Research Officer's Annual Report 2010

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List of acronyms used in report

LOCATIONS
AC – Anse Cedres
BP – Back Path on Picard
CC – Cinq Cases
CP – Coastal Path on Picard
DDM – Dune D'Messe
DJL – Dune Jean-Louis
NC – North Coast
SB – Settlement Beach
WGT – West Grande Terre

OTHER
RO – Research Officer
IM – Island Manager
HO – Head Office
SE – Standard Error
SD – Standard Deviation
CI – Confidence Interval

TURTLE TRACK TYPES
VF = Very Fresh
HM = Half Moon
ESBO = Emergence Stopped By Obstacle
FF = Fairly fresh

BIRDS
RTTB – Red-tailed tropicbird
WTTB – White-tailed tropicbird

MAMMALS
GEP – Goat Eradication Programme
JG – Judas goat
NJ – Non-Judas Goat

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1. INTRODUCTION

This annual report summarises the data collected on Aldabra during 2010 and puts it into context of interannual averages and, when deemed appropriate, seasonal variability. During manipulation and analyses of the data, one identifies errors made during data entry or observation. If these cannot be rectified, they need to be removed from analyses which they might otherwise bias. This has been done as far as possible in this report and some brief recommendations as to protocols or database design have been provided in relevant sections in the text.

Notable events and/or accomplishments on Aldabra have been documented in the relevant monthly reports from 2010, so only a brief list of some of these are included here:

- The year started with a notable setback when the new boat, Alkhadra was sunk by rough seas on Assumption in January, requiring repair to boat and engines back on Mahé, besides stranding three staff members on Assumption until early February.
- During the initial months of 2010, sixty years of climate data were summarised into a "Climate Data Report for Aldabra Atoll: 1949–2009", as part of a CC DARE funded project.
- On 3 April, a boat-load of 9 Somalis – unarmed, but suspected pirates – washed up on Settlement Beach and were restrained and guarded before being transferred to Assumption the next day, where they were picked up by the Seychelles military. The event caused a notable disruption in monitoring activities and also feelings of insecurity in staff.
- In July, volunteer Sharon Drabsch re-initiated the recording of cetacean sightings, which had been abandoned during 2008.
- During the first week of November, a team comprising the IM, RO and rangers camped at Anse Malabar and built a new camp hut there.
- October saw two groups of tourists arriving at Aldabra, which were the first tourist visitors since March 2009.
- In late November, a team of technicians conducted maintenance and inspections on the atoll, which included the installation of the Automatic Weather Station (also funded by the CC DARE project). Problems with the transmission and access to the data followed and required follow up in 2011.
- During the same period, the visit of Nancy Bunbury and Frauke Fleischer-Dogley promoted discussion around priorities of protocols and databases that required attention in following months. During the visit, adjustments to the phenology protocol were made and Philip Haupt was tasked with replacing some of the less effective databases.
- The visit of HRH Princess Anne, her husband Vice Admiral Timothy Laurence and Minister Joel Morgan on 1 December, coincided with the arrival of board members for the SIF Annual General Meeting that took place on Aldabra during 2-3 December.
- Planning and training for a frigate bird census, to be conducted in January/February 2011 by Michal Šúr and local staff, was initiated at the end of December.

Much blood, sweat and tears have gone into maintaining the monitoring programmes on Aldabra over the years and 2010 was no exception, with many people making substantial sacrifices in an attempt to ensure that data were gathered in a consistent and rigorous manner. We would like to thank SIF staff, board members and especially those Aldabra community members who have strived to improve the running of the Research Station and the conservation of what is one of the most special places left on Earth.

2. CLIMATE

2.1 Assessment of Recent Historical Data

Between January 2000 and March 2011, 4109 days of weather data have been recorded. Unfortunately the time-series for most variables are not complete, as some of the thermometers were broken or incorrectly used at various times, causing large gaps of missing or unusable data over periods of months to years in some of the data series. The figures and discussions in this section illustrate the quality of the data and provide some guidance as to which parts of the data are useful and which should be discarded during analyses.

Dry Bulb Temperatures

The dry bulb temperature record is the most complete of the thermometer time-series on Aldabra over the last decade. Except for a broken thermometer that was under-reading by ~8.6°C from March 2009 to June 2010 (when it was replaced), and a small number of obvious outliers, the time-series looks to be reasonable. Although it needs to be tested over a longer time period to confirm, the above-mentioned broken thermometer seems to be under-reading by a constant amount and does not seem to be changing over time (Figure 1.a). If this is confirmed, the data for those 15 months can be corrected (e.g. the red points in Figure 1.b), to yield a complete data-series for the last 11 years (seen in Figure 1.c with outliers removed).

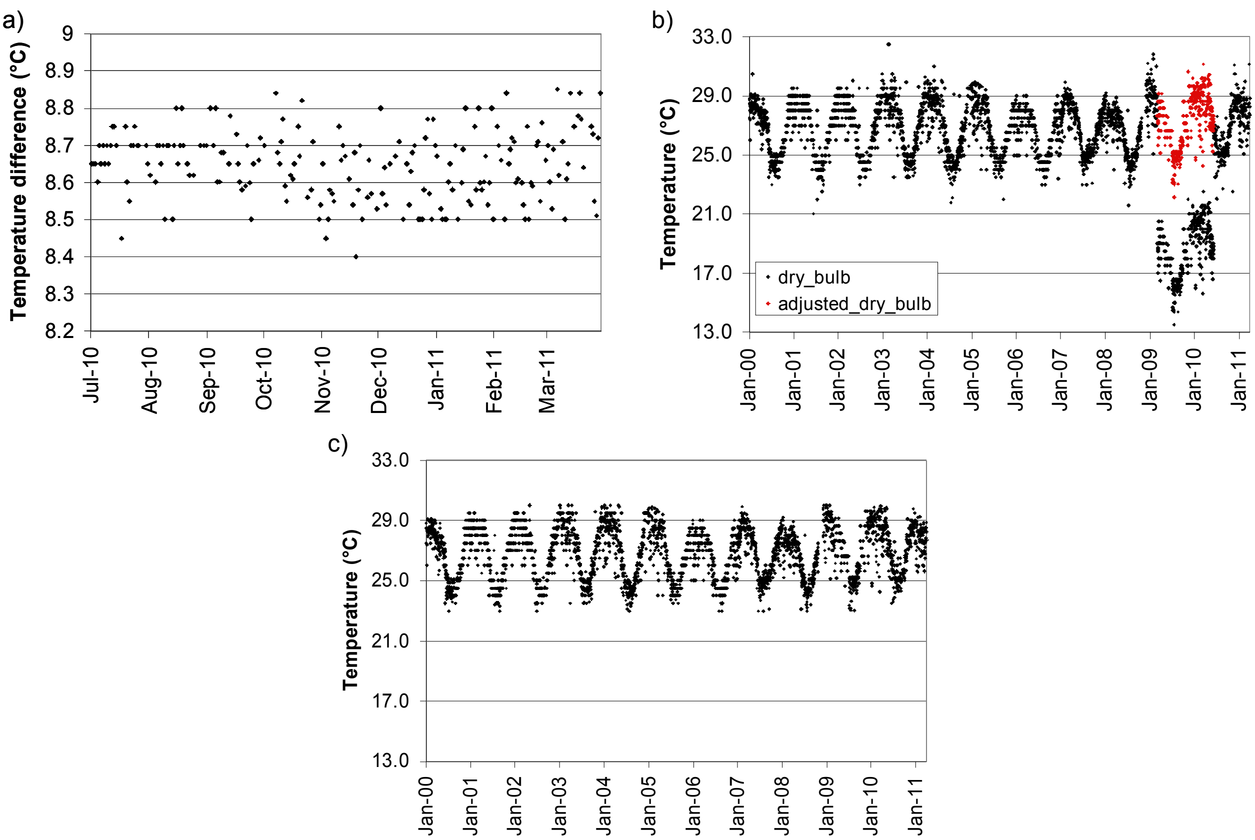

Figure 1. Dry bulb time-series diagnostics: a) Difference between the broken (under-reading) thermometer and its replacement, showing no trend over the 8 months of comparison. b) The entire 2000-2011 time-series of daily records (in black) with corrected March 2009-June 2010 data (in red). c) The entire data series with outliers and incorrect data removed.

One problem leading to inaccuracy of dry bulb (and wet bulb) thermometer readings, is the time that the readings are taken. During the early morning, the temperature is rising rapidly and recording the temperature 30 minutes later than usual can make a substantial difference to the temperature recorded. Weather measurements have been taken on Aldabra at 08:00 each morning, although scrutiny of the data and experience in the Research Officer role has revealed that frequently (due to fieldwork and staff constraints, or oversight) the weather is recorded up to an hour or two late (and occasionally early). As a result, in August 2010 the RO introduced a 'time of recording' field to the data sheet, which was not previously noted. This field allows identification (and potentially removal) of biased temperature measurements and/or correction of biased records that were not taken on time.

Another systematic lack of precision seen in the temperature records is a tendency for the recorder to have estimated temperatures to only the nearest 0.5 °C, rather than accurately estimating the decimal degree. This trend is seen roughly between September 2000 and September 2002, as well as (to a lesser extent) in July 2005 to October 2006 (e.g. Figure 1.c). These thermometers are especially manufactured to be accurate to within at least 0.1 °C and readings should certainly be estimated as accurately as possible (at least one decimal degree).

Wet Bulb Temperature and Relative Humidity

The reason for maintaining a wet bulb thermometer on Aldabra is to attain a measure of relative humidity (RH), which can be calculated (or looked up on a psychometric chart) using the dry bulb and wet bulb temperatures and assuming air pressure. However to achieve reliable RH records, both thermometers need to be accurately measured and the wet bulb thermometer especially, needs to be set up in the correct way and carefully maintained. Unfortunately this has not happened during most of the last 11 years on Aldabra, as can be seen from the RH data in Figure 2.a. The saturated muslin sock of the wet bulb needs to hang in clean distilled water, while the sock-covered bulb of the thermometer needs to be positioned above the water container, well clear of the rim, so that air movement around the sock is unimpeded in any way. In addition, the muslin sock has to be replaced and washed every two weeks, to avoid a build-up of dust and mould/algae, which would affect the evaporation rate. If set up correctly, the wet bulb temperature should always be cooler than the dry bulb (e.g. in Figure 2.b) and on Aldabra, is usually about 1.5-3°C cooler, other than on the rare days when there is nearly 100% relative humidity.

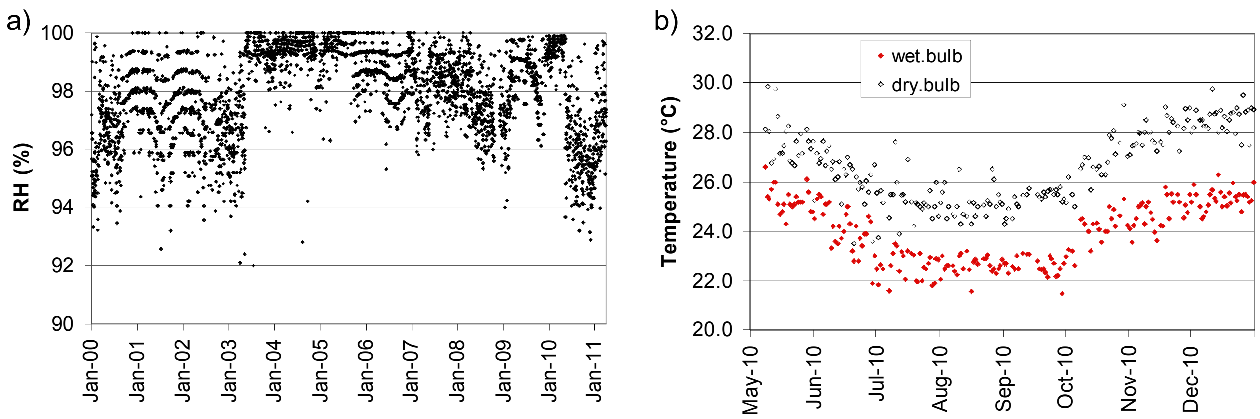

Figure 2. a) Relative humidity data over the last 11 years, as calculated from the daily wet bulb and dry bulb temperature records from Aldabra. The realistic seasonal signal can be seen in the far right of the RH graph, after May 2010, which is calculated from the data in b), where the dry bulb temperatures are consistently about 1.5-3.5 °C warmer than those of the wet bulb.

Maximum Temperature

Judging by the data, a common problem during the last 11 years was for people who were recording the weather to be uninformed of the need to reset the maximum thermometer. As can be seen in Figure 3.a, there were long periods (e.g. July 2006 – June 2008), when the maximum thermometer was not reset correctly, resulting in periods of consistently the same maximum temperatures with occasional upward steps. Unfortunately these data are not recoverable and need to be excluded from long-term averages. Figure 3.b shows the time-series once the obviously bad data and some outliers have been removed, which comprises the dataset from which the 2000-2009 averages were calculated.

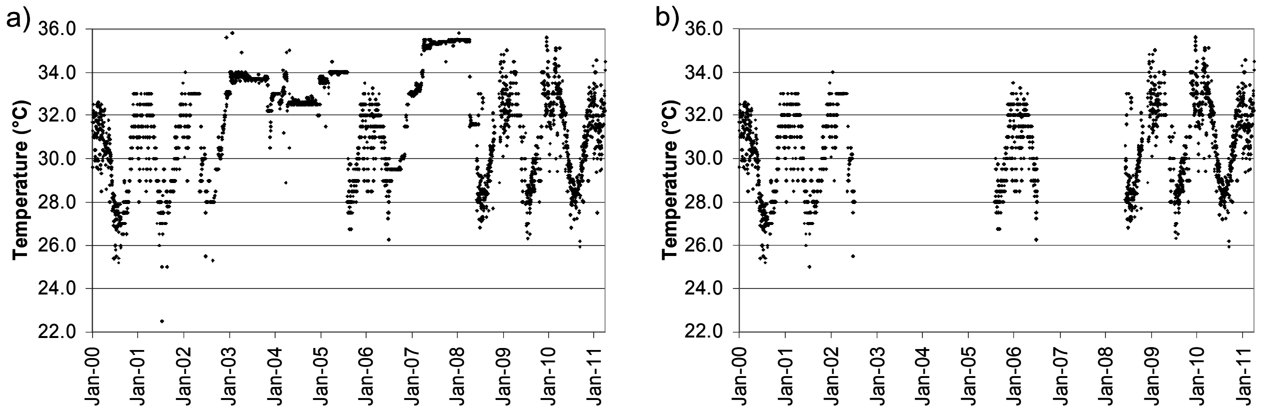

Figure 3. Daily maximum temperature records for Aldabra over the last 11 years, a) including all the recorded data and b), once obviously bad data and outliers have been removed.

Minimum Temperature

Similar to the maximum temperature records, the 2000-2010 minimum time-series also suffers from large periods when the thermometer was broken or the temperatures were incorrectly read. A minimum thermometer equally needs to be reset daily and although this does not seem to have been a problem to the same extent as with the maximum readings, there are some data that unusable due to the same mistake. A complete lack of data (assumedly due to a lack of a minimum thermometer) is seen on more than one occasion during the eleven years, with no records between May 2002 and May 2005 (Figure 4.a). The remaining data after removal of obviously incorrect data and outliers are shown in Figure 4.b, which are the records included in the weather summaries below.

