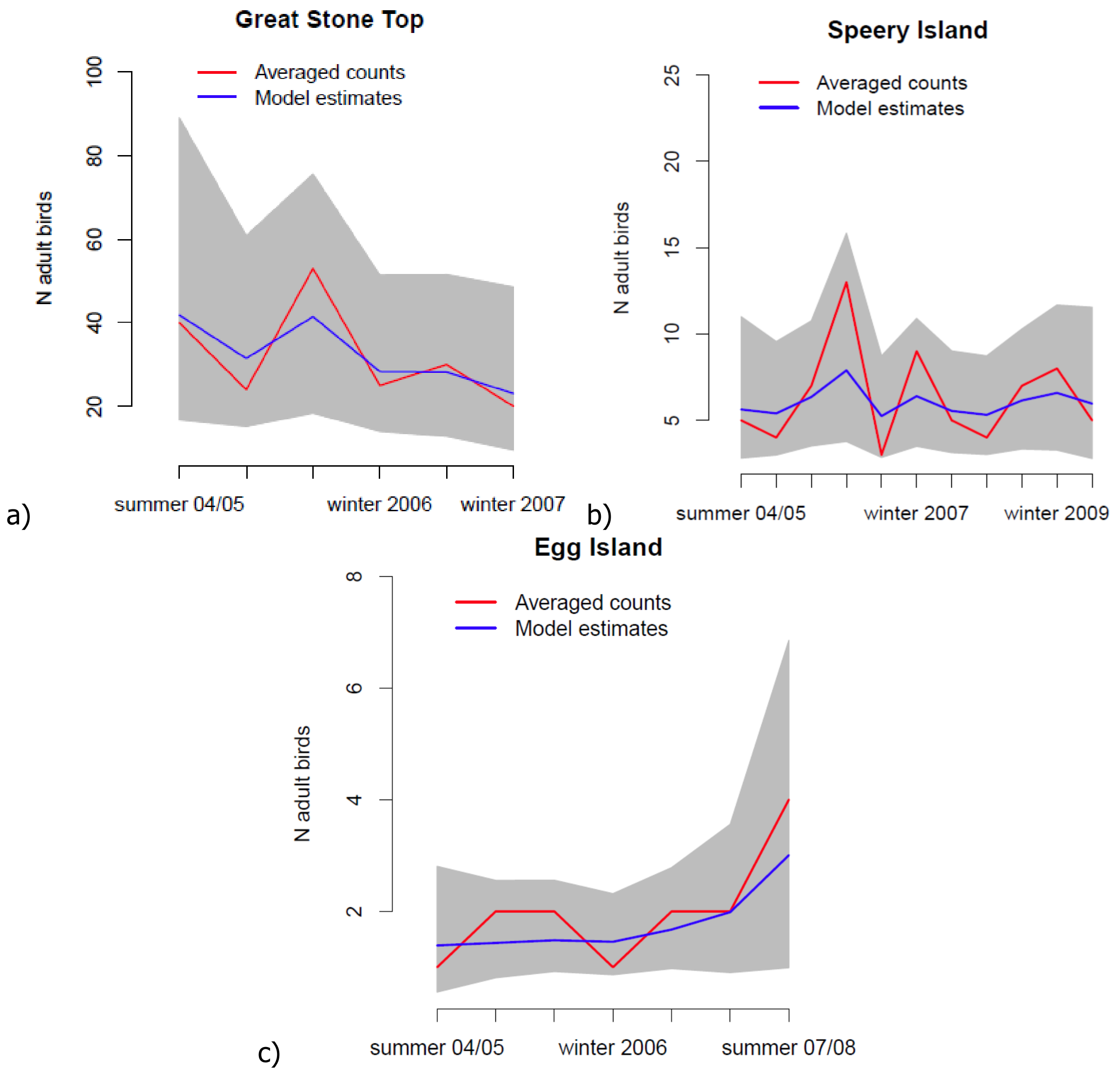

Figure 7. Population trend model for red-billed tropicbirds on a) Great Stone Top 2004-2007, b) Speery Island 2004-2010 and c) Egg Island 2004-2008.

Table 8. The hatching and fledging success of red-billed tropicbirds on Egg Island per year (n=number of nests).

Colony	Year	Hatching Success	Fledging Success	n
Egg Island	2004	0.14	0.14	7
Egg Island	2005	0.13	0.13	8
Egg Island	2006	0.38	0.38	8
Egg Island	2008	0.00	-	2
Egg Island	2009	0.00	-	1
Egg Island	2010	0.67	0.17	6

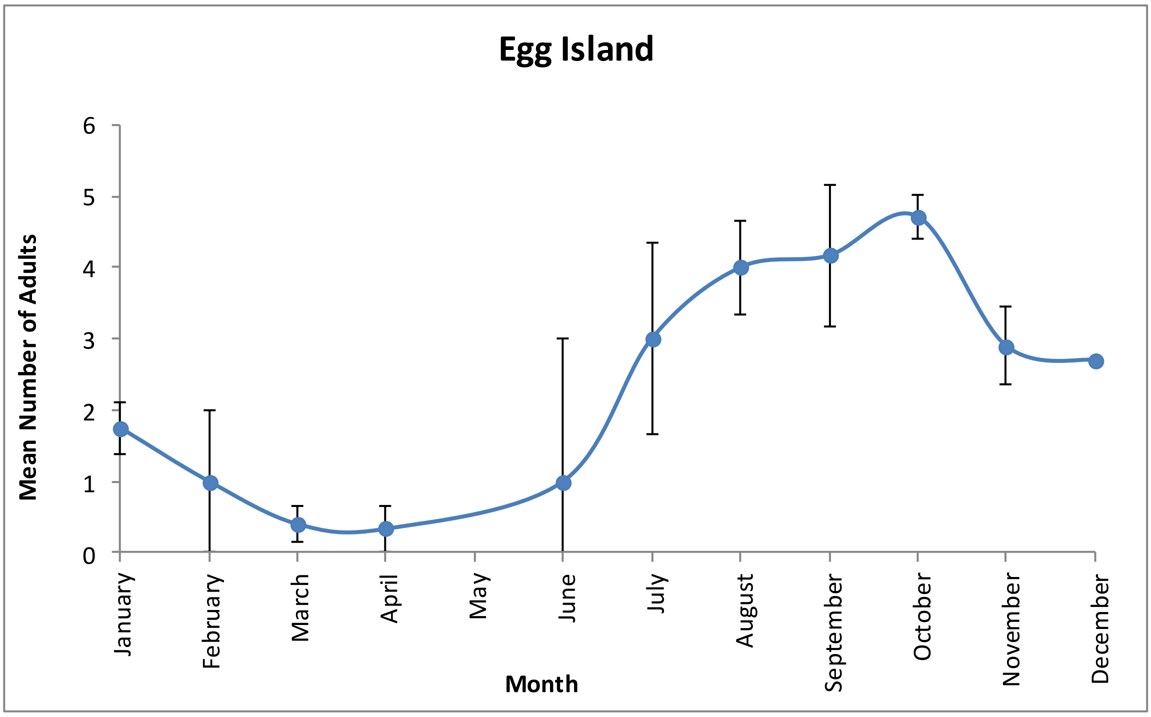

Figure 8. Mean number of adult red-billed tropicbirds (± sem) counted per month on Egg Island from 2004-2011.

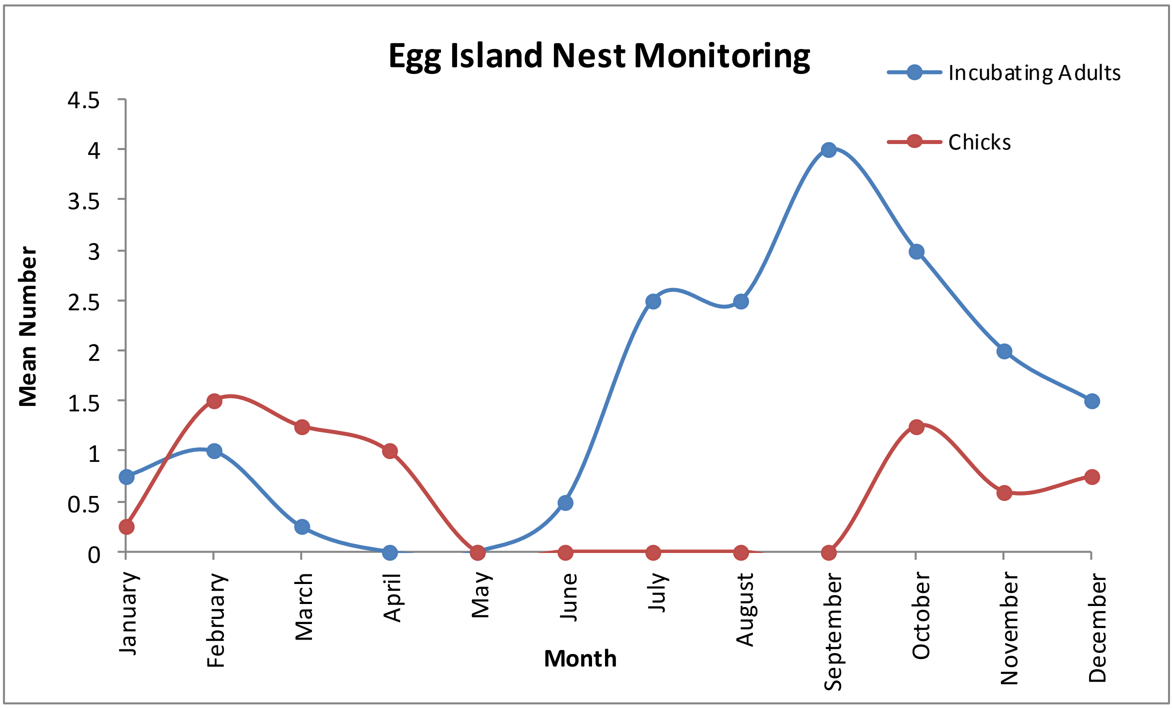

Figure 9. The mean number of red-billed tropicbird clutches and chicks present per month on Egg Island from nest monitoring data 2004-2011.

Discussion

The maximum number of adult red-billed tropicbirds seen during the six month surveys is likely to only be useful as a minimum estimate of St Helena's population size. Red-billed tropicbirds are more active at dawn and dusk but most surveys were conducted during mid-day. They are known to spend long periods of time out to sea so potentially a lot would have been missed during the surveys. The list of colonies where red-billed tropicbirds occur is not comprehensive, there are many other areas around St Helena's coastline that they are known to use. The coastal population around Ladder Hill from personal observation holds at least 30 pairs and, given the maximum number of adults seen at colonies monitored, it is likely St Helena holds between 100-200 pairs. The global population is estimated to be around 8000 pairs (Lee and Walsh-McGehee 2000) therefore St Helena's population could represent 1.2-2.5% of the global population. This makes the population of red-billed tropicbirds internationally important under the RAMSAR guidelines.

Given the importance of this species on St Helena and the potential long distances they can travel out to sea understanding their movements and the choice of foraging locations around St Helena Island could provide valuable information on their range in the South Atlantic. In 2012 a trial project was completed to test the feasibility of using GPS loggers to track red-billed tropicbird movements (Appendix 3), and a full proposal on developing this work follows this report.

Great Stone Top is the most important colony throughout the year identified from monitoring. There appears to have been a slight decline in numbers at this colony but this could not be confirmed statistically. This might be a cause for concern in the future and continued monitoring is essential to verify and track changes in the colony population. Red-billed tropicbirds are likely to breed all year around as they do on Ascension (Stonehouse 1962). However their preferred nesting habitat is on steep slopes and cliffs which make traditional nest monitoring methods difficult: hence it was only possible to monitor very few nests effectively. As a result of the low sample size, breeding activity during the less active months cannot be confirmed from the data. Red-billed tropicbird nesting and fledging success appears to be very low on the Egg Island compared to Ascension (Stonehouse 1962). However the low number of nests and the difficulty in recording may affect the accuracy of the success rates. Birds that nest on slopes as opposed to cliff faces may also represent a biased low success rate as these nesting areas may be used by less dominant pairs and would be more susceptible to predation. Although the nest monitoring data presented here is from a predator free island this factor should be borne in mind if nest monitoring continues in different areas.

5.4 Brown Noddy (*Anous stolidus*)

Species Abundance

Brown noddies were most abundant on Egg Island during their peak breeding season and on Speery Island during their non-breeding season (Table 9). There are almost twice as many birds present during their peak breeding season as in their non breeding season. However there is a lot of variation in the data. Figure 10 shows the seasonal abundance of brown noddies on St Helena per month. The population trend models are given in Figure 12 however there are insufficient data to reliably estimate a trend.

Table 9. Brown noddy mean adult abundance (±SD) during their peak breeding season and non-breeding season on St Helena 2004-2011 (* includes Camel Rock, n = number of occasions birds were recorded in each colony).

	Peak Breeding Season (November-March)			**Non-breeding Season (March-November)**		
Colony	**Mean Number of Adults**	**n**	**Rank**	**Mean Number of Adults**	**n**	**Rank**
Egg Island	206 ± 155	26	1	125 ± 138	45	2
Speery Island*	183 ± 194	24	2	137 ± 156	31	1
Shore Island	96 ± 55	15	3	51 ± 57	35	3
George Island	70	1	4	35 ± 47	22	4
Peaked Island	38 ± 35	22	5	34 ± 41	5	5
Thompson's Valley Island	16 ± 12	12	6	17 ± 17	12	6
Mainland Opposite Egg Island	12	1	7	1	1	8
Mainland Opposite Peaked Island	5 ± 8	9	8	8 ± 15	7	7

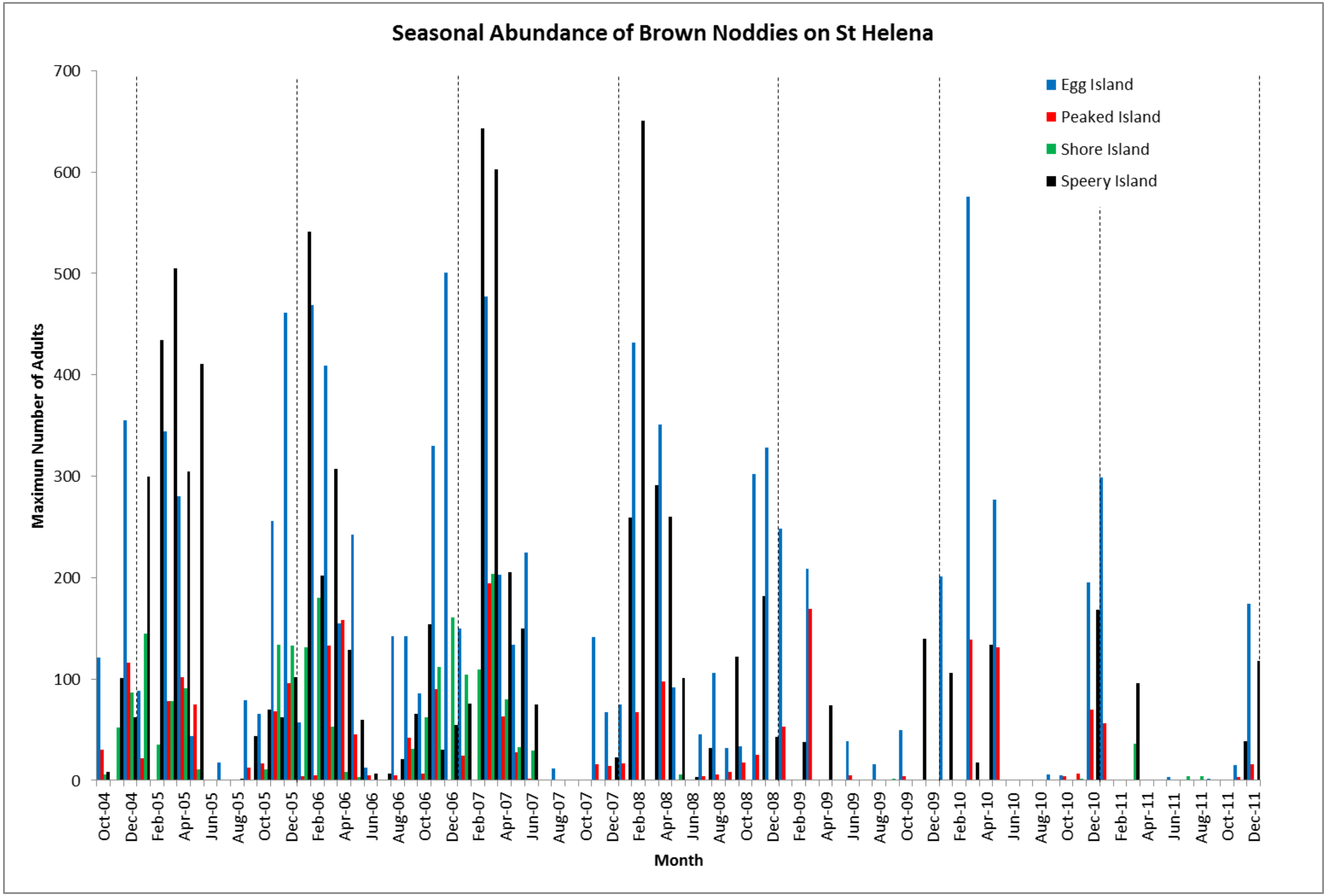

Figure 10 Seasonal abundance of brown noddies on St Helena Island (a dashed line indicates the start of a new year).

