Aldabra Research Station
Scientific Coordinator's Annual Report
2013

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1. INTRODUCTION

It was another actioned packed and exciting year on Aldabra with the start of the SIF marine programme, the continued targeting of the invasive species that threatened Aldabra's biodiversity, detailed analysis of some of the long-term monitoring data to allow informed review of these programmes and the fantastic opportunity to confirm via aerial survey that Aldabra's dugong population is bigger than previously thought! This report provides a summary of the research and monitoring activities carried out on Aldabra during 2013 and an analysis of the some of the data collected in the context of long-term trends.

1.1. Research staff

The table below details all research employees, project staff, external researchers and volunteers that worked on Aldabra as part of the research department in 2013. Following two years of leading the Research Team as Aldabra Scientific Coordinator (ASC) Dr Janske van de Crommenacker shifted the focus of her attention to the much-needed task of analysis of several of the long-term monitoring programme datasets to allow informed review of the monitoring methods with an aim to ensuring the conservation effectiveness, consistency of results and resource efficiency. In addition to this she is also now working on the landbird genetics work with an emphasis on the critical question of whether the Madagascar fodies have hybridized with the Aldabra fodies, and doing the genetic research on the Aldabra rail. Heather Richards was delighted to be given the opportunity to take on the ASC role from May 2013. Key staff remained constant in the form of Terence Mahoune (AASC / Takamaka Team Leader) and Catherina Onezia (Senior Ranger), it cannot be emphasised enough how important it is to retain such staff with their significant knowledge of Aldabra and the research monitoring carried out here. We also welcomed new staff and said farewell to others as detailed in the table below. For details of the Logistics Team staffing please refer to the Island Manager's Annual Report 2013, however, it should be emphasised that the support, participation and collaboration of the logistics staff has been greatly appreciated and is essential for research and project activities. The fantastic hard work, dedication and enthusiasm of all Aldabra staff have enabled the research activities detailed in this report to be undertaken.

Table 1. Research staffing on Aldabra in 2013.

Position	Name	Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Notes
ASC	Janske van de Crommenacker	X	X	X	X							X	X	Started as Resident Researcher in May, based in the UK for lab work May-Oct
	Heather Richards					X	X	X	X	X	X	X	X	
Acting ASC	Wilna Accouche				X	X							X	Standing in during ASC leave
AASC / Takamaka Team leader	Terence Mahoune	X	X	X	X	X	X	X	X	X	X	X	X	
Senior Ranger	Catherina Onezia	X	X		X	X	X	X	X	X	X	X	X	On Mahé for medical attention in April
SFRA	Ravi Moustache					X	X	X	X	X	X	X		
	Daig Romain											X	X	
FRA	Jeremy Raguain					X	X	X	X	X	X	X	X	

Ranger	Andy Gouffé	X											
	Curtis Baker	X											
Trainee Ranger	Michel Malbrook	X											
	Shanni Etienne	X											
	Sheril de Commarmond											X	X	MTC work attachment Nov, started as TR Dec
	Stephanie Marie											X	X	MTC work attachment Nov, started as TR Dec
	Rebecca Filippin											X	X	MTC work attachment Nov, started as TR Dec
ISTO – Takamaka	Lotte Reiter	X	X	X	X	X								Volunteer on reef mapping in January
	Unels Bristol			X										
	Patrick Banville			X	X	X								
	Jamie McAulay											X	X	
Trainee ISTO	Edme Durup				X	X								
	Laurent Leite			X	X	X								
	Ronny Gabriel						X	X	X	X	X	X		
Project Officers	Christina Quanz	X	X	X	X	X	X	X	X	X	X			EMS Project Officer
	Martijn van Dinther	X	X	X	X		X	X	X	X	X	X	X	IAS Project Officer
	Philip Haupt	X										X	X	GEF Project Coordinator
	Richard Baxter	X	X	X	X	X	X							ZARP Project Officer
External Consultants / Researchers	Dr Grant Harper		X	X	X									IAS Rat/Cat Consultant
	Dr Dennis Hansen		X	X	X									ZARP Researcher
	Peter Haverson				X	X								IAS Consultant/HUnter
	Wilfredo Falcon											X	X	ZARP PhD Student
Volunteer	Calum Ferguson	X	X	X	X									Reefing mapping
	Arjan de Groene	X	X	X	X									Reefing mapping
	Glenn McKinlay		X	X	X									Takamaka IAS Project

1.2. Notable non-research events

Table 2. 2013 Transport Schedule

Flights	Supply Boats
17th January	14th February
20th February	9th May
23rd February	18th June
26th February	2nd December
6th March	
8th April	
10th May	
30th October	
20th December	

February

The 33rd SIF Annual General Meeting was held on Aldabra. On February 24th a Scientific Symposium was held in which presentations were given by various SIF staff members and Board members

M.Y. Danah Explorer visited Aldabra from 21st Feb–4th March owned by His Excellency the Sheik of Saudi-Arabia. His Excellency came ashore and had a meeting with SIF's Chairman and CEO and it was decided that Save Our Seas and SIF should collaborate more in future. The yacht was equipped with a Zil Air helicopter and a gyrocopter which was used by Aldabra staff and Board Members to get an aerial view of Aldabra and a unique opportunity to survey for dugongs.

March
M.Y. Danah Explorer returned to Aldabra on 27th March to drop off construction materials

October
M.V. Pangaea arrived at Aldabra on 21st October, used as a platform for marine research at the atoll until 21st November.

November
Aldabra hosted members of the IDC board and SIF CEO from 10th–12th November.
Seabird Yacht visited Aldabra 10–12th and 16–17th November.

December
Seabird Yacht returned to Aldabra (6–7th December)
On 20th December photographer Imran Ahmad and his wife Debbie Tan Hwee Yee arrived on Aldabra to take photographs of the atoll with a focus on the marine environment.

1.3. Notes on monthly schedules

Throughout the year the monthly research programme was set by the ASC following discussion with the AASC (when based on Picard) and Senior Ranger. Figure 1 shows a map of Aldabra with all monitoring locations. All routine monitoring data was collected in accordance with the methodology detailed in the respective protocols. The specifics of existing monitoring methods are not therefore detailed in this report; please refer to the monitoring protocols for full details. If any changes in methods have occurred during 2013, these have been discussed in the relevant section of this report.

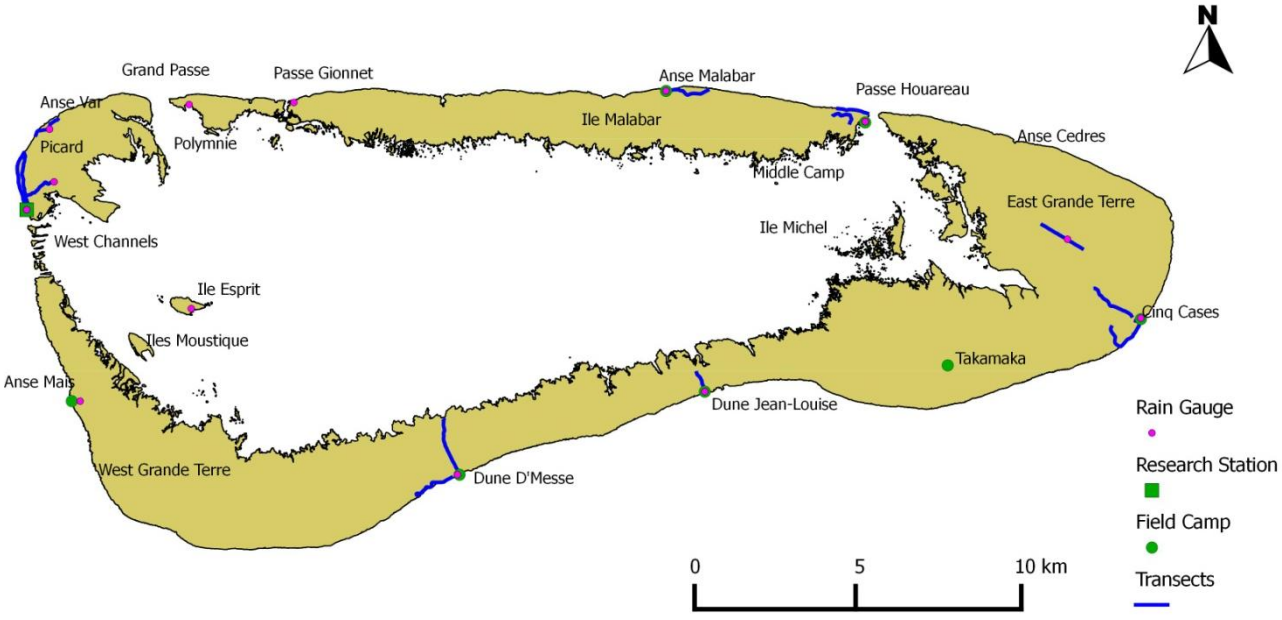


Figure 1. Map of Aldabra Atoll with camps and locations of monitoring transect/activities.

MONITORING PROGRAMMES

2. CLIMATE

A set of weather variables are recorded every morning at 8.00am at Aldabra Station, Picard. In addition monthly rainfall data is collected from 12 rain gauges (excluding the Research station) across the atoll.

2.1. Dry and wet bulb temperatures

The Stevenson screen was turned towards the southern hemisphere on 9th March, and back towards the northern hemisphere on 7th October. Only readings taken before 8:30am were included in this analysis. The dry bulb temperatures recorded in 2013 were consistent with patterns observed in previous years (Figure 2).

In keeping with previous assessments, only the wet bulb temperature data from May 2010 onwards is included (Figure 2), as most previous data is incomplete or inaccurate (see 2010 Annual RO report). Wet bulb temperature patterns for 2013 are in-keeping with normal trends observed.

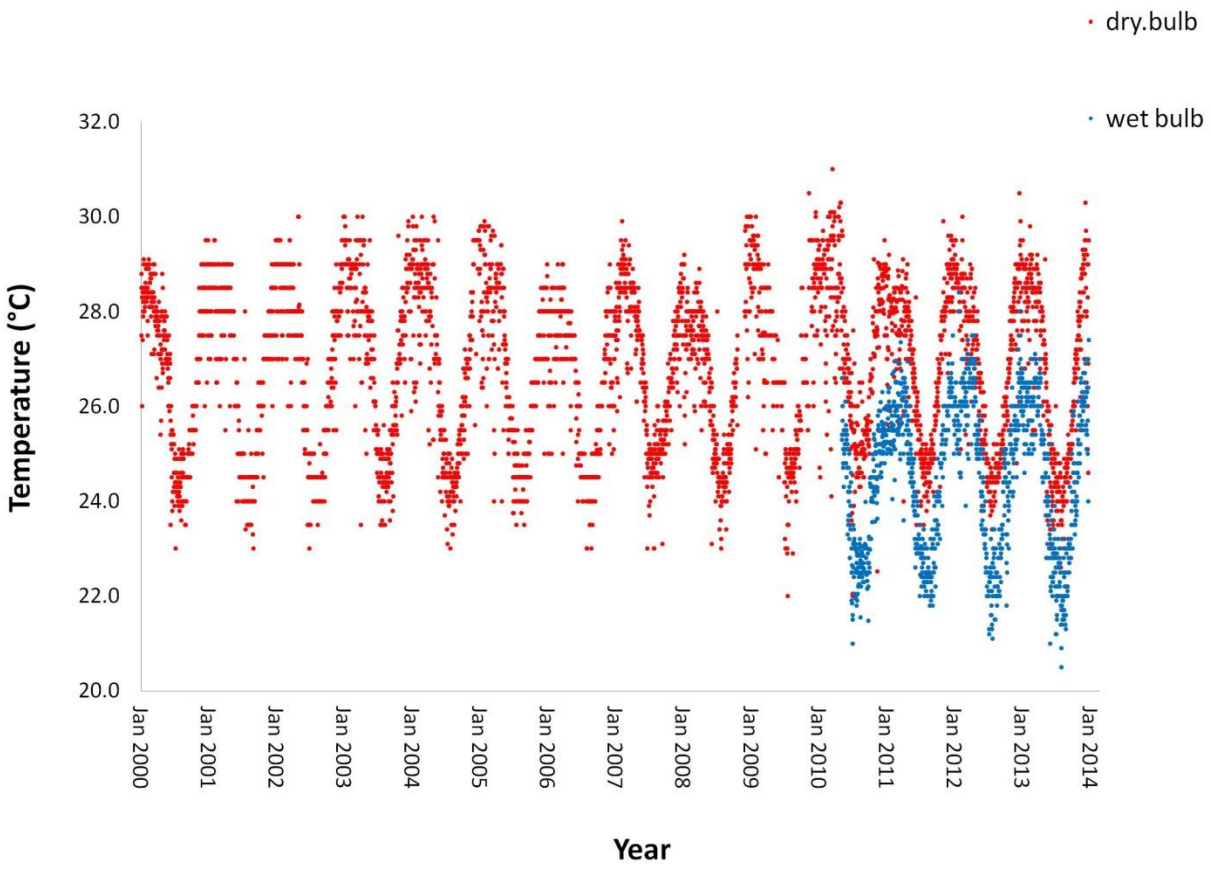


Figure 2. Daily dry bulb (red dots) and wet bulb (blue dots) temperatures (°C) recorded at the Aldabra Station between 2000-2013 (May 2010 – Dec 2013 for wet bulb only).

2.2. Maximum and minimum temperatures

The maximum monthly temperature patterns for 2013 are consistent with long term averages (Figure 3), with higher temperatures in the NW monsoon and lower maximum temperatures in the SE monsoon. However, it can be seen that during the SE monsoon (June – September) the maximum temperatures for 2013 were consistently lower than the long term maximum temperature averages.

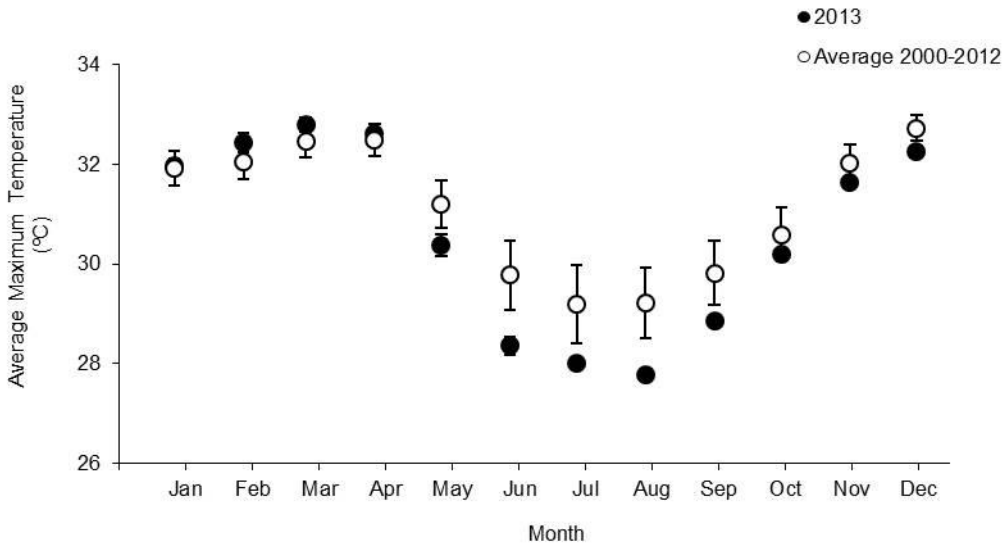


Figure 3. Maximum average monthly temperature comparing 2013 (black dots) to the long term monthly averages 2000-2012 (white dot) with s.e.

The monthly minimum temperatures for 2013 although mirroring the pattern of the long term minimum temperature trends were consistently lower than the average for the previous twelve years (Figure 4). Particularly during the SE-monsoon it was noted that the minimum temperatures recorded by the Automatic Weather Station (AWS) were several degrees higher than those recorded manually from the Stevenson Screen thermometer. A new minimum thermometer was installed in December 2013 for comparison and from the limited number of readings so far it appears that the existing thermometer is consistently recording lower minimum temperature values. Further investigation will be undertaken in 2014 into the minimum readings; however, if the difference between the new and old minimum thermometer is always the same then the previously recorded values could be recalibrated.

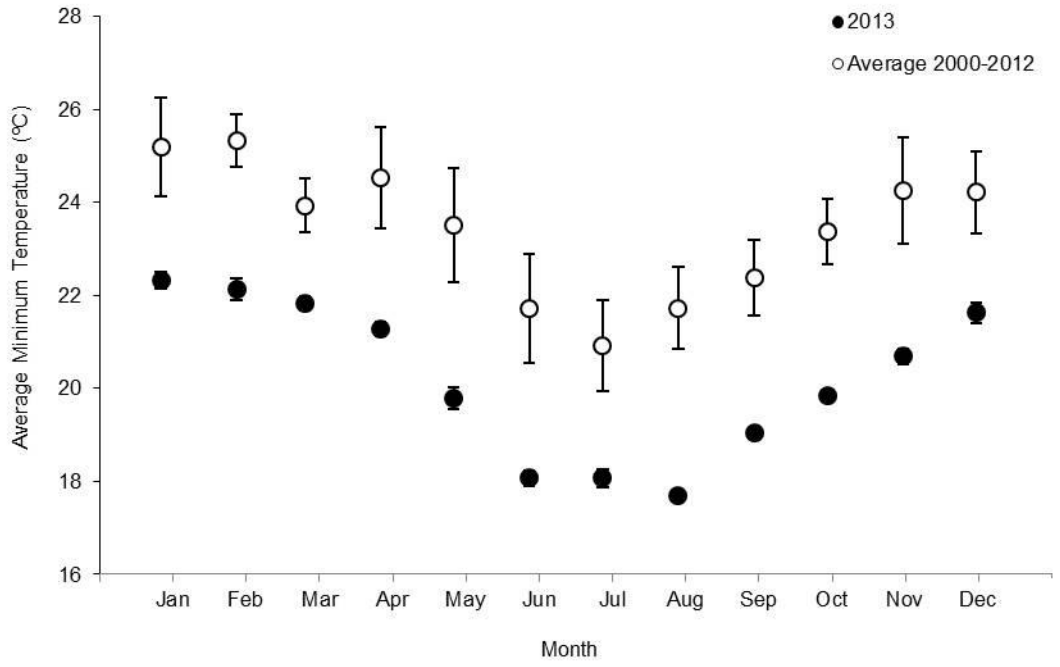


Figure 4. Minimum average monthly temperature comparing 2013 (black dots) to the long term monthly averages 2000-2012 (white dot) with s.e.

2.3. Rainfall at Picard Station

2013 has generally been an extremely dry year; this is particularly noticeable between January – April when rainfall at the Research Station was considerably lower than 2000–2010 averages and in most of these months, when rain is usually expected, less than half the average rain fell (Figure 5). The SE-monsoon was dry but with slightly more rain in August. However, the start of rainy season at the end of 2013 suggests that, this NW-monsoon may be wetter, with rain in November in the normal range and December rainfall exceeding average rainfall.

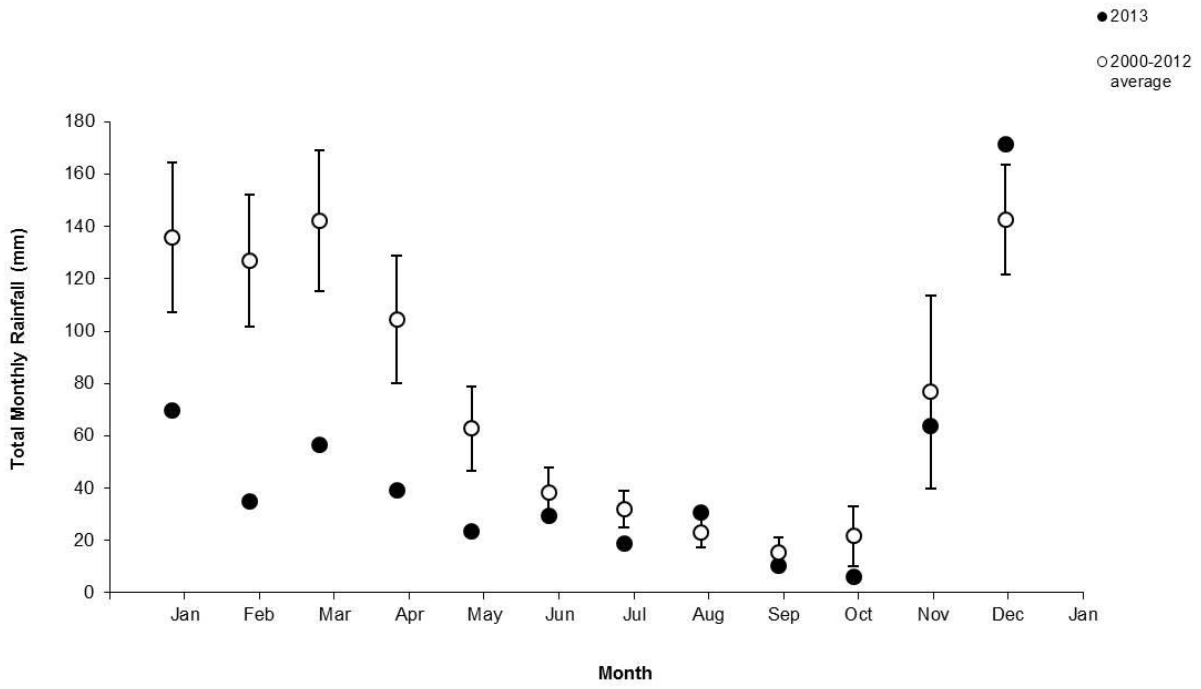


Figure 5. Total monthly rainfall (mm) (closed dots) recorded in 2013 at Aldabra Station, Picard compared to average total monthly rainfall (mm) for 2000-2012 (open dots) with SE.

2.4. Rain gauges around the atoll

At all locations the cumulative annual rainfall data for 2013 was considerably less compared to the previous 12 years (Figure 6). In general the west of the atoll was drier in comparison to the rest of Aldabra during 2013.

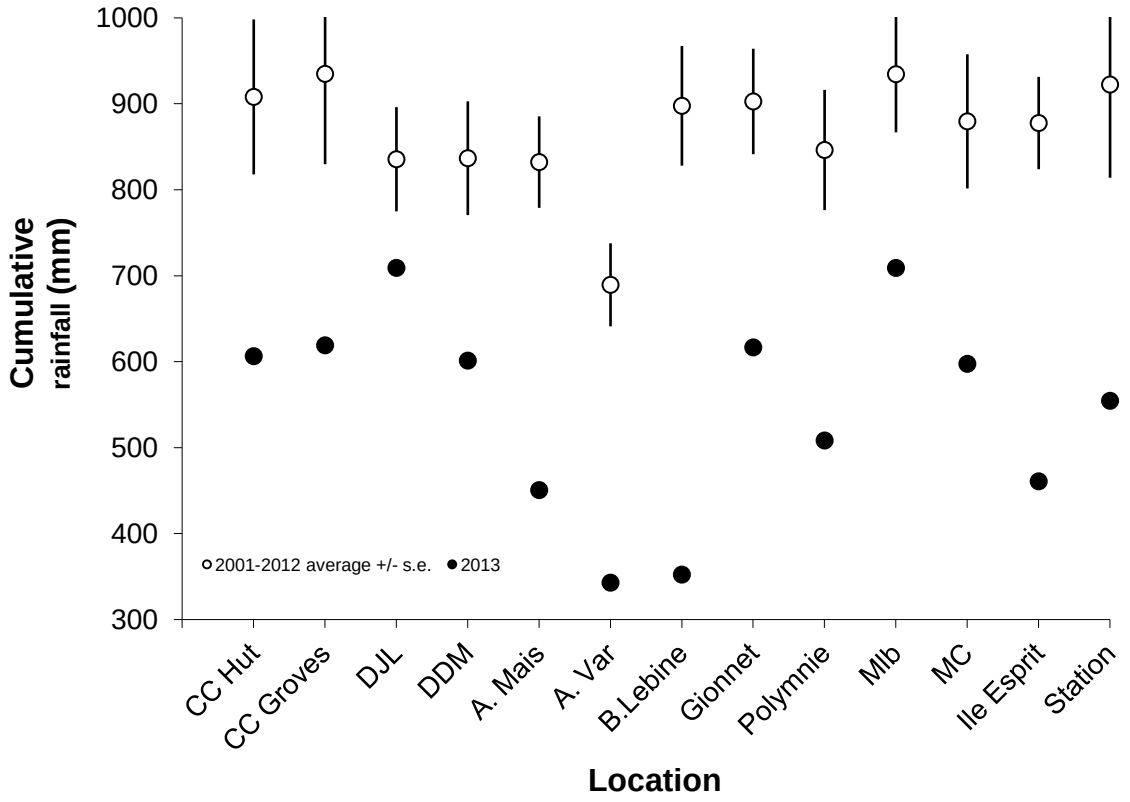


Figure 6. Annual rainfall totals for the rain gauges around the atoll in 2013 compared to 2001-2012 averages (± s.e.)