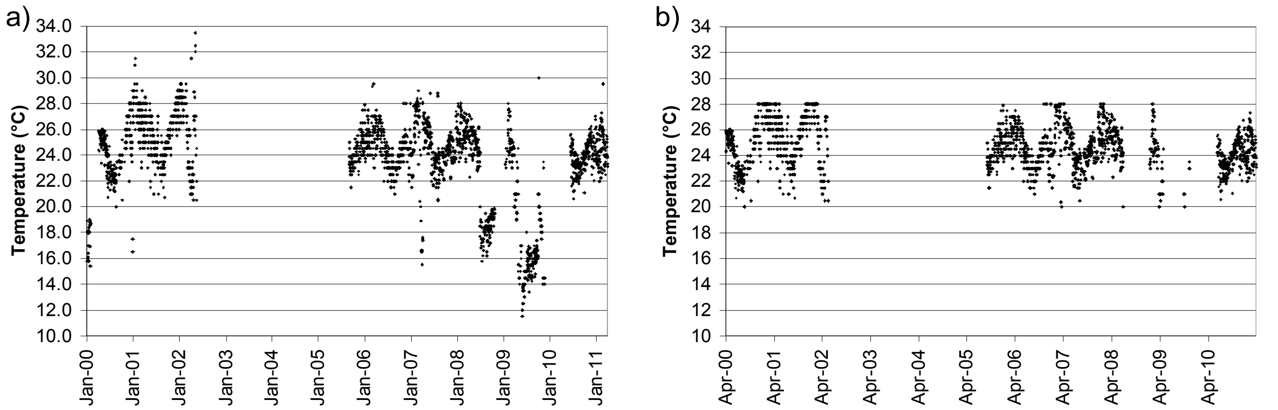

Figure 4. Daily minimum temperature records from Aldabra over the last 11 years, a) including all recorded data and b) showing those records remaining after obviously bad data and outliers have been removed.

Thermometer Checking and Backup Thermometers

In June 2010 the RO found a collection of old thermometers in a drawer in the laboratory. Not knowing how any of them would perform or whether they were useful to keep as backups for future use, he marked them, added them to the Stevenson screen and started recording their temperatures daily, building up a dataset of measurements over time. Of these thermometers, some have been removed, labelled and sent to HO as they were not providing good temperature records.

One of these 'extra' dry bulb thermometers was used to replace the 'new' dry bulb in October 2010, as the former was providing very similar (and precise) records to the 'new' dry bulb that had been sent from Mahé in early June. This latter 'new' thermometer suffered a discolouration of the mercury tube, making it very difficult to read accurate temperatures within a certain range (See

September 2010 monthly report for details).

Remaining in the Stevenson screen from the collection of old thermometers, is one dry bulb (labelled as # 4) and one maximum (# 2). Diagnostic plots of their performance over time and at different temperatures are shown in Figure 5. Both thermometers seem to be constant over time and the range of measurements made. Dry bulb # 4 seems to measure a very similar temperature to the main dry bulb that is in use (difference of ~0.07 °C), although it does not do so with as much precision as is seen between the two maximum thermometers (Figure 5). Although very precise (i.e. low variability in differences), the maximum thermometer # 2 provides records that are consistently ~0.16 °C higher than that of the main maximum thermometer in use (Figure 5). Further data over a longer time-period for these 'extra thermometers' will be useful to confirm their performance. Presently their data look promising enough to consider them potentially effective backup replacements.

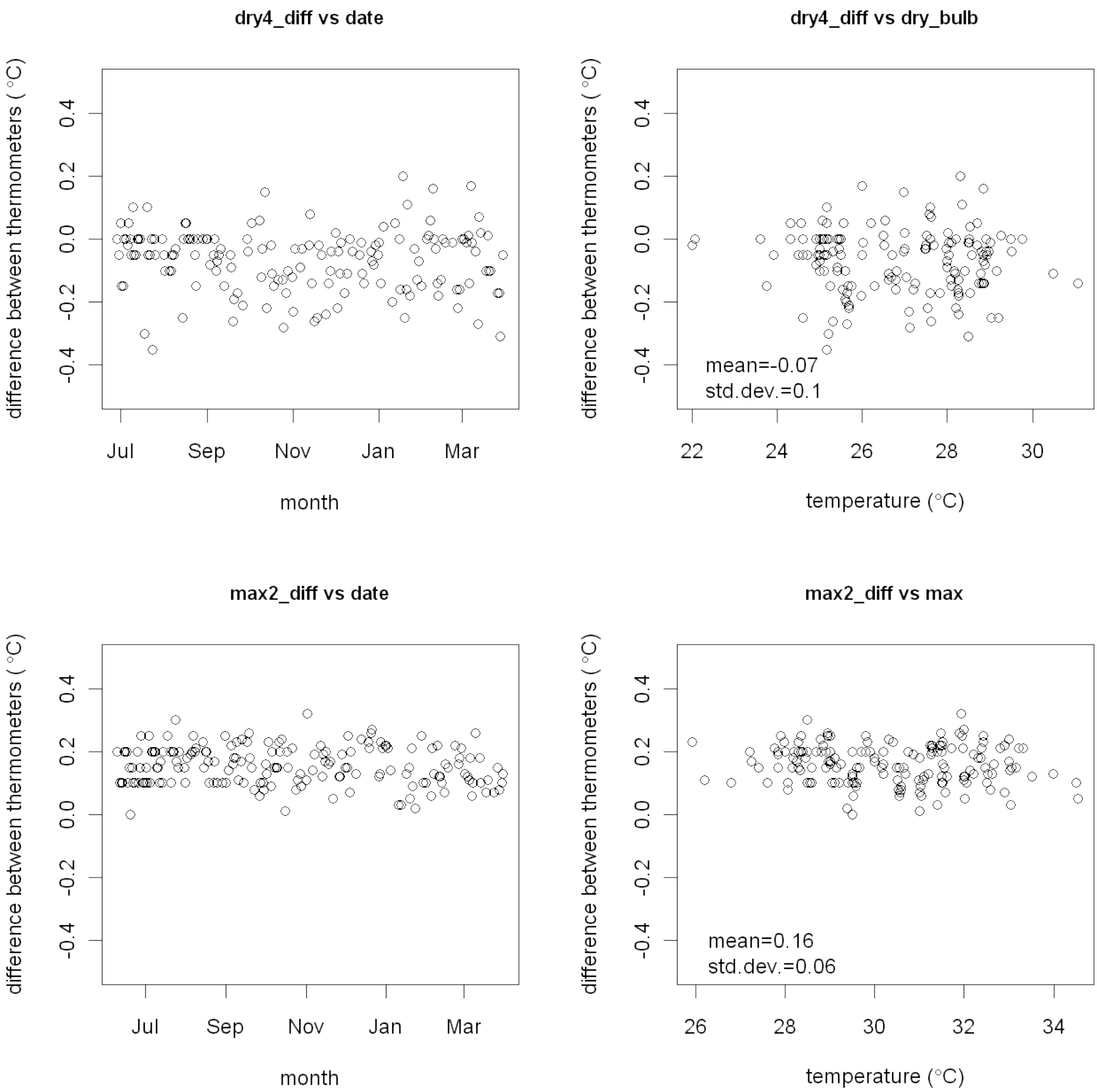

Figure 5. Diagnostic plots over time (on left) and over the range of temperature readings (on right) of the difference between the 'extra' thermometers (dry bulb # 4 and maximum # 2) and their respective index or 'active' thermometers.

2.2 Climate Summary for 2010

Overall, 2010 seems to have been a slightly warmer year than the 2000-2009 averages (Figure 6). The wet bulb, maximum and minimum averages (2000-2009) may not be completely reliable, as there are large gaps in the time-series and there may still be systematically biased data remaining in the periods used for these averages. For example the notable discrepancy between 2010 wet bulb temperatures and their average in November/December might be partially due to the average of these two months being biased upwards due to incorrect placement or maintenance of the wet bulb in the past. The strange average seasonal profile of minimum temperatures is also expected to be partially due to biased data that would require more in-depth analyses to identify.

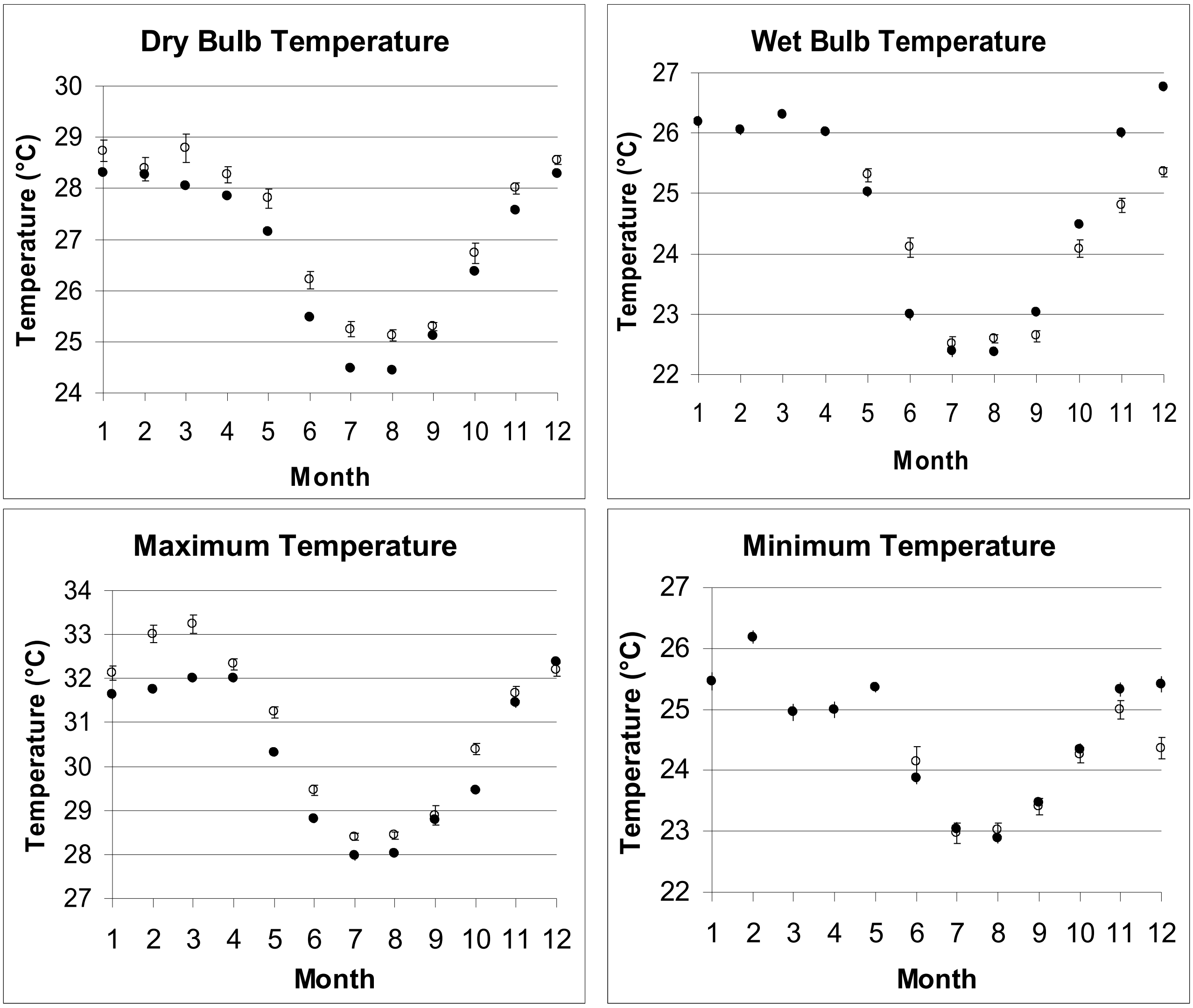

Figure 6. Monthly average temperatures (± SE) for 2010 (open circles) and 2000-2009 (filled circles) of dry bulb (top left), wet bulb (top right), maximum (bottom left) and minimum (bottom right) temperature records. Note: The wet bulb thermometer was not correctly installed prior to May 2010 and there was no working minimum thermometer prior to June 2010.

The raingauges located around the atoll suggest that 2010 was drier in most parts of the atoll compared to the averages of the previous decade (Figure 7). The station total for 2010 (733 mm) was ~140 mm less than the average of 2000-2009, although there has been substantial interannual variability over the last decade, as indicated by a SD of 408 mm.

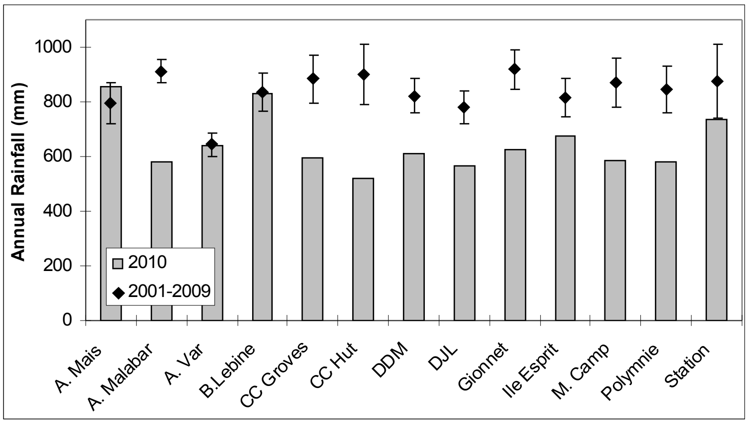

Figure 7. Annual rainfall totals for 2001-2009 (± SE) and 2010 for raingauges around the atoll.

The monthly rainfall data of the Station (Figure 8), shows that January, March, November and December 2010 were drier than their 2000-2009 averages, whereas February was the only month which was notably wetter than its average.

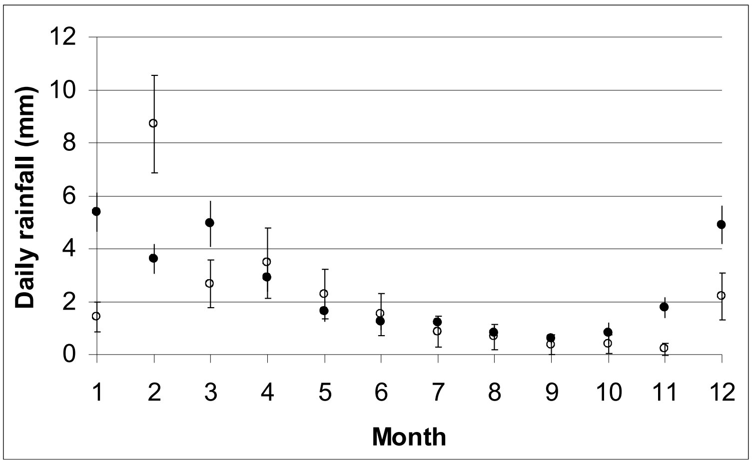

Figure 8. Monthly average rainfall (± SE) for 2010 (open circles) and 2000-2009 (filled circles) from the Research Station.