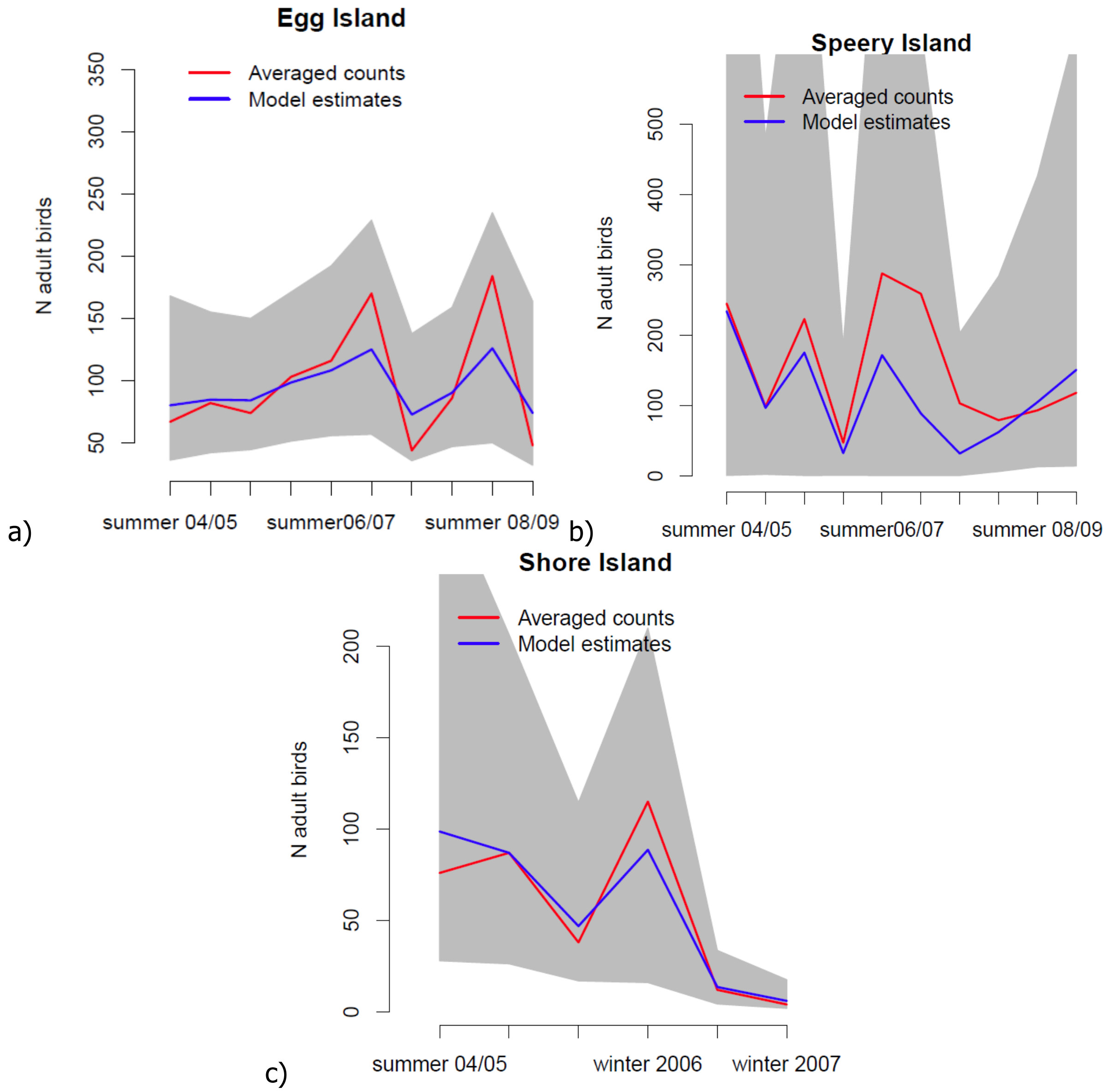

Figure 11. Population trend model for brown noddies on a) Egg Island b) Speery Island 2004-2009 and c) Shore Island 2004-2007.

Nest Records

A total of 1412 nests were recorded for Egg Island, Peaked Island and Thompson's Valley Island from 2004-2011. 1214 nests were identified as consisting of one egg clutches and 5 with clutches of two eggs. However only 82% (1156) of the nest records were suitable for analysis (Table 10). The main breeding season from Egg Island data is from November to March (Figures 12 and 13). There is a peak in the number of nests with eggs occurring in December and a peak presence of chicks in February. There is a lot of fluctuation in success rates from year to year. Brown noddies on Egg Island have an mean hatching success rate of 0.50 and fledging success of 0.38 (n=823), on Peaked Island the hatching success was 0.45 and fledging success of 0.13 (n=321), on Thompson's Valley Island the hatching success was 0.83 and fledging success was 0.58 (n=12).

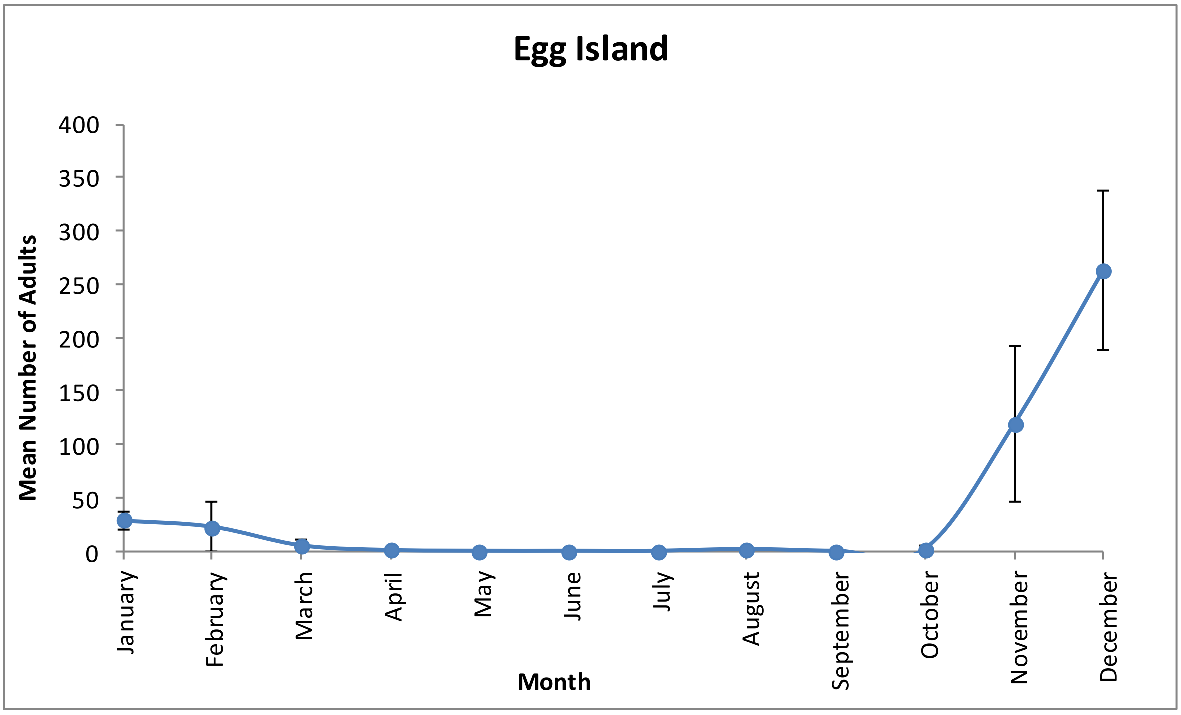

Figure 12. The mean number of brown noddy adults breeding on Egg Island per month from nest monitoring data 2004-2011

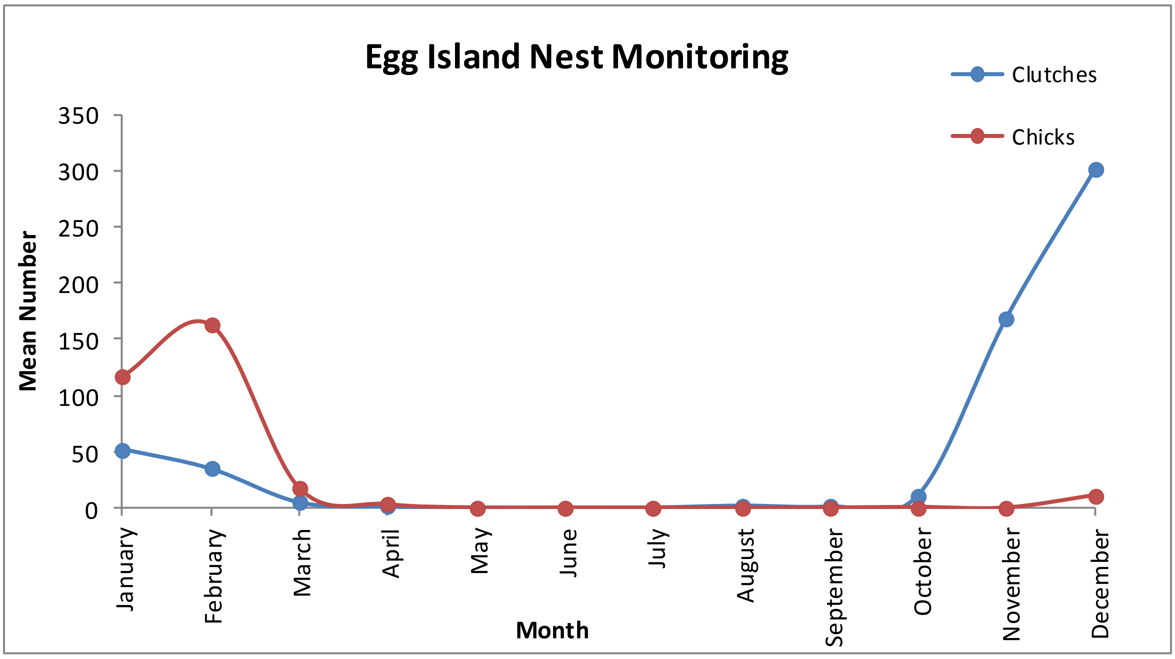

Figure 13. The mean number of brown noddy clutches and chicks present per month on Egg Island from nest monitoring data 2004-2011.

Table 10. The hatching and fledging success of brown noddies on Egg, Peaked and Thompson's Valley Island per year (n=number of nests).

Colony	Year	Hatching Success	Fledging Success	n
Egg Island	2004	0.51	0.44	117
Egg Island	2005	0.53	0.46	288
Egg Island	2006	0.47	0.36	276
Egg Island	2007	0.56	0.30	54
Egg Island	2008	0.57	0.22	23
Egg Island	2009	0.63	0.18	40
Egg Island	2010	0.14	0.00	21
Egg Island	2011	0.00	-	4
Peaked Island	2004	0.30	0.11	37
Peaked Island	2005	0.45	0.06	80
Peaked Island	2006	0.49	0.21	146
Peaked Island	2007	0.20	0.10	10
Peaked Island	2008	0.54	0.00	35
Peaked Island	2009	0.44	0.00	9
Peaked Island	2011	0.00	-	4
Thompson's Valley Island	2007	1.00	0.00	1
Thompson's Valley Island	2010	0.82	0.64	11

Discussion

St Helena's population of brown noddies is likely to represent a very small proportion of the global population (<1%) which is estimated to number c.180,000-1,100,000 individuals (BirdLife International 2012). Egg Island and Speery Island are the most important colonies for brown noddies identified from the monitoring data. It is likely that they are present all year around but with small numbers occurring during their non breeding season. Where the majority of birds go during this time remains unknown. From personal observation (Beard, 2012) over the last few years there has been a shift in their breeding cycle, however due to the irregularity of nest monitoring conducted on Egg Island there were not enough data to show this. Why this is happening remains unknown. They usually start to nest just as the black noddies are finishing but over the past few years the onset of nesting has been delayed in both species. This issue alone warrants further investigation. St Helena's laying period for brown noddies is shorter than on Ascension which is from October-June. However during the brown noddy study on Ascension, heavy rollers may have been partly to blame for the extended laying period as eggs and chicks got washed away causing pairs to re-lay (Dorward and Ashmole 1963, Stonehouse 1963). Egg Island is clearly a very important breeding ground for brown noddies on St Helena but there are also historical breeding records for Lighter Rock, Speery Island, Camel Rock, Shore and George Island (Rowlands *et al.* 1998) which were not confirmed as breeding sites during the seabird monitoring.

5.5 Black Noddy (*Anous minutus*)

Species Abundance

Black noddies are most abundant on Egg Island throughout the year (Table 11). Their monthly abundance for the four largest colonies is given in Figure 14. The population trend models are given in Figure 15. There appears to have been a decline in numbers at Egg, Shore and the mainland colony opposite Peaked Island since 2007, but the trend is not significant at the 5% confidence level (estimated mean population growth rate, lambda = 0.98, 95%Cl: 0.91-1.04, 0.93, 95%Cl: 0.74-1.11 and 0.82, 95%Cl: 0.08-1.04 respectively) and more data are needed for confirmation.

Table 11. Black noddy mean adult abundance (±SD) throughout the year on St Helena 2004-2011 (* includes Camel Rock, n = number of occasions birds were recorded in each colony).

	Throughout the Year		
Colony	**Mean Number of Adults**	**n**	**Rank**
Egg Island	622 ± 483.39	77	1
Mainland Opposite Peaked Island	158 ± 114	63	2
Shore Island	152 ± 120	49	3
Peaked Island	80 ± 59	66	4
George Island	52 ± 47	9	5
Speery Island*	42 ± 52	61	6
Mainland Opposite Egg Island	36 ± 43	4	7
Thompson's Valley Island	3 ± 3	5	8

Nest Records

The data on breeding black noddies are insufficient to reliably estimate breeding cycles on St Helena and there was just one nest record from Egg Island in 2007 which hatched but failed to fledge.

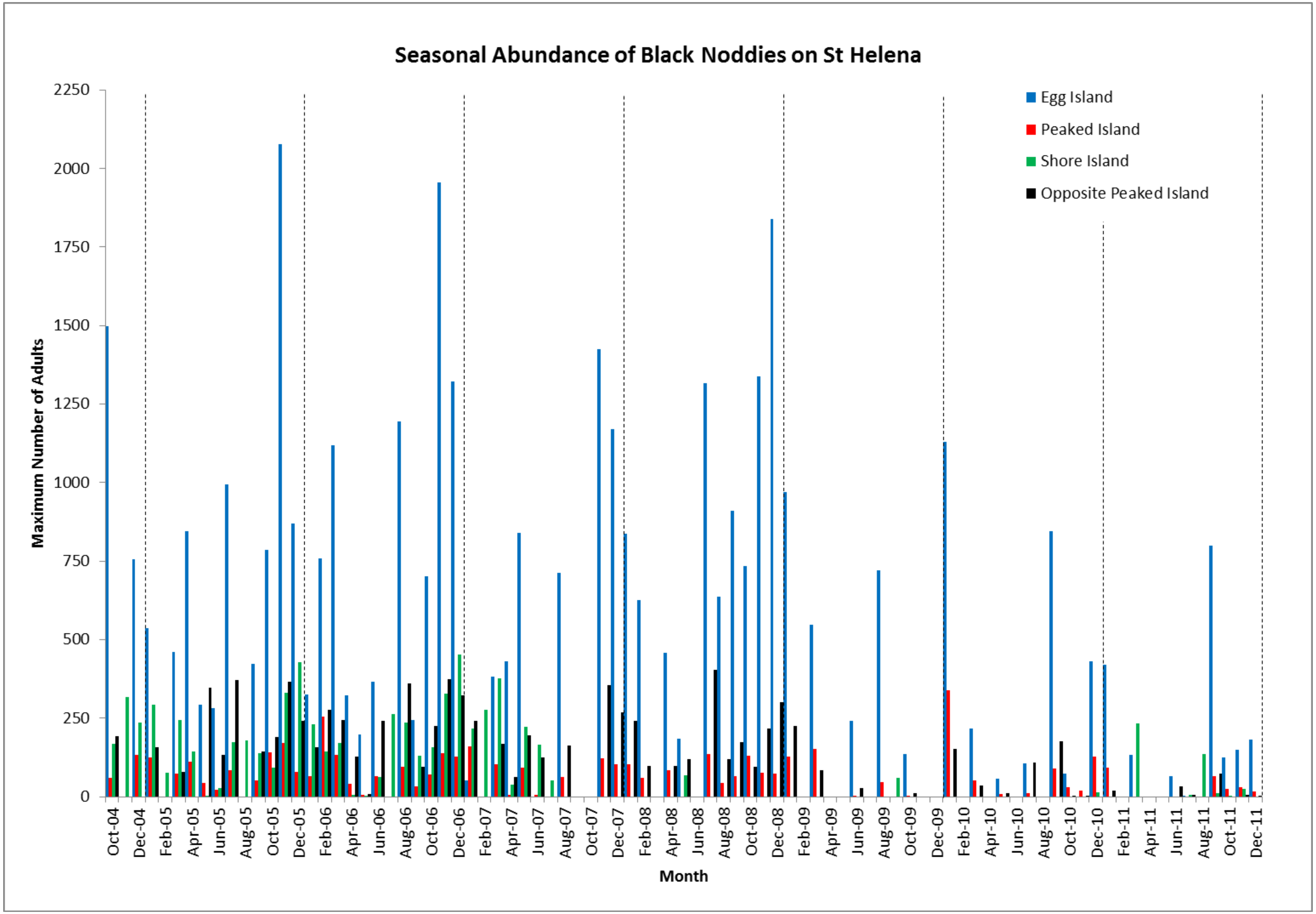

Figure 14 Seasonal abundance of black noddies on St Helena Island (a dashed line indicates the start of a new year).