Consistent with normal rainfall patterns Aldabra experienced two seasons (dictated by wind direction), the dry south-east monsoon (May–October) and the wetter north-west monsoon (November–April) (Figure 7). However, particularly during the early months of 2013 the distinction between the two seasons was less defined in comparison to normal trends as a result of low rainfall. What is also interesting is the considerable amount of local variation in rainfall patterns, illustrated by DDM and Middle Camp receiving >100 mm less rainfall compared to DJL (ca 7 km away) and Malabar (ca 8 km) respectively.

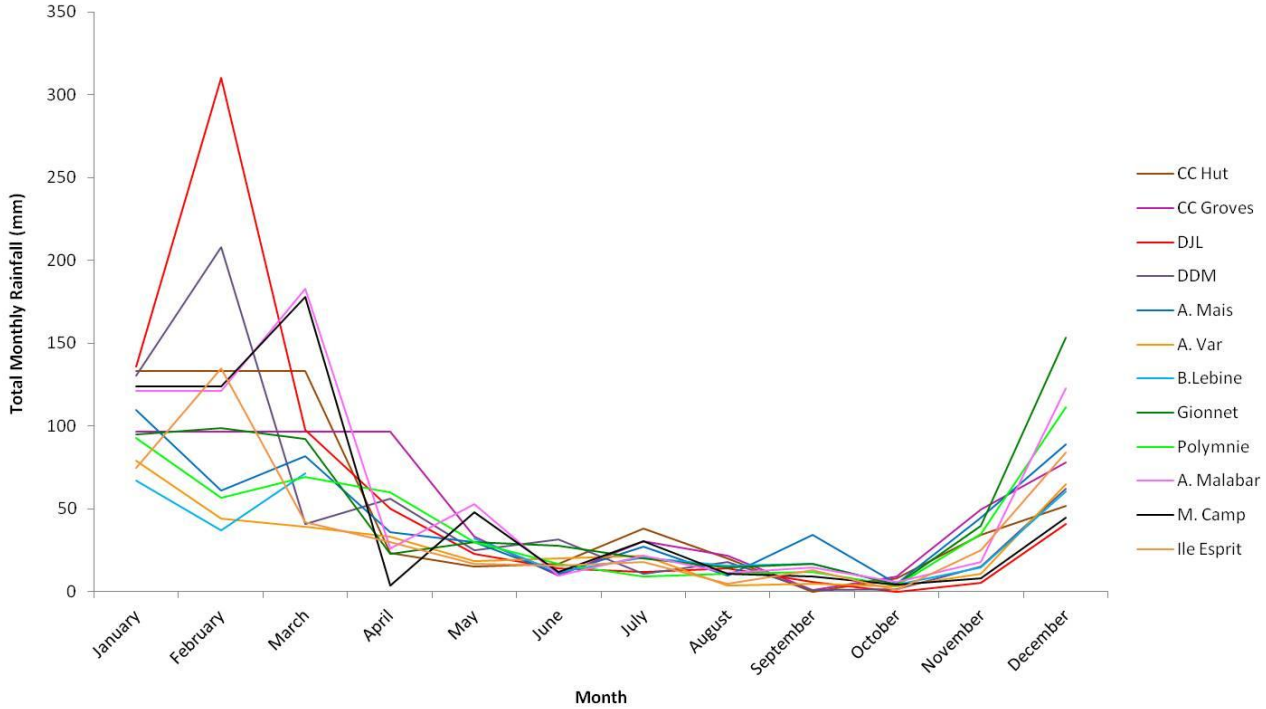


Figure 7. Monthly rainfall totals for 2013 for all atoll rain gauges

2.5. Automatic Weather Station

Following the maintenance visit by Seychelles National Meteorological Services (Meteo) staff late 2012 for the Automatic Weather Station (AWS), Meteo reported that data is being received via satellite and internet. There continued to be technical issues with the receiving of AWS data in to the Aldabra station database, however, this was finally resolved at the end of June 2013. In September the laptop that hosted the AWS data-download program crashed, requiring maintenance. To address this problem a temporary solution of installing the program on the ISTO's laptop (M. van Dinther) was undertaken. For the rest of 2013 the AWS continued to run without any further problems. A long-term solution needs to be found for the downloading of the data from the AWS, ideally the fileserver should be used but technical IT support is needed to realise this solution.

3. TERRESTRIAL ENVIRONMENT

3.1. Giant tortoises *Aldabrachelys gigantea*

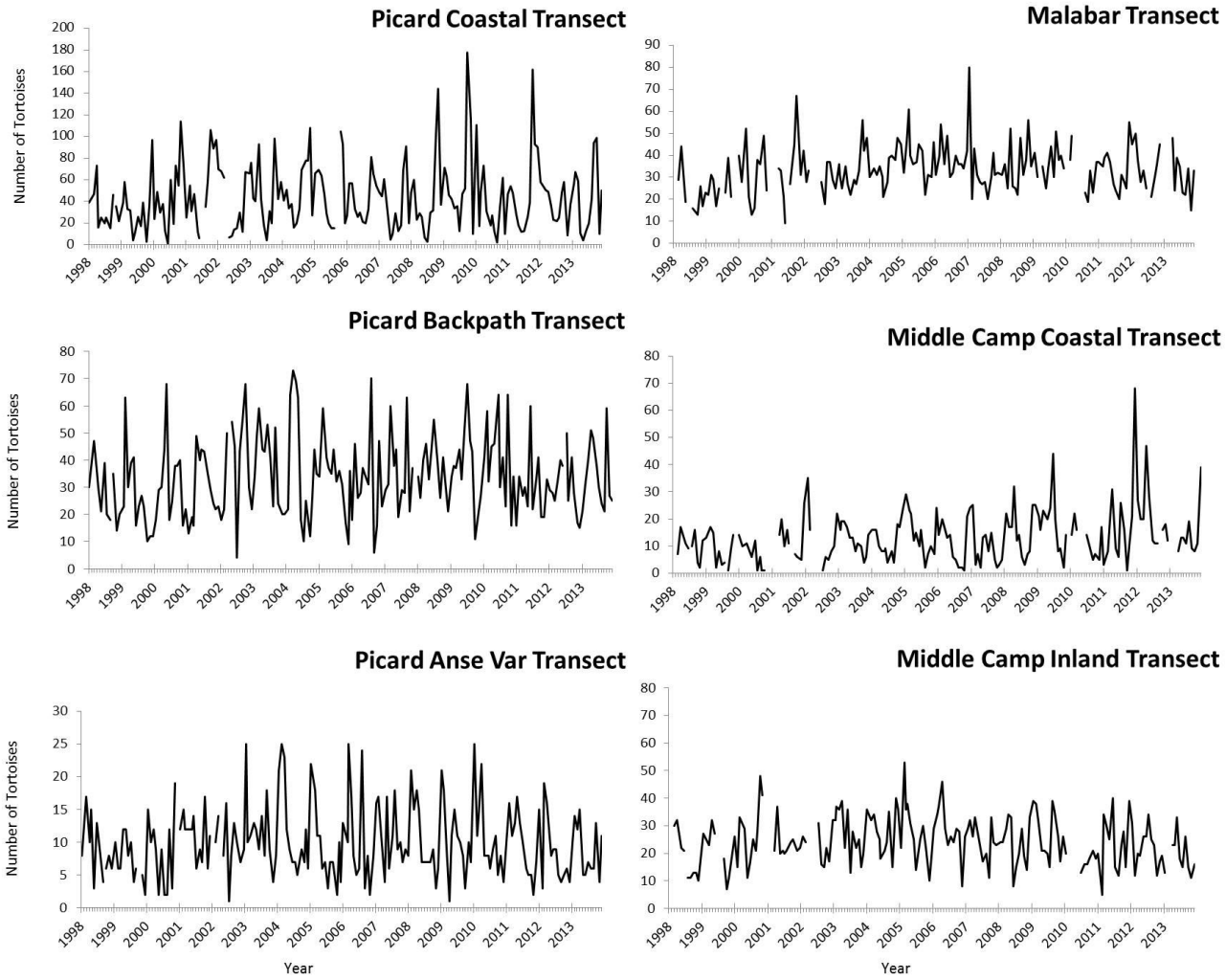
In May 2013, the 4-year long debate concerning the official scientific name of the Aldabra giant tortoise was concluded by the International Commission on Zoological Nomenclature. The commission voted to conserve the name *Testudo gigantea* and suppress the name *Testudo dussumieri*. The genus name *Aldabrachelys*, a later synonym of *Testudo*, is therefore the correct name to apply to this species following the decision, meaning that *Aldabrachelys gigantea* will be used as the correct scientific name of the Aldabra giant tortoise in all documents. Over 100

scientists and practitioners had commented on this case, including SIF and several local conservationists.

3.1.1. Regular transect monitoring

Since 1998 12 tortoise transects around the atoll have been monitored on a monthly basis. The seasonal differences in tortoise numbers in these areas is apparent, in addition to the considerable variation in abundance of tortoises in these areas (Figures 8). It can be seen that tortoise numbers for 2013 were within the normal range and that patterns observed over the years suggest a very stable population.

The tortoise dataset is currently being analysed by Dr Lindsay Turnbull (ZARP, University of Zurich, now University of Oxford, UK) and it is anticipated that a publication of these results will be finalized in 2014. This dataset allows levels of change which are beyond the normal seasonal variation to be determined, which would imply localised population level increases/decreases in tortoises. These parameters are vital for interpreting tortoise data collected and alerting should management intervention be required. The tortoise monitoring programme will be reviewed in 2014 to reflect the findings of this analysis and ensure that the monitoring is appropriate to answer the key questions to inform management and to ensure it is resource efficient.



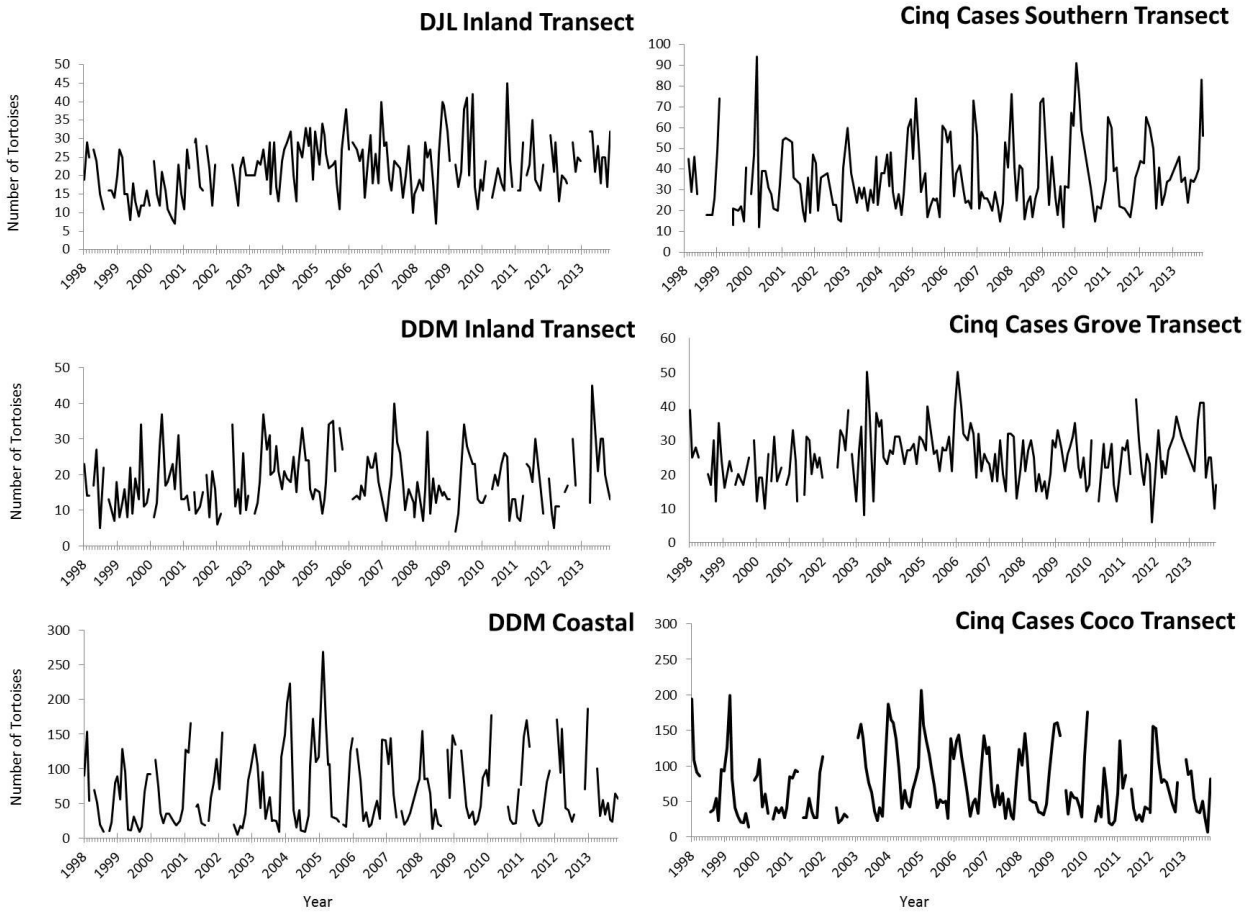


Figure 8. Seasonal patterns in tortoise numbers for the 12 monitored tortoise transects (1998–2013)

3.1.2. ZARP project (Zurich-Aldabra Research Platform) (*contributed by Richard Baxter*)

The first phase of the ZARP/SIF tortoise ecology collaborative project (see ASC Annual Reports 2011–2012) came to an end this year after two successful field seasons ending in June 2013 when ZARP Project Officer Richard Baxter left the atoll. Project tasks that were refined during 2012 were continued and new elements were added to the overall project protocol (summarized below).

- Total tortoises marked on Picard (toasted) for the year was 139, bringing the overall total of toasted tortoises to1143. There are likely to be many more tortoises to mark on Picard but marking will be stopped until there is somebody dedicated to resume this work.
- Sex ratio of marked tortoises on Picard: Male 47%, Female 52%, Juvenile 1%
- Blood-sampling effort increased during the 6-month field season as more SIF staff were trained in the technique.
- 307 blood samples were collected in 2013, making an overall total of 650 samples which is just over half of the marked tortoise population.
- 70 tortoises were weighed in 2013 on Picard. Overall males have an average weight of 92.9 kg, females have an average weight of 62.4 kg (see table 3).

Table 3. Average tortoise weights in kg for the different islands of Aldabra, sample size in brackets.

	Picard	**Malabar**	**Grand Terre**
Male	92.9 (45)	46.1 (10)	22.7 (36)
Females	62.4 (25)	37.3 (9)	21.7 (42)
Unknown	n/a	15.2 (9)	9.9 (8)
Total Tortoises Weighed	**70**	**28**	**86**

- Over the past two years 86 tortoises were weighed on Grand Terre and 28 tortoises on Malabar, the averages of their weights can be seen in table 3.
- *Gato*, a large male that is often seen around the research station was weighed every week for 12 months. His average weight for the period was 116.8 kg. There are two obvious peaks in July 2012, 135 kg, and June 2013, 127 kg, which is just before the dry season kicks in, whilst his lowest weight of 108 kg was recorded at the height of the dry season in September (Figure 9).

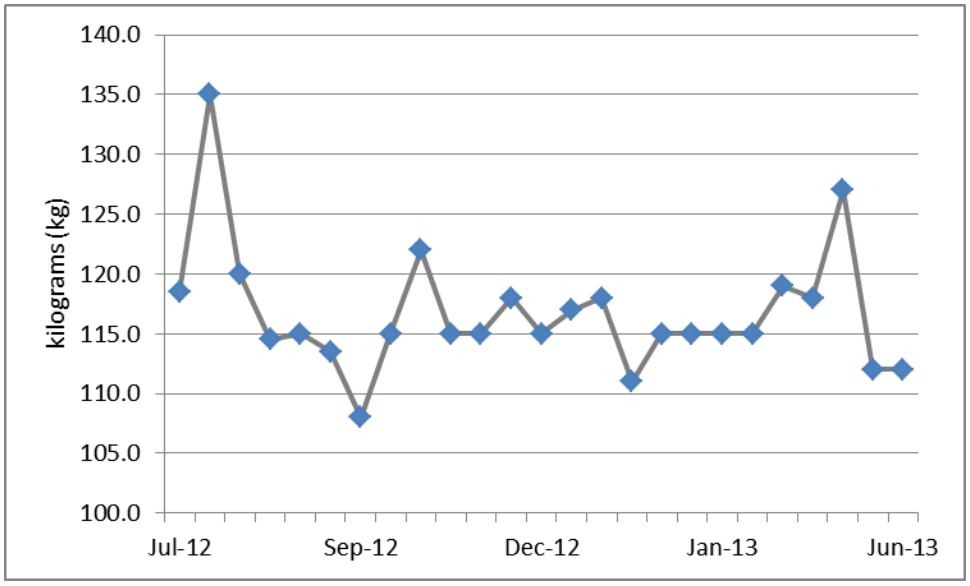


Figure 9. Variation in the weight of Picard tortoise 'Gato' (July 2012-July 2013)

- 1ml blood samples were collected every month by the PO and SIF staff from the 8 tortoises on Picard with transmitters. Blood was spun down in the Aldabra lab and the plasma stored in the freezer. The samples were sent to Zurich for endocrinological analysis to investigate hormone cycles of both female and male tortoises. This will assist Zurich Zoo in caring for their captive breeding tortoise populations and potentially provide a reliable way of sexing tortoises from blood samples.

GPS transmitters

- 31 tortoises with GPS transmitters were tracked, and the aim is for the research team to sight each individual every 2 months (June 2013 onwards) to check that the tag is still attached securely. The data was downloaded from the tags at least every five months (see Figure 10). In December the radio-tracking receiver stopped working which required repair, this limited ability to monitor these tortoise for two months until a new receiver was obtained in early 2014.
- iButton temperature loggers, attached to the shells of the transmitter tortoises, recording ambient temperature, were removed and the data stored for future analysis.
- Transmitter maintenance was carried out when possible but some tortoises were not visited for many months due to logistical constraints. Unfortunately, one male tortoise was found deceased with the tag still attached. The tortoise appeared to have been dead for a number of months and the tag was reset then redeployed on a male in the same area. After 12 months of operation four tags were found detached from tortoises on different islands and in two of the cases were reattached to the original tortoises but when original tortoises could not be found, the tags were redeployed on new individuals.

All of the movement data collected will be used for an MSc thesis by former ZARP Project Officer Richard Baxter at the University of Zurich (see below for further details).

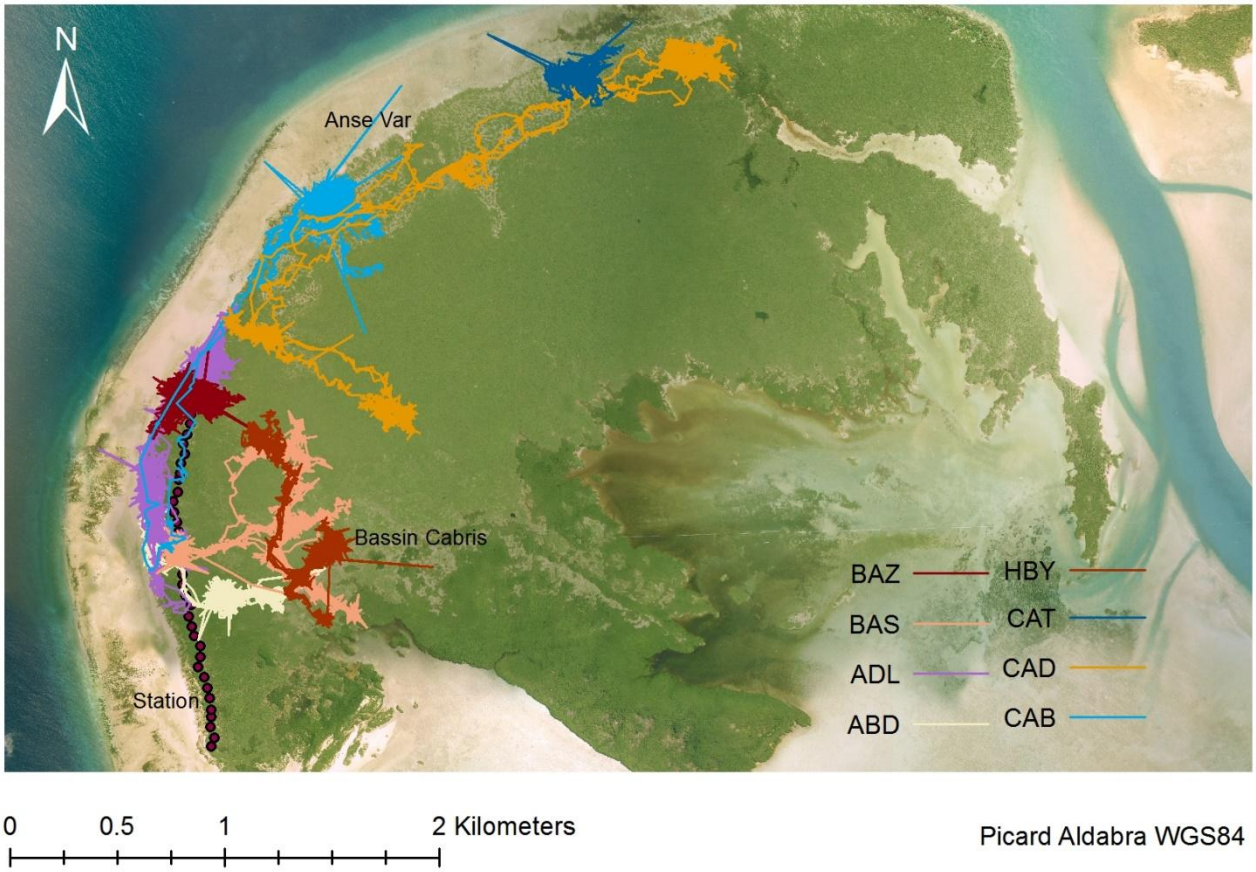


Figure 10: Map illustrating two years of movement data for the eight tortoises on Picard

Pinning

- Following a meeting with Paolo Cherubini at the University of Zurich and MSc student John Shekeine it was decided to carry out 'pinning' on *Ochna ciliata* on Picard. Pinning is a method which is a great tool to look at cambium activity and the results are able to give an indication of tree growth within a small space of time, in this instance, one year. The method involves damaging the cambium with a small pin every month. The tree quickly regrows and repairs the damage but by marking the site with the date, you can see the cambial activity over that month. This allows you to link the static rings to active wood production. Pinning should be carried out on each tree once a month for a year before cutting the tree down and removing pinned tree section for analysis. Four trees have been chosen on Picard from the area where 10 *Ochna* trees were cut for growth ring analysis in 2012. The *Ochna* pinning will be completed in February 2014 after which the samples will be sent for analysis in Zurich.

Exclosures

- Exclosures to study the influence of tortoise grazing on different habitats were due to be built in March and April on East Grand Terre. A design was drawn up to estimate how much material would be required to construct a single unit. Six exclosures will be built on the coastal turf and six exclosures on the inland 'tortoise turf' to study how the different vegetation types respond to not being grazed upon by tortoises.

- Due to logistical problems with obtaining materials the exclosures were not constructed and instead will be built in 2014.

Training

- SIF staff were trained by the Project Officer in marking techniques, general DNA blood sample collection, and hormone plasma samples. Staff were also trained in telemetry tracking the tortoises with tags and downloading the data. All staff present for training were successful in acquiring these skills.