3. MARINE ENVIRONMENT

3.1 Turtles

Turtle Track Counts

The number of turtle track surveys conducted during 2010 are summarised in Table 1. SB is counted daily, WGT should be surveyed at least four times monthly and the other beaches once monthly. Although Jeanne Mortimer's 'turtle monitoring protocol' recommends that lagoon beaches are surveyed weekly (western beaches) and monthly (eastern beaches) from September to March, such frequencies are beyond what was practically possible with the schedule, staff and boat constraints in 2010.

In addition to the 'normal' records of the different kinds of turtle tracks that are surveyed on all the Aldabra beaches (as per instruction in Jeanne Mortimer's protocols), previous RO Naomi Doak, initiated the collection of further details on SB in January 2010, in the form of GPS coordinates of each individual track, as well as visually assessing whether the turtle was likely successful or not in laying a clutch of eggs during her emergence. These additional details are useful information which can allow many interesting spatial analyses, besides baseline estimates and comparisons over time of the clutch-laying success of green turtles on SB. Unfortunately the error rate during electronic entry of these data is frustratingly high, especially up until late June, before which each

GPS coordinate was manually entered in the spreadsheet by hand. A brief report of these errors and their rectification to allow the below analyses, is included in Appendix A.

Table 1. Number of turtle track surveys conducted on the various beach groups during 2010.

Location	**Month**												**Total**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
SB	31	28	31	30	31	30	29	31	30	31	30	30	362
WGT	1	4	3	3	5	4	2	3	4	3	3	4	39
DDM	2	1	1	0	1	1	1	2	2	2	2	1	16
DJL	1	1	1	0	1	1	1	2	2	2	2	2	16
CC	0	0	1	0	0	1	1	1	1	2	2	1	10
NC	0	0	0	1	4	5	3	1	1	0	1	3	19
Lagoon*	0	0	2	n/a	n/a	n/a	n/a	n/a	2	2	2	2	10

*Only surveyed between September and March

Of Aldabra turtle track count datasets, those for SB are by far the most comprehensive and well-surveyed, both presently and over the past 13 years, due to the easy access from the Station. Table 2 summarizes the number of emergences counted on SB during 2010. As mentioned above, the 'nest' category is only differentiated on SB and is included in the 'VF' category on all other beaches. It is a category judged as those emergences that result in what looks like a typical green turtle nest on the surface and very likely contains a clutch of eggs. The estimate resulting from this category is almost certainly an under-estimation of the true number of emergences that result in eggs being laid, as turtle tagging experience has shown that not all nests are recognisable as such. Supporting this notion, Mortimer (1988) suggests that one of every 1.4-3.2 emergences on Aldabra (a proportion of 0.71-0.31 respectively) result in a successful nest, which is greater than the average proportion of 0.27 for 2010 (Table 2).

Table 2. Summary of green turtle emergence types encountered on SB during 2010. ESBO = 'emergence stopped by obstacle', HM = 'half-moon' track (no digging), NEST = judged to be a successful nest, VF = 'very fresh' - emergence from previous night, which involved digging attempts.

Emergence Type	**Sum of Emergences**	**Proportion of Total**
ESBO	341	0.07
HM	180	0.04
NEST	1267	0.27
VF	2947	0.62
Total	4735	1

When plotting the number of 2010 emergences as a function of their distance from the Research Station accommodation block (essentially the southern end of the beach), one can see a notable increase in the number of emergences as one moves further up the beach. This increasing pattern in the frequencies of emergences levels off roughly 800 m from the accommodation block, which is about 500 m beyond the last house of the current Station settlement. The relatively low numbers of emergences near the Station are likely a result of boat traffic, noise and/or light disturbances from its inhabitants. Away from the influence of the station, relatively low and high frequencies likely relate to unfavourable or favourable stretches of beach for exiting the water and digging nests. For example, a stretch of champignon rock, about 80 m in length, that is situated at the boundary between Zone three and four on SB, produces a clear signal of reduced emergences and nests (arrow in Figure 9).

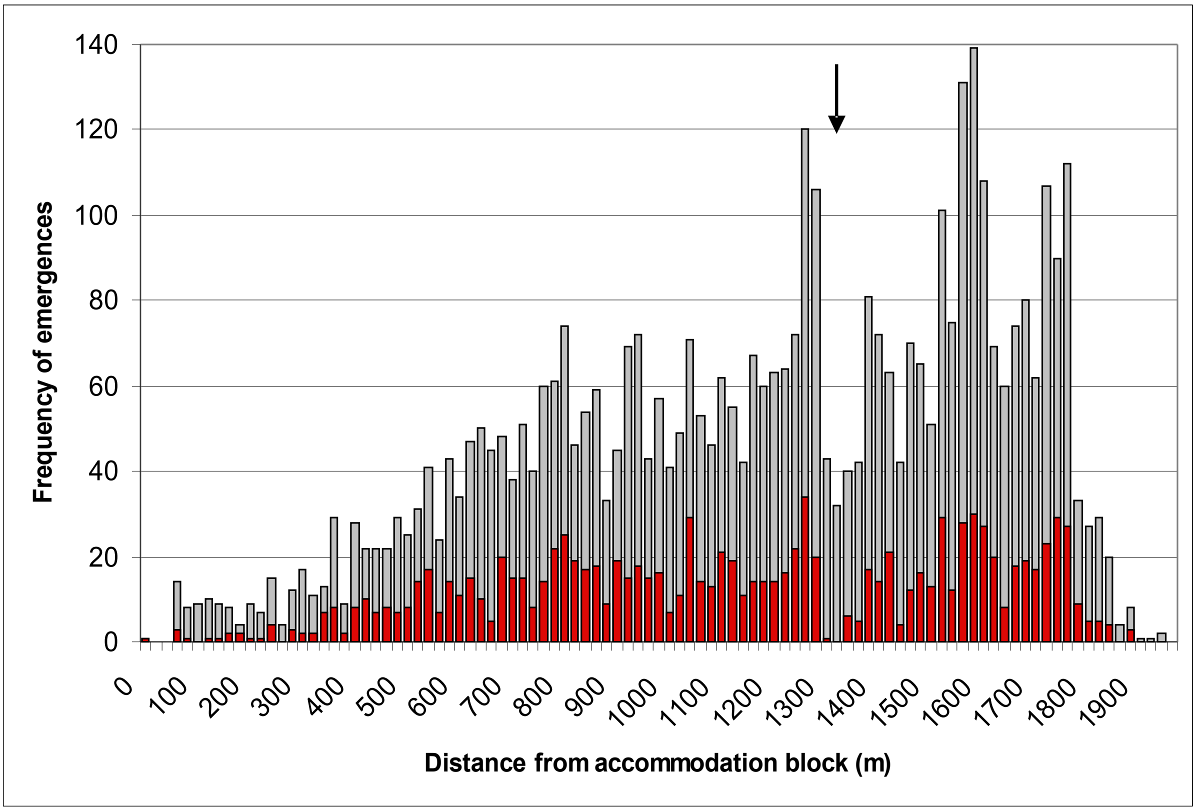

Figure 9. Bar graph displaying the 2010 frequency of total green turtle emergences (grey) and number of suspected nests (red) binned into sequential 20-m sections, measured from the Station accommodation block northwards. The arrow indicates the location of a stretch of exposed rocks at the boundary between zone three and four on SB.

The number of emergences on SB in 2010 surpassed the numbers in previous years (Figure 10), consistent with a recovering (increasing) population of nesting green turtles on Aldabra, as suggested in the eighties (e.g. Mortimer, 1988). Taking the average counts of previous-night emergences from all the outer beaches of Aldabra for 2010 and multiplying them by 365, one reaches an estimated total of 34 639 emergences on Aldabra for the calendar year. Making use of the same basic assumptions as did Mortimer (1988), of between 1.4 and 3.2 emergences per successfully laid clutch of eggs and that each female turtle will lay on average 5.5 clutches of eggs per year, we reach a bracketed estimate of nesting green turtles of 1968-4499 in 2010. This number is roughly twice the numbers that were estimated for the early eighties using the same methods (average of 941-1730 for 1981-1985; Mortimer 1988).

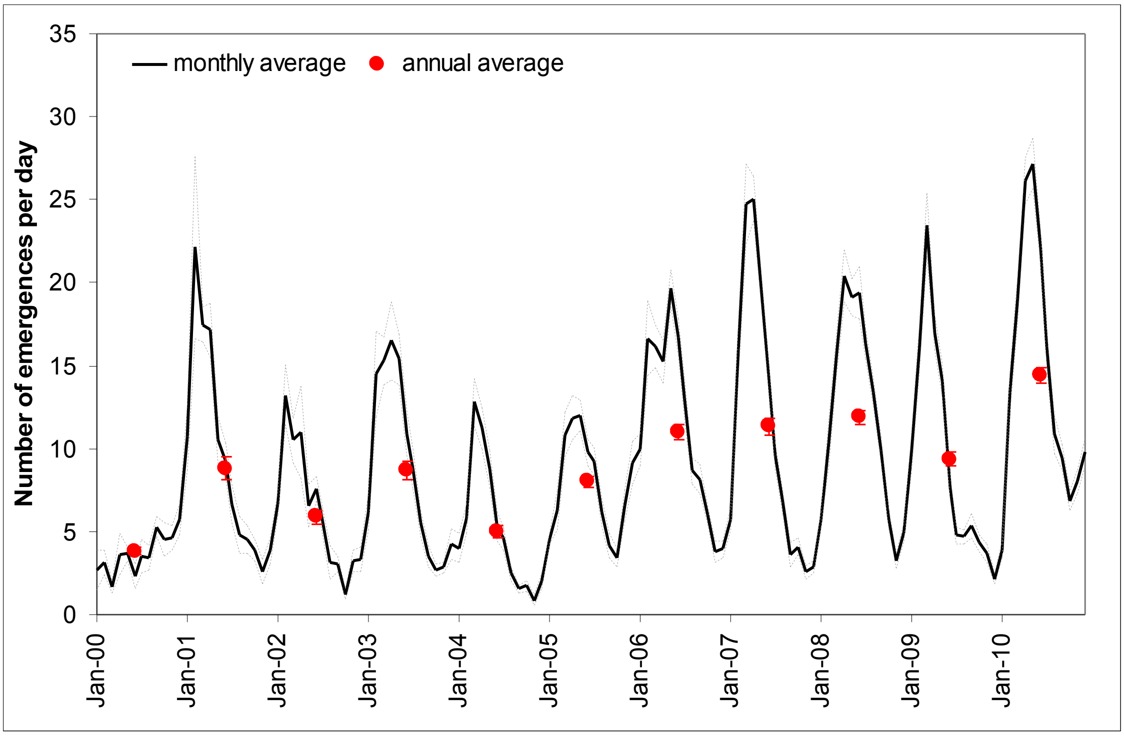

Figure 10. Average number of green turtle emergences per day on SB over 2000-2010, showing monthly (black line) and annual averages (± SE as thin grey lines and red error bars respectively). N = 2638 survey days.

The shape of the seasonal profile of emergence numbers on SB varies greatly, as is highlighted when each year is plotted separately in Figure 11. There seems to be a tendency for a peak in emergences during the first half of the year, although this peak can be as early as February (2001), as late as May (2006, 2010), or may not be noticeable at all (as in 2000).

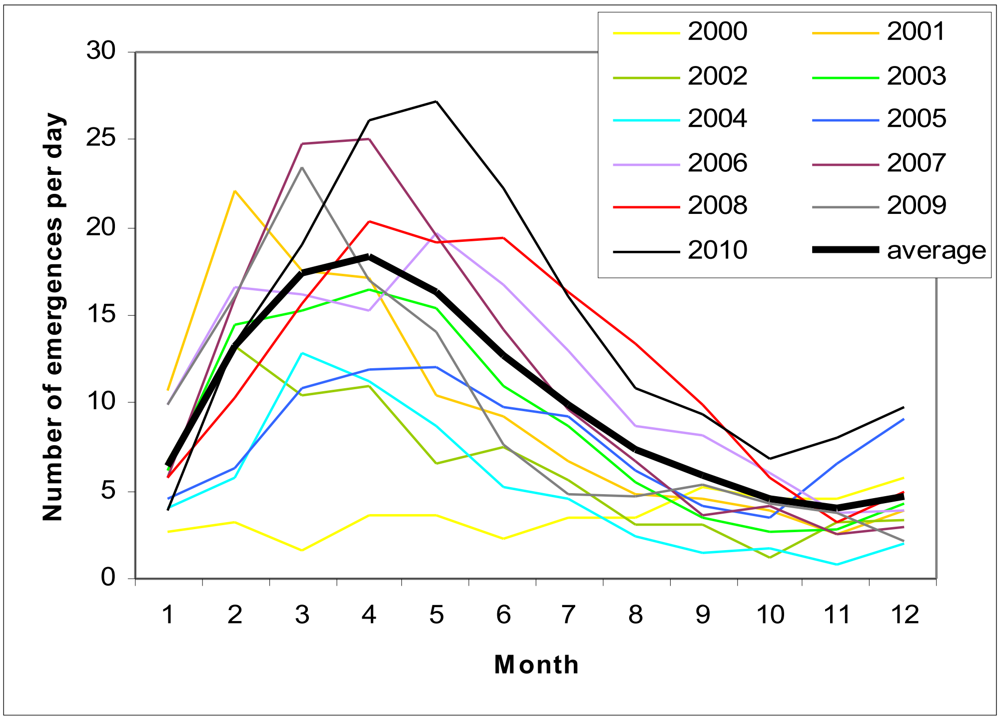

Figure 11. Seasonal signal of the average number of daily green turtle emergences recorded on SB during the calendar months of each year between 2000-2010. Note that earlier years were represented by fewer survey days.