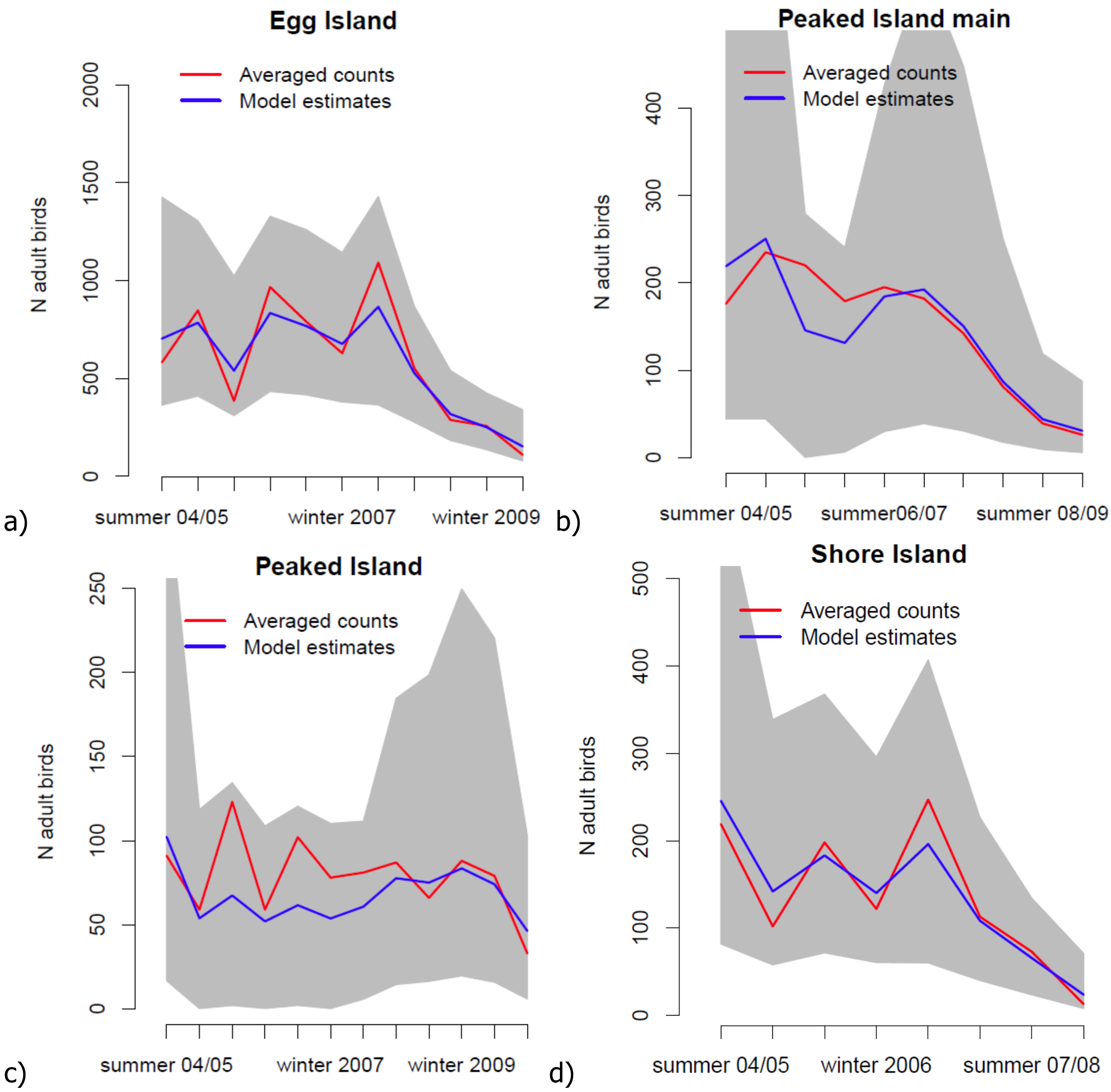

Figure 15. Black noddy population trend models for a) Egg Island, b) Mainland Opposite Peaked Island c) Peaked Island from 2004-2009 and d) Shore Island 2004-2008.

Discussion

Egg Island appears to be the most important colony for black noddies all year around. Peaked Island and the mainland cliffs opposite Peaked Island also appear to be an important area holding reasonable numbers of black noddies. According to Rowlands *et al.* (1998) the favoured nesting sites can change from year to year which might account for some of the variation in the population trend models in different colonies. Black noddies nest in colonies on guano ledges on cliff faces, which make nest monitoring virtually impossible, hence the lack of nesting data. This may be a species where photographic surveying of the cliff faces could be used to individually identify nests and nesting attempts if the technique is developed in the future. It is interesting to note that although nest monitoring data was very sparse, adult black noddies were recorded on nests (AON) on Shore, George, Peaked, Speery and Egg Island as well as the mainland opposite Peaked Island. There are also historical records of black noddies breeding on Lighter Rock, Upper and Lower Black Rock, The Needle and Camel Rock (Rowlands *et al.* 1998). On Ascension Island their main laying period is from April-September with a peak in June (Stonehouse 1963) unfortunately this cannot be confirmed for St Helena. However, from personal observation, black noddies usually start to breed before brown noddies and have the highest abundance from September-November which might indicate that they breed slightly later on St Helena than they do on Ascension.

5.6 Brown Booby (*Sula leucogaster*)

Species Abundance

Brown boobies have been recorded in very low numbers on St Helena (<20) with the highest abundance occurring on Shore Island (Table 12). Their monthly abundance on the three largest colonies recorded is given in Figure 16. There does not appear to be any seasonal pattern in abundance however this could not be tested statistically due to the low numbers observed. The population trend model for Shore Island is given in Figure 17, the mean trend estimates indicate an annual decrease of 3%, but this was not significant at the 5% confidence level (estimated population growth rate, lambda = 0.97, 95%CI: 0.78-1.15). The numbers of brown boobies have fluctuated in previous years; therefore the decrease may be a result of natural variation.

Table 12. Brown booby mean adult abundance (±SD) throughout the year on St Helena 2004-2011 (* includes Camel Rock, n = number of occasions birds were recorded in each colony).

	Throughout the Year		
Colony	**Mean Number of Adults**	**n**	**Rank**
Shore Island	6 ± 3	53	1
Peaked Island	3 ± 2	2	2
Speery Island*	2 ± 2	23	3
George Island	2 ± 1	3	4
Egg Island	1 ± 1	19	5

Nest Records

There are no nest records for this species and there is little data to substantiate the breeding status of this species around St Helena. However there are five individual records of a single downy chick, seven of a single downy chick with feathers and 6 of a near fledged chick being observed on Shore Island between July and February from 2004-2011. There is also one record of a single near fledged chick observed on Speery Island in June 2011.

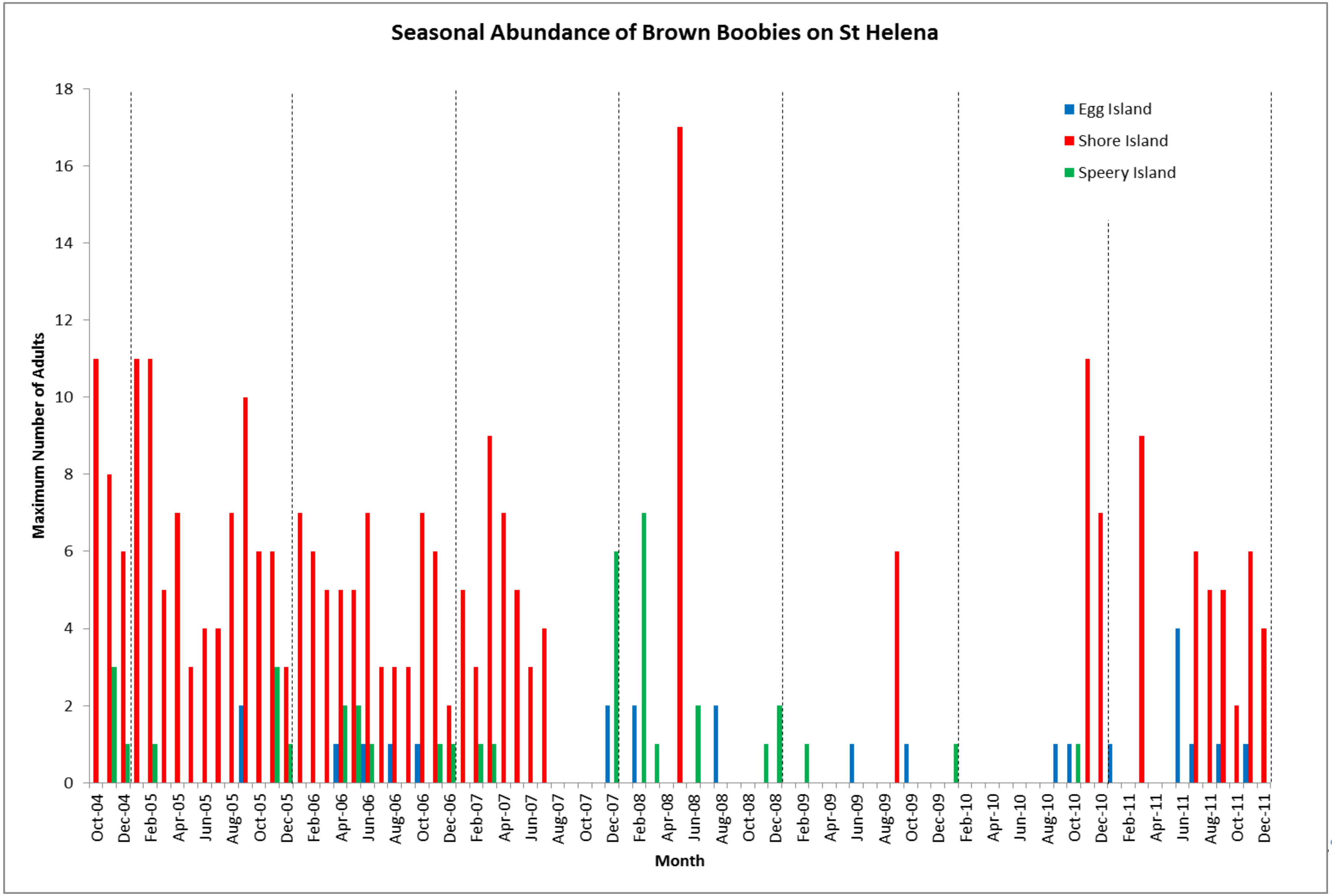

Figure 16 Seasonal abundance of brown boobies on St Helena Island (a dashed line indicates the start of a new year).

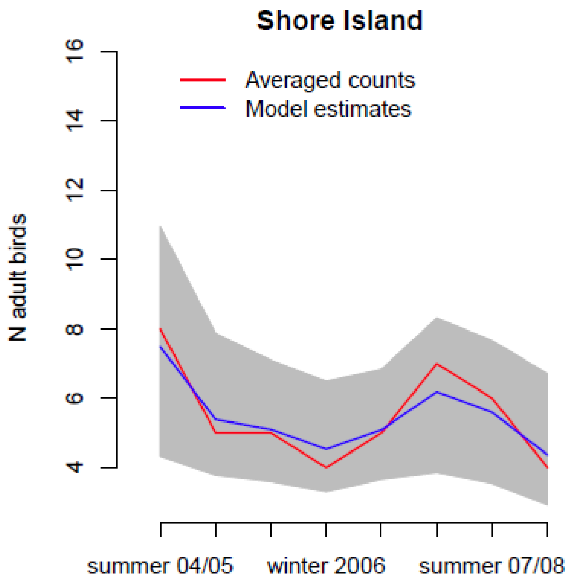

Figure 17. Population trend model for brown boobies on Shore Island 2004-2008.

Discussion

Brown boobies have a small population on St Helena. This is likely to represent a very small proportion of the global population which is estimated to be 200,000 individuals (del Hoyo *et al*. 1992). Shore Island is the most important colony for this species. There are anecdotal records from fisherman that brown boobies only breed on George and Shore Island (Rowland *et al.* 1998). The fact that the majority of observations of chicks seem to occur on Shore Island would seem to support this statement. Unfortunately their breeding cycles remain unknown.

5.7 Masked Booby (*Sula dactylatra*)

Species Abundance

Masked boobies are most abundant during their peak breeding season in the Lot's Wife colony. During the lowest period of their breeding season they are more abundant on Speery Island although there is a lot of variation in the data (Table 13). Their monthly abundance for the four largest colonies is given in Figure 18. Masked boobies were present in low numbers in the Lot's Wife area roosting during 2005-2006 from the 6 monthly counts but it wasn't until confirmed breeding in 2009 that monthly monitoring commenced. The population trend models for the three largest colonies are given in Figure 19. The mean trend estimates indicate an annual decrease of 4% on Shore Island from 2004-2008, but the 95% confidence interval includes population stability (lambda = 0.96, 96%CI: 0.88-1.04). There is insufficient data to reliably estimate a trend for the other colonies where masked boobies are present.

Table 13. Masked booby mean adult abundance (±SD) during their peak breeding season and lowest breeding season on St Helena 2004-2011 (* includes Blue Point, # includes Camel Rock, n = number of occasions birds were recorded in each colony).

	Peak Breeding Season (July-January)			**Lowest Breeding Season (January-July)**		
Colony	**Mean Number of Adults**	**n**	**Rank**	**Mean Number of Adults**	**n**	**Rank**
Lot's Wife*	92 ± 61	22	1	63 ± 43	10	2
Speery Island#	76 ± 32	46	2	94 ± 31	21	1
Shore Island	34 ± 18	37	3	42 ± 17	16	3
George Island	5 ± 2	5	4	7 ± 5	4	4

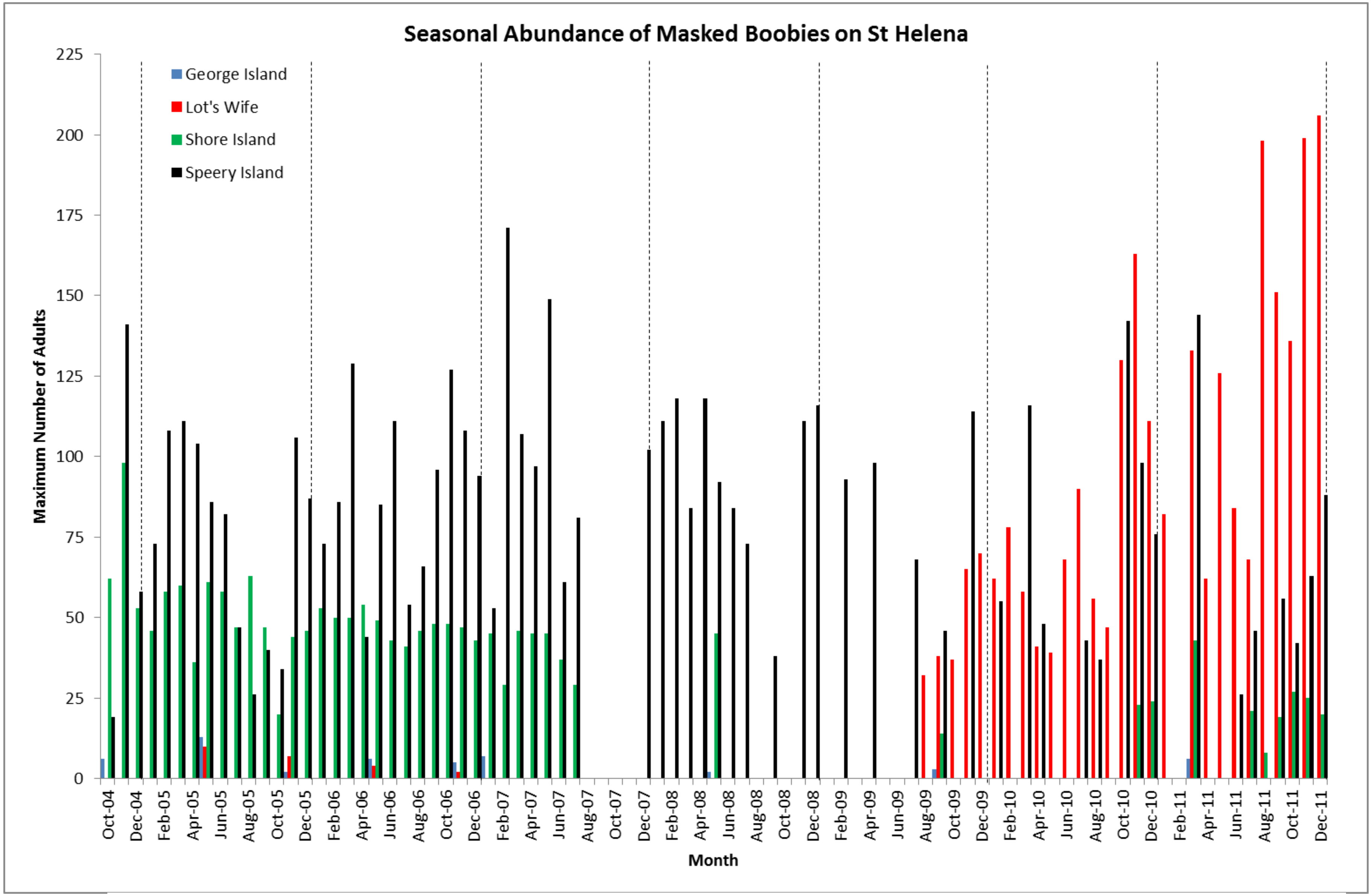

Figure 18 Seasonal abundance of masked boobies on St Helena Island (a dashed line indicates the start of a new year).