Scanning of data

- Survivability: Dr Arpat Ozgul (University of Zurich) recommended investigating the survivability of tortoises on Grand Terre and Malabar where there are tagged tortoises from the 1970s. As there are a limited number of resighted individuals in the SIF database (n=300), it would be useful to sweep the islands to locate tortoises tagged with metal disks and record their measurements, weight and location. This data can be compared with Royal Society tortoise census data which has the information of when each tortoise was initially tagged.
- All records of tortoises or tortoise observations between 1971 and 1974 and the census carried out in 1983 in the Aldabra library were digitised.

Tortoise cave

Figure 11. Cinq Cases Tortoise Cave (Richard Baxter)

In March, during an afternoon excursion we came across the most amazing place; a cave with 50 to 60 tortoises inside (Figure 11). They were starting to move out into the afternoon sun when we

noticed tortoises dispersing across the coastal turf but without an obvious source. The champignon rock on the side of the entrance has been polished smooth from the millennia that the tortoises have been going in and out for reprieve from the midday sun. The GPS location of the cave was taken and has been saved in the Aldabra GIS data files.

Masters project

The former ZARP Project Officer Rich Baxter is now enrolled in the Specialised Environmental Science MSc at the University of Zurich and will be analysing data collected from the GPS tags attached to 31 tortoises for his thesis under the supervision of Dr Dennis Hansen and Dr Gabriela Schaepmann-Straub. He will investigate how ambient temperature and rainfall influences home range size and activity patterns of giant tortoises on Aldabra. In conjunction with this, vegetation data will be investigated to find links between food availability and tortoise movement patterns. The MSc thesis should be completed and submitted in 2014.

Analysing home range size will also provide an indication of habitat selection, which is important knowledge for future investigations on tortoise behaviour and vegetation dynamics. The movement data will also be an essential part of developing an individual-based model for tortoise seed dispersal, which is part of a new project on seed dispersal on Aldabra to start in 2014.

3.2 Birds

3.2.1. Landbird point counts

Landbird data has been collected by means of point counts on seven transects across the atoll since 1999 using similar methods, however, data prior to 2002 is incomplete. Janske van de Crommenacker is currently analysing this dataset to detect any trends in the landbird populations monitored (especially of conservation concern), assess any effects of location, season and habitat on abundance and review the monitoring methods with an aim to improve the reliability of results, conservation effectiveness and resource efficiency of the monitoring programme. The findings and discussion of this analysis will be finalised and published in 2014.

The monitoring programme only obtains sufficient data for seven of the 13 landbird species monitored (Figure 12). It may be appropriate to investigate alternative methods for assessing the other six landbird species (white-throated rail, Madagascar coucal, Madagascar sacred ibis, Madagascar kestrel, Madagascar nightjar and pied crow). Encouragingly for the seven landbird species where there is sufficient data for meaningful analysis all except the drongo have increased over time (Figure 12). Following completion of the analysis, a review of the landbird monitoring will be undertaken in light of these results and changes implemented as necessary in 2014 to ensure the programme is suitable for its intended purpose.

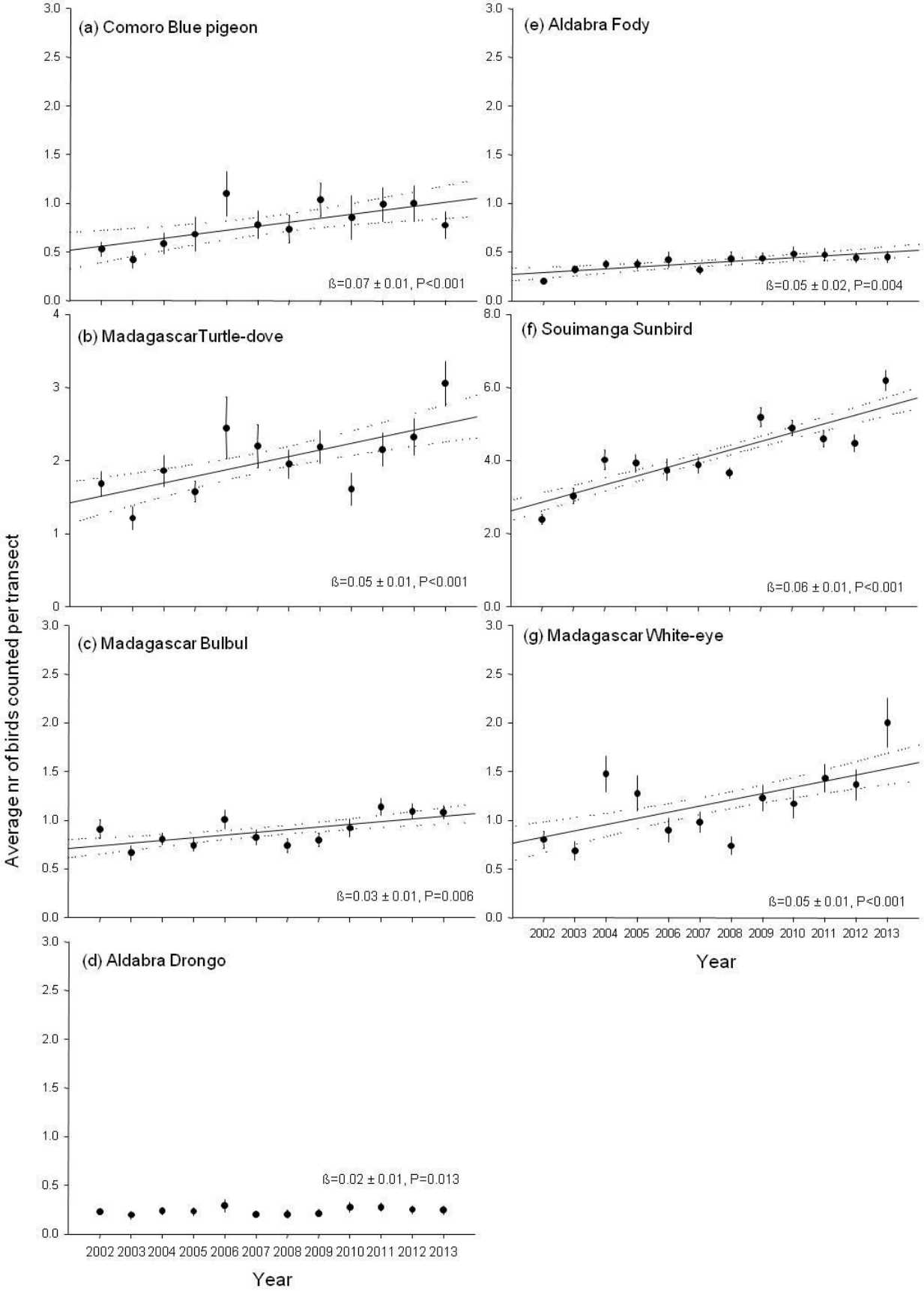


Figure 12 Trends in Aldabra landbird counts (average number of birds per transect point ± s.e.) across all seven landbird transects (2002-2013) (Figure produced by Janske van de Crommenacker)

3.2.2. Landbird genetics (*contributed by Janske van de Crommenacker*)

Of the 13 land bird species resident on Aldabra, only one (the Aldabra drongo) is a recognised endemic species. The others are all described as subspecies derived from close relatives in the Western Indian Ocean region, mainly Madagascar. Some earlier studies have attempted to resolve the status of Aldabra's landbirds based on morphology and genetics, but failed to deliver conclusive results. Resident Researcher, Janske van de Crommenacker, was based at the Durrell Institute of Conservation and Ecology, University of Canterbury (Kent, UK) from July until mid-October to conduct phylogenetic analyses on a selection of the Aldabra landbird blood samples previously collected. Key project aims and rationales are:-

1. Confirmation of taxonomic status (fody, rail)

The genetic research focuses on the Aldabra fody (*Foudia eminentissima aldabrana*) and the Aldabra rail (*Dryolimnas cuvieri aldabranus*), not only because they are the most likely contenders for species status but also because of conservation management purposes (i.e. with the current threat of the introduced Madagascar fody invasion it will be important to know whether the Aldabra fody is an endemic subspecies or a full species) and symbolic status (i.e. from a fund-raising and IUCN protection perspective, having a study that confirms the Aldabra rail population to be a separate species would help a great deal).

It is important to note that even with genetic data it is difficult to prove that a population is a distinct species, as there is no universal definition of a 'species concept'. Rather, what one can expect from the genetic data is a sense of whether the island population is sufficiently evolutionarily different to be treated as a separate conservation management unit. Also, it is unlikely that a genetic study alone will be sufficient to make such a conclusion; morphology and behaviour are also important aspects which must also be considered. However, these data are available and can be used to support the genetics results.

2. Assessment of hybridisation between introduced Madagascar fodies and endemic Aldabra fodies
After the discovery of an introduced Madagascar fody population in the Takamaka region (early 2012), the team came across a number of fodies, particularly males, that were not 100% confidently identifiable as either Aldabra or Madagascar fodies. The 'suspicious' birds were showing a mixture of features, which raised the concern of hybridisation between the invasive and native fodies. Madagascar fodies are known to have hybridised with other endemic fodies of the region and given their close relatedness with Aldabra fodies, this risk is realistic. Examination of morphological data and photographs can attempt to distinguish birds, but only DNA analyses can verify whether the Aldabra and Madagascar fodies have interbred and hybridised.

The current study aims to confirm whether the Madagascar fody (MF) and Aldabra fody (AF) at Takamaka have interbred and hybridised, based on genetic comparison. The hybridisation rate results can also be used to investigate the timing of the MF invasion (e.g. before or after the start of the Assumption project). Linking these results to photos taken can help the team next season to recognize hybrid fodies in the field.

The landbird genetics analysis is currently ongoing, and a summary of the key progress achieved in 2013 is provided below. For full details please refer to Janske van de Crommenacker's monthly progress reports.

Summary of activities/results in 2013

- 17 Aldabra fodies, 22 Madagascar fodies and 16 potential hybrid fodies samples were extracted and sequenced for all genetic markers. These DNA sequences were then edited.

- Additional Mauritius fody samples were extracted and included in the analysis as this should make the assessment of hybridisation more robust.
- A mitochondrial DNA fody phylogenetic tree has been constructed.
- Two birds identified as Aldabra fodies were confirmed as hybrid birds.
- Most birds identified by the field team as potential hybrids are carrying Madagascar fody mitochondrial DNA, which confirms that generally these birds can be distinguished aesthetically and with morphometric measurements.
- Photo sheets of museum skins of Aldabra Fodies and Madagascar Fodies produced to assist with identification in the field.
- A draft of the fody hybridisation manuscript was prepared.
- Fody primers were tried on a test batch of five rail samples and they all worked, which potentially means that these primers could be used for the rail analysis in the future.

Aims for 2014

- Complete the fody hybridisation manuscript
- Statistically analyse the morphological differences between Madagascar and Aldabra fodies and examine how the confirmed hybrid birds fit in.

3.2.3. Landbird nest success monitoring

Starting in October 2013 and continuing throughout the landbird breeding season, the research team located and monitored landbird nests on Picard to provide further data on the nesting success of Aldabra's landbirds and possible causes of failure. Following on from the studies of Wanless in 2000/2001 and Šúr 2011/12 it was recommended that additional data was required for a meaningful analysis of nesting success. In general the previous studies suggest that the overall nesting success of the Aldabra landbirds is relatively low; however, nesting success varied considerably between years. As the data collection is ongoing, the results from this study will be compiled in 2014 following the completion of the breeding season in March / April. The data is collected using the same methods as Šúr (2012), focusing on a defined area of Picard, which is easily accessible. The monitoring aims to find nests for all landbird species, however, some prove difficult to find. A total of 87 nests have been found so far this breeding season, comprising Aldabra Fody (22), Aldabra Drongo (8), Madagascar Kestrel (3), Madagascar Nightjar (3), Pied Crow (1), Aldabra Rail (6), Souimanga Sunbird (43) and Madagascar White-Eye (1).

3.2.4. Wader counts

Settlement Beach wader counts (waders, herons and terns) are undertaken every two weeks at low tides when the reef is exposed. In addition, wader counts are also undertaken on the Dune Jean-

Louis coastline, Dune Patate area and Dune d'Messe generally once per month. In general the monitoring results suggest that numbers of the common wader species encountered are fairly stable, aside from Whimbrels and Bar-tailed godwits where an increase in numbers looks to be occurring (Figure 13).

There is seasonal variation in the wader species that occur on Aldabra, with migrant species generally present or occurring in much greater numbers during the north-west monsoon (e.g. crab plovers, bar-tailed godwits etc.) and disappearing or reducing in number during the south-east when they travel to their breeding grounds. In addition tide height, weather conditions and time of low tide are all likely to influence the abundance of waders during the counts. Consistent with her research on the landbird dataset, Janske van de Crommenacker will be analysing the data obtained from the wader counts to look at the influence of these factors, identify trends and allow for an informed review of the wader monitoring programme in 2014.

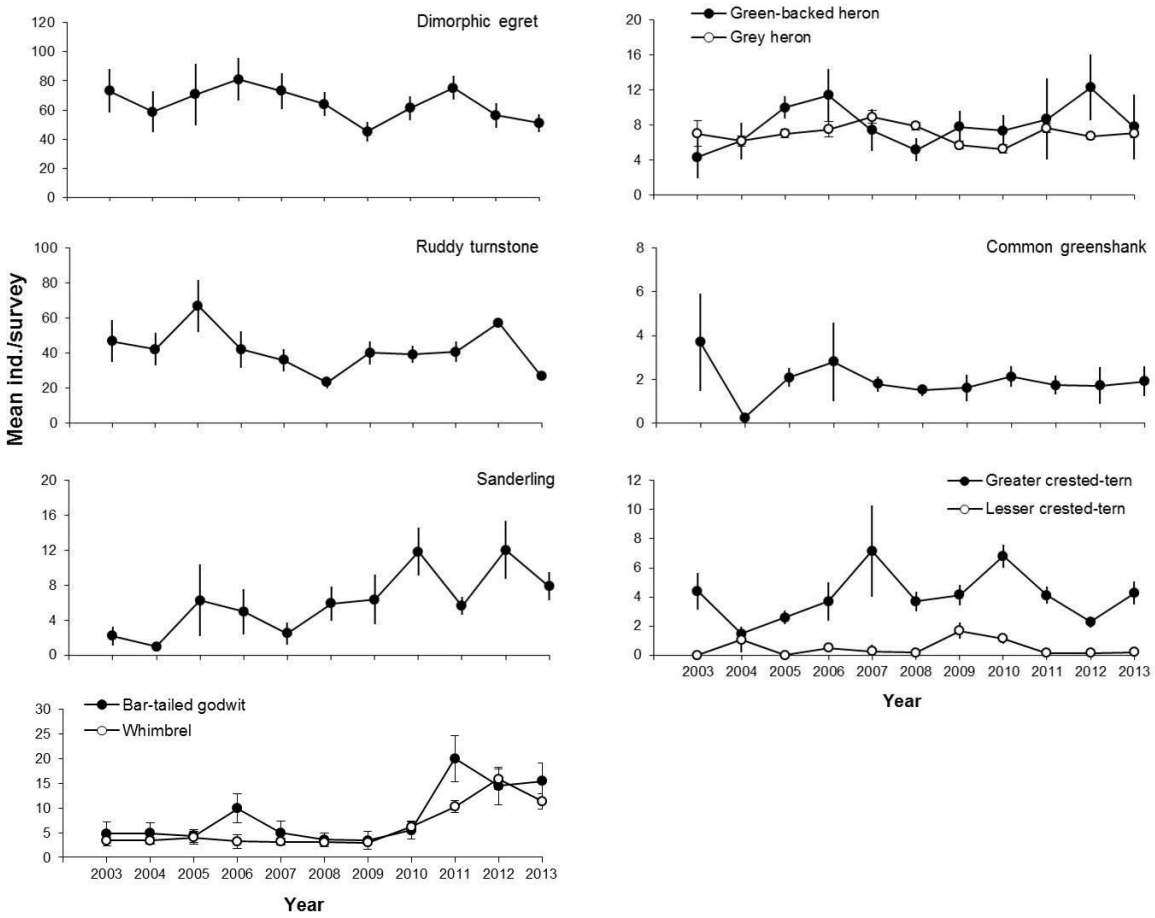


Figure 13. Mean number of individuals per survey for ten of the most commonly observed species in the wader surveys 2003–2013.

3.2.5. Crab plover daily counts

Daily crab plover counts are undertaken in combination with the turtle track monitoring. The average number of crab plovers encounters in January and February was higher in comparison to historical averages (Figure 14). Consistent with 2012 and distinct from 2007–2012 averages the crab plover encounter rates in March were lower again suggesting that crab plovers are migrating away from Aldabra earlier than in previous years.

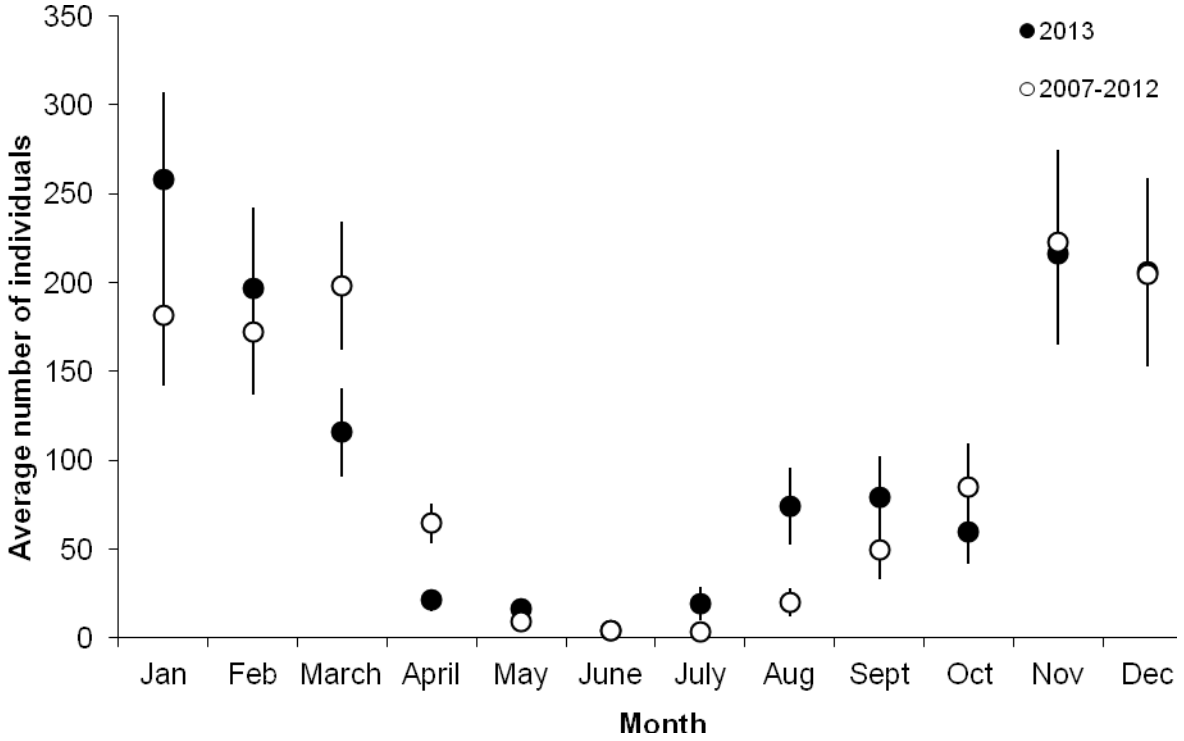


Figure 14. Average daily encounter rates of crab plovers in 2013 compared to those of 2007–2012.

3.2.6. Tropicbirds

Red-tailed and white-tailed tropicbird nests are monitored every two weeks on a spring low tide on La Gigi islets, Picard. Changes to the monitoring methods were implemented in October 2011 (see 2011 ASC Annual Report for full details) ensuring that each new nesting attempt received a unique nest site number to allow assessment of nesting success. A rule-based criteria for pre-October 2011 nest data was used to define new nests and incorporate the data into the new database. Review of this data suggests that there is likely to be an over estimation of pre-October 2011 new nesting attempts and also likely successful nests.

Typically nests are found at egg stage, however, according to the data in 2010 numerous nests were found at later stages of nesting (Figure 15). This could have been explained if fewer monitoring trips were made in 2010 compared to other years, however, more monitoring events occurred (2009: 23; 2010: 28; 2011: 24; 2012: 21; 2013: 25). It should be noted that pre-May 2011 it was not always recorded whether all islets were checked during the visit, however, it was assumed that if nests were recorded for an islet during a monitoring trip then the islet was searched. Prior to the change in methodology birds were recorded in relation to the nesting spot and from assessment of some of the nests 'found' at C3 stage it is likely that a number of these have occurred as a result of a C3 moving away from its initial nesting spot, which has been observed to occur. A rule-based criteria was used to format the old data to be consistent with the revised monitoring methods with each new breeding attempt being assigned a unique number. It is likely that some of these new nests found at later chick stage have resulted from this assignment criteria rather than being true new nests.

Comparison of the number of nests found at egg stage would suggest that the number of nesting attempts by tropicbirds on the monitored islets is fairly static, although there was potentially still a slightly greater number in 2010 (Figure 15). The number of new nests at egg stage remaining

constant over the last 3 years suggests that the monitoring programme is not discouraging tropicbirds from nesting on these islets.

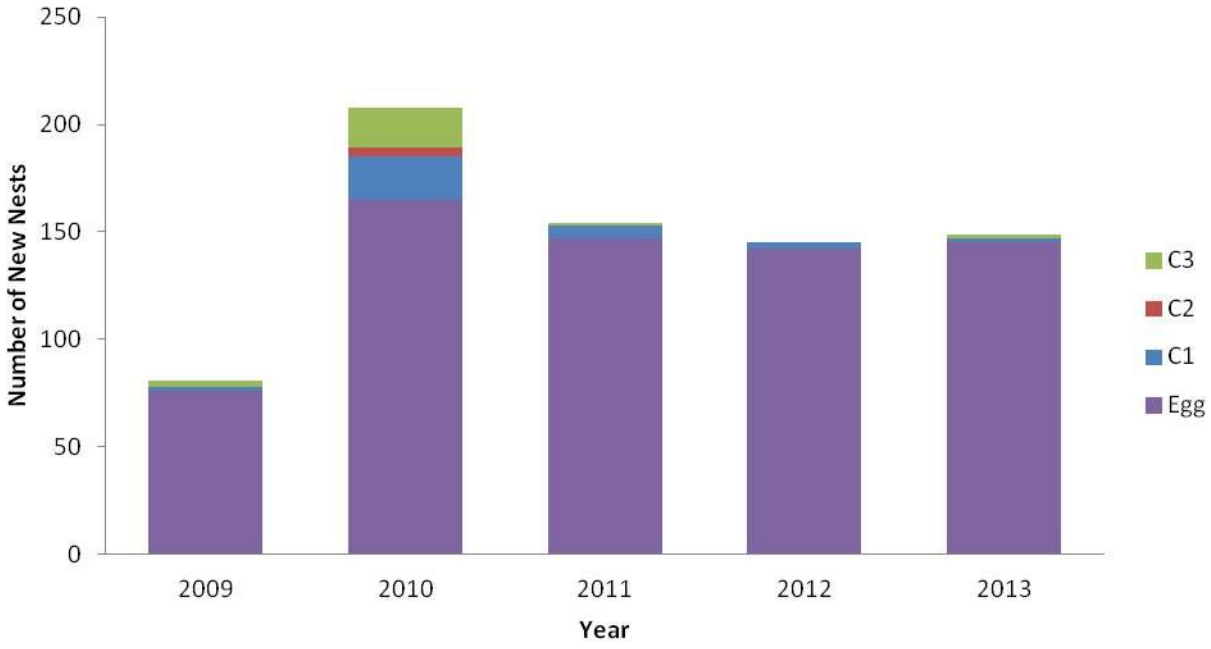


Figure 15. Total number of new tropicbird nests found 2009-2013 illustrating stage of nest when initially found

Previous analysis of nesting success in relation to rat presence revealed that there was no significant difference between the inner (rats present) and the outer (rats not present) tropicbird islets suggesting potentially that rat predation is not a key factor in the failure of tropicbird nests. In an attempt to further investigate causes of nest failure, up to five camera traps were placed at active tropicbird nests throughout 2013. Initially this yielded an exciting observation of a juvenile drongo predating a C1 chick whilst the parents were absent from the nest, which was an unexpected result. A grey heron was also potentially implicated in the failure of another nest although the footage was not conclusive. Disappointingly there have been a number of technical issues with the camera traps (refer to ASC/ISTO monthly reports for details) resulting in failure to capture any other predation events / causes of nest failure. These limited findings suggest that the causes of tropicbird nest failure may be more complex and predators more numerous than initially thought. It is hoped that in 2014 some of the issues with the camera traps can be resolved to further inform on the causes of nest failure.