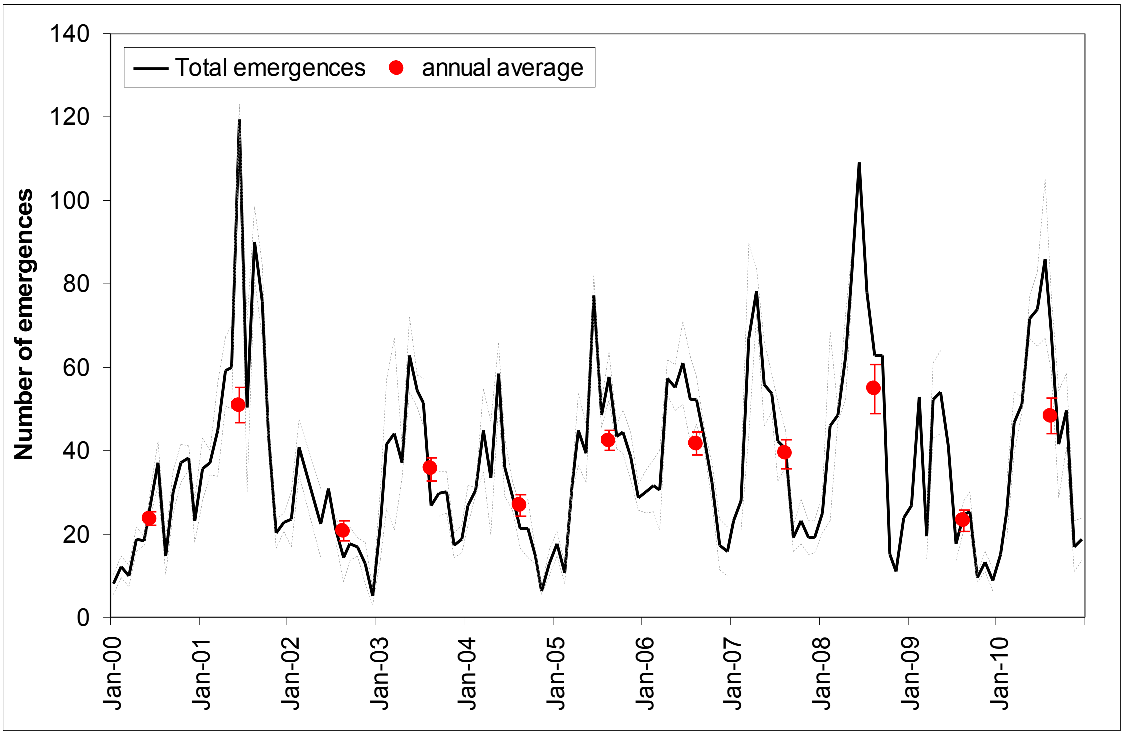

Figure 12. As Figure 10, but for the WGT group of beaches instead of SB. N = 460 survey days.

In comparison to SB, WGT track counts similarly show a pronounced seasonality (Figure 12), although its shape is not well resolved due to the low number of surveys per month. The WGT annual numbers in 2010 are similar to those of 2008 and 2001, with nearly 50 turtles leaving the water each day on average. A closer look at the seasonal distribution of emergences over the past 11 years (Figure 13), suggests that the WGT beaches have a peak later in the year (and perhaps less pronounced) than does SB (Figure 11). The month with the peak number of emergences has ranged between April and July over the last decade.

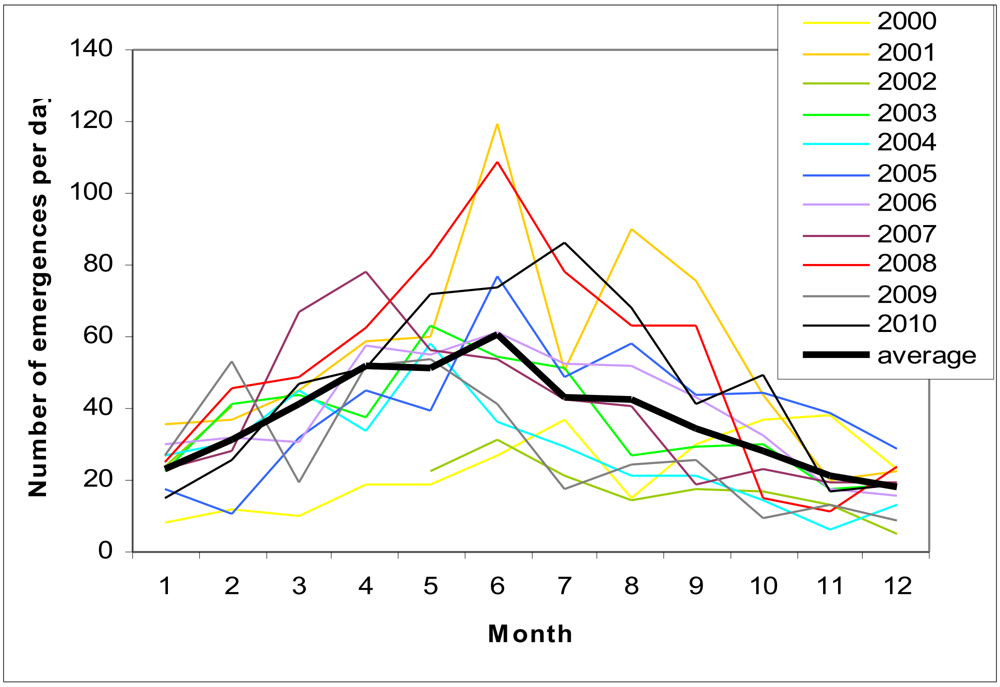

Figure 13. As Figure 11, but for the WGT group of beaches.

Turtle Tagging

During tagging operations, a total of 123 nesting green turtles were encountered during 2010 and 19 were captured inside the lagoon (Table 3). Of these, 86 turtles were newly tagged, while the remaining turtles were re-captured (and re-measured) individuals. In 2010, a lack of available lagoon boats, human resources and competition with other monitoring requirements during the few days of appropriate spring high tides, usually limited in-water 'rodeo' tagging sessions to not more than one a month.

Table 3. Summary of turtles encountered during tagging operations during 2010.

Turtles encountered	Total	Newly Tagged	Resights
Nesting green	123	73	50
In-water green	14	11	3
In-water hawksbill	5	2	3

Recommendations

Despite the likely under-estimation of turtle nests, the recording of green turtle nests and their GPS location on SB could provide useful indices of the changes in nesting suitability of the beach and/or seasonality in the nest laying success rate, and should therefore be continued. To ensure continuity in the data and consistency in the judgement of what qualifies as a 'successful nest', a brief written protocol (with pictures) should be produced.

Turtle tagging activity has decreased in recent years, presumably due to a greater emphasis on other monitoring programmes and perhaps a lack of motivation or interest as there seems to have been no application or investigation of the tagging data. Attention to creating a more user-friendly database, that allows easy retrieval of records of previously tagged individuals and which could be linked with a regional tagging database, would be very beneficial and interesting.

3.2 Subsistence Fishing

During 2010, there were 37 subsistence fishing trips recorded, totalling a catch of 567 fish that weighed 1742 kg. Nearly half of this weight (yet more than twice the number of fish) was made up of bottom-dwelling reef fish, almost exclusively groupers/rock cods (subfamily Epinephelinae), snappers (Lutjanidae) and emperors (Lethrinidae).

Table 4. Summary of fish numbers and weights for all species of fish that were recorded from subsistence fishing trips during 2010.

English name	Creole name	# Fish	Weight	Average weight/fish	Proportion of Total Weight
Blacktip grouper	Madanm dilo	11	3.65	0.3	0.2
Brown marbled grouper	Vyey goni	1	1.3	1.3	0.1
Camouflage grouper	Vyey masata	18	48.95	2.7	2.8
Coral hind	Vyey zannannan	5	3.8	0.8	0.2
Giant grouper	Vyey krab	1	29.5	29.5	1.7
Humpback snapper	Terez	24	34	1.4	1.9
Marbled coral grouper	Vyey babonn	3	24.6	8.2	1.4
Moontail seabass	Kwasan	37	74.3	2.0	4.2
Napoleon fish	Aya zerar	1	15	15.0	0.9
Potato bass	Vyey toukoula	2	26.5	13.3	1.5
Redgill emperor	Baksou	4	3.3	0.8	0.2
Saddleback grouper	Babonn sesil	1	8.34	8.3	0.5
Smalltooth emperor	Gel long	1	2.7	2.7	0.2
Snubnose grouper	Vyey sat	3	2.8	0.9	0.2

Spangled emperor	Kaptenn rouz	81	208.1	2.6	11.8
Titan trigger fish	Bours	1	1.9	1.9	0.1
Tomato hind	Msye angar	3	6.5	2.2	0.4
Twinspot snapper	Varavara	95	163.42	1.7	9.3
Whitebloched grouper	Vyey plat	84	171.56	2.0	9.8
Yellowlip emperor	Bawa	1	2	2.0	0.1
Total bottom fish		**377**	**832.22**	**2.2**	**47.3**
Bigeye tuna	Big eye	9	50.7	5.6	2.9
Bluefin trevally	Karang ver	37	112	3.0	6.4
Bonito	Bonit	39	66.55	1.7	3.8
Camouflage jobfish	Zob zonn	2	4.2	2.1	0.2
Dog-tooth tuna	Ton ledan	9	53.8	6.0	3.1
Giant trevally	Karang ledan	57	369	6.5	21.0
Green jobfish	Zob gri	8	23.7	3.0	1.3
Marbled coral grouper	Vyey babonn	1	17	17.0	1.0
Rainbow runner	Galate	11	25.4	2.3	1.4
Wahoo	Kin fis	7	86.8	12.4	4.9
Yellowfin tuna	Ton zonn	10	116.7	11.7	6.6
Total trolled fish		**190**	**925.85**	**4.9**	**52.7**
Grand Total		**567**	**1758.07**	**3.1**	**100.0**

Figure 14 shows how the annual catch was spread over the year and how this related to the total effort that was spent fishing. The relatively high catches and low effort in March and April are responsible for a sharp peak in overall catch per unit of effort (CPUE) for both bottom fish and those caught while trolling (Figure 15). These high values of CPUE were driven mainly by efficient catches of lutjanids (snappers) and serranids (groupers) in the former, and carangids (trevally) and scombrids (tuna) in the latter. Lethrinids (emperors) seem to have made up a notable contribution only in the months of September-January.

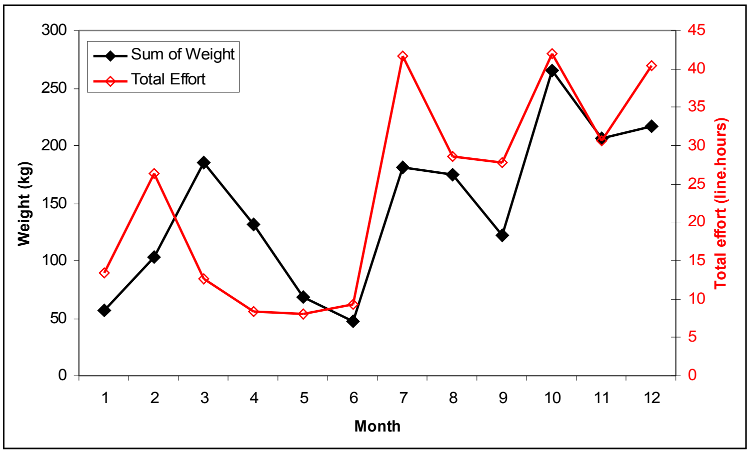

Figure 14. Monthly totals of the weight of fish caught (in black) and fishing effort (in red; calculated as number of fishing lines*number of hours)

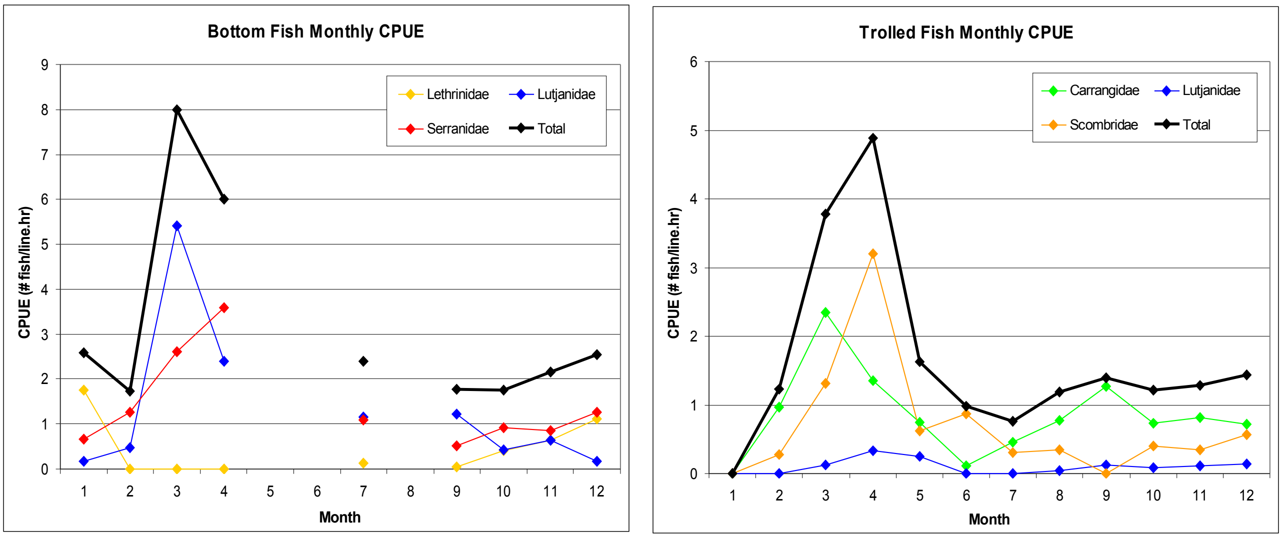

Figure 15. Catch per unit of effort of the families of commonly caught 'bottom'/reef fish (on left) and trolled fish (largely pelagic species; on right).

As of January 2011, a much-improved fish catch database had been developed by Philip Haupt and was put into use. Besides being a vast improvement in terms of its user-friendliness and efficiency to either enter or access data, this new database allows both length and weight measurements to be entered from each fish caught. For some (unknown) reason, both length and weight measurements of every fish have been taken for several years, and yet the previous database did not allow length measurements to be entered and only allowed the summed weight of each species (rather than individual weights). As a result, much data resolution was lost during data entry. Subsequent to its completion, the 2010 fishing data were also entered into this new database, allowing the above plots of CPUE, and for example, evaluation of length-weight relationships for each species (e.g. Figure 16). As can be seen in Figure 16, the length-weight plots are useful to identify outliers of erroneous data (note the outlier to the top left of the curve), when either the weight or the length have been incorrectly recorded. In addition, such relationships are of interest to fisheries biologists and for many of the species commonly caught here, there are not yet published length-weight relationships from the region.

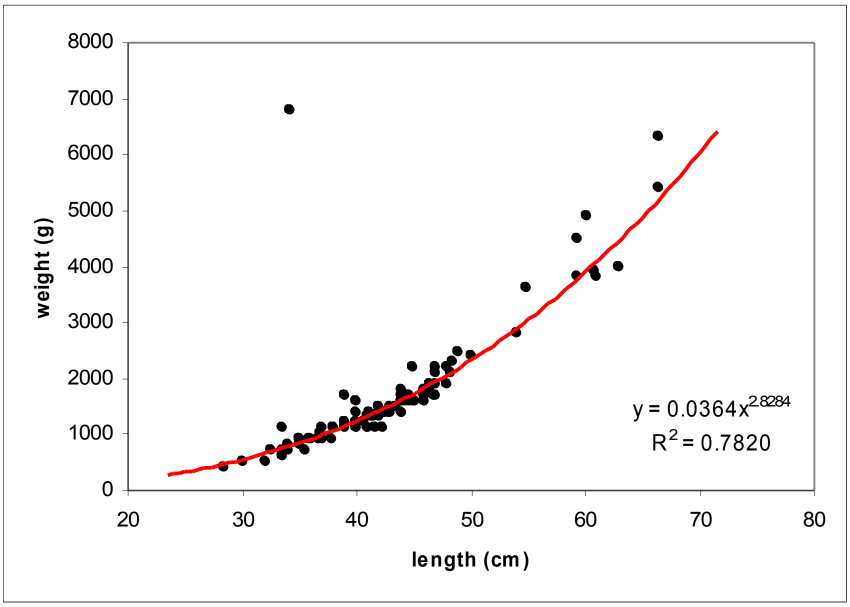

Figure 16. Example of a length-weight relationship from *Lutjanus bohar* (twinspot snapper/varvara) individuals caught during 2010. N = 95.