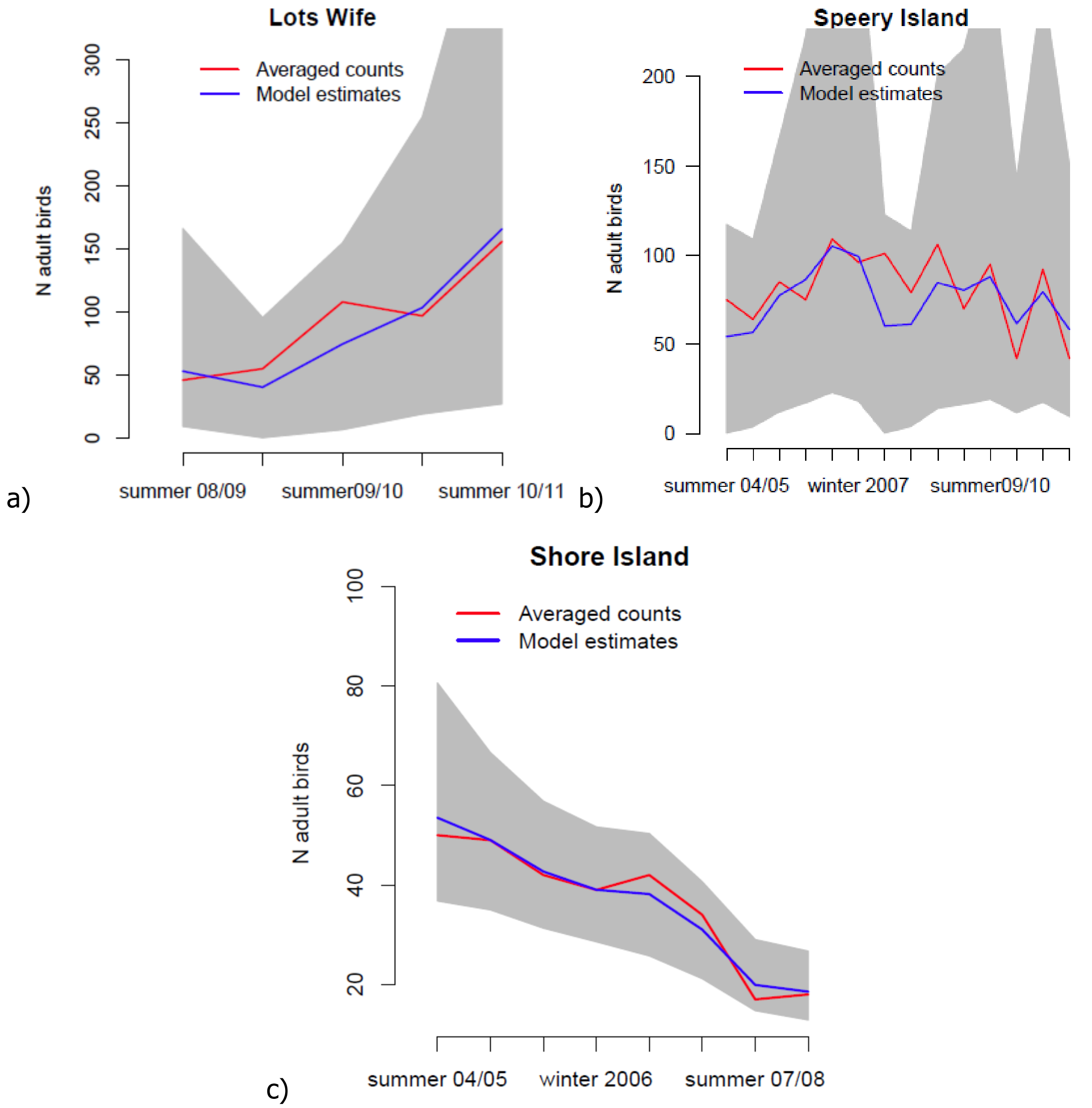

Figure 19. Masked booby population trend modes for a) Lot's Wife (including Blue Point) 2009-2011, b) Speery Island 2004-2011 and c) Shore Island 2004-2008.

Nest Records

Of the 115 nest records of masked boobies at Lot's Wife, 22 were recorded as consisting of one egg clutches and 64 with clutches of two eggs. However only 110 were suitable for analysis. Masked boobies breed all year around, breeding adults are most abundant from July-February (Figure 20). The main laying periods is July-March with peak in September. The main chick rearing period is from October-February with a peak in the number of chicks occurring in November (Figure 21). The hatching and fledging success at the Lot's Wife colony has been fairly constant over the four years monitoring has occurred. Lot's Wife has an overall mean hatching success of 0.918 and 0.427 fledging success (n=91) (Table 14).

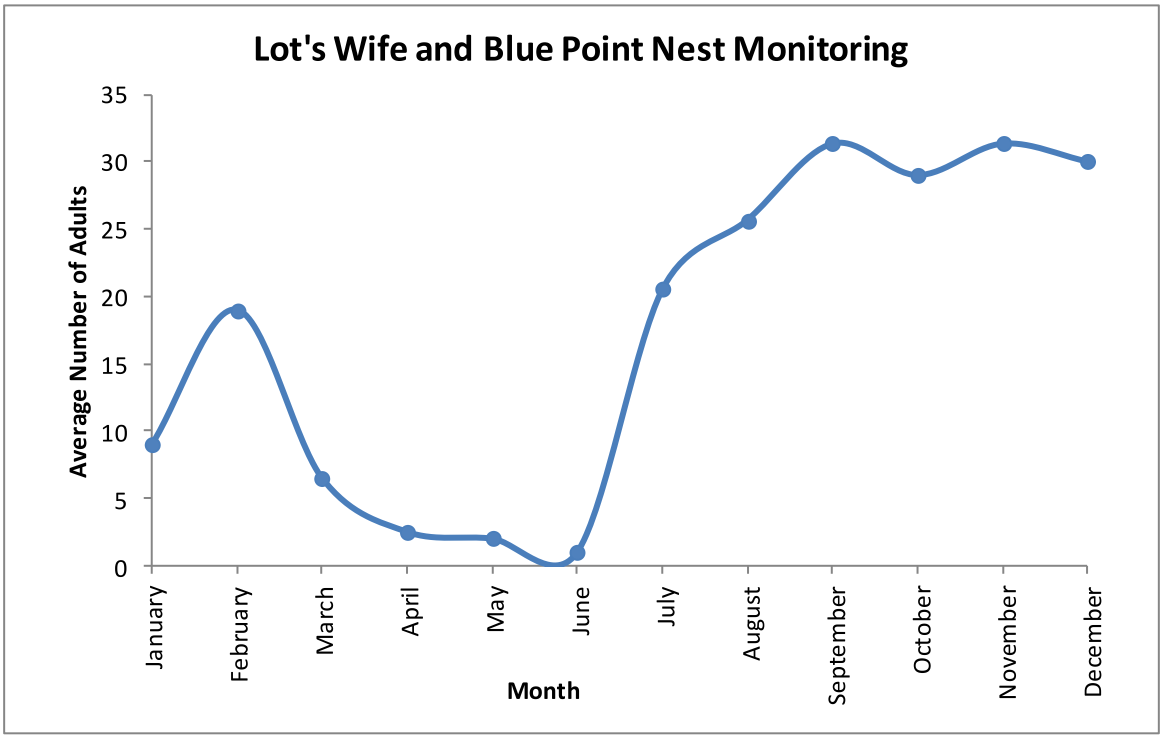

Figure 20. The mean number of breeding adult masked boobies at Lot's Wife (including Blue Point) 2009-2011

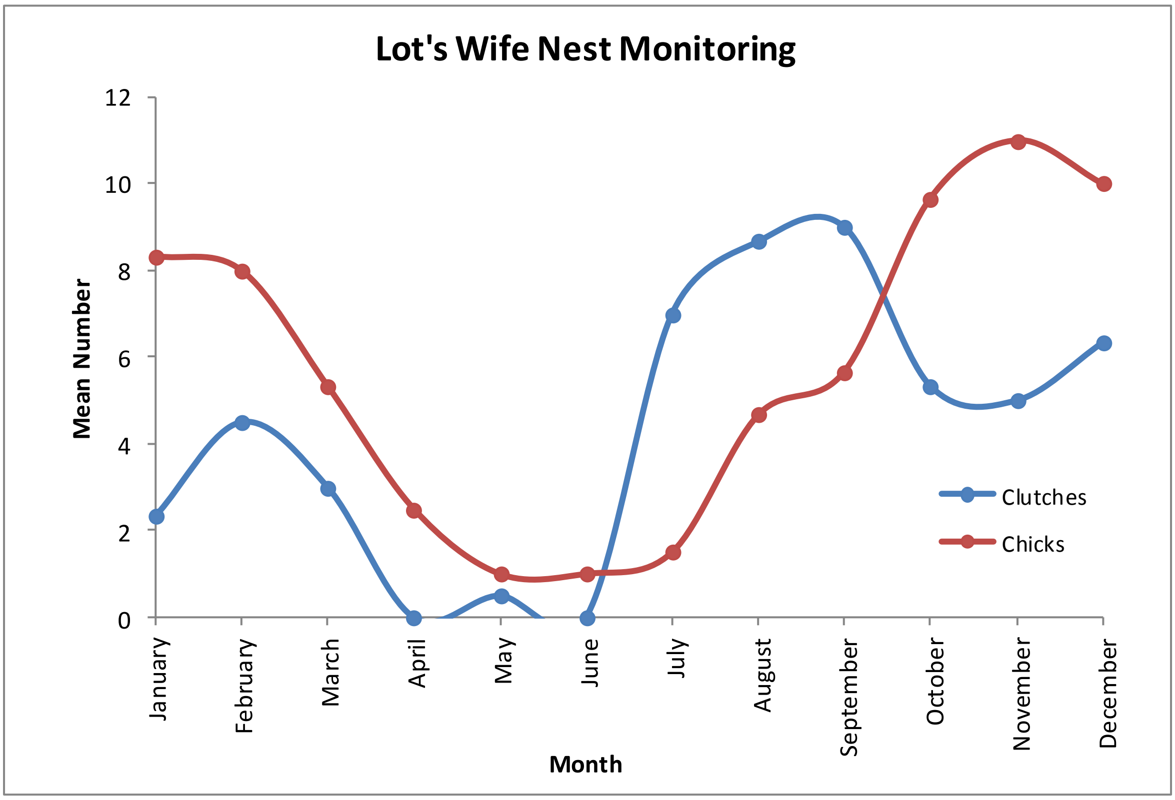

Figure 21. The mean number of masked booby clutches and chicks present per month on Lot's Wife colony from nest monitoring data 2009-2011.

Table 14. The hatching and fledging success of masked boobies at Lot's Wife per year (n=number of nests).

Colony	Year	Hatching Success	Fledging Success	n
Lot's Wife	2009	0.87	0.62	8
Lot's Wife	2010	0.85	0.46	26
Lot's Wife	2011	0.94	0.33	51
Lot's Wife	2012	0.96	0.52	25

Discussion

Historically the greatest concentrations of masked boobies were on Shore and George Island (Rowlands *et al.* 1998). Now the Lot's Wife mainland colony holds the largest concentrations. The recent re-colonisation of masked boobies on St Helena's mainland despite the presence of non-native predators such as feral cats *Felis catus* (Bolton *et al.* 2011) is an important development and the long term viability of the population warrants further investigation. The presence of cats in the area has not been quantified although cat scat has regularly been seen around the colony (pers. obs., Beard 2012) and there have been several reports of feral cats and dogs in the area. This is a potential risk to the long term survival and success of boobies on the mainland; however the current data suggests the population is doing well and the breeding success appears to be reasonably high. Data from monitoring work clearly shows the size of the mainland colony is increasing, more birds re-colonising may attract more predators to the area. An important question that has not been addressed is where have the masked boobies come from? Since 2009 when the colony was first monitored it is clear from personal observation (Beard 2012) that they are spreading further inland and over a wider area. Why this is, nobody knows. Their changing distribution on the mainland has not been recorded but could provide valuable information on the potential effect it has on their breeding success and long term survival. The use of photographic surveying from fixed vantage points in conjunction with regularly plotting breeding attempts onto a map would be advantageous in the future.

Unfortunately the gaps in the monitoring data leave other important questions unanswered such as why masked boobies started to breed on the mainland. Bolton *et al.* 2011 discusses several theories but none can be confirmed. It is therefore vital to get an overview of what the whole population of masked boobies on St Helena is doing in order to gain a better understanding of the population dynamics (if for example the masked boobies start to disappear from the mainland). Speery Island shows a higher abundance of boobies during the lowest breeding period (even though the variability is very high) which suggests that Speery Island is perhaps used more for a loafing/roosting area than a breeding colony. As Bolton *et al.* (2011) discuss, it is a difficult location to accurately assess and the breeding status on the island is uncertain. If this is the case then it supports the theory that the availability of suitable nesting sites on the offshore islands is a major limiting factor.

The nest monitoring data clearly show masked boobies breed all year around. Egg laying appears to have two waves at approximate six month intervals, the largest in September and the second in February. It is uncertain whether these are the same birds re-laying or new birds perhaps from another colony taking their turn. The number of chicks present does not follow the same two wave pattern which suggests the nesting failure rate is very high after the summer breeding peak or that there is too much variability on the data to detect the trend efficiently. The success rate of masked boobies is relatively high as Bolton *et al.* (2011) also discuss.

5.8 Madeiran Storm Petrels (*Oceanodroma castro*)

Species Abundance

Madeiran storm petrels are most abundant on Egg Island during their two known annual breeding seasons (Table 15); however they are more abundant around Speery Island during their non-breeding seasons. Figure 21 gives their monthly abundance at the three largest colonies. The high numbers observed on Egg Island are due to counts being conducted close to dusk when they are more active. The data was insufficient to reliably conduct population trend models or estimates.

Table 15. Madeiran storm petrel mean adult abundance (±SD) during their two breeding seasons and non-breeding season on St Helena 2004-2011 (including birds in flight, n = number of occasions birds were recorded in each colony).