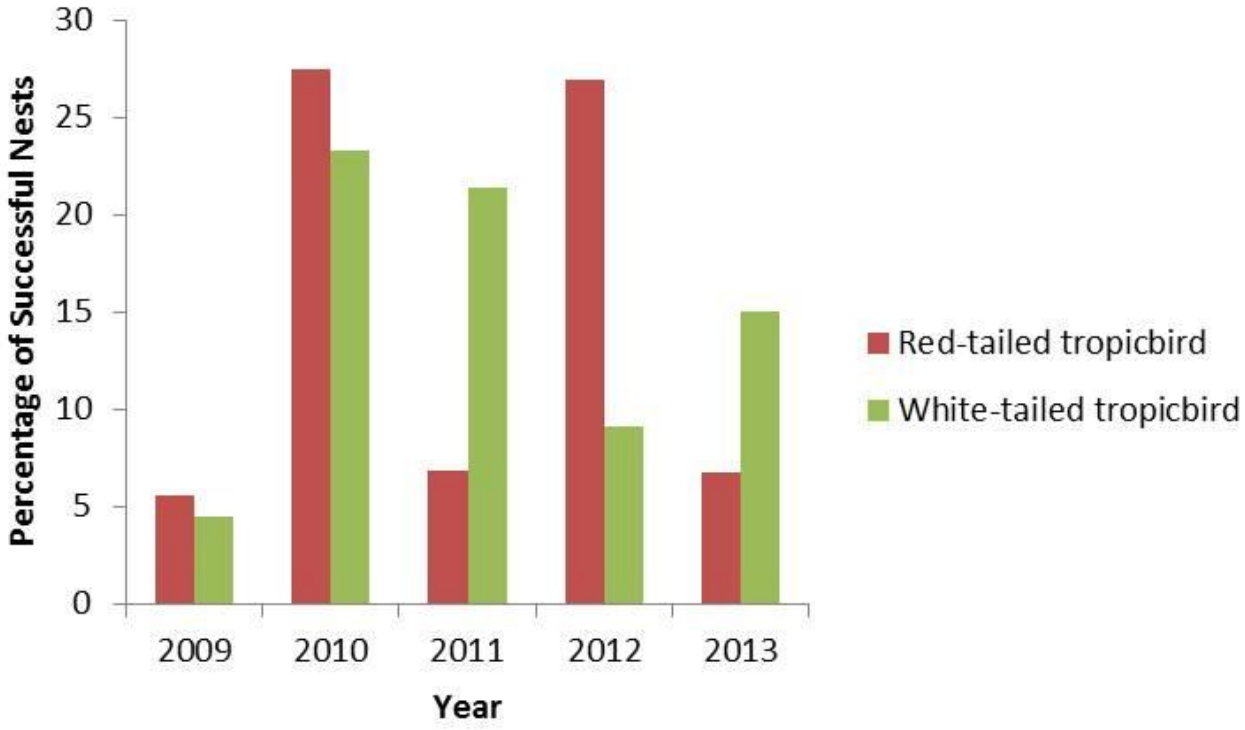


Figure 16. Successful (nests reaching C3 so assumed fledged) nests for red-tailed and white-tailed tropicbirds (2009–2013) as a percentage of total number of new nests found

Tropicbird nests are considered to be successful when the chick reached C3 stage; therefore the chick is fully feathered nearing fledging. Percentage of successful nests was calculated by dividing total number of nests reaching C3 stage by total number of new nests found (for data prior to 2011 new nests found at egg stage was used as it was thought to be most representative of new breeding attempts prior to 2011), per year (Figure 16). Following detailed review of pre-2011 data, nests recorded as successful which likely resulted from C3 chick movement or observation of a fledged chick (C4) were not included as this would result in an over inflation of nesting success.

Nesting success of both Red-tailed and White-tailed tropicbirds is seen to vary with year, this is particularly marked in Red-tailed tropicbirds. For the Red-tailed tropicbirds nesting success was much higher in 2010 and 2012 at >25% compared to the other years where it was <8%. However, for the White-tailed Tropicbirds 2010, 2011 and 2013 had comparatively high nesting success at between 15-23% but with lower success in 2009 and 2012 where less than 10% of nests fledged. The fact that the years with higher success rates are not consistent between the species is very interesting as there are a number of factors which could contribute towards increased nest failure which would likely be the same for both species (greater predation, less food available). The difference between the species in nest site preference, White-tailed tropicbirds generally preferring champignon holes and Red-tailed tropicbirds open sites under vegetation, could be one possible explanation for this difference, with Red-tailed tropicbirds nests more exposed to the elements and more vulnerable to avian predators. As per earlier discussion data prior to October 2011 was not collected using the same methods as the more recent data and therefore it will be useful to see if these patterns of variation continue in subsequent years where the data is readily comparable.

Tropicbird dataloggers

Ten Red-tailed Tropicbirds were fitted with geo-locaters in the first half of 2012 to improve knowledge of their migration ecology and the threats they are exposed to when away from Aldabra. The devices were attached to a coloured plastic leg ring, with an additional ring on the other leg for identification (please refer to ASC Annual Report 2012 for full details). The plan was to retrieve the geo-locaters from the tropicbirds when they returned to Aldabra to breed.

On 24th July 2013, more than a year after deployment of the devices, the first geo-locator was retrieved amidst much excitement when a Red-tailed Tropicbird with an orange ring was observed sheltering a young chick. The adult was later caught and the ring and geo-locater removed. Tropicbirds usually return to their previous nesting site and in keeping with this the tropicbird was nesting on the same islet as its previous breeding attempt. The data logger was sent to Dr Jannie Linnebjerg for data download and processing. In early 2014, Dr Linnebjerg mapped the journey of the bird using the logged positions (see Figure 17). Following breeding on Aldabra the bird flew more than 2000 km east to the Chagos Islands area where it stayed from October to December 2012, before returning to Aldabra in early 2013, a round trip of some 5700 km!

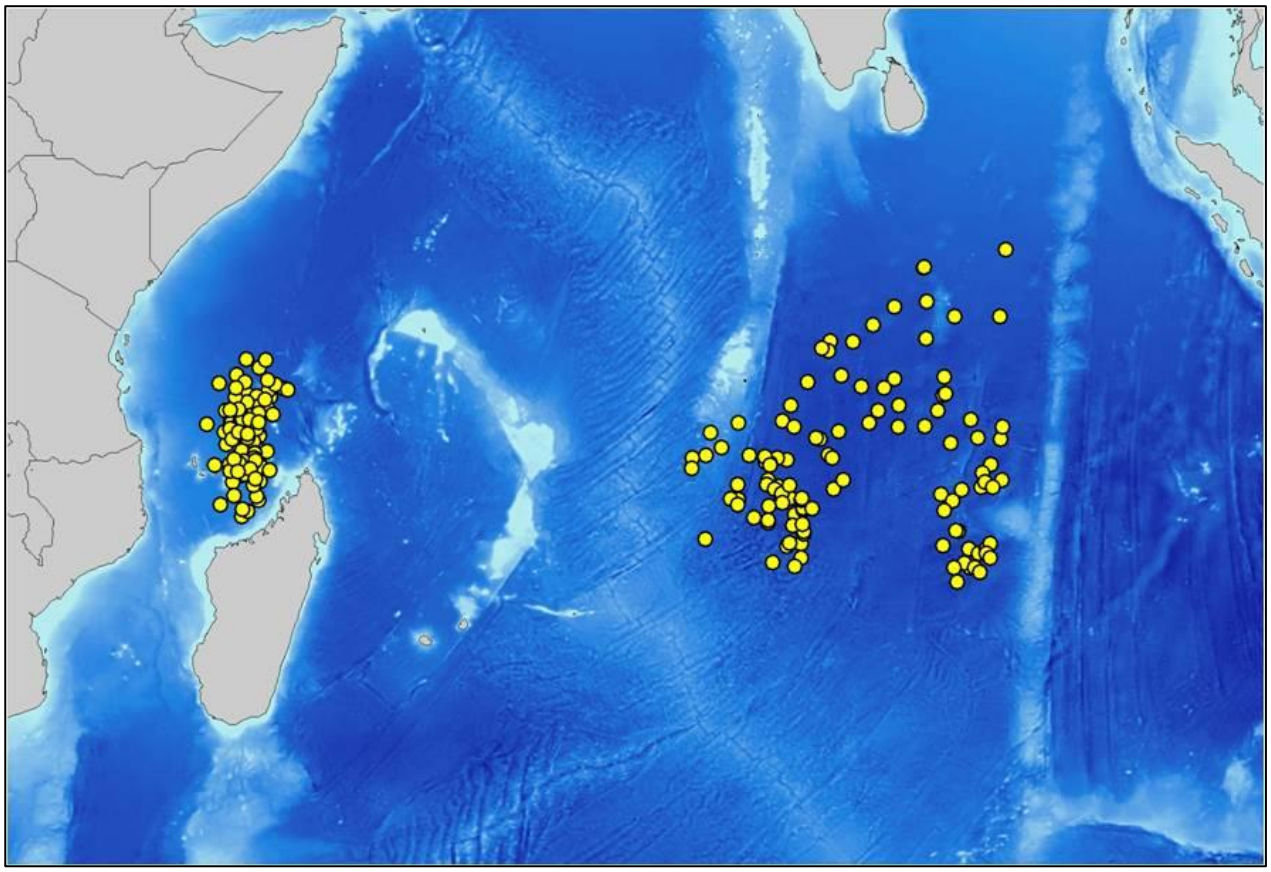


Figure 17. Logged positions (yellow dots) of the Red-tailed Tropicbird (17577) from which the geo-locator tag was retrieved in July 2013 (produced by Dr Jannie Linnebjerg)

Following the recovery of the first geo-locator in July, in an attempt to retrieve the remaining nine deployed tags, additional visits to the islets where tags were attached were undertaken 1–2 days before or after the regular tropicbird monitoring. This was to ensure that birds potentially with a tag were not being missed as the same parent was being re-sighted during each monitoring trip, illustrated with the Red-tailed tropicbird from which the geo-locater was recovered only being sighted at young chick stage when the nest had been active during several previous monitoring events but the other partner must have been on the nest during these checks. Despite this extra effort no further geo-locaters were recovered during 2013 although two other ringed tropicbirds were sighted but disappointingly these had lost the ring to which the geo-located was attached. Although all the geo-locaters deployed will now have run out of battery there is still hope that the tag may be recovered when they return to Aldabra and the data can still be retrieved.

3.2.7. Caspian terns

Consistent with previous patterns Caspian terns were sighted on Aldabra from late January until mid-September 2013. Figure 18 illustrates the distribution and frequency of observations involving at least two Caspian Terns (assumed / potential pairs).

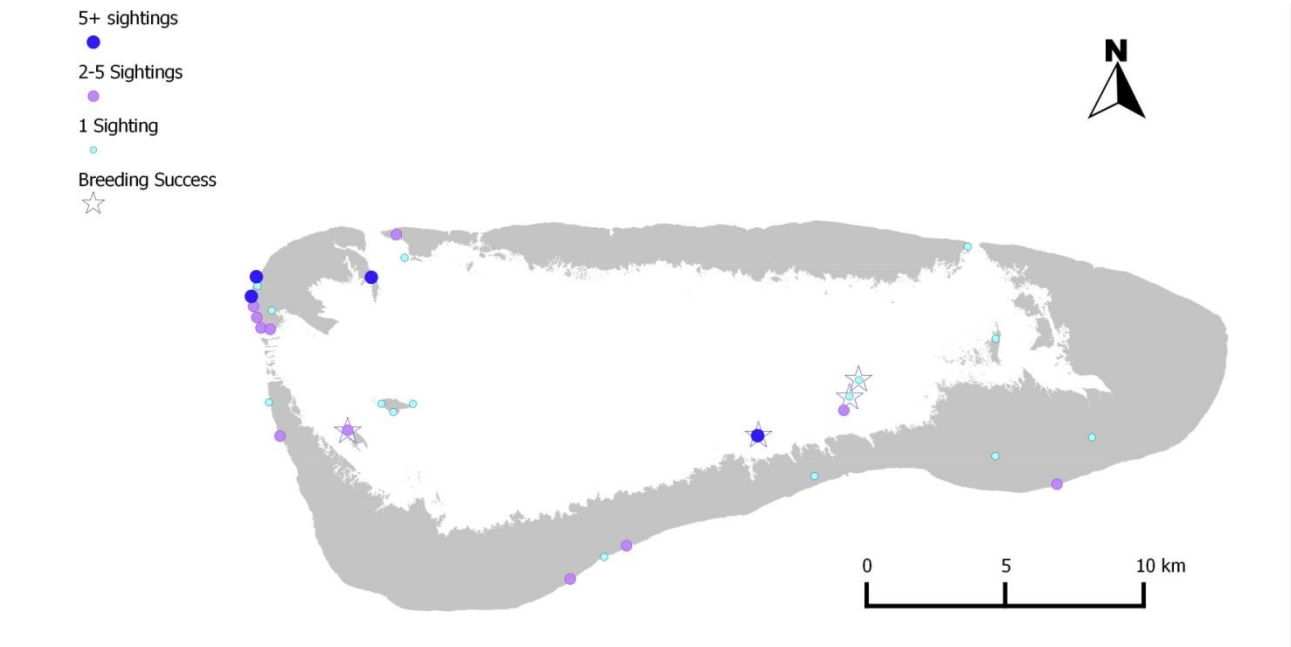


Figure 18. Caspian Tern Sightings consisting of at least two individuals (assumed pairs) during 2013 and location of likely successful breeding attempts

Nests were not found in several of the localities where Caspian terns are known to have nested previously (Table 4) despite the presence of birds in the area. Three pairs were observed with a chick or juvenile in 2013, with an additional observation of a sub-adult with a pair (Figure 18). The breeding success of 2013 is consistent with normal patterns with typically two or three juvenile Caspian terns produced per year on the atoll. A summary of the breeding activity on Aldabra is provided in table 4, however, it should be noted that observations of Caspian Terns were not recorded between 2005 and 2010. The nesting location for fledglings, juveniles or sub-adults observed is usually not known, however, it illustrates successful breeding on Aldabra.

Table 4. Summary of Caspian Tern breeding activity on Aldabra 2003-2013

Year	Location	Stage Observed	Number of Nests
2003	Ile Esprit	Nest	1
	Ile Moustique	Egg	1
	Anse Grande Poche	Egg and Chick	3
	Dune Jean-Louis Beach	Nest?	1?
2004	Ile Esprit	Egg	2
	Anse Owen	Egg	1
	Anse Grande Poche	Egg and Fledgling	1-2
	DDM landing stage	Fledgling	?
	WGT beach 6	Fledgling	?
2005	Anse Grande Poche	Egg, Chick	2
	Cinq Cases – Coco	Fledgling	?
	Anse Takamaka	Fledgling	?
2007	La Gigi	Chick	1
2010	Settlement Beach Z4	Sub-Adult	
2011	Settlement Beach Z3	Juvenile	
2012	Ile Moustique	Juvenile	1?
	DDM beach 24	Juvenile	
	Settlement Beach Z4	Juvenile	
2013	Petite mentor endans	Chick	1
	Champignon des Os	Juvenile	1
	Ile Moustique	Juvenile	1

The opportunistic sightings data collected for Caspian Terns is strongly influenced by observer presence at localities throughout the atoll illustrated with the majority of sightings of multiple birds occurring on Picard. It is therefore, not possible to draw accurate conclusions on Caspian tern numbers or population trends from analysis of this data.

3.2.8. Madagascar Pond-heron

In 2013 65 observations of Madagascar Pond-herons (MPH) were recorded on Aldabra. The majority, in keeping with previous years, were confined to the east of Grande Terre (Figure 19). However, observations were also made at DJL, Malabar and West Grande Terre. An exciting observation was a group of 17 adults in non-breeding plumage on an islet near Ile aux Cedres (Figure 19). All observations were of adults, aside from one observation of a juvenile with two adults near Takamaka Grove, confirming that successful breeding has occurred.

Figure 19. Madagascar Pond Heron sightings in 2013 (white circle = non- breeding plumage, white square = non-breeding group of 17 individuals, black circle = breeding plumage).

Consistent with observations described in 2012 annual report MPH in breeding plumage were sighted between November and February with the only exception being one individual in breeding plumage with two birds in non-breeding plumage in April (Table 5). Comparatively few MPH were seen in breeding plumage, only 11 of the 65 sightings included a breeding individual.

Table 5. Summary of Madagascar Pond Herons sighted in breeding and non-breeding plumage in the period 2009-2013. Months in which MPHs in breeding plumage were sighted are coloured in grey.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2009						0/5	0/12	0/6	0/2	0/3	4/1	-
2010	1/1	-	1/4	0/5	0/11	0/15	0/9	0/2	0/2	0/5	-	4/2
2011	3/3	0/6	3/10	0/16	0/16	-	0/5	0/2	-	-	-	-
2012	2/3	4/7	3/4	-	-	-	-	0/7	1/7	0/1	2/10	1/2
2013	-	3/9	0/5	1/8	0/9	0/9	0/7	0/5	0/2	-	3/4	4/7

A paper on the results of the first 4 years of the MPH monitoring programme was written up and accepted for publication in the journal Ibis and will be published in early 2014.

3.2.9. Flamingos

In keeping with the recommendations of 2012 no opportunistic flamingo monitoring was undertaken in 2013 to minimise impact on this species which is highly sensitive to disturbance (for further details refer to Greater Flamingo Exploration in the region of Cinq Cases (April & May 2012) by Catherina Onezia (Z:\Monitoring\Birds\ Flamingo\Reports). A monitoring protocol is currently being drafted for discussion, proposing how the Aldabra flamingo population can be monitored whilst ensuring we do not have an adverse impact on this species.

Although no targeted monitoring of flamingos was undertaken in 2013 chance encounters and involuntary observations of this species still occurred which are summarised in the table below.

Figure 20. Flock of 71 flamingos seen to the north, north-east of the Takamaka hut flying overhead

Table 6. Chance flamingo observation in 2013

Date	Time	Location	Group composition	Activity
13/03/2013	7:30	Takamaka Hut	71-72	Flying
26/05/2013	14:30	Takamaka, tidal pool	11	Feeding, Disturbed into flight
19/09/2013		Cinq Cases, landing stage trail	1	Resting
19/11/2013	14:00	Low tide sand bank near Ile Michel	20-25	Feeding
15/12/2013		Cinq Cases, tidal pool	70	Feeding, vocalising, disturbed into flight

3.2.10. Frigatebird census

In January and February 2013 the third consecutive annual frigatebird census was conducted. For full details of the survey and data analysis please refer to the frigatebird census on Aldabra 2013 Report for the third annual census (April 2013) written by Arjan de Groene. In summary the 2013 census concluded the following :-

- There are four frigatebird colonies on Aldabra at present – Passe Gionnet, Camp Frigate, Middle Camp and a new colony at Grande Poche, with *ca*. 1400 nests recorded, which was established in the last five years. The Bras Takamaka colony has not been active since the 1960s.

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

3.2.11 Vagrant birds

Figure 21. Madagascar Bee-Eater

Table 7 summarises the vagrant bird sightings for 2013, all observations were reported to the Seychelles Bird Records Committee. The sighting of the Malagasy Kingfisher (*Alcedo vintsioides*) in March was excitingly the first record of this species for the Seychelles. The vagrant sightings in August were particularly unusual because aside from a single barn swallow record this is the first time any migratory landbirds have been recorded in August in the whole of the Seychelles! Prior to the August vagrant sightings the wind had been blowing from a south to south-west direction, unusual for this time and year, and it is thought this could have blown the bird visitors to Aldabra.

Table 7. Vagrant birds observed on Aldabra in 2013

Date	Species	Location of sighting	Number of birds
03/01/13	Broad-billed roller (*Eurystomus glaucurus*)	West Grande Terre, near beach 18	1
04/01/13	Red-throated pipit (*Anthus cervinus*)	Picard, Research Station	1
12/01/13	Northern Wheatear (*Oenanthe oenanthe*)	Grande Terre, Dune d'Messe after beach 25	1
25/01/13	Yellow wagtail (*Motacilla flava*)	Grande Terre, Bassin Mackenzie, Takamaka	1
30/01/13	Common swift species (*Apus apus*)	Grande Terre, Open platin between Takamaka hut and the sea.	2
04/02/13	Northern Wheatear (*Oenanthe oenanthe*)	Picard, Station	1
20/03/13	Malagasy Kingfisher (*Alcedo vintsioides*)	Picard, Research Station	1
08/04/13	Mascarene Martin (*Phedina borbonica*)	Picard, Research Station	1
09/04/13	Barn Swallow (*Hiroundo rustica*)	Picard, Station	2
10/04/13	Great White Egret (*Egretta alba*)	Malabar, Middle Camp channel low tide	1
12/04/13	Eleonora's Falcon (*Falco eleonorae*)	Picard, Pt 12 to Cemetery on Coastal Path	15-20

01/08/13- 02/08/13	Hoopoe (*Upupa epops*)	Malabar, Middle Camp coastal transect	1
09/08/13	Madagascar Bee-eater (*Merops Superciliosus*)	Malabar, Anse Poche	4
18/08/13- 21/08/13	Madagascar Bee-eater (*Merops Superciliosus*)	Picard, Bassin Lebine	1
21/08/13- 28/08/13	Mascarene Martin (*Phedina borbonica*)	Picard, Anse Chaux	1
09/09/13	Saunder's Terns (*Sterna saundersi*)	Lagoon, entrance to DJL	25-30
10/09/2013	Little Stint (*calidris minuta*)	Grande Terre, Beach 31	1
15/09/2013	Common Ringed Plover (Charadrius hiaticula)	Picard, Settlement Beach Z3-4	2
21/10/13	Common Pratincole (*Glareola pratincole*)	Picard, Research Station	2
23/10/13	Tree Pipit (*Anthus trivialis*)	Picard, Old Settlement	1
25/10/13	Yellow wagtail (*Motacilla flava*)	Picard, Research Station	1
04/11/13	Eleonora's Falcon (*Falco eleonorae*)	Picard, Settlement Beach Zone 4	1
04/11/13	Greater short-toed Lark (*Callandrella brachydactyla*)	Picard, Research Station	1
05/11/13	Broad-billed Roller (*Eurystomus glaucurus*)	Grande Terre, Dune D' Messe	1
28/11/13	Broad-billed Roller (*Eurystomus glaucurus)*	Picard, Backpath	2
05/11/13	Barn Swallow (*Hirundo rustica*)	Picard, Anse Var	1
10/12/13	Wood Warbler (*Phylloscopus sibilatrix*)	Picard, Research Station	1