Recommendations

Unfortunately up to the present, no system is in place to differentiate whether a fish is caught during trolling effort or bottom-fishing effort and the only time one can be sure about which method caught each fish, is when only one of the two methods was employed on a trip, which is infrequently the case. For those species which are commonly caught by both methods (e.g. bluefin and giant trevally, jobfish and dog-tooth tuna), a bias and lack of resolution affect the data as one has to assign them to one group a priori. This lack of resolution could be amended with very little additional effort during fishing trips, by marking or separating the fish caught by each method.

3.3 Marine Mammals

Cetaceans

Volunteer Sharon Drabsch re-initiated the active collection of cetacean sightings information and photos in July 2010, after it had had petered out in 2008. The season of humpback whale sightings on Aldabra ran from 16 July to 1 November, with 26 sightings recorded during this period (compared to a range of 22 to 134 annual sightings over the years of 2002-2007). Most of these sightings were of pairs or small groups of three to four individuals, often including young calves. The largest group seen contained at least eight individuals.

Records of spinner dolphin sightings were made inconsistently and the data are not representative of 2010 sighting frequencies and therefore cannot be used for population estimates or interannual comparisons.

Dugongs

Only one sighting of a single dugong was confirmed on Aldabra during 2010. It was seen in relatively shallow water about 100 m NE of Ile Esprit on 26 November, during a routine lagoon track count and raingauge trip. Both photos and video footage of the dugong were captured, while the boat circled it for a few minutes. A second unconfirmed report by a trainee ranger was made of a dugong seen above the reef flats in front of the Station at high tide on 27 June 2010.

Recommendations

A decision needs to be made as to whether spinner dolphin records will be kept or not, and if this decision is positive, then full and consistent implementation needs to be enforced and records of all sightings need to be kept. Such data would be useful as baseline estimates of dolphin sightings and distributions, which might be sensitive to climate change or changes in human activity (e.g. growth or changes in tourism) in future.

4. TERRESTRIAL ENVIRONMENT

4.1 Giant Tortoises

An attempt to monitor 12 tortoise transects around the atoll at monthly intervals, has been ongoing since 1998. These transects provide estimates of tortoise densities among different vegetation types (which feed into Bourn's population model) and also provide data on the sizes of tortoises, in the way of widths of their third dorsal scute.

Sizes

The average tortoise sizes are strikingly different among different islands and slight (but consistent) differences are evident even among transects on the same island, suggesting limited movement or dispersal of tortoises across the islands, even though some seasonal migration is evident between coastal and inland areas (e.g. Swingland and Lessells, 1979). With limited movement patterns, there may be substantial re-sampling of the same individuals on the same transects. The average sizes measured in 2010 are consistent with the longer-term averages of the 1998-2009 period (Figure 17).

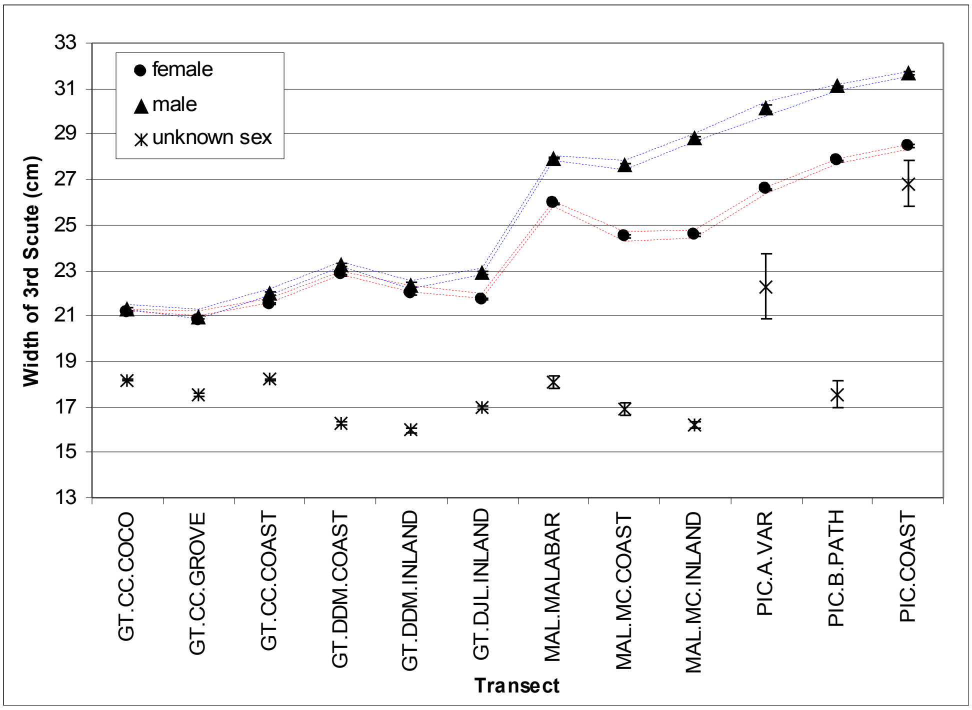

Figure 17. Width of the third dorsal scute of tortoises encountered on the 12 tortoise transects around the atoll. Thin blue and red lines indicate the estimated 95% confidence intervals of average male and female sizes over the 1998-2009 period, while the black symbols represent the average 2010 sizes (± SE).

When average sizes from individual transects are plotted over time, most of the transects do not exhibit notable changes over the 13-year period. However some transects do suggest trends or decadal variation in average sizes (Figure 18). These changes over time are very slight and would require more detailed investigation to confirm and/or explain. They could perhaps be an indicator of the state of the local population in relation to its carrying capacity, and thereby the level of (intra-population) competition for resources. A similar increasing size pattern was evident in all Picard transects, however the inland transect was the only one on Malabar which suggested a slight downward trend.

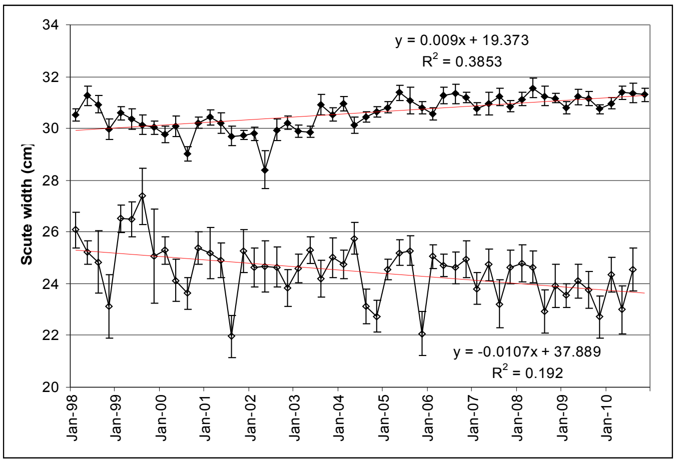

Figure 18. Average quarterly widths (± SE) of tortoise scutes over the period of 1998-2010 for the Picard coastal transect (filled squares) and the Middle Camp inland transect on Malabar (unfilled squares).

Population Estimates

Bourn's population model was automated inside a Microsoft Access database in 2004, by an IT consultant using the Visual Basic programming language. Unfortunately for much of the time since, this automated system has not functioned due to problems of broken links among files and erroneous data causing fatal errors in the code. These problems were recently overcome and the first population estimates generated since the 2007 RO annual report. For future reference, a brief description of the trouble-shooting process is provided in Appendix A.

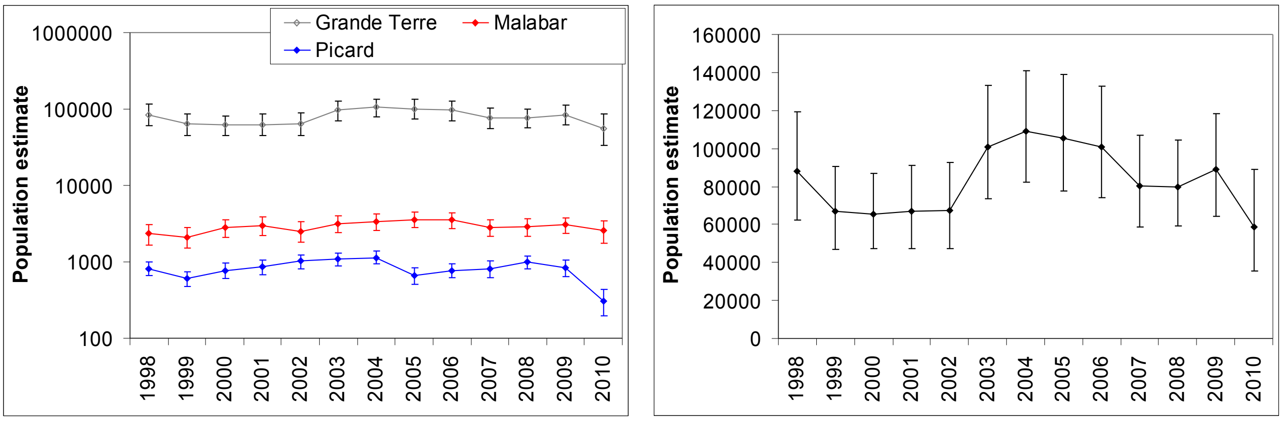

Figure 19. Annual giant tortoise population estimates of the three monitored islands (left; log scale) and their total (right), as generated by Bourn's model for the 1998-2010 period. Error bars are 95% CI.

Bourn and Coe (1978) estimated a population of 150 000 tortoises on Aldabra from surveys conducted in 1973/1974, although this estimate was later revised to 129 000. A repeat survey in 1997 pointed to a significant decrease on Grande Terre and increases on Picard and Malabar, with a total population estimate of 100 000 (Bourn et al. 1999). The 1998-2010 annual population estimates generated by the automated Bourn's model are provided in Figure 19. As can be seen, the Grande Terre population absolutely dominates the atoll population in numbers and therefore changes in the estimates for Grande Terre drive the changes seen in the atoll-wide estimates. There is considerable variability in the data and the very wide 95% confidence intervals suggest that there has been no significant change among atoll-wide annual averages over the last 13 years, despite variations in estimates between ~58 500 and ~109 300 within these years. Taking into account the confidence intervals, the only island that might have statistically significant interannual changes is Picard, where the low 2010 estimate looks as if it may be significantly lower than some of the previous years. However more detailed investigation would be required before any conclusions are drawn from these kind of interannual changes. Tortoises are long-lived and slow-growing, which means that unless there is a sudden disease (or severe natural disaster) causing rapid mortality, in which case one should notice an increase in dead tortoises, sudden interannual fluctuations are more likely related to the application of the survey method. There is an ever-changing team of research staff conducting these transects and both their accuracy in distance estimation (of the transect boundaries) and their commitment levels to including and measuring all tortoises accurately, are likely factors that affect year-to-year population estimates. The Picard coastal transect is especially prone to serious systematic error, as it is the only one of the 12 transects which is supposed to be surveyed with a 20 m wide transect instead of a 10 m width, and it is very likely that research staff occasionally forget to apply the wider transect dimensions. If there were however a seemingly consistent trend over a number of years, then one could have more confidence that it was indicative of real changes in the population numbers.

Applying the Bourn's population model to the entire dataset of 1998-2003, results in an estimate of 82 244 (95% CI of 75 279 - 89 600) tortoises on the three islands of GT, Malabar and Picard. Including the entire dataset considerably narrows the confidence intervals, which suggests that there may have been a further decline since the 1997 estimate of 100 000 (or that the previous estimate was too high).

4.2 Coconut Crabs

The coconut crab monitoring programme on Aldabra was initiated in 2006. Initially data were collected from several camps and included mark and recapture studies in 2007. However the programme has since been downscaled and currently two transects on Picard (BP and CP transects) are surveyed after dark twice a month. The carapace length, colour morph and sex of each individual within a 10-m wide transect are recorded.

When plotting the average monthly transect counts, there does not seem to be a strong seasonal signal, although greater numbers of crabs are evident in the first and second quarter of the year, which is especially pronounced on the BP transect (Figure 20). Fewest crabs are encountered during the late dry season, which might be due to coconut crabs needing to keep their branchiostegal lungs moist and therefore prefer humid environments and are less likely to leave their burrows during the driest time of the year.

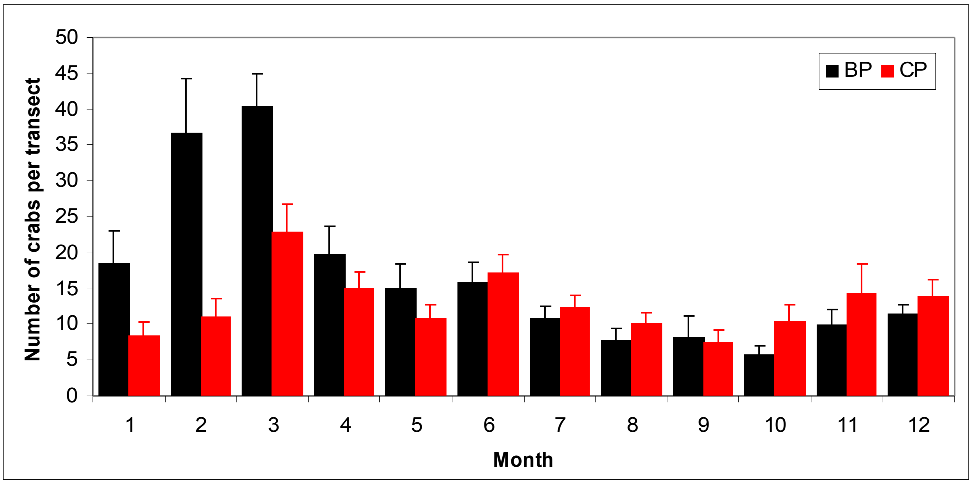

Figure 20. Seasonal signal of average monthly numbers (± SE) of coconut crabs along the BP and CP transects for the 2007-2010 data

Plotting the quarterly average transect counts over time, reveals no obvious pattern other than the consistent peak in numbers encountered on the BP during the first quarter of the year (Figure 21).