	Breeding Seasons (April-August, November-January)			**Non-breeding Season (January-April, August-November)**		
Colony	**Mean Number of Adults**	**n**	**Rank**	**Mean Number of Adults**	**n**	**Rank**
Egg Island	87 ± 166	29	1	4 ± 8	12	2
Speery Island	2 ± 1	20	2	3 ± 2	8	1
Peaked Island	2 ± 1	6	3	1 ± 1	2	3
Shore Island	1	1	4	-	-	4

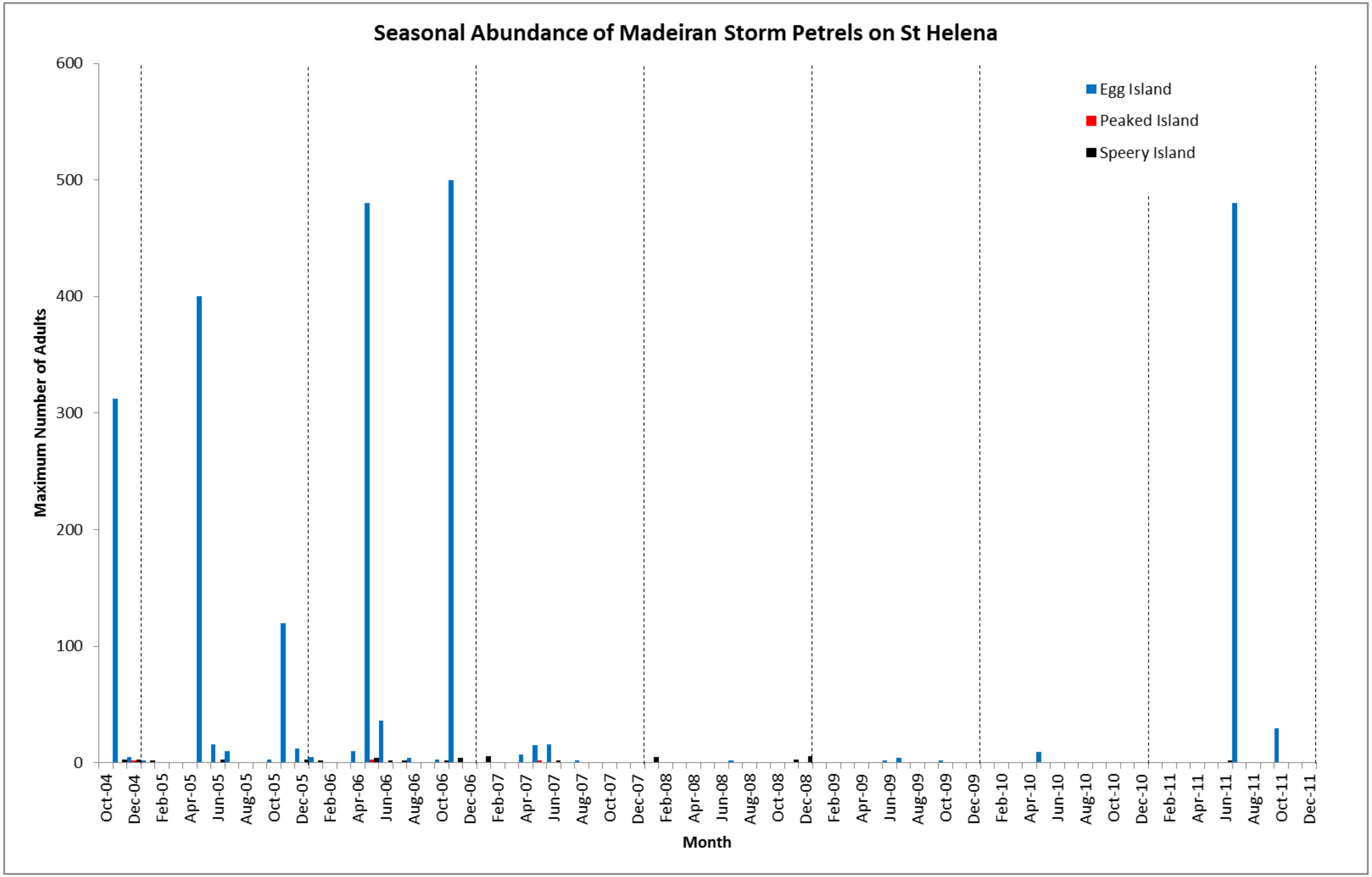

Figure 22 Seasonal Abundance of Madeiran Storm Petrels on St Helena Island (a dashed line indicates the start of a new year).

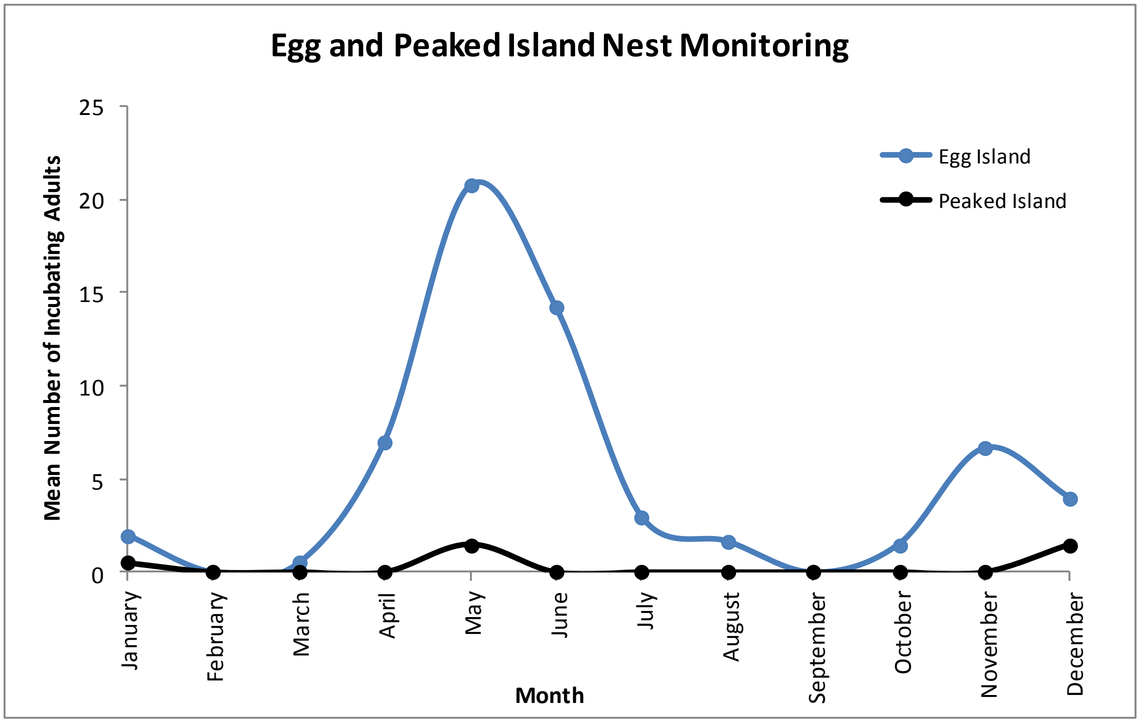

Figure 23. The mean number of incubating adult Madeiran storm petrels per month on Egg Island and Peaked Island 2004-2011.

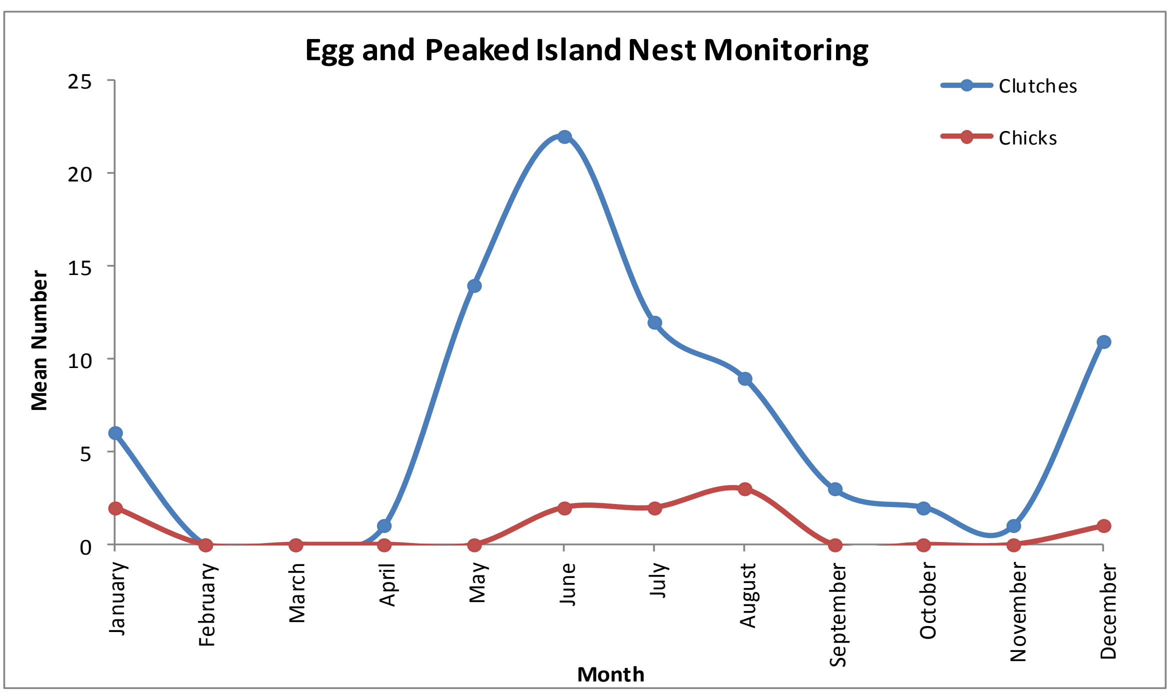

Figure 24. The mean number of Madeiran storm petrel clutches and chicks present per month on Egg and Peaked Island from nest monitoring data 2004-2011.

Nest Records

There were in total 264 nest records for Madeiran storm petrels recorded from 2004-2011; 250 from Egg Island, 13 from Peaked Island and one from Thompson's Valley Island. 68 nests were identified as consisting of one egg clutches. However only 216 of the nest records were suitable for analysis (Table 16 and 17). Figure 23 shows they have two distinct breeding seasons on St Helena; a "cool" breeding season from March-August and a "hot" breeding season from October-January. There are substantially more Madeiran storm petrels breeding in the "cool" season than in the "hot" season. Their peak egg laying periods are in June and December (Figure 24) and their chick rearing peaks in August and January.

Table 16. The hatching and fledging success of Madeiran storm petrels during the "Cool" breeding season (March-August) on Egg and Peaked Island per year (n=number of nests).

Cool Breeding Season (March-August)				
Colony	**Year**	**Hatching Success**	**Fledging Success**	**n**
Egg Island	2005	0.56	0.15	39
Egg Island	2006	0.51	0.09	82
Egg Island	2007	0.24	0.03	29
Egg Island	2009	1.00	0.00	4
Egg Island	2010	0.38	0.00	8
Peaked Island	2005	0.50	0.00	2
Peaked Island	2006	0.33	0.00	3
Peaked Island	2007	0.00	-	3

During the "cool" breeding season Madeiran storm petrels on Egg Island have a mean hatching success rate of 0.48 and a fledging success rate of 0.09 (n=162). On Peaked Island the hatching success rate is 0.25 and fledging success 0.00 (n=8).

Table 17. The hatching and fledging success of Madeiran storm petrels during the "Hot" breeding season (October-January) on Egg and Peaked Island per year (n=number of nests).

Hot Breeding Season (October-January)				
Colony	**Year**	**Hatching Success**	**Fledging Success**	**n**
Egg Island	2004	0.60	0.30	10
Egg Island	2005	0.07	0.07	15
Egg Island	2006	0.21	0.07	14
Egg Island	2007	0.00	-	2
Peaked Island	2004	0.00	-	1
Peaked Island	2005	0.00	-	1
Peaked Island	2006	1.00	0.00	1
Peaked Island	2007	0.00	-	1
Thompson's Valley Island	2008	0.00	-	1

During the "hot" breeding season on Egg Island Madeiran storm petrels have an mean hatching success rate of 0.24 and fledging success of 0.12 (n=42). Peaked Island has an mean hatching success rate of 0.25 and a fledging success rate of 0.00 (n=4).

Discussion

Bennett *et al.* (2009) described in detail the two discrete egg laying periods of Madeiran storm petrels on St Helena, which was an important discovery. At the time of this review data are still being analysed on the call vocalisations and genetic differences between the "hot" and "cool" breeding populations to be able to compare against other sympatric seasonal populations. Morphological work shows that the seasonal populations on St Helena do not differ from each other, and Ascension differs only from the St Helena 'hot' population in having a slightly thicker bill. However, all three populations are highly different from the Madeiran Storm-petrel *O. castro*, which is how these populations are currently classified (M. Bolton, pers. comm.). If St Helena's Madeiran storm petrel population does warrant recognition as a separate species they would be St Helena's only endemic seabird and definitely of international conservation importance. Other supporting data on their vocalisations may also need to be collected to confirm the species separation. Storm petrels are particularly vulnerable to predation from cats and rats being a small burrow nesting species, therefore monitoring populations for declines are particularly important. This species is arguably the most difficult to accurately monitor as it is nocturnal and nests in burrows which are difficult to access. Specific targeted methods clearly need to be used to get reliable data on the abundance and distribution of this species. During July 2012 a trial project to use sound recording to detect Madeiran storm petrel vocalisations were completed (Appendix 4). This technique has been successfully used as an alternative census method for a number of other species such as shearwaters (Blumstein *et al.* 2001, Buxton and Jones 2012, Celis-Murillo *et al.* 2012, Swiston and Mennill 2009). A full proposal on using this technique for Madeiran storm petrels follows this report. Ringing is also likely to be an important technique in addressing the data gaps for this species. The Ringing Scheme proposal also outlines specifically how Madeiran storm petrels should be targeted.

6 Additional Research

6.1 Seabird Ringing

Up to 2011 a total of 112 seabirds had been ringed on St Helena (Table 18), the majority (71%) were Brown Noddies. There were no recaptures of ringed birds (recoveries) during this time; however recent work on Egg Island in 2012 yielded one Madeiran storm petrel recovery. The recovered bird was originally ringed as a nestling on Egg Island in July 2009 making it at least three years old.

Table 18. Summary of seabirds ringed on St Helena from 2004-2011 by the Marine Section.

Species	2007	2011	Total
Black Noddy	28	-	28
Brown Noddy	72	8	80
Red-billed Tropicbird	2	2	4
Total seabirds ringed			112

6.2 Seabird Sightings

From 2004-2011 a total of 197 seabird sightings were reported to the Marine Section. 14% (27) were of unidentified species and over 50% (100) were of "Cape Hen" also known as Artic skua (*Stercorarius parasiticus*) and pomarine skua (*Stercorarius pomarinus*) (Table 19). Cape Hen were mainly present from October-December (Figure 25) and usually seen in Zone A which includes James Bay (Table 20).

Table 19. The sightings of "Cape Hen" also known as Artic skua and pomarine skua per month from 2004-2011.

	Year							
Month	2004	2005	2006	2007	2008	2009	2010	2011
January			2	3		1	2	
February				1				
March				1			1	
April			2					1
May				1				
June				4				
July			2					
August								
September		1	2					
October	3	9	15				2	
November	1	2	14	3		4	9	1
December	2	1	2		1		4	3

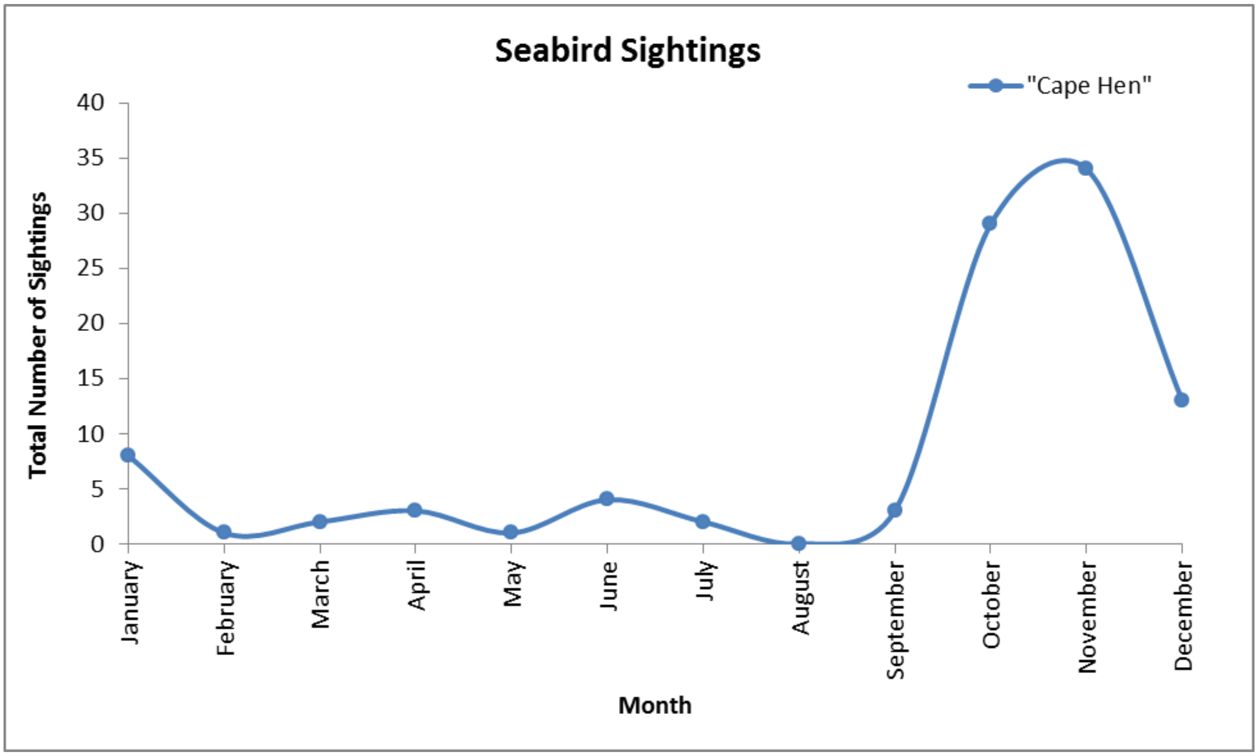

Figure 25. The frequency of "Cape Hen" sightings per month.

Table 20. The main areas where "Cape Hen" were sighted.

Zones	Range	No of Sightings
A	Half Moon Battery to Sugar Loaf	48
B	The Monkey to Half Moon Battery	5
C	South West Point to the Monkey	38
D	Castle Rock Point to South West Point	1
H	Sugar Loaf to Barn Long Point	2

There were 70 sightings (36%) of seabird species that are rarely noted in and around St Helena's waters (Table 21).

Table 21. The occurrence of rare and accidental visitors to St Helena.