3.3. Vegetation

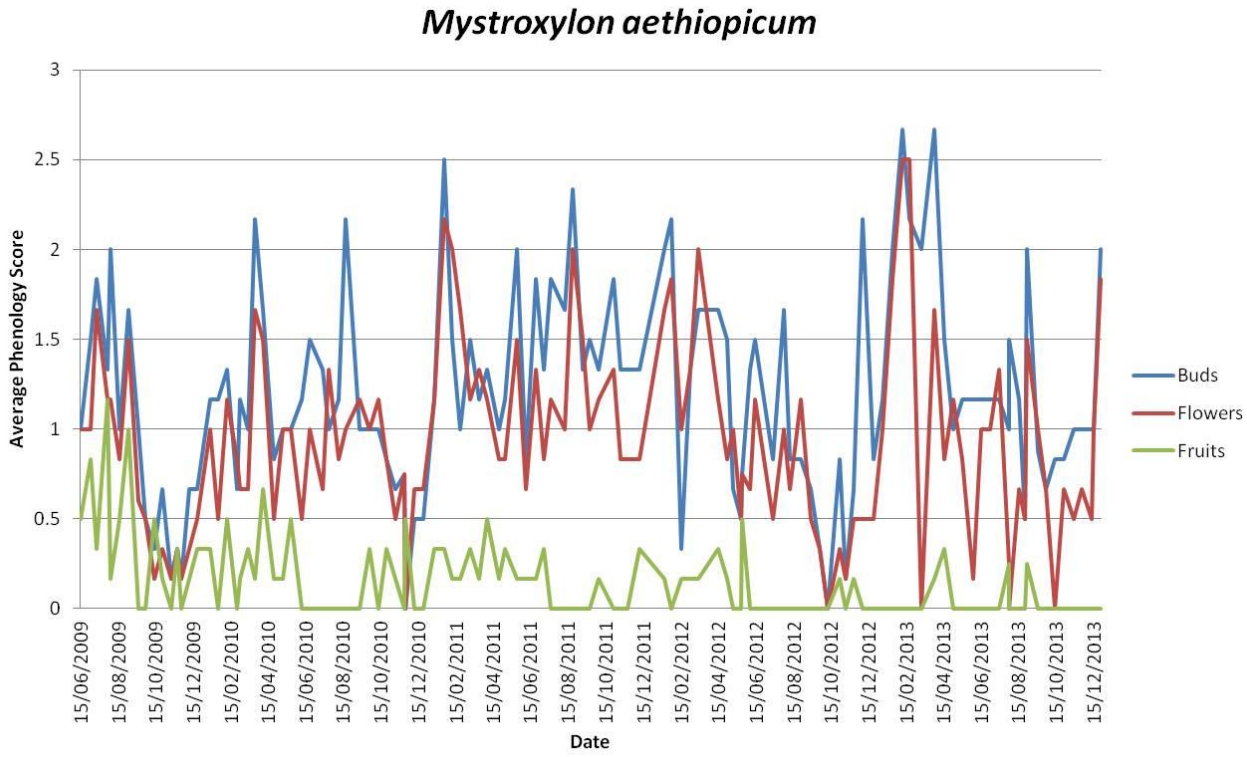
3.3.1. Phenology transects

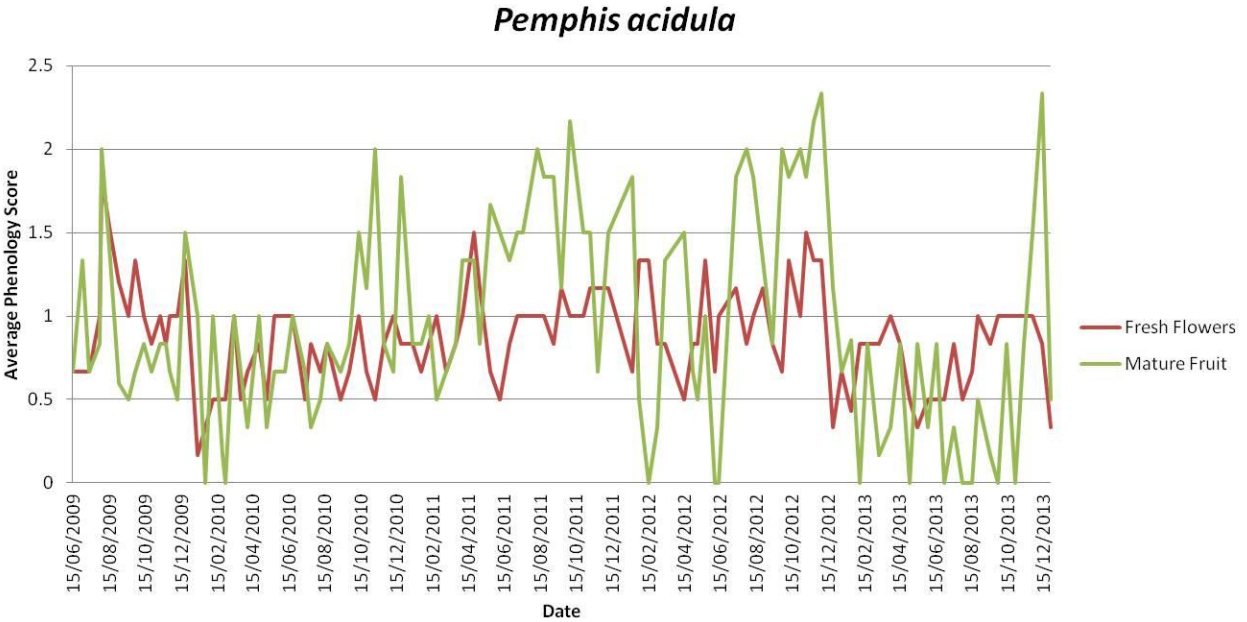
During 2013 phenology surveys were conducted every two weeks on the 33 species monitored as per the monitoring protocol. Detailed phenology monitoring has now been undertaken on Picard since 2009, providing a data set which can be used to illustrate the biological characteristics of the different species as well as examine annual patterns and change. In general the patterns for 2013 were consistent to that observed previously, however, there is some evidence of the reduced rainfall with pemphis generally having fewer fruits in the SE monsoon (March–October 2013) in this year compared to previous years . In addition the higher than average rainfall in August 2013 may have resulted in the earlier flowering of Clerodendrum (Figure 22).

During 2013 a number of the plants monitored died and these were replaced with a healthy individual of the same species and assigned a new identification number. Details of these replacements are given below. In a few cases it was assumed that a individuals was about to die and a replacement was selected in preparation. Mortality in *Lomataophyllum aldabrense* was particularly high this year and in at least one case the plant died as a result of tortoise damage.

Solanum aldabrense 22E died February (22M assigned which subsequently died in November)
Pleurostelma cermuum 31C died January (31G assigned in March)
Lomatophyllum aldabrense 12G, 12H and 12I added in August. 12F and 12D died in September. 12I died in September and replaced by 12J.
Capparis cartilaginea 6A died in September replaced with 6G
Jasminium elegans 11H added in August. 11B and 11C died December

As illustrated in the 2012 Annual Report Aldabra plants adopt a number of different strategies for dealing with the dry season, either defoliating or retaining their leaves. In addition species vary in their reproductive approaches, with some species flowering and fruiting simultaneously (e.g. Pemphis, Mystroxylon, Figure 22) and throughout the year whereas other species flower and fruit successively and seasonally only in the wet season (e.g. *Trianolepsis*, *Clerodendrum*).





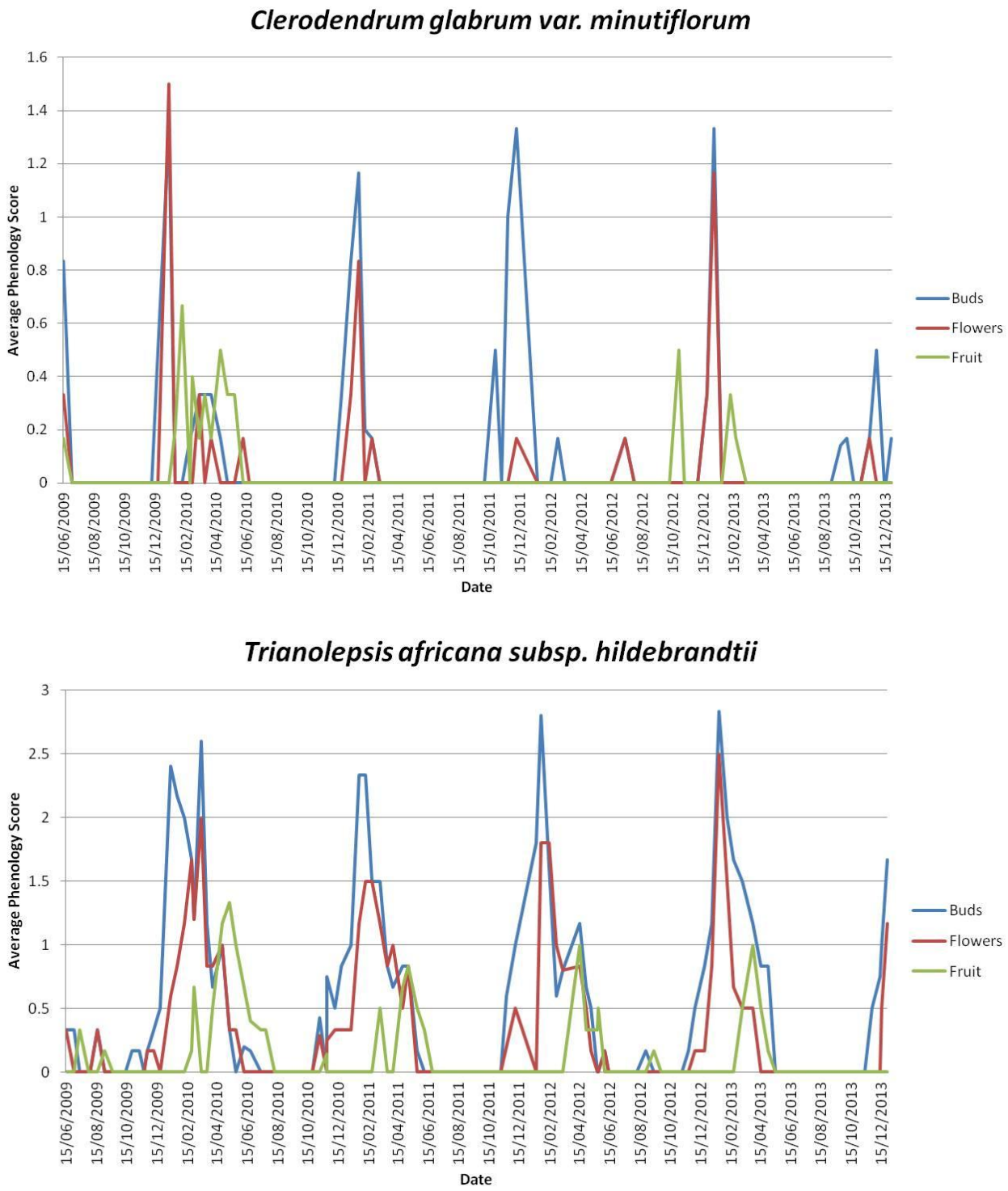


Figure 22. Average phenology scores recorded every 2 weeks from 2009 to 2013) of flower buds, fresh flowers and mature fruit presence for four species: (a) *Mystroxylon aethiopicum*, (b) *Pemphis acidula*. (c) *Clerodendrum glabrum var. minutiflorum*, (d) *Trianolepsis Africana subsp. hildebrandii*

3.4. Coconut crabs *Birgus latro*

Since 2006 coconut crabs have been monitored twice per month on Picard as per the protocol on both Backpath and Coastal path. Consistent with trends observed last year the number of coconut crabs encountered on these transects appears to be increasing, particularly evident on the Coastal Transect (Figure 23). This seven-year dataset has been used to assess seasonal patterns, difference in male/female composition, moult stage and effect of moon phase on encounter rates. It is planned in 2014 that Resident Researcher Janske van de Crommenacker will complete analysis of the coconut crab dataset for publication and this will feed into a review of the monitoring programme.

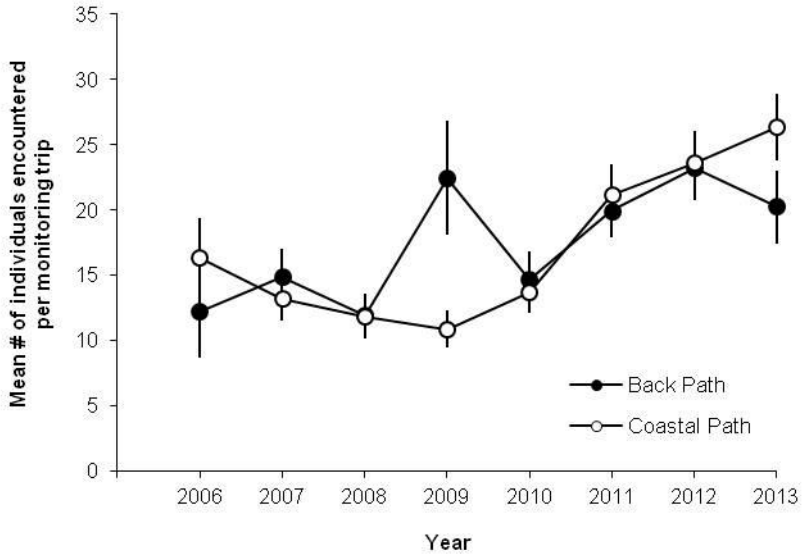


Figure 23. Mean number of coconut crab individuals encountered per monitoring trip in 2006-2013 (± s.e).

4. MARINE ENVIRONMENT

4.1. Turtles

Track counts of green and hawksbill turtles were conducted on potential turtle nesting beaches around the atoll (Figure 24) throughout 2013.

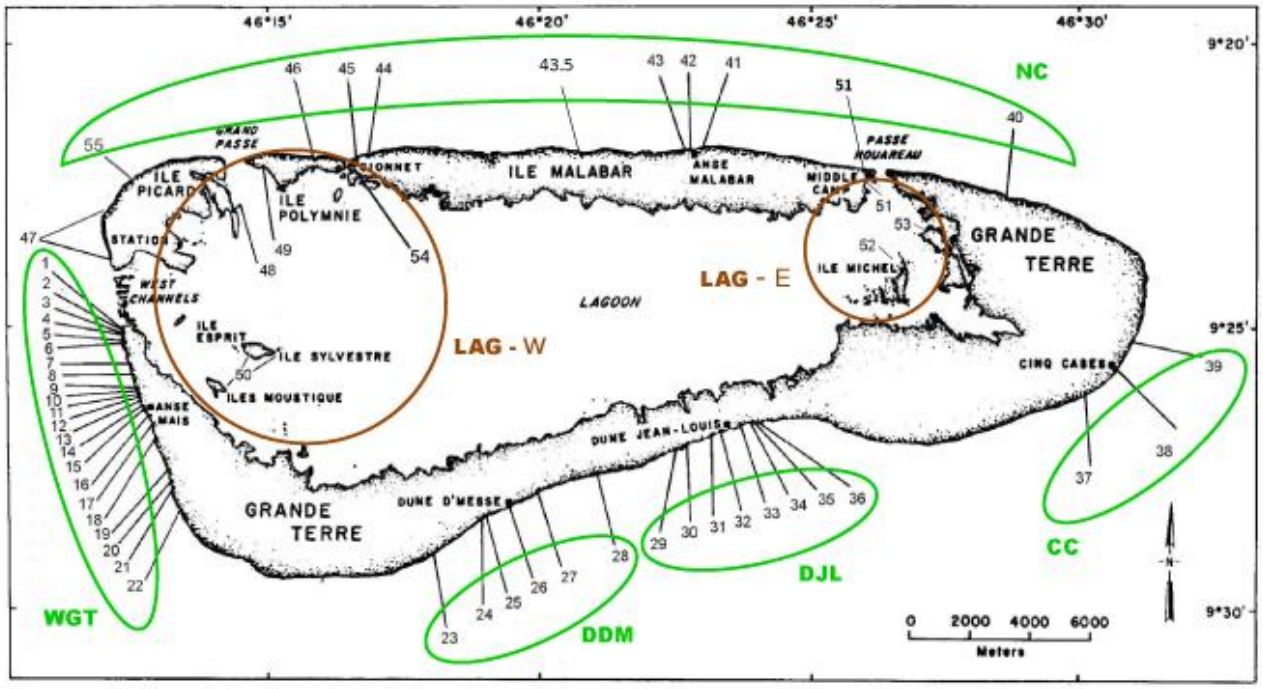


Figure 24. Numbered beaches on which turtle track counts are conducted and beach groups shown (derived from turtle track count field protocol by Mortimer 2009). The outside beaches with green labels are monitored principally for green turtle tracks and the lagoon beach with brown labels are monitored mainly for hawksbill turtle tracks

4.1.1. Track counts of green turtles

The green turtle track surveys conducted during 2013 are summarised in Figure 25 and Table 8 and compared to the previous six years. The number of surveys conducted in 2013 on the turtle beach was similar to previous years.

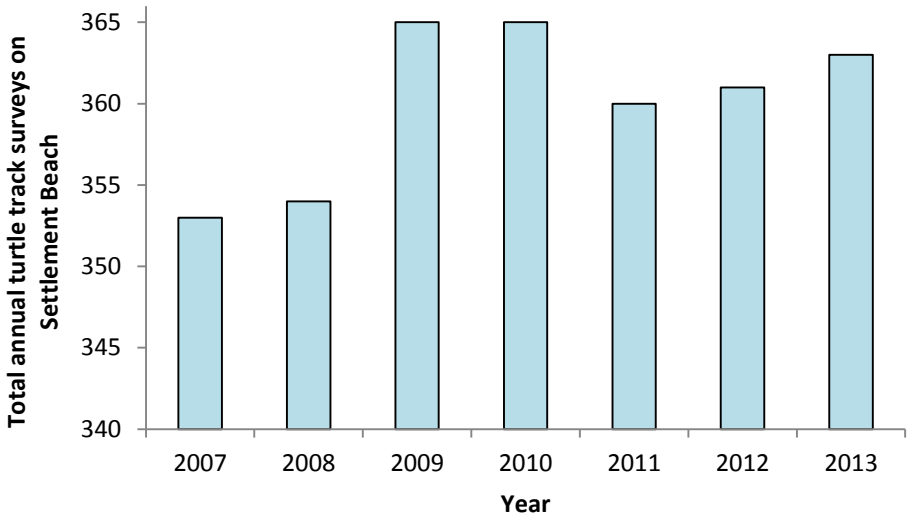


Figure 25. Number of turtle track surveys conducted on Settlement Beach 2007-2013

Table 8. Number of turtle track surveys conducted on the beach groups 2007-2013

Location	2007	2008	2009	2010	2011	2012	2013
WGT	50	27	35	41	40	33	**45**
DDM	19	14	16	16	22	16	**20**
DJL	20	12	13	16	20	17	**20**
CC	15	10	16	10	23	19	**15**
NC	20	15	21	19	20	26	**22**
Lagoon	5	3	12	10	9	11	**16**
AnseVar	18	16	12	14	12	14	**18**

Settlement Beach

Daily data was collected throughout 2013 on Settlement Beach turtle tracks, including GPS coordinates of each emergence track and whether it was considered to be a successful nesting attempt.

In 2013 the pattern of turtle emergence was similar to previous years with a high nesting peak in March / April (Figure 26) and numbers decreasing towards an annual low during December. What is very encouraging is that the peak of turtle emergences in March 2013 resulted in an average monthly daily emergence of 38.2 which is considerably more than in previous years, with 2011 having the previous highest daily peak with monthly daily average of 28 emergences (Figure 26). This illustrates that at the peak of the nesting activity in 2013 there were considerably more turtles coming ashore to nest on Settlement Beach this year compared to the previous twelve years.

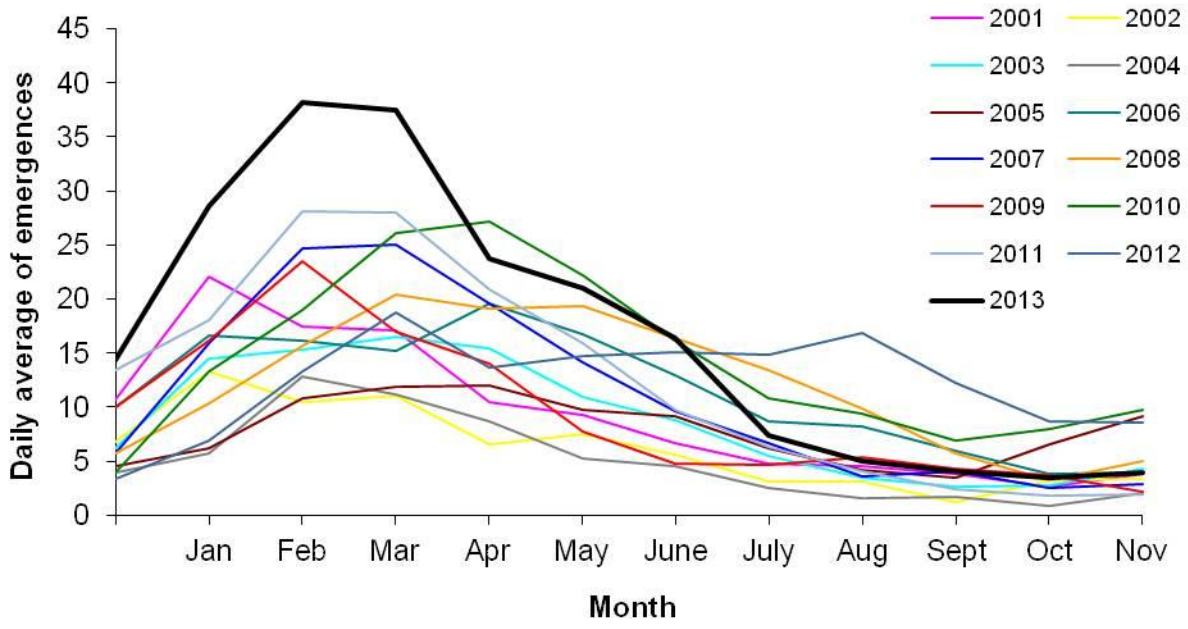


Figure 26. Daily averages of green turtle emergences on Settlement Beach (2001-2013)

This increase in turtle emergences can also be seen from the annual total with 6128 emergences in 2013 which is considerably higher than any previous year (Table 9). Previously 2010 held the record for the most emergences with 4627 VF tracks recorded and an average annual emergence per day of 14.3, however this was surpassed in 2013 when 5245 VF tracks were recorded with an average annual daily emergence of 16.9. This is fantastic as it suggests the number of turtles nesting on Aldabra is continuing to increase.

Table 9. Total number of emergences and calculated average emergence (Total emergence /total track counts) on Settlement Beach for each year in the period 2000-2013.

Year	Total # track counts	Total # emergences	Total # VF	Total # HM	Total # ESBO	Average # emergences per day
2000	116	444	375	23	46	--
2001	134	1181	1021	60	100	--
2002	136	801	653	57	91	--
2003	167	1452	1254	76	122	--
2004	178	894	801	34	59	--
2005	206	1649	1435	61	153	--
2006	274	3010	2599	161	250	--
2007	353	3937	3393	213	331	11.2
2008	354	4189	3547	211	431	11.8
2009	365	3407	2774	209	424	9.3
2010	365	5211	4627	199	385	14.3
2011	360	4500	3789	232	479	12.5
2012	359	4426	3690	278	458	12.3
2013	**362**	**6128**	**5245**	**375**	**508**	**16.9**

West Grand Terre

Turtle track counts on West Grand Terre were undertaken four times per month, by foot when logistically possible. At WGT there is not such a clear pattern in the number of emergences but this is likely due in part to the lack of consistency with the monitoring in comparison to Settlement Beach. What is noticeable in 2013, is a very clear peak in April, illustrating greater emergencies in this month in comparison to previous years. Then emergences remained reasonably high until July when they started to decrease (Figure 27).