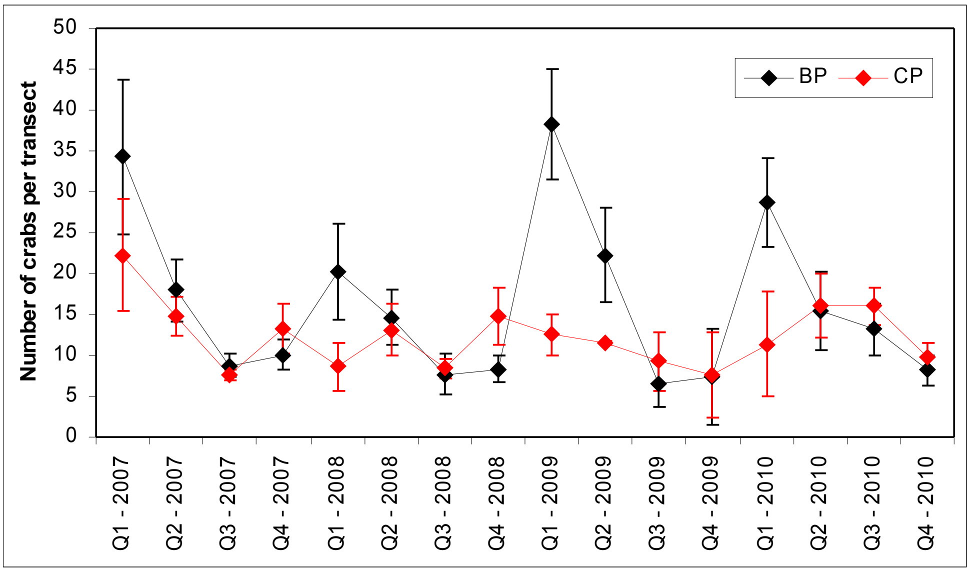

Figure 21. Average number of crabs per quarter (± SE) on the BP (black) and CP (red) transects between 2007 and 2010.

Females are clearly smaller on average than are males, with an average carapace length (± SE) of 30.4 ± 0.28 and 40.6 ± 0.28 for the 2007-2010 data. A plot of their sizes over time, averaged by quarter, reveals no pattern in the sizes of the females, yet the male sizes seem to show both a seasonal pattern and a decreasing trend over time (Figure 22). The average male size seems to be consistently the largest during the first quarter of the calendar year, which might suggest that certain cohorts (or size ranges) are more active during certain seasons than others. Further investigation showed that average male sizes were notably higher in January-April, than in the remainder of the year (not shown). To investigate which size-classes are driving this seasonal pattern, size frequency distributions were plotted for three trimesters (i.e. 'seasons' of four months each; Figure 23). There is a clear tendency for a greater proportion of larger size-class males to be encountered during the first four months of the year, than in the second and third trimester. As Figure 21 shows that there are also the most crabs during the early part of the year, this suggests that there is a substantial influx (or emergence from burrows) of large males during the first few months of the year. Why these large males appear at this time of year is not clear. As the surface area to volume ratio decreases with size, it is unlikely that these large individuals are more sensitive to humidity or moisture levels than are small crabs. Perhaps this seasonal pattern is related to reproductive requirements, although one might expect these to affect the females more than the males.

Comparing the size-frequency distributions between 2007 and 2010 (Figure 24), provides some insight as to what might be driving the gradual decline in average male sizes seen in Figure 22. The 2010 frequency distribution shape suggests that there are a smaller proportion of larger individuals and correspondingly greater proportions of smaller size-classes. The very pronounced bimodal distribution in the male sizes from 2007 is almost completely lacking in the 2010 sizes, which suggests that either there has been a notably greater mortality rate of large males in recent years, or that the large proportion of large males in 2007 was a result of a particularly strong cohort that has been eroded by natural mortality. To explain these patterns with any confidence, more in-depth analyses and investigation of coconut crab growth rates and other literature would be required. The fact that the female size frequency distribution shows a very prominent cohort of 30-35 mm crabs in 2007, whereas in 2010 the most crabs are in the 35-40 mm size-class, supports the idea that certain years (or perhaps groups of years) produce strong recruitment and that such strong cohorts might affect the size frequency of the sampled population by their sheer numbers.

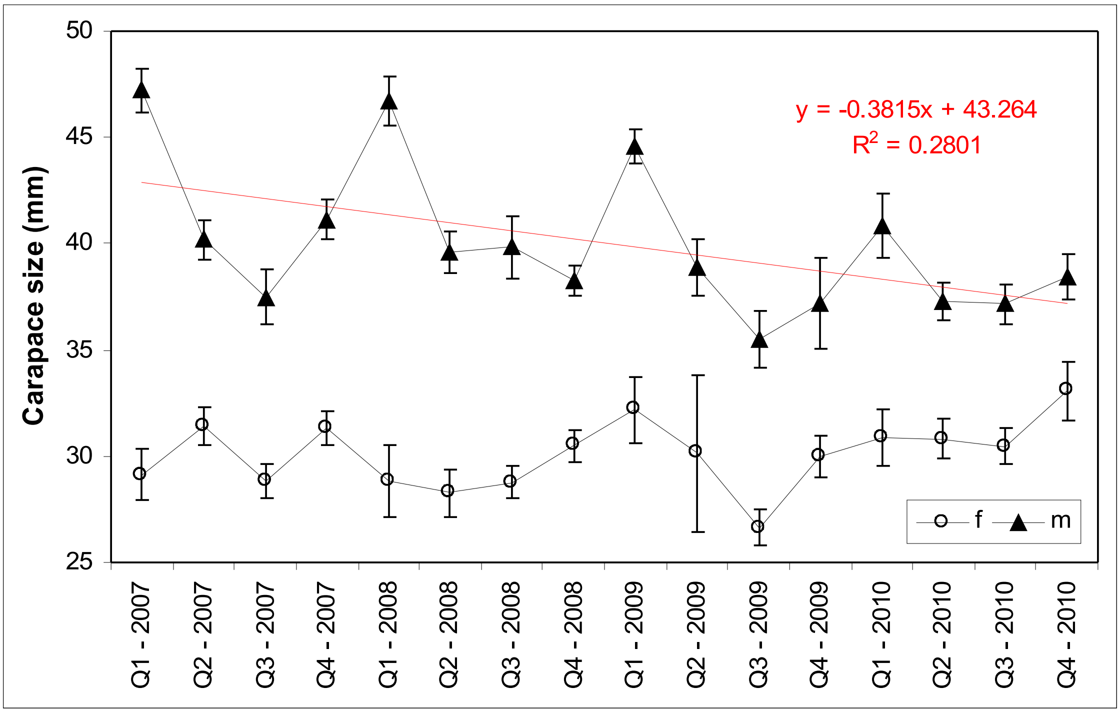

Figure 22. Average quarterly carapace sizes (± SE) of male (m) and female (f) coconut crabs over the period of 2007-2010.

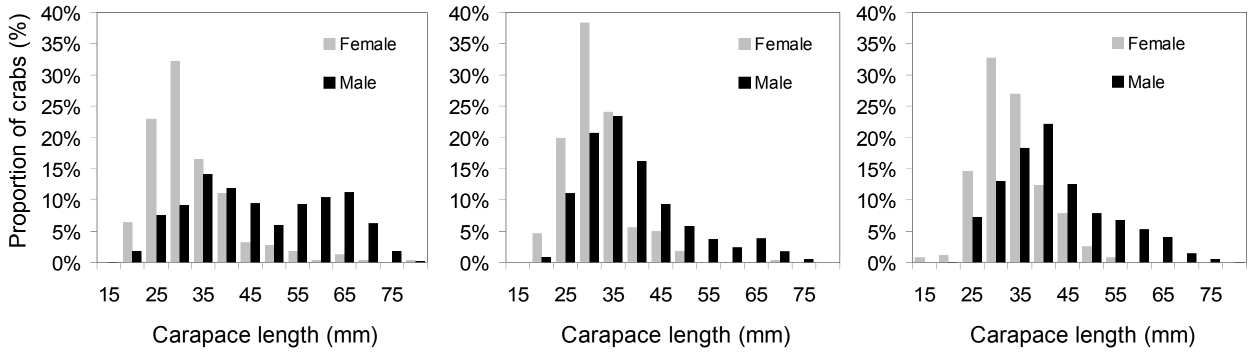

Figure 23. Frequency distribution of coconut crab carapace lengths for the 2007-2010 data, separated into four-month trimesters of January-April (left), May-August (center) and September-December (right).

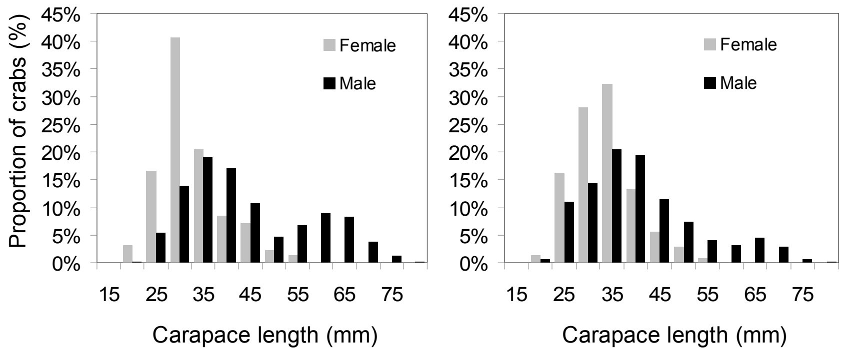

Figure 24. Frequency distribution of coconut crab carapace lengths for 2007 (left) and 2010 (right) data.

It is interesting to note a difference in the average moult score between males and females between November and April (Figure 25). This might potentially indicate specific seasons with a certain degree of synchronous moulting, which differs between males and females, possibly due to seasonal reproductive costs. The 2007-2010 data suggest that females might have a lower average moulting status (i.e. more females than average have moulted recently) during January-March, while males seem to have a higher-than-normal moulting score during March/April (i.e. more males than average have not moulted recently and will likely moult soon). However these patterns are only tentative and require more data to investigate.

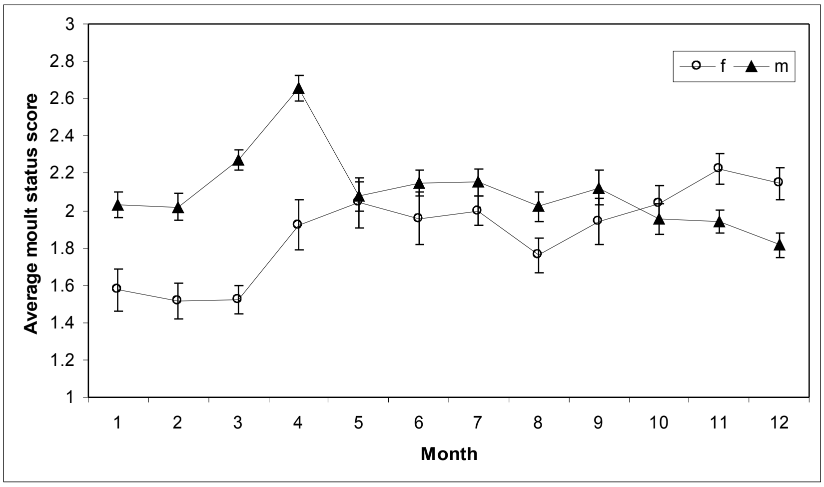

Figure 25. Average moult status per calendar month for the 2007-2010 data.

The break-down of sexes and colour morphs recorded in a pie-chart (Figure 26), highlights the uneven sex ratio and also demonstrates the uneven proportion of blue and orange colour morphs in the coconut crab population on Picard. The male:female sex ratio of the 2007-2010 dataset is

3.3:1, while there are on average five orange crabs recorded for every blue colour morph encountered. What has become clear from experience in the field is that occasionally a crab is encountered which is in between an orange and a blue morph in colour, which is a situation that should be acknowledged and catered for in the protocol and the database. At present, the database only allows for ‘orange’, ‘blue’ and ‘unknown’ records in the colour morph field.

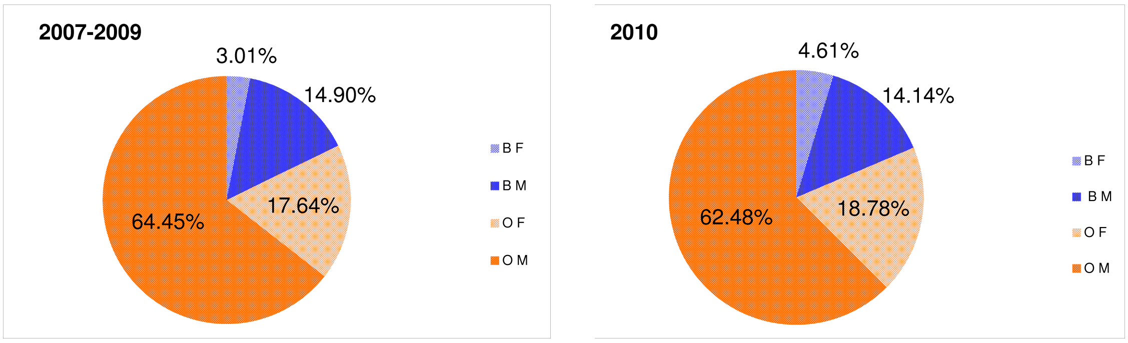

Figure 26. Relative proportions of each sex (M = male, F = female) and colour morph (B = blue, O = orange) within the Picard coconut crab population, showing both the historical breakdown (averaged over 2007 – 2009) and that for 2010.

Recommendations

There is a need to clarify and standardize the judgement/scoring of moult status and to clearly formulate this in a written protocol. The RO recently found Table 5 in the coconut crab MS Access database, which describes how the moult status was apparently assessed in 2006/2007 when the coconut crab monitoring programme was initiated by then RO, Pierre Pistorius. However over time, emphasis seems to have been placed more on the judgement of the abdomen size (which swells as the moult gets ‘older’), to the extent that the dactyl was generally not considered in 2010 when the RO was replaced in April. Such lack of consistency in methodology demonstrates the urgent requirement for written protocols for all monitoring programmes.

Table 5. Description of codes used for assessing coconut crab moulting status, as listed in the coconut crab MS Access database.

Code	Name	Description
1	newly moulted	dactyl is needle-sharp, lots of new hairs present
2	recent moult	dactyl looks sharp but doesn't prick the skin, new hairs present
3	old moult	dactyl blunt, worn hairs present
4	very old moult	dactyl very blunt or absent, no hairs present

4.3 Vegetation Phenology Monitoring

Thirty-three plant species have been monitored on Picard (mostly along the Back Path transect) since June 2009, to determine patterns of plant phenology. Six individuals of each species are marked and scored every two weeks for a suite of variables assessing coverage of leaves, flowers, fruit and disease or damage. Two species (*Tournefortia argentea* and *Pandanus tectorius*) are represented by less than six individuals as additional mature specimens have not been found in the vicinity of the Station. The list of species surveyed and the average number of plants surveyed for each species during 2010 is provided in table A1 in Appendix A.

In November 2010, the protocol was simplified slightly (see November 2010 RO report for details) to reduce the substantial fieldwork demand and improve the data quality. Despite these amendments, continuous data for several variables, including young and mature leaves, open/fresh flowers and flower buds, mature fruit and presence of any fruit, insect and fungus damage, as well as the presence of rat damage, have accumulated for well over 20 months.