Species	Family/Scientific Name	Number of Sightings	Year	Additional
Albatross	Diomedeidae	5	2006 & 2007	
Ascension Frigatebird	*Fregata aquila*	30	2003-2007 & 2011	
Bulwer's Petrel	*Bulweria bulwerii*	3	2005 & 2011	
Cory's shearwater	*Calonectris diomedea*	1	2003	
Kelp Gull	*Larus dominicanus*	2	2006	
Red Footed Booby	*Sula sula*	7	2010-2012	2006 2 Unconfirmed reports
Shearwater	-	1	2007	
Southern Giant Petrel	*Macronectes giganteus*	20	2005	
White Faced Storm Petrel	*Palagodroma marina*	1	2009	2011 confirmed by fishermen from picture

7 General Discussion

7.1 Six Month Surveys

The six month survey did provide data on the occurrence and abundance of species around the whole of St Helena. However the 'around the island' survey was highly weather dependant. Poor weather conditions decreases visibility of coastal areas and observer ability to count and record birds overall, hampering the accuracy of the survey. Some species such as sooty terns were very seasonal on St Helena and may thus have been inadequately covered during the six month surveys. Some surveys were likely to have occurred at times when certain species were breeding and therefore abundant, whilst others not breeding were less abundant. Fairy terns also have a large proportion of their population living inland which was not surveyed.

Not all the surveys for the six month total count took place on the same day as it was physically impossible. There is a risk that some birds would have been counted more than once as they moved around between colonies in between surveys. The diurnal timing of the surveys may have also influenced the total numbers of birds counted. For example red-billed tropicbirds are more active at dawn and dusk therefore were less likely to be counted accurately at midday. It is highly possible that a large proportion of this population were feeding out to sea when surveys were conducted. This issue was partly addressed for Madeiran storm petrels which were counted at dusk. However only one side of Egg Island was counted and estimating the number of birds in flight against the backdrop of the island is extremely difficult, particularly in the fading light.

The six month counts do document the seabird distribution around St Helena's coastline which when compared may be able to be used to monitor shifts in their distribution. The reliability of the six month surveys in detecting long-term population trends is very low and the total population estimates provides a baseline but caution should be used as a consequence of the issues mentioned. This survey method is clearly unsuitable for all species and future surveys would be of little value unless specific species targeting survey methods are developed that could be used simultaneously.

7.2 Seabird Ringing

Seabird ringing on St Helena has yet to become established as a regular part of the seabird monitoring programme. The relatively few number of birds ringed from 2004-2011 provide little information on longevity as of yet, however if more concentrated effort was focused on ringing this may improve. Marking birds so they can be individually identified from each other is the only practical way survival rates can be estimated. Ringing has the potential to provide valuable information on species that are difficult to monitor through other techniques and will be an essential tool in addressing many data gaps such as estimates of population size, site faithfulness and breeding success. A full proposal for setting-up and running a ringing scheme for St Helena also accompanies this report.

7.3 Seabird Sightings

The Marine Sighting Scheme has proved highly successful in recording rare and seasonally abundant species that would have been missed during the Seabird Monitoring Programme. It is unfortunate that the two species of Cape Hen can not be easily distinguished in the field and from the descriptions given the records as this would be useful information. The identification of Ascension Frigatebirds were questionable as Rowlands *et al.* (1998) reports that all other historical records could not be confirmed to species. Given the description of some of the records it is unlikely to be the species found on Ascension. The sighting scheme is clearly an important part of seabird monitoring not only to record pelagic species which use St Helena waters for migration or foraging but also to gain a better idea of rare breeders and their distribution around St Helena. All additional records are centrally collated, which are readily accessible in the Marine Sighting Database.

7.4 Photographic Surveying

The risk of falling rocks was deemed too high for human safety after five initial surveys of the West Rocks cliff area so monitoring ceased. Although the data collected for this area were not suitable for nesting and fledging success to be analysed, they did provide valuable information about the numbers of nesting red-billed tropicbirds in the area. This technique has a lot of potential to be developed further however it may prove inappropriate in gaining an estimate of breeding success as eggs and chicks are unlikely to be able to be seen from a distance. There are clear benefits in using photos in conjunction with traditional monitoring methods, not only when relocating nests but creating a historical record of where birds occur on the island which would not be accessible easily by a person.

7.5 Regularity of Monitoring

A schedule of surveys was put in place from the beginning of the OTEP project (at approximately monthly intervals) however this was not necessarily kept to, particularly when the project finished. Staff shortages and rough sea conditions meant that some surveys either were not completed or were delayed. Some colonies were not visited at all for a number of years because of such factors, and this has impacted the usefulness of the data for analysis. Any future monitoring will need a full contingency plan in conjunction with an appropriate schedule to account for every eventuality. Surveying approximately only once per month also does not account for any day-to-day variation where one day you might see lots of birds and on the next very few therefore the survey data has automatically been interpreted as monthly variation. Future monitoring will need to employ a design that would facilitate the estimation of observation variance such as 2-3 repeat counts (on subsequent days, or within a week or so) per survey to overcome this problem.

7.6 Data Recording

One of the fundamental issues affecting the value of the analysis was that data were only recorded when birds occurred on colonies. Occasions when none were seen, particularly in colony monitoring, generally were not recorded. It is therefore difficult to distinguish 'absence' from occasions when no data was recorded, e.g. through the abandonment due to bad weather. 'Absence' was missing from the database and was not clear on the paper records. On some occasions, for example when the sea was unsuitable to complete a full survey, it was noted on the record sheets, but there is still a lot of uncertainty. For this reason, it has been impossible to include the zero values in the colony monitoring analysis. It must be borne in mind that this factor could easily lead the reader to misinterpret the seasonal abundance charts as the gaps in the monthly survey dates are both when surveying did not occur and when species were not seen. It may have also impacted the outcome of the population models as it introduces bias into some parts of the data set, and reduces the sample size which makes statistical tests less powerful. Double checking all fields are filled in even if they are zeros is a simple but important part of recording any data.

It was also evident going back through the paper records that there were inconsistencies in the activity coding system (Appendix 1) that was used to describe what birds were doing e.g. roosting. These were transcribed when the data had been entered electronically rather than being corrected. This partly stemmed from ambiguities in what the activity codes signified and the observers interpretation of them. The obvious example is 'apparently occupied territory' (AOT) which some observers took to mean the number of adults on territory rather than the number of territories. Therefore in some records the total numbers of territories were over estimated as two AOT were counted where two birds were on the same territory. The database itself also created inconstancies through the flexibility given in what data could be inputted. Various codes could mean the same e.g. nEG and 1EG. Setting clear precise recording codes and procedures is vital to maintain consistency for any future seabird monitoring work.

7.7 Data Management

The seabird database that was originally set up by Mr Alan Mills was adapted from another database. As a consequence, it was not specifically developed to meet the needs of the monitoring project. Minimal training was given in its use and there was no follow up in its management, so if anything went wrong it was not necessarily fixed. There are clear benefits in using a customised database over other data management options such as spread sheets. Basic analyses could be completed at a touch of a button and there is potentially far less room for error when entering and managing data. However development of such a database will take time and expertise.

7.8 Data Analysis

Given the timeframe for preparation of this report and the complexity of the data, it was not possible to complete all desired analyses. For example, population trends were inconclusive in many cases but it was clear from personal observation that some populations were showing a shift in numbers. The models used may not have been appropriate and/or the data may have not been suitable for that type of analysis. None of the authors of this review have yet received advanced statistical training. Any statistical modelling was performed using default state-space models based on an analysis script supplied by Dr Steffen Oppel, but interpretation of the trends, other than at a basic level, is beyond the scope of this report. Further data investigation with more sophisticated techniques and skills are needed to quantify population changes and other analysis.

7.9 Nest Recording

Nest recording proved highly successful in identifying breeding seasons for key species and helped in the estimation of the numbers of breeding birds. However, on some occasions, only samples of the nests were monitored on some of the offshore islands rather than all accessible nests. This would only be useful in indicating their breeding seasons rather than accurately assessing the overall number of nests and monitoring change in numbers of breeding birds using the islands. For species that are known to breed all year round monitoring just a part of their breeding cycle may give inaccurate data on the abundance of breeding birds as the months when monitoring is not done will be excluded. Nesting and fledging success may also be different at different times of year. Thus, in order to obtain accurate information on seabird population health a detailed nest monitoring scheme is essential. There are a number of questions that remain unanswered such as what proportion of nests monitored are pairs breeding more than once in a season (repeat laying) or replacement clutches due to previous nest loss or failure? Do pairs nest in the same location in successive years and do pairs remain with the same partner in successive breeding cycles? These could be addressed if breeding birds were individually identified through ringing. The growth of the chicks and development of the young is another area that has not been examined in any detail.

7.10 Nesting and Fledging Success

For species that have a short breeding cycle, nest failures could have been easily missed due to the relatively long length of time in between nest visits. This is also why near fledged chicks had to be included in calculating fledging success as otherwise very few would have been registered as fledged. Often, once a near fledged chick was seen, by the next visit the nest was empty, either because it had fledged and moved away from the area or because of failure. It is impossible to gauge which of these alternatives is correct, but we have assumed that mortality was low at this stage. Discounting nest visits where the nest was not re-found, there was an unknown outcome or that were empty could have also have led to an over estimation of the success rate, because at least a moderate proportion of these may have failed. Marking individual birds and chicks and making more frequent nest visits would allow survival and nesting success rates to be estimated with higher accuracy.

7.11 The Airport Development

The airport development on the south east coast is in close proximity to two of the major seabird breeding colonies; Great Stone Top which holds the largest breeding colony of red-billed tropicbirds and Shore Island which is home to at least 5, probably all 8, breeding species.

The construction and operation of the airport will have an unknown impact on these colonies unless monitoring continues to measure any population changes which may result from the construction and increased air traffic. It is therefore vital that these sites continue to be monitored especially as construction has already commenced at the time of this report and a new baseline needs to be re-established before changes can be accurately assessed. All monitoring work will need to be co-ordinated with all relevant parties such as Basil Read, Halcrow and the Project Management Unit (PMU) to ensure the safety of staff at all times.

7.12 Monitoring and Conservation Priorities

Population numbers vary naturally over time but trends need to be assessed ideally over a longer period. To be able to monitor long term trends in species populations it is necessary to get a comprehensive view of the majority of the population to accurately assess what and why changes may occur. In the case of the masked boobies due to the majority of the main colonies not being monitored effectively for a number of years this has left a data gap that leaves us unable to explain where they have re-colonised from and why. To prevent this from happening again for masked boobies and other species monitoring should continue regularly. However the monitoring methods used in the seabird programme are clearly not suitable for all species. The data analysis has highlighted many data gaps, notably for sooty terns, red-billed tropicbirds and Madeiran storm petrels which pose difficulties in monitoring accurately using conventional methods. Species targeted approaches are needed to address these separately. Given the potential higher conservation priority for red-billed tropicbirds and Madeiran storm petrels research proposals have been outlined to target these species which follow this report.

Other data gaps include basic information about the offshore islands, specifically Speery, Shore and George Island which probably hold the highest abundance and diversity of breeding seabirds. They are also some of the largest offshore islands around St Helena however accessibility has proved difficult in monitoring them effectively. Information on the importance of George Island for St Helena seabirds is very sparse. Yet this island could be a very important breeding colony for possibly six of the eight breeding seabird species. This is a big gap in the data on the islands which are part of the Offshore Islands Nature Reserve National Conservation Area (NCA). Further research is needed on these islands to support their designation and protect them for the future.

Colonies that have been identified as of high importance for continued monitoring are;

Speery Island; holds the largest abundance of sooty terns and is an important area for non-breeding masked boobies and brown noddies. This island is also an important breeding colony for probably all eight species of seabird on St Helena.

Thompson's Valley Island; A important predator free island for breeding fairy terns as well as occasional brown noddies, Madeiran storm petrels and probably red-billed tropicbirds.

Peaked Island and the mainland cliffs opposite Peaked Island; Arguably the most important area for breeding black noddies. Peaked Island also supports breeding brown noddies and occasionally fairy terns and Madeiran storm petrels.

Egg Island; five of the eight breeding seabird species have been recorded nesting on this colony and it holds the highest abundance of breeding Madeiran storm petrels and brown noddies. It is also an important area for non-breeding black noddies.

Great Stone Top; holds the largest abundance of breeding red-billed tropicbirds and is also an important area for breeding fairy terns.

Shore and George Island; Shore Island holds the largest proportion of brown boobies and is a known breeding colony for at least five but probably all eight seabird species. Six seabird species have been recorded nesting on George Island. The mainland opposite Shore Island at Gill Point was within the last 50 years an established breeding colony until predation from cats caused them to decolonise the area. Predation pressure in this area should be monitored as this could be a future re-colonisation site.

Lot's Wife and Blue Point; currently holds the largest known breeding colony of masked boobies. Castle Rock at Blue Point also holds the second largest colony of red-billed tropicbirds.

James Bay to Rupert Bay; the cliff areas have the largest abundance of fairy terns and Jamestown is likely to be an important nesting area that has not been quantified yet. Red-billed tropicbirds nest on the slopes which are accessible. The cat predation in the area is likely to be a significant limiting factor that is yet to be quantified.

7.13 National Conservation Areas (NCAs)

The network of proposed National Conservation Areas under the Land Development Control Plan (LDCP) 2012 includes many of the identified important seabird monitoring and conservation priority areas. Development of appropriate habitat management and restoration plans for these areas needs careful consideration. Issues that should be addressed include invasive species monitoring, management and control, the impacts of increased tourism on sensitive areas such as Lot's Wife and around the Offshore Islands, future research areas to address data gaps and improved legislative protection.

7.14 Stable Isotope Analysis

The recent emergence of stable isotope analyses (SIA) has added a powerful tool to the study of broad avian migration patterns. The utility of stable isotopes (e.g. hydrogen, carbon, nitrogen) as indicators of avian migration patterns is based on the strong correlation between the concentration of some isotopes in the local feeding environment and the concentration of these same isotopes as they are assimilated in avian tissues, most notably feathers. Since some isotopes in the environment tend to demonstrate predictable patterns over continental scales, the concentration of isotopes in feathers can reflect the general location of the bird when moult and feather growth occurred. In July 2012 the tip of a set number of particular feathers on each bird were taken from Madeiran storm petrels, masked boobies and red-billed tropicbird as feather samples for SIA. These were sent to Professor Jacob González-Solís at the University of Barcelona who, together with Teresa Militão (a PhD student), have a project to map isotopes in all seabird species in the south Atlantic. Sampling other St Helena seabird species would be beneficial to add to this valuable resource and would be a rare opportunity to gather data on the feeding grounds of St Helena's seabirds. However time may be a limiting factor in making use of this opportunity.

8 Recommendations

8.1 General

St Helena's Seabird Monitoring Programme has provided highly valuable baseline data on the seabird populations during its first eight years. Reliable population trends will only become apparent over longer time periods therefore it is vital that monitoring continues to protect and conserve them for the future. To maintain continuous monitoring coverage and prevent gaps in future data recording which is highly damaging to the ability to interpret meaningful trends, all future seabird monitoring work should be scheduled a minimum of a year in advance and include detailed contingency plans such as back up dates for each survey particularly for boat surveys on the windward side of the island which are highly weather dependent.

To maintain consistency for all future seabird monitoring work clear precise recording codes and procedures should be set. This should include double checking procedures so that all fields are filled in even if they are zero values. A research proposal should be drafted for a student to retrieve the zero data from the null counts in the existing data set which would be beneficial information. The development of a custom-designed database would be worthwhile. This is a large investment of effort and would need to be commissioned professionally. It is a highly technical job and current staff could not afford the time to work on it. A nominated data officer should be appointed to train all staff in its use and fix arising problems. Production of a user guide should follow the database creation. The database should also incorporate simple reporting functions to allow basic data analysis to be completed as and when necessary to track changes in population trends.

An external body should be sought to provide more detailed statistical analysis on the current data set to enable assessment and interpretation of the complex trends over the large amount of random variation present. The current Marine Section staff cannot currently conduct these analyses without advanced level training.

To address some of the gaps in species knowledge and to assess the threats to species survival and provide appropriate evidence based advice that can be used to develop conservation action plans detailed monitoring of selected species is essential. Specific species targeted approaches have been proposed in the research proposals that follow this report, notably the establishment of a ringing scheme would provide valuable new information. Given the current staffing levels and budget in the Marine section it will not be possible to implement all of the research proposals without additional funding and support. Sourcing extra funding and support to implement the proposals should be a priority.

8.2 Sooty Terns

Speery, Shore and George Islands should be monitored on minimum monthly basis including a minimum of two repeat counts per monthly survey throughout the year to monitor changes in the population numbers. A minimum of two repeat monthly boat surveys of George Island may enable a more accurate count of sooty terns using the island than would be gained from observing the island from the mainland observation point. Gill Point, Castle Rock Plain and Point should be checked regularly for sooty terns during routine monitoring of Blue Point and Shore Island. Any nesting attempts on the mainland should be documented and monitored at a minimum of 7 day intervals as predation in these areas is likely to be a major factor affecting nesting success.