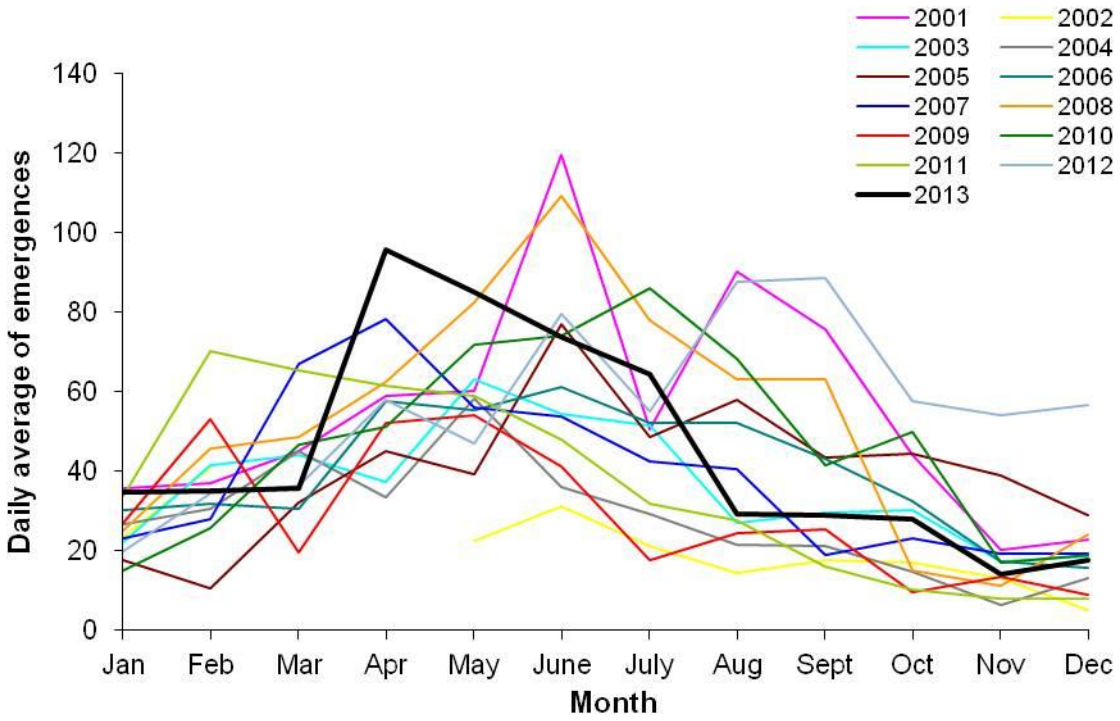


Figure 27. Daily averages of green turtle emergences throughout the year on WGT, for the period 2001-2013.

4.1.2. Track counts of hawksbill turtles

During the period September–March, track counts of hawksbill turtles are conducted, where possible, every two weeks on the beaches inside the lagoon (Figure 24). According to Mortimer (Aldabra Turtle Monitoring Protocol 2009), probably less than 30 hawksbill females emerge yearly on Aldabra. The number of surveys undertaken per month varies across the years, however, it can be seen that the data for 2013 and the previous ten years supports very limited nesting by hawksbill turtle on the beaches of Aldabra (Table 10).

Table 10. Monthly totals of hawksbill turtle emergences on the lagoon beaches 2003-2013, with the number of surveys conducted in brackets.

Month	Total number of hawksbill emergences (# surveys)										
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Jan	4 (4)	4 (3)	3 (2)	6 (2)	2 (2)	2 (1)	6 (1)	n/a	2 (1)	2 (1)	0 (1)
Feb	1 (2)	0 (1)	n/a	3 (1)	2 (1)	3 (2)	n/a	n/a	5 (2)	2 (2)	2 (3)
Mar	n/a	0 (1)	n/a	0 (2)	0 (1)	n/a	n/a	1 (2)	0 (2)	0 (0)	1 (1)
Sept	0 (1)	0 (1)	3 (1)	0 (1)	n/a	n/a	n/a	0 (2)	n/a	0 (2)	0 (2)
Oct	1 (2)	0 (1)	0 (1)	1 (1)	n/a	n/a	1 (4)	3 (2)	4 (2)	1 (2)	0 (3)
Nov	0 (3)	2 (1)	1 (3)	1 (2)	4 (1)	n/a	3 (2)	2 (2)	4 (3)	4 (2)	3 (2)
Dec	2 (1)	2 (1)	9 (2)	3 (2)	n/a	n/a	14 (4)	11 (2)	2 (1)	2 (1)	5 (2)
Total	**8 (13)**	**8 (9)**	**16 (9)**	**14 (11)**	**8 (5)**	**5 (3)**	**24 (11)**	**17 (10)**	**16 (11)**	**11 (11)**	**11 (14)**

4.1.3. Turtle tagging

In total 285 nesting green turtles were encountered during tagging activities in 2013, of these 176 were newly tagged and the remaining 109 were re-sightings (Table 11). During in-water tagging sessions in the lagoon, 55 juvenile turtles were captured, of these almost all were newly tagged green turtles. As a result of the satellite tagging project there were increased efforts in turtle tagging in 2012 which accounts for the much higher encounter rate in comparison to other years. In addition to in-water tagging one nesting hawksbill turtle was tagged and a DNA sample was obtained which is needed to understanding the dynamics of the Aldabra hawksbill population. A total of 217 green turtles and seven hawksbill turtles were newly tagged in 2013. In the last 11 years a total of 4070 green turtles and 138 hawksbill turtles (including two nesting females) have been tagged by the Aldabra research team.

Table 11. Summary of turtles encountered during tagging sessions 2003-2013and the total for this period.

	Year	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Green turtles													
Nesting	Encountered	246	207	455	490	346	378	126	126	148	446	**285**	**3253**
	Newly tagged	184	160	272	337	231	219	56	71	85	187	**176**	**3003**
	Re-sighted	62	43	183	153	115	159	70	55	63	259	**109**	**2101**
In-water	Encountered	135	162	162	159	106	66	33	12	41	46	**48**	**1322**
	Newly tagged	110	105	118	108	97	62	27	9	34	43	**41**	**1067**
	Re-sighted	25	57	44	51	9	4	6	3	7	3	**7**	**255**
Hawksbill turtles													
In-water	Encountered	1	0	2	38	42	38	17	7	20	32	**7**	**204**
	Newly tagged	1	0	0	33	30	20	10	2	11	23	**6**	**136**
	Re-sighted	0	0	2	5	12	18	7	5	9	9	**1**	**68**

Of the nesting green turtles re-sighted in 2013 the 'oldest' had been tagged in 1996. Consistent with previous years none of the re-sighted turtles had been encountered in the two years prior to 2013, confirming that they typically spend at least two years away at their feeding grounds. Most of the re-sightings were first tagged between 2006 and 2008 (Figure 28), this could be possibly a product of greater tagging effort in these years, however, in 2012 the majority of re-sighting were from turtles tagged 2005-2007 therefore providing some evidence that females typically spend 4-6 years at feeding grounds before returning to nest.

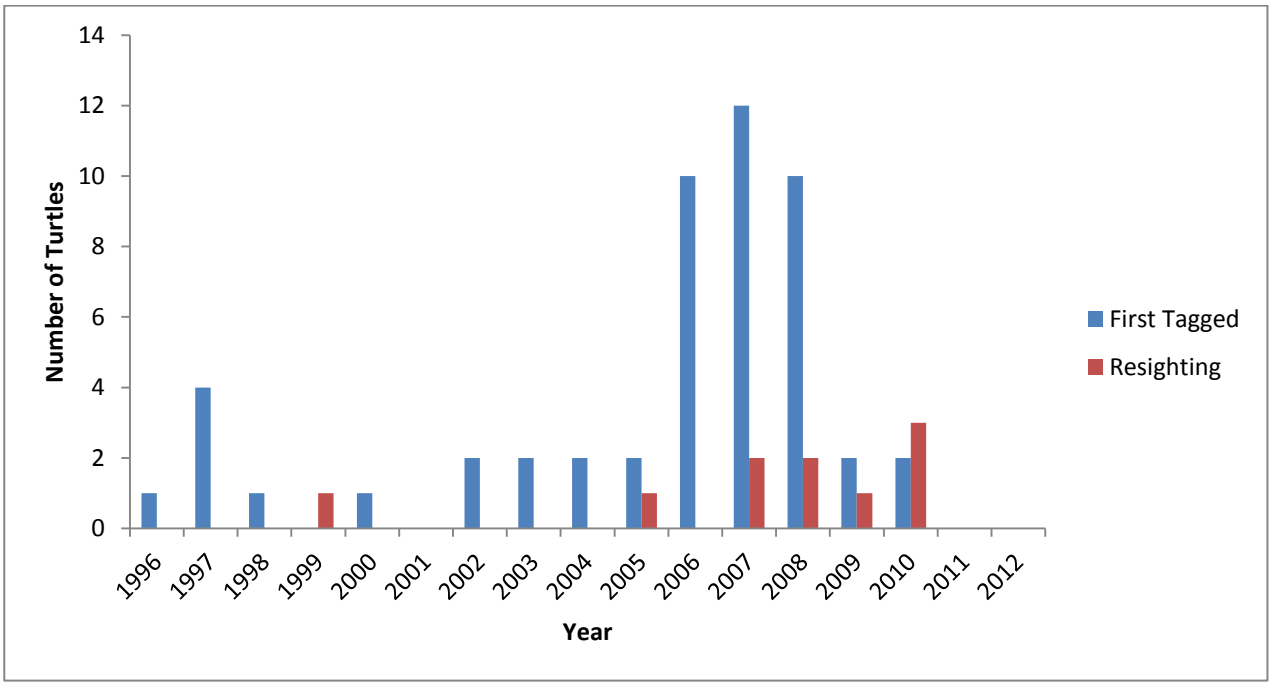


Figure 28. The year of tagging and re-sighted years for nesting turtles re-sighted in 2013

4.1.4. Has the switch to solar energy and construction of a lighthouse affected turtles nesting on Settlement Beach?

In March 2012 the old generators were turned off on Aldabra and the Research Station made the switch to solar energy, thereby reducing noise and vibration at the Station. In addition in December 2012 a lighthouse was constructed at Station and has been functioning ever since. As a result of the beach shape and vegetation it is principally Zone 1 and Zone 2 which are affected by the lighthouse beam. There has been concern / interest to know whether either of these events would have an impact on turtle emergences and nesting on Settlement Beach close to Station.

It is thought that Zone 1 would be the section of beach most affected by the generator and lighthouse and therefore the number of turtle tracks recorded between 2011 and 2013 in Zone 1 have been detailed in Figure 29. The results (Figure 29) do not indicate an obvious decline in the number of turtles nesting in Zone 1 since the activation of the lighthouse. There were in fact more tracks in Zone 1 following the switch to solar power compared to before, perhaps indicative of the past effects of noise disturbance, however, this is also a reflection of the inter-annual variation and seasonal variation in nesting turtle numbers. To account for the variation in annual / seasonal nesting frequency Figure 30 illustrates the number of very fresh turtle tracks counted in Zone 1 as a percentage of total turtle tracks on Settlement Beach before and after the generator and lighthouse change which illustrates again that there appears to be no adverse impact of the lighthouse and if anything Zone 1 appears to be used slightly more post solar power installation, with a great increase in very fresh tracks compared to the other zones on Settlement Beach (Table 12).

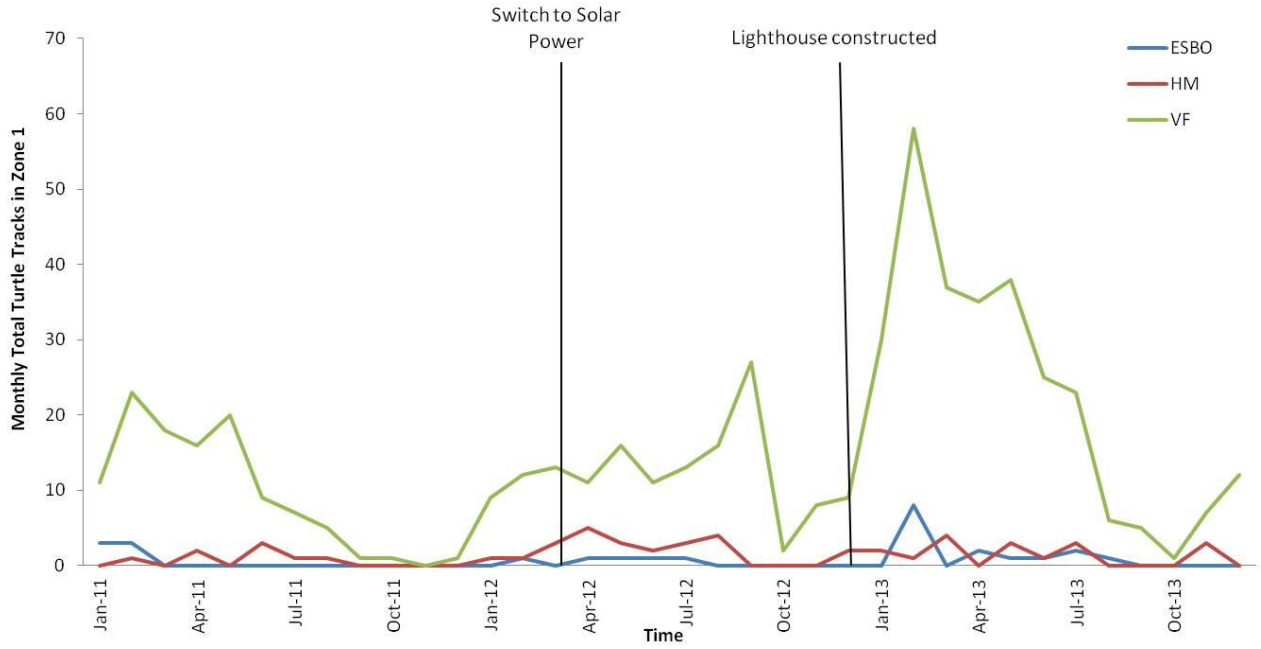


Figure 29. Monthly totals for Emergence stopped by Object (ESBO), Half Moon (HM) and Very Fresh (VF) turtle tracks in Zone 1 of Settlement Beach, Picard (2011-2013) before and after the switch to solar power and the lighthouse construction.

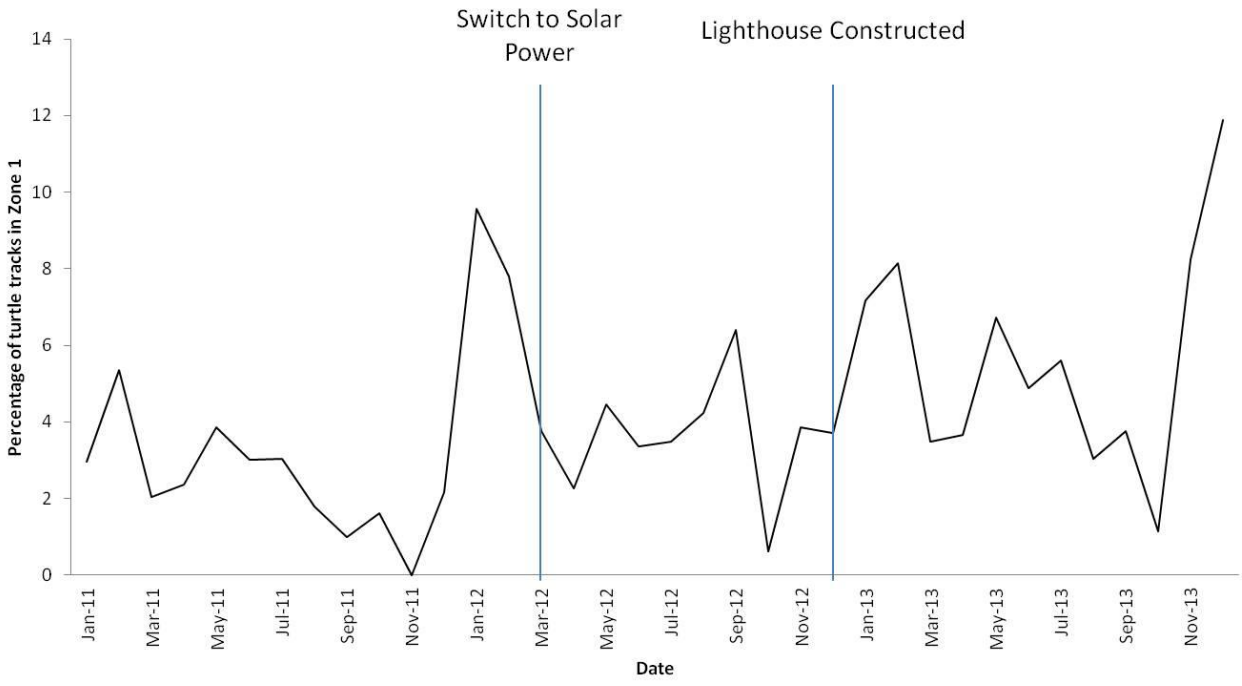


Figure 30. Percentage of Settlement Beach Very Fresh turtle tracks occurring in Zone 1 (2011-2013) before and after the switch to solar power and the lighthouse construction.

Table 12. Number of very fresh tracks per Settlement Beach zone and average annual increase in the 5 years before 2012, and in 2013

	Total # very fresh emergences						Average annual rate of increase (s.e.)	# emergences 2013	% increase 2012–2013
Zone	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**			
1	138	123	119	169	112	147	1.1% (10.4)	277	46.9%
2	791	853	801	1178	972	1067	4.9% (7.4)	1492	28.5%
3	874	1004	788	1432	1108	1010	1.0% (12.7)	1430	29.4%
4	1596	1567	1066	1861	1585	1485	-2.4% (12.4)	2046	27.4%

It is reassuring that the lighthouse does not appear to having an adverse impact on female nesting. However, to assess any potentially change in nesting patterns it would be necessary to also take into account beach profile and nesting platform availability which contributes to the suitability of Zone 1 for nesting. In addition there are still other disturbance factors such as light and noise associated with Station existing prior to and post switch to solar and the construction of the lighthouse.

There has been some suggestion that potentially turtle hatchlings may be more affected by the light disturbance than the adults. Field experiments were used to investigate the issue of whether lighthouses disrupt the orientation of turtle hatchlings in Florida to assist in informing management and it was found that the hatchlings crawled towards the ocean and were not affected by the lighthouse (Reintsma *et al*, 2014). In keeping with this study there have been no confirmed observations of disorientated hatchlings as a result of the lighthouse in Zone 1 and hatchling tracks seen also do not suggest an issue.

4.1.5. Green turtle satellite tagging

SIF has been running a Green Turtle satellite tagging project over the last two years (initially funded by the International Sustainable Seafood Foundation). For the background and data received up to 2012 from this project refer to ASC Reports 2011 and 2012. The two remaining satellite tags were not attached in 2013 as discussions were ongoing to try and ensure that more data is obtained from the remaining satellite tags, as data received ceased prematurely. One of the possible causes of failure is that the tag becomes detached from the turtle. Martijn van Dinther sourced the epoxy glue recommended by the tag manufacture at the end of 2013. This was received on the atoll in late 2013 and in the aim is to find suitable female turtles for these two satellite tags in 2014.

4.2. Subsistence fishing

In 2013 a total of 50 subsistence fishing trips were undertaken, of which 24 trips involved both bottom fishing and trolling, 11 only trolling and 15 only bottom fishing. A total of 1055 fish were caught that weighed in total 2888.5 kg, which represents a decrease in total catch compared to 2012 despite more fishing trips (Figure 34).

Catch per unit effort (CPUE) provides a measure of fishing efficiency, which are used to inform stock management decisions. It can be seen that consistent with previous years, Trolling yielded a greater CPUE in comparison to bottom fishing, meaning that in respect of time spent, trolling is more efficient than bottom fishing (Figure 31 & 32), as greater weight of fish is yielded by trolling compared to bottom fishing for the same amount of time. In comparison to 2012 it can be seen that the CPUE for both bottom fishing and trolling fell in 2013, which was particularly marked in trolling. However, CPUE is still within the range of previous years for both fishing methods (Figure 31 & 32).

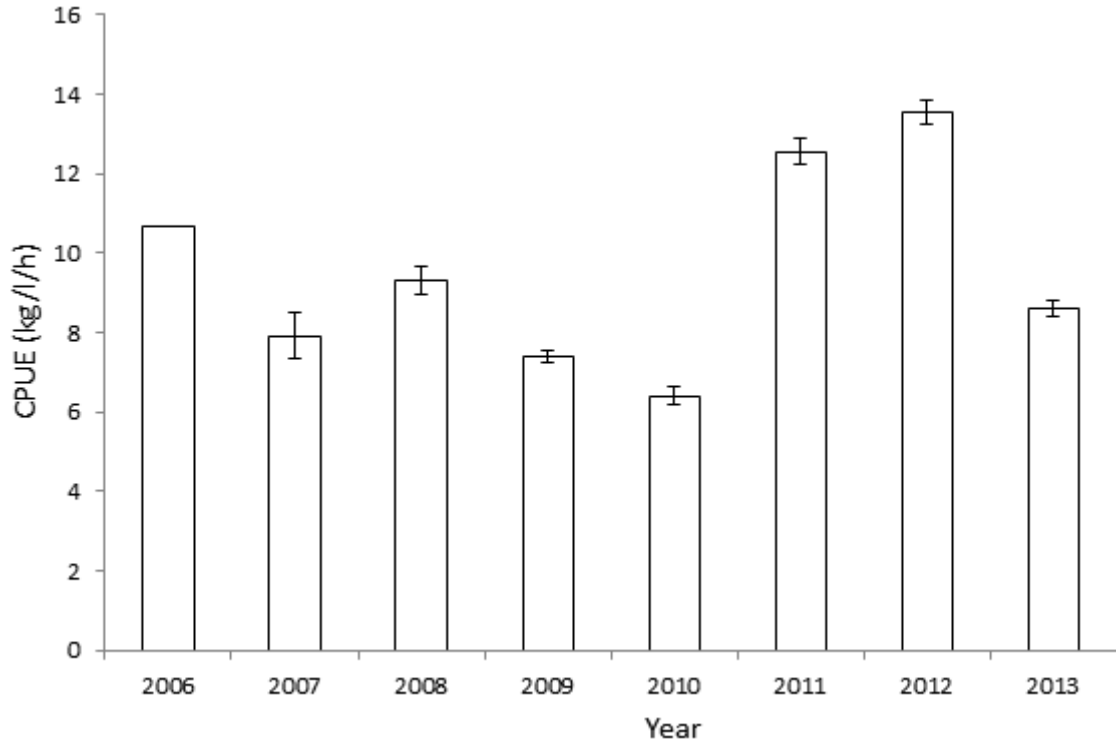


Figure 31. Trolling Catch per Unit Effort (CPUE, kg/l/h) (± s.e.) 2006–2013, CPUE calculated per trip. There is insufficient data from 2006 to include an error bar.