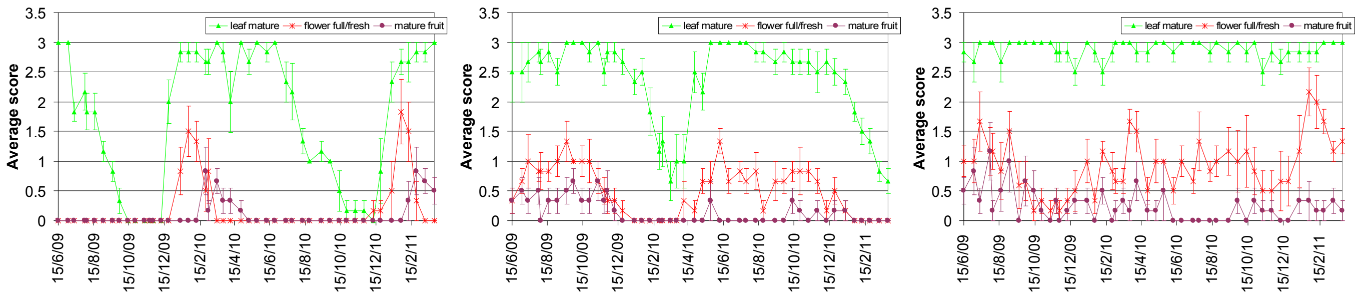

Figure 27. Three examples of different phenologies, shown by *Allophylus aldabricus* (left), *Capparis cartilaginea* (center) and *Mystroxylon aethiopicum* (right). The time series represent bi-weekly average coverage (± SE) of mature leaves (green), fresh flowers (red) and mature fruit (purple).

Three different phenological strategies are shown in Figure 27, with most surveyed species exhibiting some variation of one of these: The 'most typical' pattern that is seen in the majority of plants, including *A. aldabricus* (Figure 27), tracks the rainfall season as one would logically expect, water being a vital resource (and scarce during the dry season on Aldabra). The wet season is causes a flourish of fresh growth of leaves and flowers (December/January). Flowers are then followed by a fruiting season in the late wet season for *A. aldabricus* (about February-April), after which the mature leaves last until about the middle of the dry season (~July), when they start dropping off the plant.

A second strategy, as demonstrated by *C. cartilaginea*, is almost the complete opposite pattern to the first, with both leaf coverage and reproductive outputs peaking over the long dry season, between about May and December. During the remaining wet months of the year, *C. cartilaginea* loses almost all its leaves and looks unhealthy. Although this species is fairly unique in the way it loses its leaves during the wet season, other species similarly flower during the dry months of the year, including *Azima tetracantha, Dracaena reflexa* and *Jasminium elegans*.

The third strategy depicted by *M. aethiopicum* in Figure 27, is to maintain a relatively constant level of leaf growth and reproduction throughout the year. Such a continuous growing and flowering strategy is similarly seen in *Cassipourea lanceolata, Pemphis acidula, Pleurostelma cermuum* and *Tournefortia argentea*.

5. BIRDS

5.1. Land Birds

Land bird monitoring has been carried out since 2002 on Aldabra. All land birds heard or seen within a 25-m radius at designated points along seven of the (inland) tortoise transects are recorded over a four minute period.

Figure 28 shows the total annual counts from all transects combined, over the period 2002-2010. In years when counts were not performed during one or more months, such missing data were replaced with monthly averages from remaining counts. Analyzing these data in this way is not optimal, however it is one of the few strategies which can be applied to compare among years, without having to perform tedious re-organisation of the entire dataset, which would likely take weeks due to the unwieldy shape that the data are in.

During the roughly 580 point counts each year, no more than five nightjars have been recorded in any one year and none have been counted in the last three years (hence their numbers are not plotted below). Plotting the annual totals for each species over time, different interannual patterns are evident (Figure 28). The numbers of fody, sunbird and blue pigeon suggest a possible increasing trend between 2002 and 2010, while those of the rail, the turtle dove and the drongo showed signs of increases over certain groups of years, however they seem to have levelled off subsequently. The remaining species show no obvious pattern, although there is substantial interannual variation in their numbers.

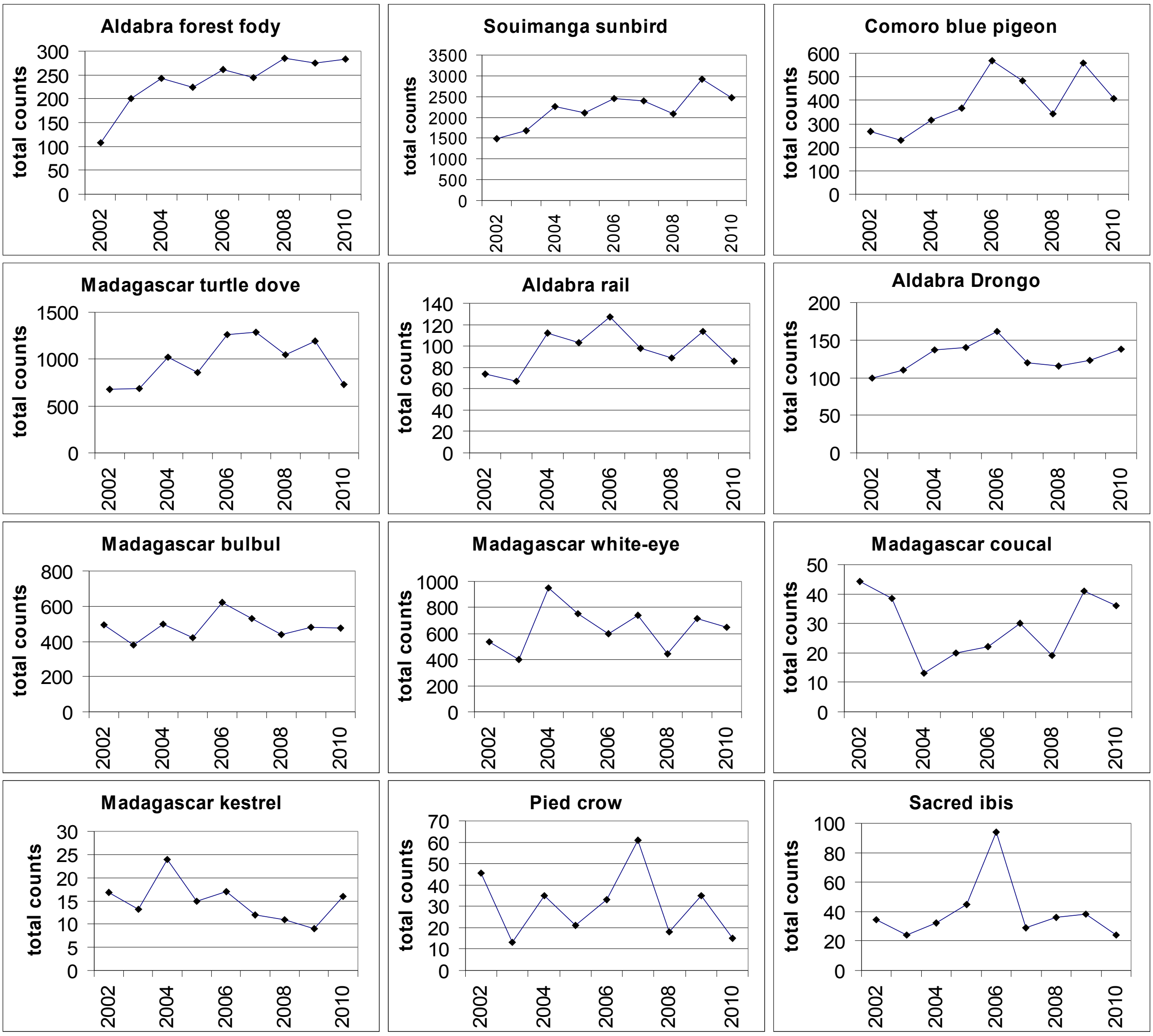

Figure 28. Annual totals of land birds counted on the seven transects around the atoll. A plot for the Madagascar nightjar is omitted as these birds are very rarely detected in counts.

Recommendations

At present, the excel spreadsheets in which land bird data are stored, are in a format that makes even simple comparisons a tedious task. There have been about 100 counts completed on each of the seven transects in the past 10 years. This adds up to about 700 surveys and about 5000 point counts, counting 13 species of birds. The current shape in which data are being stored is totally inadequate for such large datasets, making meaningful analyses difficult. Constructing a better database for land bird surveys should therefore be a priority in 2011 and thereafter the migration of the historical data into such an improved format should be considered.

Up until October 2010, the location of the point counts conducted was not clearly identified (only the sequence was). Some of the transects would certainly have been surveyed back to front on occasion, yet trying to figure out in which direction the transects were surveyed in retrospect is difficult, if not impossible, challenging any comparisons among vegetation types with most of these historical data. Future efforts and protocols should emphasize the importance to carry on recording the transect marker number at which point counts are conducted and not revert back to recording only the sequence of each point count.

These point count methods are undoubtedly not the best methods for quantifying all land bird species on Aldabra and for cryptic species such as the nightjar, are certainly not adequate (as evidenced by the data). In addition, the coucal, kestrel, pied crow and sacred ibis are encountered at very low numbers during counts and other methods of censuring their populations might offer more robust results.

5.2 Waders

Counts of waders along SB take place at least twice a month at low spring tides. Additional counts between DDM and DJL area often done on two consecutive days when at camp there. Although these surveys are called “wader counts” several non waders are recorded as well, such as herons, egrets and terns.

Settlement Beach

Throughout 2010 at least two counts were conducted in most of the months (Table 6), apart from April when only one count resulted in only nine individual birds counted (which is very unlikely to be a properly conducted survey). Analyses of the wader data are difficult as many factors potentially influence the number of birds, some of the obvious factors being the tidal and weather conditions. Not only the absolute height of the tide is important, but the timing of the survey relative to the tidal cycle potentially has a large effect, as a dropping or a rising (low) tide has important implications as to how much wader habitat is accessible in the lagoon (where the tidal cycle lags 1-3 hours behind the outer tides).

From the large variability (error bars) in plots below (and others not shown), it is obvious that to gain an average number that is representative of one specific month and which can be compared to other months, more than two wader surveys per month will be needed.

Despite the many factors that potentially introduce noise to the signals, some obvious seasonal patterns do emerge from the data and these patterns can help group the birds into five distinct categories:

- Regular wintering waders
- Resident breeders using the reef in high numbers
- Terns
- Resident breeders only occasionally seen
- Vagrants

Table 6. Number of wader surveys conducted on Aldabra during 2010.

Month	Location		
	SB	DJL - DDM	Dune Patates
1	6	0	0
2	4	1	0
3	4	0	1
4	1	0	0
5	4	0	0
6	2	0	0
7	2	0	0
8	3	0	0
9	2	0	0
10	2	0	2
11	2	0	1
12	2	0	2
Total	34	1	6

Regular Wintering Waders

These birds are common on the atoll and their numbers are related to their breeding season in the northern hemisphere. Their numbers are very low or absent between April and July, but often have a pronounced peak during migration times either side of this, as birds assumedly stop over on Aldabra on their way northwards or southwards (in about March and September/October). Species included in this group are Bar-tailed godwit, Greater sandplover, Lesser sandplover, Common ringed plover, Grey plover, Crab plover, Ruddy turnstone, Sanderling and Whimbrel. As there are too many species to plot all of them, two examples of the Greater sandplover and Ruddy turnstone are shown in Figure 29. Of this group of waders, the Greater sandplover and Lesser sandplover are the most difficult to tell apart (especially when not seen together) and may be misidentified in the field

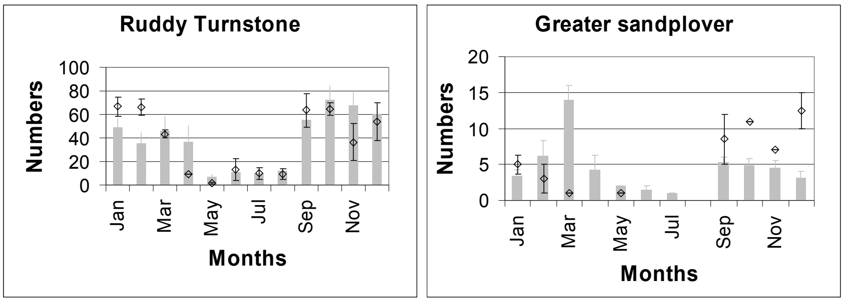

Figure 29. Monthly average counts of 'regular wintering waders' examples, showing their 2003-2009 averages (grey bars) and 2010 counts (black symbols). Error bars represent SE.

Common Resident Breeders

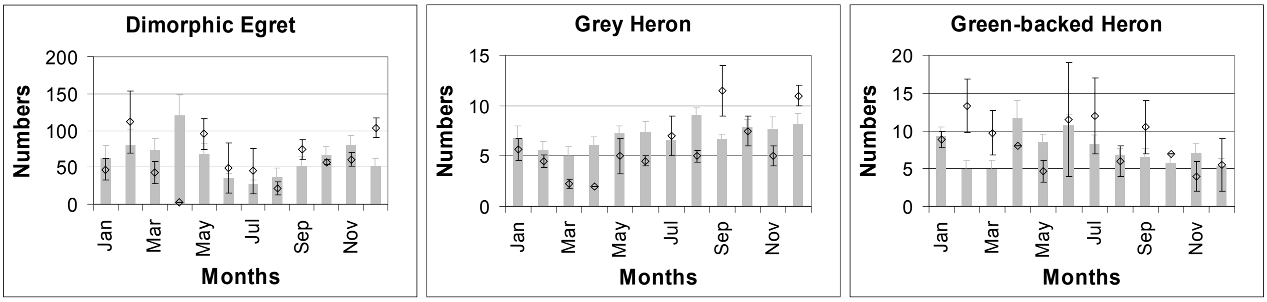

Figure 30. Monthly average counts of 'common resident breeders', showing their 2003-2009 averages (grey bars) and 2010 counts (black symbols). Error bars represent SE.

This group is made up of only three species, namely the Dimorphic egret, Green-backed heron and Grey heron. The Dimorphic egret seasonal pattern shows slightly depressed winter numbers and a peak in April, suggestive of the same pattern as displayed by the 'wintering waders' above (Figure 30). However this species is considered sedentary and the seasonal pattern might rather be related to its breeding cycle on Aldabra. The other two species show relatively constant numbers throughout the year, although Green-backed herons are perhaps more visible on the reef during April-June and Grey herons seem more abundant after April.

Terns

Greater Crested terns have two laying periods on Aldabra, namely December to January and June to August. However their average monthly counts do not show any obvious seasonal signal and neither do the Lesser Crested terns. There is a good probability that these two similar species are confused at times, which might partly explain a lack of signal in both species.