8.3 Fairy Terns

A minimum of two repeat counts monthly throughout the year of Jamestown together with two repeat counts three times a month from June to August of the cliff faces from James Bay to Rupert's Bay, Thompson's Valley and Speery Islands to monitor the population. Continued nest monitoring on Thompson's Valley Island as well as in Jamestown and other inland sites with fewer cats than Jamestown would be advantageous to help quantify any differences in breeding cycles and the affect cat predation may have on their breeding success year to year. A trial island wide census during their peak breeding season (July) should be completed; this would yield a more appropriate population estimate for this species and if done annually would give an indication of fluctuations in the population numbers. However if the trial is deemed inappropriate and/or unfeasible then dawn counts at likely transit points where birds go out to feed for the day and travel to and from a roost such as James Valley would give a population index that could be compared year to year.

8.4 Red-billed Tropicbirds

This species is difficult to monitor accurately using conventional survey techniques due to their preferred choice of nesting location on steep inaccessible cliffs, their activity pattern and wide range around St Helena's coastline, therefore new monitoring approaches must be considered. Mark recapture techniques as outlined in the Ringing Scheme Proposal will focus on estimating the abundance and survival rates of red-billed tropicbirds on St Helena. In addition to this work a minimum of three repeat monthly colony counts completed at dusk should be conducted throughout the year to monitor changes in the population numbers. They should focus on the colonies with the highest abundances; Great Stone Top, Blue Point, Ladder Hill and Munden's. Nest monitoring in conjunction with the tracking project at Ladder Hill and Munden's as outlined in the proposal will address the low amount of data on breeding success for this species.

8.5 Brown Boobies

Given the small population of brown boobies on St Helena counts should be conducted opportunistically when ever other seabirds are counted particularly at Shore, Peaked, Egg, Speery and George Islands. Verification of their breeding cycle and success rates will be difficult given the small numbers observed. A minimum monthly survey by boat of Shore Island may enable nests to be identified and monitored. Therefore breeding cycles may be inferred but the likely low numbers may be insufficient for success rates to be calculated accurately. Given St Helena holds only a small proportion of the global population and there is no evidence to suggest that it is currently in decline this species' is considered a low priority in addressing the species data gaps.

8.6 Masked Boobies

The re-colonisation of masked boobies onto St Helena's mainland despite the presence of cats is a very rare event and understanding the reasons behind it, together with the successes and failures of the attempt is of global interest to seabird ecology. It is therefore a scientific and conservation priority. A minimum of two repeat monthly colony counts should be conducted throughout the year to monitor changes in the population numbers on at least two mainland and two offshore colonies with the highest abundances; Lot's Wife and Blue Point, Speery and Shore Island. Mark-recapture techniques as outlined in the Ringing Scheme Proposal in conjunction with monthly colony counts and nest monitoring will yield higher quality information on productivity, reproductive success and adult survival rates. Nest monitoring visits should ideally be at a minimum of 7-10 day intervals to increase accuracy of success rate calculations for a minimum trial of one year. All active nests and territories should be mapped using a GPS device or plotted by hand as accurately as possible on a map to monitor the changing distribution of the mainland colony. In addition the mainland colony should be documented photographically at set vantage points on every visit as additional evidence. Given the recommended actions for this species it may be appropriate to seek external scientific funding for a PhD project to enable a comprehensive study on the population. This could facilitate more tracking and ringing work to be done and provide supplementary information on areas that have not been researched yet such as behaviour and predation.

8.7 Madeiran Storm Petrels

Understanding more about the population of possibly endemic Madeiran storm petrels on St Helena is of high importance as little is currently known about them and they are likely to be of international conservation importance. Conventional monitoring methods are unsuitable for this nocturnal burrow nesting species therefore alternative approaches are needed. Mark recapture techniques as outlined in the St Helena Ringing Scheme Proposal and autonomous digital sound recording outlined in the Sound Recording Proposal will focus on estimating the abundance and distribution of Madeiran storm petrels on St Helena. Depending on the outcome of the sound recording project this technique could potentially be used in the future as a long term population monitoring tool.

8.8 Black and Brown Noddies

For population trends to be assessed for these species, Egg, Speery and Peaked Island as well as the mainland cliffs opposite Peaked Island should at the very least be continued to be monitored. However due to the uncertainty of the black noddies breeding season and the shifting breeding cycle of brown noddies this will be difficult. If the brown noddies annual breeding cycle had remained consistent then two repeat counts three times a month from November to March would have been appreciate. As it stands two repeat counts on a monthly basis together with nest monitoring on a minimum of a monthly basis on Egg and Peaked Island will also help accurately access population trends by feeding into the monthly count estimates in these areas and allow data to be collected on the changing breeding cycles. Development of photographic surveying by boat in conjunction with normal monthly cliff counts may be used to identify accurately black noddy breeding cycles and possibly estimate breeding success.

8.9 Six Monthly Counts

Gaining accurate population estimates for all of St Helena's seabird species is vital information necessary to accurately assess the importance and conservation status of species in a global context. This information however is not easy to gather for various reasons described in the discussion but the six monthly counts have provided valuable baseline estimates for minimum population estimates. Until species specific targeting survey methods are developed that can be used to get this information the six monthly counts should cease.

8.10 Seabird Ringing

Increased effort to ring and recover ringed birds is needed to increase the likelihood of catching a ringed bird and therefore gain valuable information on their life histories. Implementing the St Helena Seabird Ringing Proposal and sourcing external funding for its long term establishment should be a priority.

8.11 Seabird Sightings

Continuation of the Marine Sightings Scheme will enable rare and occasional visitors to be recorded with relatively little investment of time and effort. Effort should be made to increase the extended network of observers that record sightings as this would increase coverage around the island. A quick identification chart for insertion into sighting record books should be produced to enable differentiation between the two species of cape hen. A summary of all marine sightings should be published annually to inform members of the public and encourage reporting of sightings.

8.13 The Airport Development

Shore Island and Great Stone Top should be surveyed as soon as possible to re-establish a baseline before impacts due to the airport construction and operation can be accurately assessed.

8.13 Feral Cats

All evidence of cats in the Lot's Wife, Blue Point and Gill Point area should be documented; the amount and GPS location of all cat scat found along the route used for monitoring should be recorded on each visit, descriptions of visual sightings of cats documented (colour, coat pattern, cat type) along with any bird carcases or remains found during monitoring work. A minimum of 2 cat traps should be set for at least a week every six months in each area to relieve local predation pressure. Records of the trapping success including descriptions of the cats caught should also be kept.

8.14 George Island

To improve our knowledge of the abundance of species occurring and possibly breeding on this offshore island a targeted approach is needed. The distance from the mainland observation point at Gill Point to George Island is too far to accurately count and identify seabirds. Therefore a minimum of two repeat boat surveys monthly for one year would provide valuable information. This could then be scaled down to two-three repeat boat surveys per month for the months when the most abundant species are breeding.

8.15 Other

If the preliminary stable isotope analysis is successful then feather samples from fairy terns, sooty terns, brown boobies, black and brown noddies following the sampling guidelines set by the University of Barcelona for further analysis would be advantageous.

9 Acknowledgements

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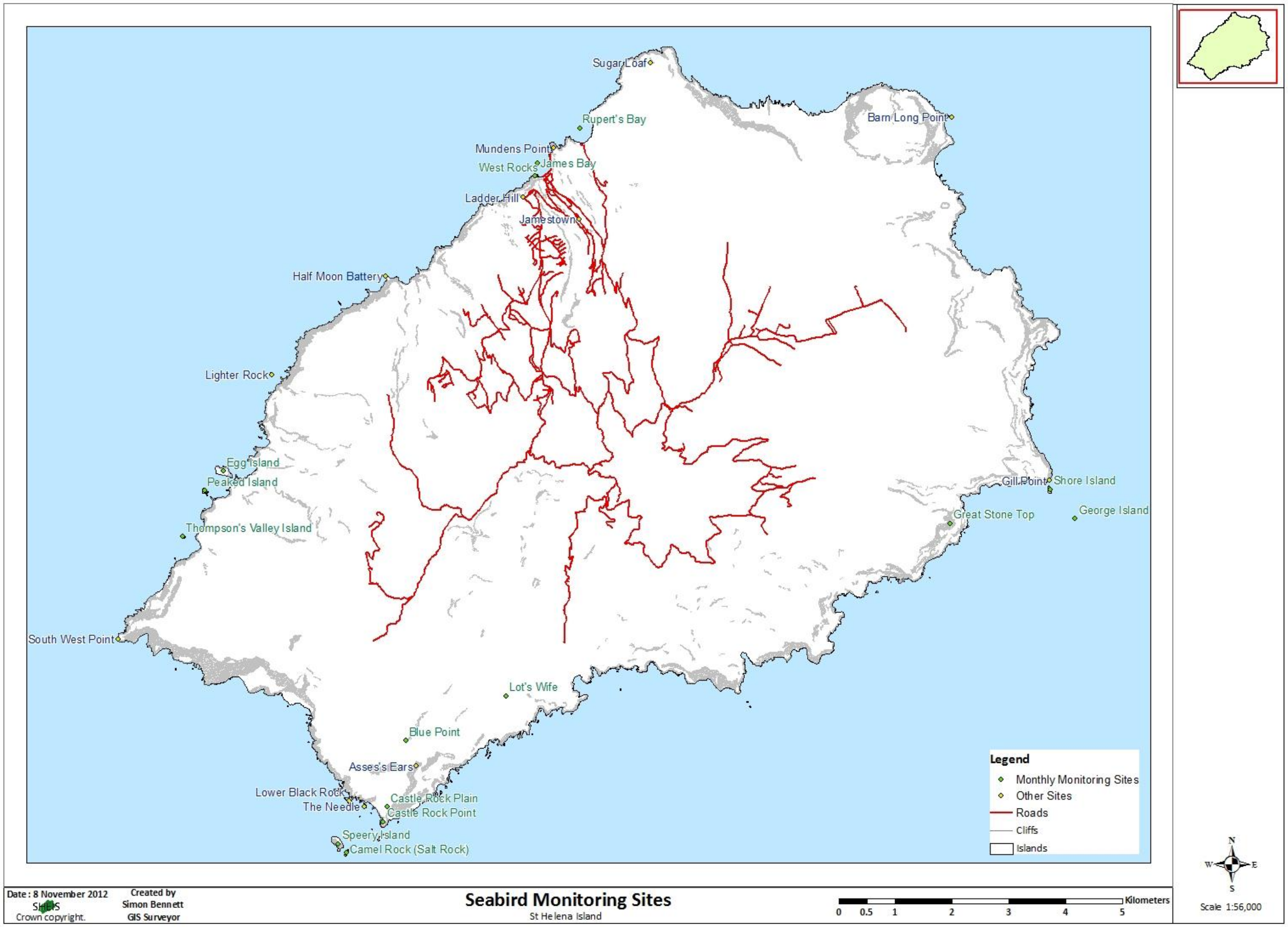
Appendix 1 Activity Codes

Code	Description
EMPTY	Nest/site empty (use FAIL if empty after a failed breeding attempt)
BP	Bird or birds present in the area, but not associated with a nest/scrape
AOS	Apparently occupied scrape - any evidence of nesting (e.g. lined scrape, copulating birds)
AOT	Apparently Occupied Territory
ROO	Roosting
AON	Adults on Nest
AIA	Apparently incubating adult(s)
nEG	Number of eggs (e.g. 2EG); for minimum values, use + sign (e.g. 1+EG)
nNK	Number of naked chicks
nD1	Number of small chicks with some down on back
nD2	Number of small chicks, fully covered with down
nD3	Number of half-size chicks, completely covered with down
nD4	Number of full-size chicks, completely covered with down; beak fully grown
nF1	Number of full-size chicks, mostly downy but with some feathers
nF2	Number of full-size chicks, mostly feathered, with some down still present
nF3	Number of fully feathered chicks (but not yet flying out to sea)
nFL	Number of fledged chicks
FAIL	Nest/site failed
UNK	Status unknown
NNF	Nest Not Found

Appendix 2 Seabird Monitoring Sites



Note: James Bay-Rupert's Bay monitoring area consists of the cliff face starting at the Customs shed on Mundens's side of Jamestown around to the cliffs face by Argos Atlantic cold store in Rupert's Valley.

Appendix 3 Identifying Foraging Ranges and Important Foraging Areas of Red-billed Tropicbirds Breeding on St Helena Trial Project

1 Background

Seabirds are often used as indicators of the health of a marine environment. Understanding their movements and the choice of foraging locations around St Helena Island could provide valuable information on their range in the South Atlantic. Red-billed tropicbirds *Phaethon aethereus* (RBTB) are poorly studied and masked boobies *Sula dactylatra* (MABO) are easily accessible from mainland St Helena, both species' range potentially very far out to sea.

1.2 The Trial Project

In July 2012 a trial project was conducted on St Helena, the primary aim was:

To test the viability of using GPS data loggers on breeding red-billed tropicbirds to identify foraging ranges and important foraging areas at St Helena.

Objectives:

- Collect tracking data from a minimum of10 individuals with GPS tracking devices
- Estimate foraging ranges from tracking data
- Identify important foraging areas

2 Methods

2.1 The Capture Sites

Effort was concentrated on four sites that were identified as easily accessible with sufficient numbers of breeding seabirds occupying the surrounding slopes. These were Ladder Hill, Munden's, Egg Island and Lot's Wife.

2.2 Monitoring and Deployment of Loggers

Initially slopes around Munden's, Ladder Hill and Egg Island were visually searched for possible RBTB nest cavities. All RBTB nest cavities found containing eggs were noted and a GPS reading of the location was taken. Before deployment each I-Got-U logger was fully charged and pre-programmed using the @Trip PC software to start recording at a set time and record its location every 100 seconds. Each device weighing approximately 13g was also sealed in a waterproof casing.

Birds were caught by hand or with the use of a hook or noose to extract from the cavity, following guidelines from Redfern and Clark (2000). Where possible a BTO ring was fitted by a licenced BTO ringer and full morphometric measurements were recorded prior to fitting of the devices. One person held each bird whilst the other fitted the device to the bird's back. Salt water-resistant sticky tape (Tesa, Beiersdorf AG, Hamburg, Germany) was used to secure the device to the birds back using their feathers as an anchor. Birds were then placed on the ground near their nest or a ledge where it could fly off and return to the nest cavity, giving the people involved a little time to clear the area. As few incubating RBTB could be found, masked boobies *Sula dactylatra* at Lot's Wife were also used to trial the GPS loggers.

2.3 Retrieval

Nest cavities were then checked on a regular basis in order to retrieve the devices safely and assess the outcome of deployments. Birds found with devices were caught as described above. One person held the bird whilst the other carefully removed the device from the bird. All materials used were removed from the bird prior to being released back onto the nest.

2.4 Data Analysis

Raw data were downloaded from the retrieved devices using @Trip PC software then were analysed using a customised algorithm provided by Birdlife International (P. Taylor and M. Miller, pers. comm.). Identified foraging trips were then mapped using Google Earth.

3 Results

Devices were deployed on 15 occasions in total; 8 occasions onto re-billed tropicbirds and 7 occasions onto masked boobies. Only 4 devices in total were retrieved. Table 1 shows the outcome of deployments. The two retrieved GPS loggers from red-billed tropicbirds (00330 and 2216) showed that after deployment the birds did not leave their nest cavities for up to 4 days. One of the retrieved GPS loggers on a Masked Booby (0058) stopped operating 18hrs after deployment. However, the recorded data showed the bird did not leave the nest area whilst it was working. One retrieved GPS logger on a male Masked Booby (00326) successfully collected 3353 location data points that showed three distinct foraging trips from the Lot's Wife colony (Figure 1). Two trips were approximately 54km offshore from St Helena and the longest trip was approximately 87km offshore. All outgoing foraging trips followed the coastline in an easterly direction before moving out to sea. On each return journey to the island each foraging trip followed the coastline in a westerly direction before reaching its nest location.

Table 1 Summary results of GPS logger deployments.