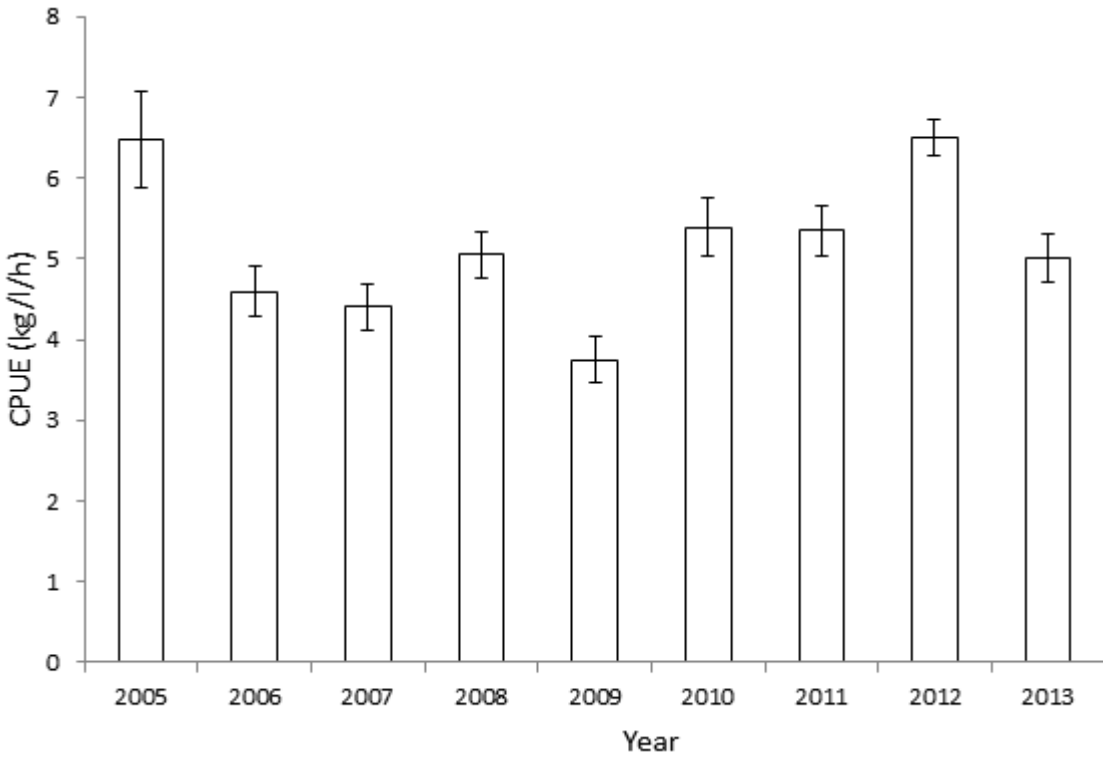
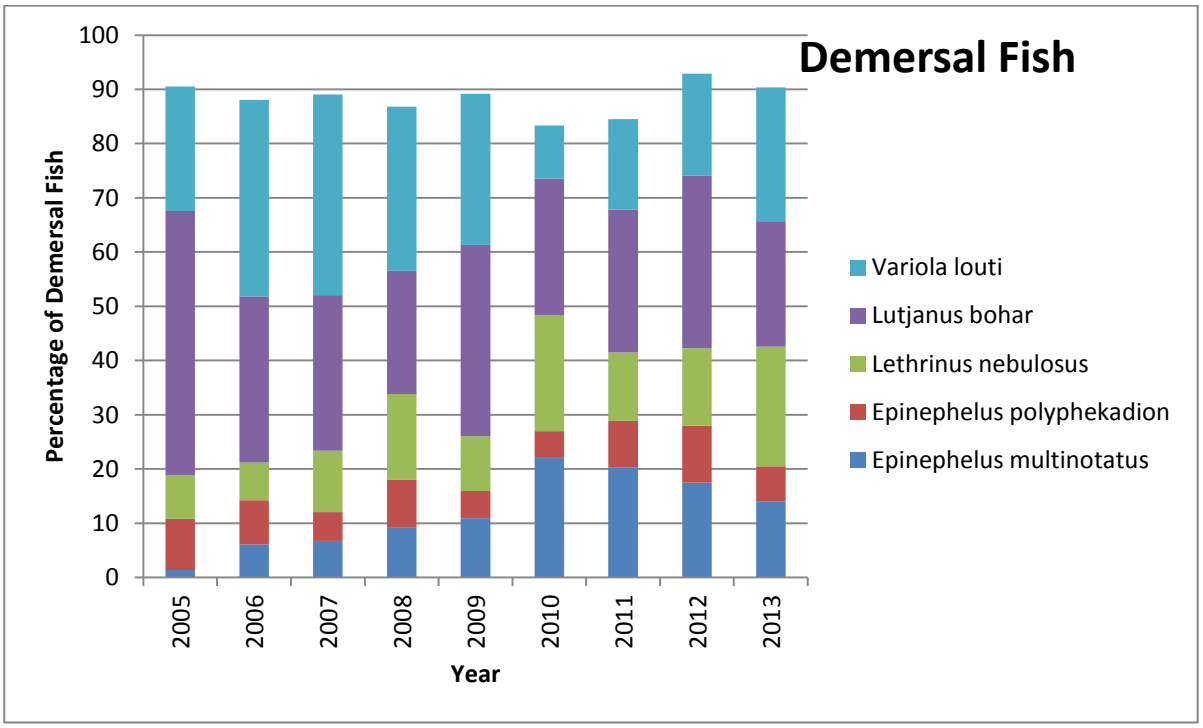


Figure 32. Bottom Fishing Catch per Unit Effort (CPUE, kg/l/h) (±s.e.) 2006–2013, CPUE calculated per fishing trip

In 2013 the total fish catch (weight) fell in comparison to 2011 and 2012 (Figure 34), although, 2013 was still the third highest annual subsistence fish catch since accurate records have been kept. Trolling contributed to a smaller proportion of the total fish catch weight in comparison to recent year (post-2010 when proper trolling rods were introduced), this can be explained partly by appropriate trolling lures and fishing gear limiting trolling activities in the second part of 2013.

The five demersal fish species that are caught most often in the subsistence fishing have made up more than 80% of the total demersal catch over the past eight years (Figure 33). The five species comprise four piscivorous predators (*Variola louti*, *Lutjanus bohar*, *Epinephelus polyphekadion and E. multinotatus*) and one benthic invertivore (*Lethrinus nebulosus*). Three of these species are slow-growing, long-lived species and consequently are vulnerable to fishing pressure. However, the consistency in composition of the top five species may indicate that there has not been a trophic shift towards smaller, meso-predators which suggests a healthy marine ecosystem and stable fishery. There is variation between years as to the importance of these species to the fishery but there is no consistent trend across the years.



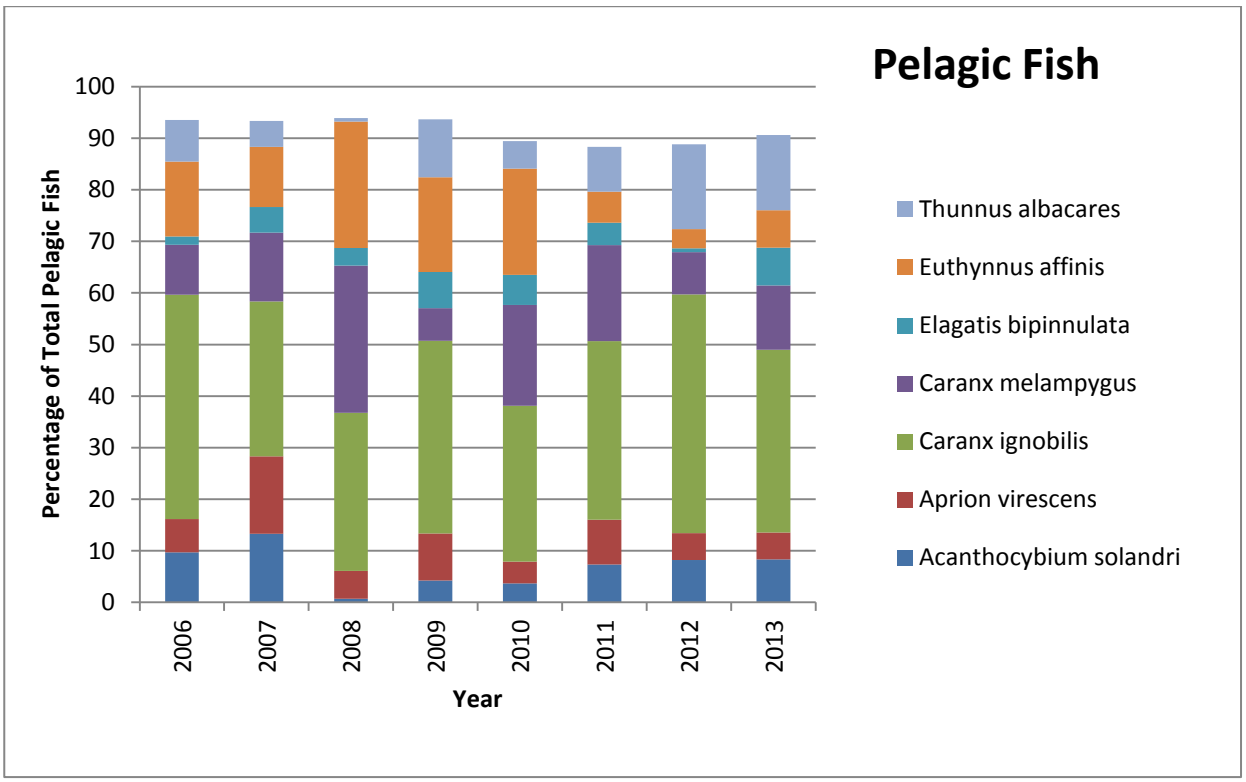


Figure 33. Fish species that represent >1% of the total number of fish caught for demersal and pelagic fish catch (2006-2013)

Pelagic fish catches are dominated by *Caranx ignobilis* and a varying contribution of a further six species (Figure 33). Consistent with the demersal fish the composition of the pelagic catch has remained fairly consistent over the past eight years. All of these fish species are characterised by shorter life cycles and quicker turnover time and are therefore less vulnerable to fishing pressure compared to the demersal fish species.

Table 13 details fish species caught in 2013 which have been asigned categories on the IUCN Red List of Threatened Species as "Near Threatened", "Vulnerable" on "Endangered". Of these six species the Napolean wrasse is of most concern as it has been assessed as endangered as a result of severe declines in all places where data is available, occuring very soon after fishing begins, reducing numbers by more than 50% and where management is not effective. IUCN state that it is a species which appears to be highly conservation dependent. The Blacksaddled Coral Grouper is also of particular concern as this has been assessed as vulnerable to extinction, the IUCN state although widespread it is naturally rare, has heavy fishing pressure throughout its range and has shown declines in abudance of at least 30%. The Blacksaddled Coral Grouper was also the rarest species in a demographic study of Aldabra serranids (Grandcourt, 2005). The Camouflage Grouper also needs consideration as has been categorised as "Near Threatened" and is one of the top five most commonly caught demersal fish in the Aldabra subsistence fishery. The IUCN state that although widely distributed the Camouflage Grouper is particularly susceptible to overfishing.

Table 13. Fish species caught on Aldabra in 2013 which the IUCN has categorised as "Near Threatened" and "Vulnerable" to extinction

Name	**Species**	**Number of individuals caught**	**Total Weight (kg)**	**Average weight (kg) ± s.e.**	**IUCN Status**
Napoleon wrasse / Aya Zerar	*Cheilinus undulatus*	1	25.5	-	Endangered
Blacksaddled Coral Grouper / Babonn Sesil	*Plectropomus laevis*	2	15.7	7.85 ± 0.65	Vulnerable

Brown marbled grouper / Vyey goni	*Epinephelus fuscoguttatus*	5	22	4.4 ± 0.73	Near Threatened
Camouflage grouper / Vyey masata	*Epinephelus polyphekadion*	62	154	2.48 ±0.11	Near Threatened
Rovin coral grouper / Babonn zannannan	*Plectropomus pessuliferus*	2	10.5	5.25 ± 2.35	Near Threatened
Yellowfin tuna / Ton zonn	*Thunnus albacares*	14	160.9	11.49 ± 2.03	Near Threatened

A total of 36 identified fish species were caught in 2013, however, less than half of these have been assessed by the IUCN. The IUCN Red List of Threatened Species is not necessarily the best means for estimating the vulnerability of fish to fishing pressure because of the widespread nature of tropical marine fish contradicting the qualifying criteria and a large number of fish species have not been assessed or lack the data to be assessed. A possibility for consideration in the future is an assessment of the intinsic vulnerability of Aldabra fish speices to fishing pressure based on their life history characteristics which might be a better means for informing fishing activities on Aldabra. In particular for longlived, slowgrowing species (e.g. Potato Grouper, Napolean Wrasse etc.) it is important to consider the role of big old fecund female fish which produce exponentially more offspring than smaller individuals.

Although considered, it is unfortunatly not usually possible to release fish once caught because of barotrauma resulting from bringing the fish up very quickly from depth. As a result of the high shark abundance slow retreival is not really an option. Deflating the swim bladder may be an option to return individuals suffering from barotrauma but requires training and equipment. With the current fishing methods it is unavoidable to catch these species. With the upcoming review of the Aldabra Management Plan certain areas will be designated as total no-take zone which will be the most practical solution to ensure that there are areas where there is no impact on these fish species. In addition it is important that investment in good trolling equipment is realised as pelagic species are more resilent to fishing pressure as a result of their life histories.

It is planned to collect further data pertinent to the subsistence fishery following review in 2014. It is proposed to collect GPS coordinates for the catch location of each individual fish caught so this can be related to species, size and weight. In conjunction with the reef map and MPA expansion as part of SIF's component of the GEF project, no-take zones will be created which is an essential component of any MPA. These no-take zones will ensure a representation of habitats with no fishing pressure and create a baseline with which to monitor potential impact of the subsistence fishing activities. With almost three tons of fish being caught in 2013 (Figure 34) it is vital to understand if this could be having an adverse impact on fish abundance / composition to allow for effective conservation of this resource and management of the MPA.

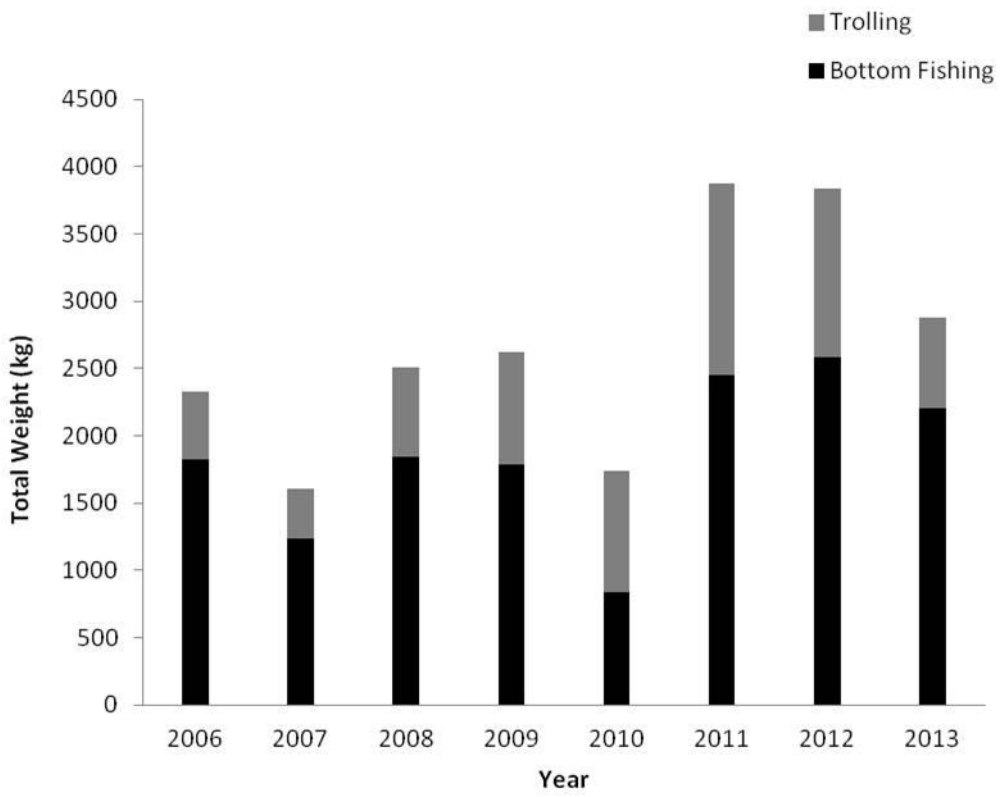


Figure 34. Total fish catch weight (kg) for 2006–2013 showing proportion of weight caught by trolling and bottom fishing methods

4.3. Marine mammals

4.3.1. Cetaceans

Figure 35. Spinner Dolphins (left) and Humpback whale (right); Catherina Onezia

The first humpback whale for 2013 was observed on 5th July at Middle Camp by Jude Brice and observations continued until the final sighting on 28th November, which is over a month later than the last observation for 2012. Observations therefore suggest that humpback whales remained around Aldabra later in 2013 in comparison to the previous year (Figure 36). A total of 98 sighting of humpback whales were recorded during these months (Figure 36), which is significantly more than in 2011 and 2012. Consistent with previous year's most observations were of 1–2 individuals, however, on four occasions the group consistent of 3 whales and interestingly a group of 5–6 individuals was seen on four separate occasions from the Cinq Cases coastline. The sightings in

October and November of this comparatively large group were over a month apart and therefore particularly interesting as humpback whales are known for living alone and groups formed tend to disband quickly. Reassuring, in contrast to 2012 when only one calf was observed, 25 of the observations in 2013 included a juvenile (26%).

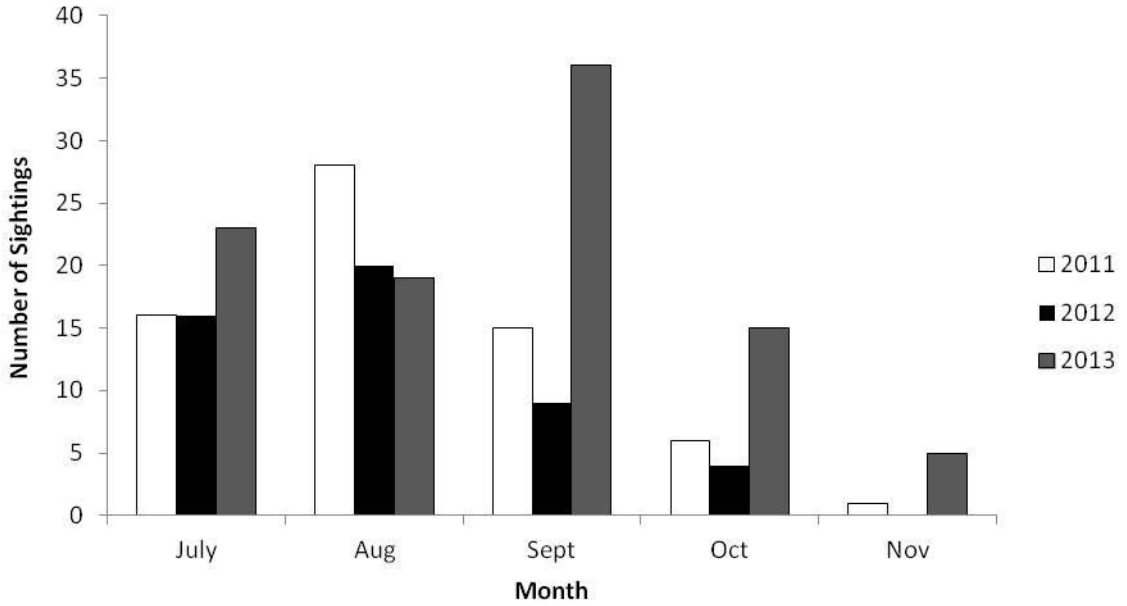


Figure 36. Number of humpback whale sightings (2011-2013)

A total of 52 observations of dolphins were recorded in 2013, of these the majority of sightings consisted of spinner dolphins. However, one observation of two bottlenose dolphins was recorded in February and a pod of 30–60 common dolphins was seen in October. The pod size of the spinner dolphins varied but was generally between 10–150 individuals. However, on three occasions huge groups of spinner dolphins were observed with estimates of 200–500 individuals.

4.3.2. Dugongs

Prior to February 2013 the rare sightings of dugongs have mostly been limited to single individuals or pairs which suggested that the dugong population consists of only a small number of individuals. M.Y. Danah Explorer made available its helicopter and gyrocopter providing an amazing opportunity to undertaken aerial visual surveys for dugongs. Between 23rd February and 2nd March seven aerial surveys were carried out which showed the Aldabra dugong population is larger than previously thought, illustrated with a maximum count of 14 unique individuals observed in one survey (the whole lagoon was not covered). Most sightings were located in the area between Dune d'Messe and Dune Jean-Louis. The estimate for the total dugong population at Aldabra is therefore 20–25 individuals taking into account the rest of the lagoon and potentially missed individuals. For full details of the surveys undertaken and dugong observations please refer to *February 2013 – Aldabra Dugong Sighting Report* (Janske van de Crommenacker).

The presence of the helicopter and gyrocopter on Aldabra provided a fantastic opportunity to collect further data on the presence of dugongs in the lagoon and water close to the atoll and demonstrated the effectiveness of detecting these species using aerial surveys. It is hoped that in 2014 further knowledge can be obtained on Aldabra's dugong population.

Figure 37. Dugong seen from shore on Picard (Catherina Onezia)

In addition to the aerial surveys three dugong sightings were recorded during 2013. One observation from the shore on 29th October and two observations from boats later in the year. Details of these observations can be found in table 14.

Table 14. Dugong Observations in addition to those made during the aerial surveys in 2013

Date	# Dugongs	Location	Details
29th October	1 adult	End of Settlement Beach	Inside the reef at low tide ~25m from champignon cliff
30th October	1 adult	Zone 3-4 Settlement Beach	Just inside the reef in 3-5m of water on seagrass beds. It surfaced several times briefly before it disappeared.
7th November	1 adult	Channel to the south of Ile Esprit	Observed ~8 minutes, surfacing to breath four times as it swam closer to Ile Esprit before it changed speed and swam off fast east.

It is interesting to note that three observations were made of dugongs outside the lagoon in 2013, aside from the 2012 sighting, previous observations have been limited to the lagoon. This illustrates that the outer reef is utilised by dugongs and all of these observations (four) were in a similar location between the end of Settlement Beach and Main Channel.

4.4 Marine Projects

4.4.1. Reef mapping Project (*contributed by Philip Haupt*)

The data collection component of the reef mapping project was finalised at the start of 2013, please refer to 2012 Annual ASC Report for details. GeoEye satellite imagery was acquired for the reef map in September 2013. The satellite imagery will be processed and a ground-truthed reef map derived in late 2014. A key finding at this stage in the project has validated an unprotected area of reef requiring protection. Areas previously thought to be barren wave beaten tracks of algal reef and bedrock coastline hosted rich patches of *Acropora* coral beds along the South Coast. Clear signs of coral recovery and colonisation post 1998 coral bleaching were recorded. The information will be used to validate the Aldabra Marine Protected Area expansion, also to follow in 2014. The habitat map will serve as the baseline from which large-scale change over decadal phases can be compared, and form a base map from which scientific inquiry is planned, to ensure that studies provide representative data spanning across different habitat types. This also sets the start point for the Aldabra Marine Monitoring Programme, as part of the GEF project.

4.4.2. Pangaea project (*contributed by Philip Haupt*)

The 'Pangaea Project' was a collaborative research initiative between the South African Institute for Aquatic Biodiversity (SAIAB), the Seychelles Fishing Authority (SFA), the Seychelles Islands Foundation (SIF) and the Island Conservation Society (ICS). The 190-foot luxury vessel M/V Pangaea was used as a research platform to, (i) undertake snap-shot surveys and short-term data collection at numerous sites throughout the south western Indian Ocean (SWIO) and (ii) establish long-term monitoring projects at selected sites such as Aldabra. The main research themes were to (i) undertake baseline fish surveys to investigate species composition (ichthyofaunal biodiversity) and record the abundance and size frequency of important fishery species, and (ii) evaluate connectivity by studying fish behaviour, habitat use and movement behaviour, as well as genetic stock structure of geographically separated populations.

The Pangaea cruise took place between 17th October and 29th November 2013 and research was conducted at Aldabra, Cosmoledo, Etoile, Boudeuse Island, Rémire and African Banks. Several scientists led different components of the project, namely: Dr Paul Cowley (SAIAB, and chief project scientist overseeing all work), Dr Anthony Bernard (SAEON, and specialist in BRUVs deployment), Dr Jude Bijoux (SFA, trap fishery), and Philip Haupt (GEF project coordinator for SIF, SIF SCUBA surveys and BRUVs).

A summary of the different methods used and data collected is as follows:

- Baited (BRUVs) and Unbaited (RUVs) Remote Underwater Video systems, using GoPro cameras, were used to investigate fish species composition across habitats and depths at different localities. A total of 105 RUV and BRUV deployments of approximately 1 hour each were done at Aldabra, while another 63 BRUV deployments were completed at other sites (See detail on Aldabra Marine Monitoring for more detail).

Figure 38. Footage from Baited Remote Underwater Video surveys

- Traditional fish traps equipped with GoPro cameras were deployed to investigate species composition and catch-per-unit-effort at several sites exposed to different levels of fishing pressure. More than 60 deployments were completed during the cruise.
- Research fishing using conventional fly-fishing and jig casting tackle took place mostly at Cosmoledo and Aldabra. A total of 659 fish were caught, identified, measured and released. Fin clip samples for genetic studies were collected from 580 individuals and 126 fish were tagged with conventional plastic dart tags.
- Acoustic telemetry will be used to collect high resolution, long-term data on selected species at Aldabra. An array of 14 receivers was deployed on the western side of the atoll and a total of 15 blacktip reef sharks and three potato groupers were surgically equipped with acoustic transmitters.
- Opportunistic biological sampling was conducted (outside Aldabra), with emphasis on grouper species. Fish were sexed, gonad maturity state recorded and otoliths were collected.
- Bird, turtle and coral monitoring was also conducted on the last leg of the Pangaea cruise, post Aldabra, when ICS personnel were on board. Additionally, a number of sightings of rare fauna were also recorded at Aldabra. These included one dugong, two whale sharks, five reef mantas and several other large shark sightings (tiger shark, bull shark and oceanic thresher shark).
- Benthic and fish surveys were conducted using SCUBA at seven sites at two depths around Aldabra. Seven sites were prepared and surveyed for benthic coverage and fish counts conducted using Underwater Visual Census techniques (See Aldabra Marine Monitoring for more detail).