Species	GPS ID	Location	Deployment Date	Retrieval Date	Outcome
RBTB	00330	Ladder Hill	08/07/2012	10/07/2012	Failed - Never left nest cavity
RBTB	00330	Firing Range Ladder Hill	12/07/2012	25/07/2012	Failed - lost at sea
RBTB	00707	Firing Range Ladder Hill	12/07/2012	25/07/2012	Failed - lost at sea
RBTB	00324	Egg Island	13/07/2012	24/07/2012	Failed - lost at sea
RBTB	00348	Egg Island	13/07/2012	29/07/2012	Failed - lost at sea
RBTB	0048	Egg Island	13/07/2012	29/07/2012	Failed - lost at sea
RBTB	0094	Ladder Hill	16/07/2012	30/07/2012	Failed - lost at sea
RBTB	2216	Ladder Hill	16/07/2012	20/07/2012	Failed - Never left nest cavity
MABO	00326	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Successful - Data logged
MABO	0068	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Failed - lost at sea
MABO	GULL17	Lot's Wife - Top Ridge	21/07/2012	26/07/2012	Failed - lost at sea
MABO	0058	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Failed- Never left nest
MABO	00327	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Failed - lost at sea
MABO	0096	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Failed - lost at sea
MABO	0064	Lot's Wife - Top Ridge	21/07/2012	25/07/2012	Failed - lost at sea

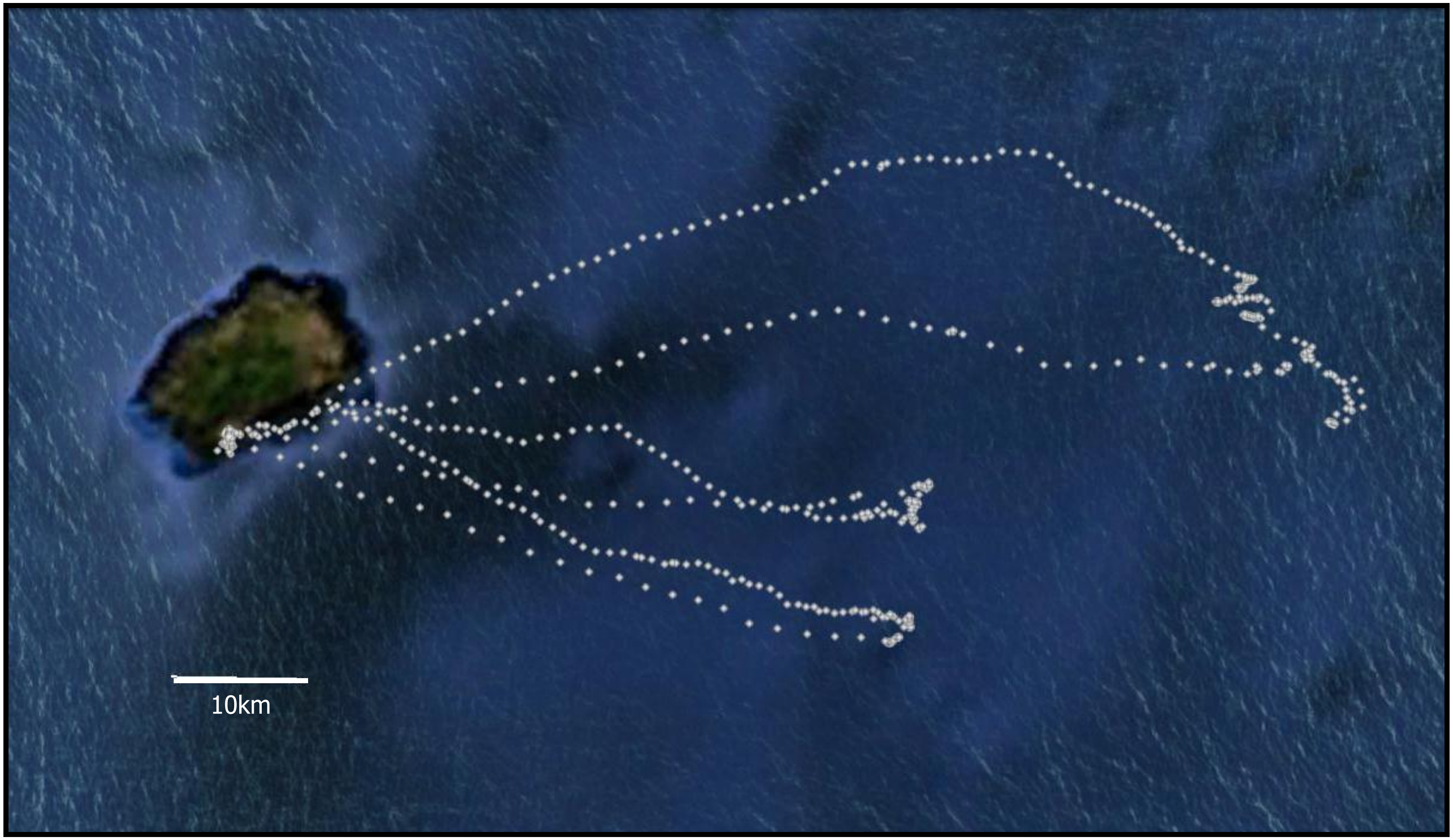


Figure 1.Three Masked Booby foraging trips identified from logger 00326.

4 Discussion

It is clear from the results that valuable data on seabird foraging trips can be gathered using the GPS data loggers. However a bigger sample of foraging trips needs to be gathered in order to be able to try and clearly identify important foraging areas. The low retrieval rate also indicates that the deployment and retrieval methods used were not ideal. The incubation shifts between parents during the incubation period for red-billed tropicbirds were much longer than anticipated. In reality it was between 5-10days rather than 3-4days which greatly affected the success of each deployment and retrieval. If the deployment was timed poorly loggers could run out of battery life before the bird changes shift to go foraging or run out of battery life mid trip. This could be improved by increasing the frequency that each nest cavity is checked prior to deployment so that deployment is timed closer to when an incubation shift change over is likely to take place. The use of a nest camera to record nest attendance would decrease the amount of disturbance and man hours required to gain an idea of the incubations shift schedule before deployment. The loggers have around a 4-7day battery life with the settings we used which should be ample to record a foraging trip if the deployment is timed effectively to coincide with an incubation shift change over.

The fact that no RBTB returning from a foraging trip still had the logger attached shows the attachment method used is not suitable for extended periods of time at sea. Using an alternative attachment method such as a harness to secure the loggers onto the bird's back should decrease the risk of loosing loggers out to sea, extend the amount of time they could be deployed for and increase retrieval success. Masked boobies on the other hand appear to be much more sociable parents with shorter incubation shifts. Therefore retrieval sooner after deployment is possible and could increase retrieval success. Mounting the loggers on the masked boobies tail feathers using salt resistant sticky tape may be a just as effective and cheaper alternative to using a harness, this technique has proved successful on brown boobies on Dog Island off Anguilla (Dr Jenny Bright pers. comm.) During this trial only birds incubating eggs were targeted but it is also possible to deploy loggers onto birds feeding young as Sommerfield and Hennicke (2011) showed the incubation shifts of tropicbirds are much shorter during that phase. This could potentially improve the success of logger recovery. However this may not give representative data on the extent of foraging ranges as tropicbirds are more likely to take shorter foraging trips when feeding their young.

During the trial it was also evident that identifying individual tropicbird parents in nesting cavities in order to recover the loggers caused some unnecessary disturbance. Although using individually numbered rings will enable birds to be identified in the long-term when handled if they are sitting tight in their cavities, it is very difficult to read a ring number or see a logger on its back without disturbing the bird. Using a different method to make a clear externally visible mark on one nesting parents by using for example a semi-permanent dye would reduce the amount of disturbance and enable differentiation between parents.

There is great potential to developing this trial project further to improve our knowledge of seabird foraging ranges however it cannot be ignored that there is a risk that important foraging grounds may not be able to be identified from analysis of foraging trip data. Given the interest expressed by personnel in the local fishing industry and the indirect economical and sustainability implication it may have on them there is scope to develop a partnership. This would build up relationships within the fisheries sector and could reduce overall project running costs. This would need to be negotiated sensitively and transparency maintained throughout.

5 Recommendations

The following recommendations are made for a full project proposal;

- Red-billed tropicbird nests should be checked a minimum of once a day prior and post deployment via a nest monitoring camera.
- One parent from each red-billed tropicbird nest found incubating an egg should be marked externally upon discovery.
- Loggers should be attached to red-billed tropicbirds via a custom made harness and to masked boobies tails with Salt water-resistant sticky tape (Tesa, Beiersdorf AG, Hamburg, Germany).
- Purchasing of GPS loggers should allow for some losses during the project.
- Retrieval of GPS loggers on masked boobies should not exceed 3 days after deployment.

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7 Costs Incurred

Direct costs incurred during the trial to the Marine Section of the Nature conservation Division of the EMD totalled £500 (Table 2).

Table 2 Costs incurred to the Marine Section during the trial.

Item	Unit Cost	Quantity	Total Costs
Boat trip on "Two Rivers"	125	2	250
Boat trip on "Gannet III"	125	2	250
			£500

Appendix 4 Quantifying the Extent and Range of Storm Petrels *Pheodroma sp*. using St Helena's Coast Trial Project

1 Background

St Helena was once an important breeding ground for seabirds supporting a diverse seabird assemblage as shown by the sub fossil remains (Olson 1975). After human colonisation, hunting and the introduction of predators were likely to have caused the extinction of many of those species on mainland St Helena. There is evidence to suggest that relict populations of seabirds that were once abundant may still exist on St Helena's mainland as well as the offshore islands (Ashmole *et al.* 1999, Bolton *et al.* 2011, Oppel *et al.* 2012, Rowlands *et al.* 1998). Nocturnal and burrow-nesting seabird species like petrels are almost impossible to survey visually, however, most petrel species are very vocal in certain nights, and acoustic surveys can be a very productive way to discover and monitor petrel populations (Buxton *et al.* 2012). Autonomous digital audio sound recording devices have been used successfully as an alternative census method for species such as storm petrels, *Pterodroma* sp. and shearwaters that pose challenges to conventional monitoring techniques (Blumstein *et al.* 2001, Buxton and Jones 2012, Celis-Murillo *et al.* 2012, Swiston and Mennill 2009).

1.2 The Trial Project

In July 2012 a trial was conducted to test the viability of using autonomous digital audio sound recording devices for detecting storm petrel vocalisations on St Helena.

The primary aim of this trial was:

To assess the distribution of Storm Petrels *Pterodroma sp*. using St Helena mainland cliffs.

Objectives

- Record calls of storm petrels at three key sites around St Helena's coastline
- Identify areas where target species occur

2 Methods

2.1 The Sites

Effort was concentrated on three key areas that were identified as possible sites where storm petrels may occur, given historical records of their presence and the proximity to other known breeding colonies. These sites were:

Gill Point – Part of the East Coast Scenic Reserve NCA and documented site where Bulwer's Petrel remains were found in 1999. Shore Island and George Island directly opposite are also sites of established breeding seabird colonies and part of the Offshore Islands Nature Reserve NCAs.

Joan Hill – At Man and Horse and part of the Sandy Bay NCA with large areas of inaccessible cliff. Anecdotal accounts exist of seabirds using the area at night and Speery Island, part of the Offshore Islands Nature Reserve NCAs, is situated to the east and has a large established breeding seabird colony.

Egg Island - Part of the Offshore Islands Nature Reserve NCA and an established breeding colony for five known species of seabird. This is the most easily accessible island inhabited by large numbers of breeding Madeiran storm petrels.

2.2 Deployment and Recovery

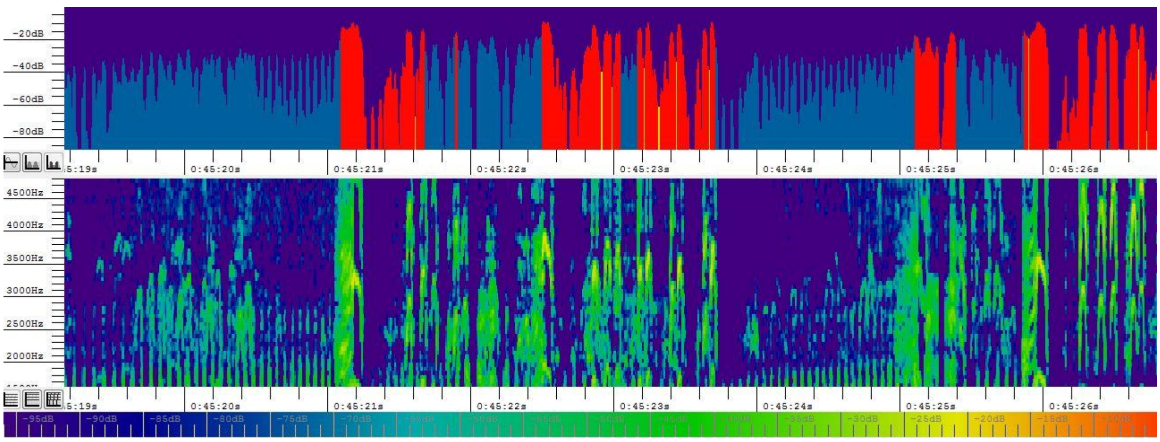
An autonomous digital sound recorder device was deployed at each site to record sound for 2 hours every night (8-10 pm) for a maximum of 1 week during the known "cold" (March-July) breeding season for Madeiran storm petrels. The device was fitted with a new set of 8AA batteries for each deployment to ensure activation of recording. The device was recovered from each site once enough data had been collected and sound recordings downloaded onto a PC.

2.3 Data Analysis

Sound recordings (MP3 files) were converted to 16,000 Hz stereo WAV files and analysed using Song Scope 2.4 (Wildlife Acoustics Inc. 2009) software. Visual searches of the sound spectrum of each recording were done manually to identify the characteristic sound profiles produced by the calls of the possible target species. All identified possible vocalisations were listened too to verify provenance. Song Scope was then used to filter out other possible vocalisations by using a 'call recogniser' defined by the operator.

3 Results

In total 46 hours of sound recordings were taken from Joan Hill and 4 hours from Egg Island. Vocalisations of Madeiran storm petrels were successfully identified from the sound spectrum using the Song Scope 2.4 software (Figure 1). Egg islands sound recordings produced numerous extremely clear vocalisations of breeding Madeiran storm petrels (Figure 1a) whereas vocalisations from Joan Hill recordings were more difficult to pick out (Figure1b).



a)

b)

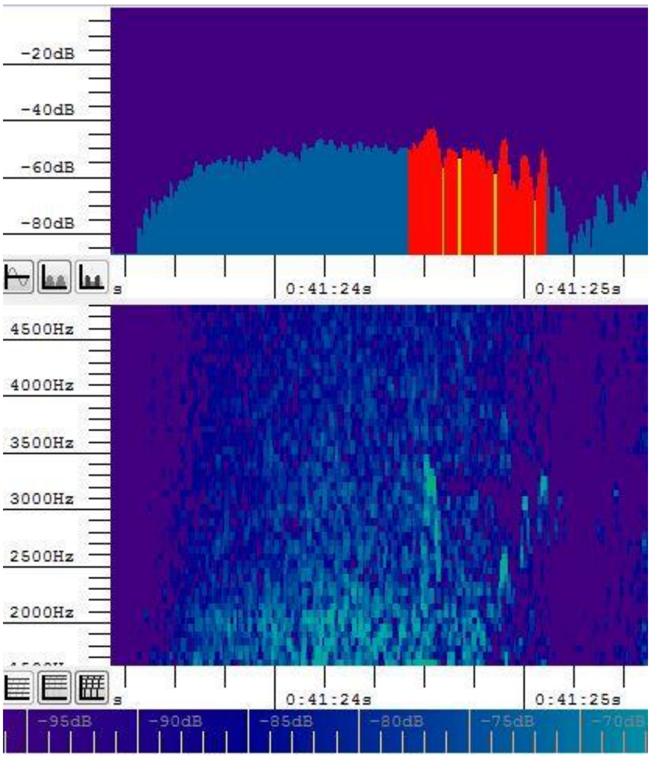


Figure 1. Sonogram of Madeiran storm petrel vocalisation at a) Egg Island and b) Joan Hill, Man and Horse cliffs. The bottom graph is the frequency and the top graph is relative power level with red indicating what is flagged by the user-defined 'call recogniser'

4 Discussion

Vocalisations of Madeiran storm petrels can clearly be recorded using autonomous digital sound recorders. There was a lot of variation in quality and vocalisation activity between recordings. Each recording from Egg Island for example was filled with numerous vocalisations throughout where as recordings from Joan hill have very few vocalisations of storm petrels if any. Studies that have used recording devices on other species (Buxton and Jones 2012) have shown that vocalisation activity can vary for numerous reasons such as the weather and phase of the moon. During the trial only one recorder was used at a time for each location which would account for some of this variation as each deployment would have been under a different set of variables. Unfortunately due to time constraints it was not possible to deploy the digital sound recorder at Gill Point during the trial. Deploying a recorder at each location and setting all of them to record at the same time for the same time period would help reduce the amount of variation between samples.

Where the recorders are deployed at each site also needs consideration as the white noise in the Joan Hill recordings from the wind did make analysis slower. Where possible positioning each recorder in a sheltered position away from the wind should enable vocalisations to be manually picked identified quicker. Vocalisations were analysed in the trial by using Song Scope 2.4 software which has also been used successfully to identify other *Pterodroma sp.* (Buxton and Jones 2012). If automated call recognition is developed for Madeiran storm petrels it may not be as efficient as other sound analysis software such as SoundID 2011 as different species are easier to identify than others.

Madeiran storm petrels are known to have two distinct breeding seasons; "cool" (March-July) and "hot" (September-December). Bennett *et al.* 2009 suggested that this may represent two seasonally separate sympatric populations warranting recognition of separate species. Documenting vocalisations of each population may help in this designation process.

For species such as petrels that are difficult to monitor using conventional methods acoustic monitoring has great potential for developing a species targeted long term monitoring programme.

5 Recommendations

The following recommendations are made for a full project proposal;

- Both the hot (late September-December) and cool (early March-July) breeding seasons are surveyed.
- A recorder is deployed at each site.
- Recorders are deployed for extended periods of time through each season ideally a minimum of 2-3 months to get >1 full moon cycle.
- Sites include offshore islands where known storm petrel colonies exist.
- Alternative power sources are used for long-term use e.g. 12v external battery charged with a small wind turbine or solar panel.
- Call-recognition models should be developed to automatically search recordings for vocalizations to aid data analysis.
- Proposal budget should include the cost of purchasing sound analysis software such as SoundID or Song Scope 2.4.

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