4.4.3. Tidal gauge (Contributed by Christina Quanz)

A quotation from Valeport (UK) was received in May 2013 for repair of the broken tidal gauge. Unfortunately it was found that the transducer was beyond repair due to the water ingress into the sensor and the logger had also suffered from water ingress into the main compartment. This resulted in a higher repair cost than had been anticipated. It was felt that the expenditure for repair could not be justified and it was recommended that tidal measurements should be revisited at a later date as part of a dedicated project to create a tidal model for the whole atoll.

During checks it was found that the second tidal gauge installed kept switching off. The battery voltage appeared to be good and the reason the unit stops recording is not known. The tidal gauge was brought back to Station in July for in house assessment. No further tidal data was collected in 2013.

A tidal gauge is an all important piece of equipment for monitoring sea level rise, as well known threat to operations of the station, and several species. It is recommended that an alternative solution is found and implemented by SIF to ensure a continuous data collection of sea level rise.

5. INVASIVE SPECIES

5.1. Madagascar fodies and red-whiskered bulbul eradication at Takamaka

(*compiled from Takamaka Team Leader, Terence Mahoune's weekly and season reports****)***

First Season

Following the discovery of Madagascar fodies and a red-whiskered bulbul in the Takamaka region in 2012 emergency funding was received from UNESCO to tackle this invasion. Following preparatory work in 2012 the intensive eradication efforts began in January 2013 with a dedicated team of six staff based at the new Takamaka field hut and led by Terence Mahoune. There was a permanent presence at Takamaka from January to April 2013. For full details of the Takamaka project please refer to the *Eradication of introduced birds at Takamaka, Aldabra* (Terence Mahoune, June 2013).

In addition to the 14 Madagascar fodies culled in 2012 a further 88 individuals were removed from the area during this period using mist netting and shooting. Further surveys were undertaken building on the point count grid used at the end of 2012 to better understand the range and abundance of Madagascar fodies. It was determined that Madagascar fodies were well established in the more open areas south east of Takamaka but the more densely vegetated areas favoured the Aldabra fodies.

The team recorded male fodies with varied breeding plumage which could not be determined as purely Aldabra or Madagascar which were termed suspicious fodies as it was thought potentially these individuals could be hybrids. Samples for DNA analysis were collected from all fodies caught and those not clearly Aldabra fodies were culled. As detailed previously, hybridization was confirmed following DNA analysis of these samples.

The presence of filarial worms was confirmed in the Madagscar fodies on Aldabra, presumed to be the same as those seen in the fodies on Assumption. It is not known if this parasite is a new introduction to Aldabra or if it has already been transmitted to Aldabra's endemic birds.

Red Whiskered-bulbul

In July 2013 Terence Mahoune and Jeremy Ragauin eliminated the single red-whiskered bulbul from Aldabra. The lone male individual which had proved so elusive to trap or shoot during season one of the project was caught in a mist-net during a trip to confirm the breeding status of the Madagascar fodies and target this red whiskered bulbul. This was a fantastic achievement as individual birds are very difficult to target and it took SIF a step close to removing avian invaders from Aldabra. The eradication was published in the IUCN Aliens Bulletin Vol 33 in October 2013.

Figure 39. Terence Mahoune with lone Takamaka Red Whiskered Bulbul

Takamaka Handbook

Following the first intensive eradication field season Terence Mahoune led the development of a Takamaka Handbook including methods and protocols, an essential reference document for

Takamaka staff to ensure consistency and brief on best practise. This document will be updated as necessary to take into account the changing nature of the eradication project and account for revision of methods.

Second Season

Intensive eradication efforts resumed in November 2013 once the Madagascar fodies were again in breeding plumage. Due to staffing difficulties in addition to Terence Mahoune (Team Leader) and dedicated ISTO Jamie McAulay general research staff took turns in assisting with the eradication efforts. Additional Takamaka project staff have been recruited and will join the project in January. Initial efforts focused on observations to obtain a good understanding of Madagascar fody breeding status, abundance and range and to best inform eradication strategy and bird targeting. Initial observations suggest that the targeting of the Madagascar fodies in the first season was effective, with more suspicious fodies (hybrid fodies) seen, rather than confirmed Madagascar fodies. Mist-netting was again used to target non Aldabra fodies observed, removal of the Madagascar fodies is the priority, with suspicious fodies a secondary target. The second Takamaka eradication season is ongoing and the outcomes of these endeavours will be documented following the end of the fody breeding season when the intensive efforts will come to a close.

References for further details:-

- Mahoune, T. (June 2013) *Eradication of introduced birds at Takamaka, Aldabra.* SIF Season 1 Report [Reports Research\Projects\IAS\1st Season Reports]
- Mahoune, T. (October 2013) *Takamaka, Aldabra Invasive Bird Eradication Project Handbook including methods and protocols* [Monitoring\Eradication\Takamaka\2013 Takamaka project\Protocols]
- Takamaka Weekly Progress Reports [Reports Research\Projects\IAS]

5.2. Rats and Cats

5.2.1. Rat DNA study

Samples of rat muscle were taken from rats on an opportunistic basis during the rat trapping associated with the rat eradication feasibility project for possible analysis of DNA and stable isotopes. These were analysed and indicate that the rats on Aldabra have an Arabian rather than a European origin, suggesting that they have been present on the atoll for much longer than initially suspected. This analysis will be written up in 2014.

5.2.2. EC rat and cat eradication feasibility project

(*compiled from Grant Harper & Martijn van Dinther's Reports*)

To investigate the possibility of eradicating introduced black rats and feral cats from Aldabra a two-year research project was initiated, led by Grant Harper. This study will conclude in 2014 with findings and recommendations on the feasibility and methods for an eradication expected at the end of the year.

The research focuses on three main themes:-

(a) The impact of rats and cats on Aldabra's native fauna and flora
(b) The population biology of the two species
(c) The feasibility of eradicating rats and cats from this large isolated atoll including an assessment of non-target effects of possible eradication methods

Rats

Rat trapping transects were established to gather information on the relative abundance, population structure, breeding status, morphometrics and diet of rats in the three main habitats (Pemphis, mixed scrub and mangrove) on Picard and Grande Terre and the trapping was repeated throughout the year to investigate seasonal changes. The Mark-Capture-Recapture technique was used to estimate the population density of rats in these three vegetation types on Picard using a grid of live traps.

The initial assessment of the data revealed that rat population densities on Picard are high at 22–32 rats/ha. The rat population in the mangrove forest was different to that in the other habitat types in that adults were larger and heavier and juveniles comprised a smaller percentage of the population.

Bait trials

To carry out eradications of invasive rats and cats on islands, trials of the most likely eradication techniques are essential. A variety of eradication techniques were considered but the only feasible option is thought to be aerial application of poison bait. Aerial baiting would aim to put bait into the home range of every rat and cat. A key risk is that other animals may consume this bait which are non-target resulting in the death of native species. Trials were therefore carried out to determine which non-target animals were likely to consume the baits and therefore be at risk and to assess the uptake of bait by rats for a given quantity of bait per area. Small-scale trials were carried out to test 15kg/ha and a reduced 10kg/ha application rates on sites with high and low land-crab densities. Dyed non-toxic bait was used to assess whether rats had consumed the bait laid out.

The non-toxic bait was highly palatable to tortoises, hermit crabs and coconut crabs and large amounts of these baits could conceivably be consumed by these non-target species during an aerial bait application. There was also some interest shown by birds – pied crows, turtle-doves and rails.

At an application rate of 15kg/ha the highest bait loss occurred where rat densities were highest, however at the lower application rate this relationship was not clearly present, potentially due to relatively higher loss due to non-target species and curtailed temporal availability of bait.

All rats trapped following the trial of 15kg/ha application had eaten the dyed bait, however, this was not the case with the reduced amount of bait. This suggests that, consistent with conclusions of Griffiths *et al.* (2011), above a threshold bait application rate of 15kg/ha, rats are able to access bait even when substantial populations of land crabs are present.

Mangrove habitat, which has been established as well utilised by rats, will be highly problematic and will be the greatest stumbling block to eradication. The twice daily inundation by seawater would wash bait away. It is proposed to trial bait bolas in the Mangrove forest in 2014 as a potential means for tackling this issue.

Cats

Cat trapping was undertaken at Anse Mais, Dune Jean-Louis and Takamaka, this resulted in a total of nine cats being caught, four males and five females. There was a marked difference between cats caught at Anse Mais and other areas of Grande Terre suggesting that Anse Mais is a particularly

favourable area for cats, which is probably due to the large number of turtle nesting beaches in the area, providing readily accessible and high quality food source.

The cage traps were surprisingly successful at catching cats and potentially these could be fine-tuned for the proposed eradication. It is likely that cats away from the turtle nesting beaches are diet-constrained and will readily take bait or enter traps and are likely to be vulnerable to secondary poisoning during the rat eradication. Further assessment of cat home ranges on Grande Terre is required to better inform eradication planning, this is planned for 2014.

References for further details:-

- Harper, G.A (April 2013) *Population ecology and impacts of black rats and feral cats on Aldabra Atoll, Seychelles*. SIF Report [Monitoring\Eradication\EC rat and cat feasibility study 2013-2014]
- Monthly IAS Report (Martijn van Dinther) [Reports Research\Monthly Reports\Project Reports\EC-projects]

5.3. Control of invasive plants

5.3.1. Sisal (*Agave Sisalana*)

(Compiled from Martijn van Dinther's sisal and monthly reports)

Sisal is the only exotic plant species on Aldabra to date which has been identified as posing a sufficiently severe threat to warrant eradication. Under the EU-funded project a stated objective is to research and develop, including feasibility trials, and implement plans to eradicate sisal from Aldabra. To achieve this objective in June 2013 Martijn van Dinther produced a report detailing the management and monitoring of sisal by the Aldabra Research Station to date (1972–2013), evaluating sisal eradication options and techniques and proposing a work plan to eradicate sisal from the atoll. It was recommended to use chemical control with herbicides as this had been proven to be effective in invasive plant eradication programmes. Sisal was known to still occur on Picard (Backpath), Anse Polymnie and Ile Michel. In the following months all areas where sisal was known to occur and the surroundings were searched, establishing all of the remaining areas of sisal (Table 15). As a result of these investigations an area of sisal was rediscovered behind Backpath, Picard.

Table 15. Locality and extent of sisal patches on Aldabra 2013

Location	Number of Adult Plants	Surface Area	GPS	Description
Backpath, Picard	40	ca. 15x30m	0632407E 8961442N	40 large plants and 200+ small plants scattered over area
Anse Polymnie	4	ca. 2x2m	0637263E 8963684N	Small clump of medium sized plants
Ile Michel	150-200	ca. 50x30m	0659065E 8960245N	Mature patch which produces several flowering plants yearly

In November 2013 a sisal herbicide trial protocol was finalised and the Backpath sisal plants were used to investigate the most effective herbicide concentrations (three dilutions) and application methods (whole spray on central leaves or spray on cut stump after removing core leaves) to use. The application of herbicide treatments was carried out in mid-November and the first assessment of the treated plant health was undertaken in December. These initial results showed that removal of the growth tip followed by treatment with 50% concentration of herbicide has a significant effect on the plants. These plants will continue to be monitored in 2014 to determine the most effective

means for treating the other sisal patches with the aim of eradicating this alien plant species from Aldabra by the end of 2014.

References for further details:-

- Van Dinther, M (2013) Report on management and monitoring of sisal by Aldabra Research Station (1972-2013), research into *Agave sisalana* eradication and proposal of a work plan to eradicate sisal from Aldabra. (Project objective 1e) [Monitoring\Eradication\Control of invasive plants\Agave sisalana\Sisal Eradication project 2013-2014\Report]
- Van Dinther, M (2013) Aldabra Sisal Eradication Project; Herbicide trials: Application and Safety protocol. SIF Report [As previous]
- Monthly IAS Report (Martijn van Dinther) [Reports Research\Monthly Reports\Project Reports\EC-projects]

5.4. Biosecurity

Introduced alien species pose one of the biggest threats to the biodiversity of Aldabra. Removing of these exotic species once introduced is incredibly difficult, costly and for some species possibly unachievable. It is therefore vital that this threat is given the highest priority when supplies and people are being brought to the island to prevent the introduction of these pests. To properly address this risk and inform future biosecurity procedures EU Project consultant Dr Grant Harper will be creating a Biosecurity Plan for Aldabra in 2014. Everyone on Aldabra has been made aware of the risk that these species present and remains vigilant for invaders especially when receiving supplies.

6. MISCELLANEOUS

6.1. Protocols

Catherina Onezia has been working on a phenology guide with photos of the different fruiting and flowering parts of each of the 33 plant species in the phenology monitoring which will be finalized in 2014.

6.2. Specimen collection

External researchers regularly request the inclusion of samples from Aldabra in their research to contribute to a national, regional or international research picture. Approval for specimen collection must be given by Seychelles Bureau of Standards (SBS) and a research agreement finalised with SIF prior to sample collection. In 2013 biological samples were collected as part of three studies as detailed below.

Encrusting Sponge
A grey encrusting sponge was recorded as highly prevalent on the Aldabra fore reef during the reef mapping project and poses a potential threat to Aldabra's marine ecosystem. Five samples were collected of the encrusting sponge from Settlement reef in 5 m depth of water for analysis. The sponge analysis was covered under the SIF research agreement for the reefing mapping project and SBS approval was gained for the export of these samples to Dr Rebecca Klaus (UK) for analysis.

Mangroves
A request was received from Katy Beaver for mangrove leaf samples for a study of genetic diversity and long-distance dispersal (Dennis de Rijck, PhD student at Vrije Uni, Brussels). Two leaves from 30 individuals from three mangrove species (*Avicennia sp.*, *Rizophora mucronata* and *Bruguiera gymnorrhiza*) were collected from two different locations (La gigi and Middle Camp / Ile Espirit) and sent in support of this study in early 2013 (SIF Research Agreement A6, signed 22/04/13).

***Ligia* Isopods**
A request was received in October from Carlos Santamaria of Sam Houston State University in Texas working on coastal isopods from the genus *Ligia* for the collection of a number of samples. He has samples from throughout the Pacific, Mediterranean and the Caribbean but has only one sample from the Western Indian Ocean (Madagascar). These isopods are highly interesting as they harbor high levels or genetic diversity and may be informative on the evolutionary processes that affect coastal organisms. He provided explanation on identification, collection methods and sample storage. *Ligia* isopods were not located during searches at La Gigi and other rocky sections of the Aldabra coastline, further efforts will be made in 2014 to obtain these specimens requested.

6.3. Staff training

Throughout the year, various presentations and training courses were given to (and in some cases provided by) Aldabra staff (Table 16).

Table 16. Presentations and training given to and provided by Aldabra staff.

Date	Training / Presentation	Participants	Given By	Notes
05/02/13	Rat eradication feasibility presentation	All Aldabra	Grant Harper	
24/02/13	Aldabra Research	Board members	Janske van de Crommenacker	AGM Science Symposium – all presentations
	EMS – Solar System		Christina Quanz	
	ZARP – Tortoises		Richard Baxter	
	Rat eradication feasbility		Grant Harper	
07/03/13	PADI Open Water Dive course (Training)	Murvin Green, Ian Mellie, Samuel Basset, Richard Baxter & Barney Marengo	Calum Ferguson	
15/03/13	PADI Advanced Open Water course (Training)	Murvin Green, Ian Mellie, Samuel Basset, Richard Baxter, Martijn van Dinther & Janske van de Crommenacker	Calum Ferguson	
26/03/13	PADI Rescue Diver course (Training)	Ian Mellie, Richard Baxter, Martijn van Dinther, Janske van de Crommenacker, Unels Bristol, Christina Quanz & Lotte Reiter.	Calum Ferguson	
30/03/13	Emergency First Response course (Training)	All Aldabra	Calum Ferguson	
14/06/13	ZARP Research & initial results (Presentation)	All Aldabra	Richard Baxter	
01/07/13	Risk Preparedness (Training)	All Aldabra	Joel Souyave	WHS Managers risk preparedness workshop attended by JS
13/08/13	Sisal (presentation)	All Aldabra	Martijn van Dinther	Historical extent, attempts to control and plans for eradication
29/08/13	Turtle mortality paper (presentation)	All Aldabra	Heather Richards	Summary of Mortimer & Brandis's paper on themortality of sea turtles nesting on Aldabra
10/10/13	Takamaka Invasive Bird Eradication Project (presentation)	All Aldabra	Terence Mahoune	Background, methods, update on progress and plans for coming season
14/10/13	Tour Guide Training	Research Staff & interested others	Catherina Onezia	Mock tour of Station and Old Settlement, briefing of do's and don'ts
15/10/13	Boat Handling Training	Jeremy Raguain, Heather Richards & Ravi Moustache	Jude Brice	Workings of outboard engine, useful knots, boat assistance followed by practical lesson on Zegret
21/10/13	Pangaea Presentations	All Aldabra	Philip Haupt, Ant Bernard, Jude Bizou, Paul Cowley	Briefing & presentations on marine research projects and SIF participation
Oct/Nov	Marine Monitoring – Diving Surveys and RUVs/BRUVs Training	All Diving Staff & All Staff RUVs & BRUVs	Philip Haupt, Lee Cassidy, Dr Anthony Bernard	Diving training – photoquadrats, video surveys and fish counts
18/12/13	Aldabra Landbird Genetics(Presentation)	All Aldabra	Janske van de Crommenacker	

7. ALDABRA SCIENTIFIC PUBLICATIONS OF 2013

Bunbury, N., von Brandis, R., Currie, J., Jean-Baptiste, M., Accouche, W., Souyave, J., Haupt, P., Fleischer-Dogley, F. (2013). Goats Eradicated from Aldabra Atoll. *Aliens: The Invasive Species Bulletin* **33**, 18-22

Bunbury, N., Mahoune, T., Raguain, J., Richards, H. & Fleischer-Dogley, F. (2013). Red-whiskered bulbul eradicated from Aldabra. *Aliens: The Invasive Species Bulletin* **33**: 7–8.

Mortimer, J.A. and von Brandis, R.G. (2013) Mortality of Adult Green Turtles (Chelonia mydas) at the Nesting Beaches of Aldabra Atoll, Seychelles. *Chelonian Conservation and Biology* **12**, 151-157.

Quanz C, Bunbury N & Fleischer-Dogley F. (2013). Improving the sustainable operation of a World Heritage Site: Increasing energy efficiency and implementing a renewable energy system on Aldabra Atoll, Seychelles. *PARKS: International Journal of Protected Areas and Conservation* **19**: 47–58

Šúr, M., van de Crommenacker, J. & Bunbury, N. (2013). Assessing effectiveness of reintroduction of the flightless Aldabra rail on Picard Island, Aldabra Atoll, Seychelles. *Conservation Evidence* **10**, 80-84.

Šúr, M., Bunbury, N. & van de Crommenacker, J. (2013) Frigatebirds on Aldabra Atoll: population census, recommended monitoring protocol and sustainable tourism guidelines. *Bird Conservation International* **23**, 214-220.

8. LOOKING TOWARDS NEXT YEAR

2014 promises to be another busy and ambitious year on Aldabra especially regarding the invasive species management. The two-year rat and cat feasibility will come to a conclusion, informing SIF on how best to tackle the future removal of these invasive mammals for the benefit of Aldabra's biodiversity. The two alien bird eradication programmes on Assumption and at Takamaka, Aldabra should be nearing their goal of restoring Aldabra to its status of 'alien avifauna free' and removing the threat of alien birds arriving from neighbouring island, Assumption. It is hoped that following the recent promising herbicide trials 2014 could see Aldabra sisal free. With the significant efforts being invested in removing alien species that arrived previously and threaten the ecosystem of Aldabra, effective biosecurity measures to prevent further invasions will be a key consideration for 2014.

The marine monitoring reinitiated in 2013 will be continued in 2014 with training a key focus, allowing for the marine surveys to be integrated into the regular research activities. Monitoring of the marine environment is critical to the effective management of the marine protected area. There is much anticipation for the deployment of the final two satellite tags on green turtles in 2014. The reef map will be finalised in 2014 which will inform the expansion of the Marine Protected Area of Aldabra to ensure all the marine assets of the atoll are protected.

We look forward to the completion of the analysis of some of the long term datasets and review of these monitoring programmes aiming to improve the reliability of results, conservation effectiveness and resource efficiency of these programmes. Another key and much anticipated activity will be the updating of the Aldabra Management Plan providing the structure and focus for the management of the atoll from the coming years.

What can be guaranteed is that 2014 will be another year of incredible opportunities to learn and discover more about Aldabra's fantastic and unique ecosystems and through continued enthusiasm and team work SIF will continue to effectively manage and protect this amazing place for the future.

9. ACKNOWLEDGEMENTS

All of the achievements, research and monitoring activities discuss in this report are the product of fantastic team work both on Aldabra, within SIF and beyond. Massive thanks are due to the 2013 Aldabra community who's hard work on the ground, dedication and enthusiasm enable plans to be achieved and made for a wonderful working environment: Wilna Accouche, Curtis Baker, Alain Banane, Samuel Basset, Richard Baxter, Patrick Banville, Jude Brice, Shane Brice, Unels Bristol, Sheril de Commarmond, Janske van de Crommenacker, Martijn van Dinter, Edme Durup, Shanni Etienne, Wilfredo Falcon, Calum Ferguson, Rebecca Filippin, Ronny Gabriel, Andy Gouffe, , Murvin Green, Arjan de Groene, Dennis Hansen, Grant Harper, Philip Haupt, Peter Haverson, Laurent Leite, Jamie McAulay, Glenn McKinlay, Terence Mahounce, Michel Malbrook, Barney Marengo, Stephanie Marie, Ian Mellie, Ravi Moustache, Catherina Onezia, Christina Quanz, Jeremy Raguain, Lotte Reiter, Daig Romain, Giovanni Rose, Marvin Roseline and Joel Souyave.

The close partnership and cooperation between the research and logistics teams on Aldabra has been essential. Not only has the logistics team been invaluable at facilitating the research team but their active participation and interest in the research activities has been greatly valued.

On Aldabra we are reliant and very thankful for the invaluable support, guidance and inspiration of the SIF Head Office especially Dr Frauke Fleischer-Dogley, Dr Nancy Bunbury, Wilna Accouche, Marille Benoit, Daniel Baccus, Mary Maria and all of the other staff members who contribute. Aldabra's participation in the management meetings, staff interviews and internal decision making has been greatly appreciated and this effective communication has facilitated solutions to problems, enabled better understanding, ensured a high standard of staff recruitment and generally allowed for a greater team connection despite the distance.

The specialist advice, support and encouragement offered by the following was greatly appreciated: The SIF Board of Trustees, Katy Beaver, Lindsay Chong-Seng, Dr Jim Groombridge, Dr Rebecca Klaus, Dr Christopher Kaiser-Bunbury, Dr Jannie Linnebjerg, Pat Matyot, Dr Jeanne Mortimer, Dr Erik Postma, Dr Sara Rocha, Dr David Rowat, Dr Gabriela Schaepman-Strub, Adrian Skerrett, Sidney Suma, Dr Lindsay Turnbull and Dr John Turner.

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European Union – Invasive Species project activities
UNESCO - Takamaka bird eradication project
University of Zurich – ZARP Tortoise work

I feel extremely privileged to be given the opportunity to work is such an amazing place and I am indebted to the Aldabra community and Head Office staff that warmly welcomed me to the atoll and my new role and have offered assistance, encouragement and advice. Working in such a remote location has considerable challenges however; the hard-work, experience, motivation and passion of the team have ensured another year full of accomplishments on Aldabra.

10. REFERENCES

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Reintsma, N., Young, M. & Salmon, M. (2014) Do Lighthouses disrupt the orientation of sea turtle hatchlings? Hypothesis testing with arena assays at Hillsboro Beach, Florida USA. *Marine Turtle Newsletter* **140**.