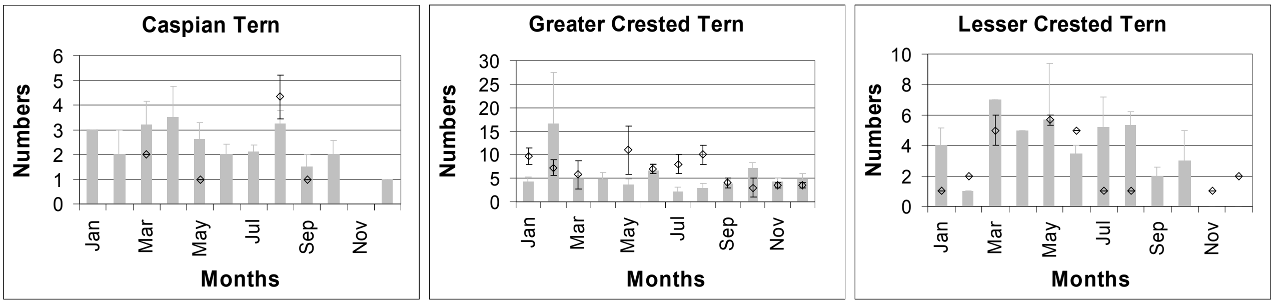

Figure 31. Monthly average counts of terns, showing their 2003-2009 averages (grey bars) and 2010 counts (black symbols). Error bars represent SE.

Resident Breeders Occasionally Seen During Counts

These are birds that breed on Aldabra in greater numbers but do not use the reef or beach for feeding and are encountered only by chance. Therefore these surveys unlikely provide useful data on these species and there is probably a valid argument to discontinue counting them. Their 2010 sightings are summarised by month in Table 7

Table 7. Monthly summary of the numbers of 'resident breeders occasionally seen during counts' recorded during wader counts from SB in 2010.

Species	Month	No. of birds
Black-naped tern	Jan	1
	Feb	1
	May	5
	Jun	2
	Sep	1
Brown noddy	Jan	1
Cattle egret	May	2
	Aug	3
Fairy tern	Jan	2
	Feb	3
	Jul	7
	Oct	3
	Nov	4

Vagrants

There are likely a substantial number of vagrants that visit Aldabra, given the size and location of the atoll. Their detection and identification however necessitates good knowledge of bird species and/or great enthusiasm. Table 8 summarizes those vagrants seen during 2010 wader counts. Curlew sandpipers seems to be far more frequent on Grande Terre and perhaps do not belong in this group, however on SB they are rarely recorded and thus included here.

Table 8. Monthly summary of the numbers of vagrants recorded during wader counts from SB in 2010.

Species	Date	No. of birds
Little tern	Jan	11
Terek sandpiper	Jan	5
	Feb	3
	Mar	1
	Aug	1
Curlew sandpiper	Aug	1

Common sandpiper	Feb	2
	Mar	1
	May	1
	Jun	2
	Jul	3
	Aug	1
	Oct	2

Wader Counts at Other Locations on Aldabra

Wader counts on Grand Terre have taken place sporadically since 2003, however there is a lack of consistency and clarity in the methods and location, to confidently make comparisons. There are four locations recorded, namely WGT, DJL, DJL-DDM and “Dune Patates”, yet there don't seem to be instructions identifying the exact locations where counts should start or end. During the latter part of 2010, the research team conducted counts behind Dune Patates, where large numbers of small waders commonly roost (often using a digital camera to take photos which helped to identify species and count numbers later). However there is an urgent need to define a clear written protocol which needs to be put into practice in order to get consistent and comparable data in future. Dune Patates seems to be an important roost for small waders (e.g. Curlew sandpiper, sandplovers, turnstone, and Sanderling), where these can sometimes be seen in their hundreds. As it is also easily accessible during camps, this area should be prioritised for further monitoring. If counts are additionally supposed to be conducted along the shore, then these data should be clearly separated from the Dune Patates roost area, which would need to be specified in the protocol.

Little Tern Misidentification

It is quite probable that most or possibly all Little tern records on Aldabra were actually Saunders’ tern. This conclusion is drawn after Michal Šúr discussed the topic with Adrian Skerret. Saunders’ tern is a relatively common vagrant in the region, while the Little tern is very rare. The two species are difficult to tell apart. The best way of distinguishing them is by the white triangle on the forehead, which in the Little tern extends as a supercilium behind the eye, but not in the Saunder's tern. This difference is difficult to see from distance without binoculars or a telescope. These two species were previously often considered to be the same species and Europeans working on Aldabra were familiar mainly with Little terns, hence most records on Aldabra are labelled as such (pers. comm. of Adrian Skerrett). To avoid mistakes in future, staff should be familiar with the differences between the two species and unless 100% sure, they should suspect them to be Saunders’ terns.

Recommendations

A factor likely adding to the variability seen in wader counts is the problem of rapid staff turnover and therewith widely-ranging levels of interest and bird identification skills. Clearly defined protocols, good training and ensuring that at least one person with adequate bird identification experience accompanies each trip, should help to minimize such bias.

In addition to perhaps greater numbers of surveys, the conditions and methodology need to be standardised as far as possible, bearing in mind the important influence of the tidal movements. Such details need to be clearly specified in the protocol, together with clearly defined boundaries of the survey areas.

A spotting scope is extremely useful to find and identify small birds at the far end of the reef, yet prior to the end of 2010 there was no habit or rule to take the spotting scope on wader counts at SB and binoculars were usually relied on instead. The spotting scope should be a compulsory part of the wader survey equipment and this needs to be included in the final protocol.

5.3 Tropicbirds

Red-tailed and White-tailed tropicbird (RTTB, WTTB respectively) nests are monitored every two weeks on a spring low tide near the Station. The nests are located on undercut 'champignon' islets in the lagoon (numbered LG01-LG18) and on a well-vegetated rocky headland on the southern tip of Picard. The nests were monitored 26 times in 2010 (twice monthly, but four times in March).

Plotting the total number of active nests per month, shows the seasonality of nesting activity for these locations (Figure 32). The RTTB do show a nesting seasonality in 2010, with a peak of 67 active nests in March and lowest numbers from June to October, before picking up again. The WTTB on the other hand do not show any obvious seasonality in their nesting numbers and remain low (relative to the RTTB) throughout the year, with fewest nests in June.

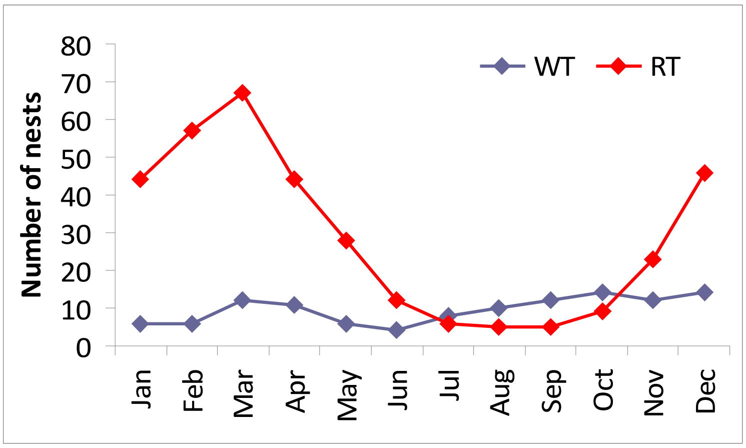

Figure 32. Total numbers of active nests in each month of 2010, for RTTB (red) and WTTB (grey).

The RTTB results are summarised over time in Table 9 and by location in Table 9. LG13 is clearly the most important RTTB nesting islet of those surveyed, with the largest number of nests and relatively successful in terms of fledging rates (Table 9). Surprisingly Picard, where there are certainly rats, had two successful RTTB fledglings out of four nests. Both other islets on which evidence of rats was seen during 2010 only had one RTTB nest each and thus not much can be deduced as to potential rat predation from them. Of the 99 RTTB nests that concluded within 2010 (i.e. were not on-going into 2011), the data suggest that 53 failed at egg stage, 19 failed at chick stages and 27 nests fledged.

Table 9. RTTB nest monitoring results for 2010, as summarized by month (39 nests were ongoing into January 2011).

Variable	Month												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
# Nests ongoing from previous month	20	38	49	40	25	12	4	5	3	3	8	21	N/A
# New nests found	24	19	18	4	3	0	2	0	2	6	15	25	118
Proportion egg failure	11%	12%	31%	14%	18%	17%	0%	0%	0%	0%	9%	11%	54%
Proportion chick failure	2%	2%	4%	14%	7%	25%	0%	0%	20%	0%	0%	4%	19%
Proportion of nests fledged	0%	0%	4%	16%	32%	25%	17%	40%	20%	11%	0%	0%	27%

Table 10. RTTB nest monitoring results for 2010, as summarized by islet/location. An asterisk (*) denotes those islets where evidence of rats has been observed.

Variable	Location												
	LG01	LG02	LG06*	LG07	LG08	LG12*	LG13	LG14	LG15	LG16	LG17	LG18	Picard*
# Nests ongoing from December 2009	2	0	0	0	2	0	11	3	0	0	0	2	0
# New nests found	7	2	1	2	5	1	33	13	2	0	35	13	4
Proportion egg failure	57%	100%	100%	100%	50%	0%	37%	64%	100%	0%	56%	50%	50%
Proportion chick failure	29%	0%	0%	0%	33%	0%	19%	14%	0%	0%	22%	20%	0%
Proportion of nests fledged	14%	0%	0%	0%	17%	0%	44%	21%	0%	0%	22%	30%	50%
# Nests ongoing into January 2011	2	0	0	1	1	1	17	2	0	0	8	5	2

WTTB results are summarised in Table 11 by month and Table 12 by location. The far lower nesting rates of the WTTB make it difficult to have any confidence in statistics calculated from these data. LG01 had the highest number of WTTB nesting attempts during 2010, but it also had a very high egg failure rate and only one nest was judged to have fledged. Of the 42 nests that concluded within 2010 (i.e. were not on-going into 2011), 74% (31) were judged to have failed at egg stage, 14% (6) at chick stage and only 12% (5) were assumed to have fledged successfully. These seem like worryingly low success rates for the WTTB, although it is not clear what is causing such high proportions of nest failure. Judging from the data, it is certainly a problem of egg failure that is causing the highest losses in both species.

Table 11. Same as Table 9, but for WTTB (8 nests continued into January 2011).

Variable	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
# Nests ongoing from previous month	4	3	4	8	5	2	3	7	3	10	9	11	n/a
# New nests found	2	3	8	3	1	2	5	3	9	4	3	3	46
Proportion egg failure	33%	33%	25%	55%	67%	25%	0%	50%	8%	21%	8%	21%	74%
Proportion chick failure	17%	0%	0%	0%	0%	0%	0%	10%	8%	7%	0%	14%	14%
Proportion of nests fledged	0%	0%	8%	0%	0%	0%	13%	10%	0%	7%	0%	7%	12%

Table 12. Same as Table 10, but for WTTB.

Variable	Location												
	LG01	LG02	LG06*	LG07	LG08	LG12*	LG13	LG14	LG15	LG16	LG17	LG18	Picard*
# Nests ongoing from December 2009	3	0	0	0	0	0	1	0	0	0	0	0	0
# New nests found	13	0	1	1	0	7	3	9	0	2	5	3	2
Proportion egg failure	83%	0%	100%	100%	0%	100%	25%	88%	0%	50%	25%	67%	100%
Proportion chick failure	8%	0%	0%	0%	0%	0%	25%	0%	0%	50%	50%	33%	0%

Proportion of nests fledged	8%	0%	0%	0%	0%	0%	50%	13%	0%	0%	25%	0%	0%
# Nests ongoing into January 2011	4	0	0	0	0	1	0	1	0	0	1	0	1

Recommendations

To help identify the cause of egg and chick failures, it might be very insightful to install some cameras (either continuous video or perhaps motion-sensor activated) at nesting sites.

5.5 Crab Plovers

Daily crab plover counts are conducted along SB, coincident with the daily turtle track counts. The data of 2010 represent the first complete calendar year of data for these counts, which started in March 2007, but were abandoned after April 2008. In January 2010 they were recommenced and are ongoing until the present.

There is a strong relationship between tidal height and numbers of crab plovers on SB, which has been documented previously (e.g. 2007 RO Annual Report). As with the wader counts, it is the tendency of the tide as well as the absolute height at the time of count, which affects their numbers, due to the fact that the lagoon tides are lagged behind the outer tides (by ~1-3 hours). The highest numbers of crab plovers found on outer beaches (including SB) will be during the 1-3 hours after an extreme high tide (e.g. > 3.5 m), as during these hours there is the least roosting space available within the lagoon. The peak counts are therefore encountered on a roughly two-week cycle (Figure 33), when peak high tides occur at (or rather a couple of hours before) the morning track counts.

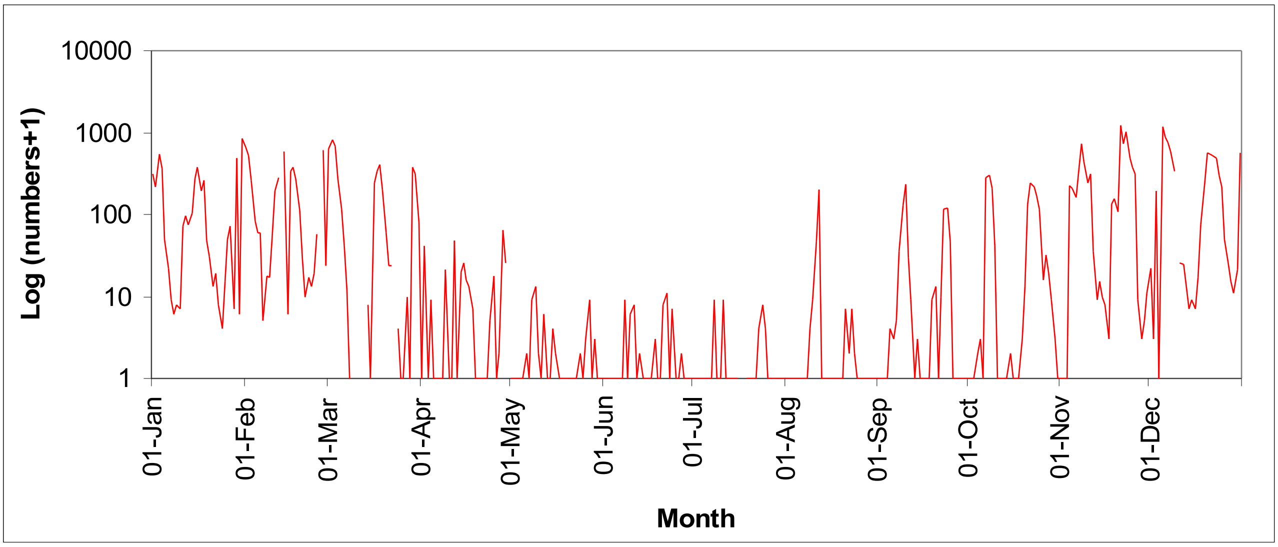

Figure 33. Daily crab plover counts from 2010, plotted on a Log scale to demonstrate the periodic cycles in the data caused by the coincidence of spring high tides with the morning counts.

As can be seen in Figure 33, superimposed on the strong tidal influence, is a clear seasonal cycle. Figure 34 shows the 2007/2008 monthly averages compared to the 2010 numbers, which demonstrates the substantial drop in numbers during the austral winter. The only notable difference between the 2007/2008 counts and those of 2010, is that the crab plovers seem to have departed Aldabra a few weeks earlier in 2010. April is the month where data are available for both 2007 and 2008, which both showed an average of over 90 birds/day, whereas 2010 has an average of 10 birds/day and a highest count of 65 for April.

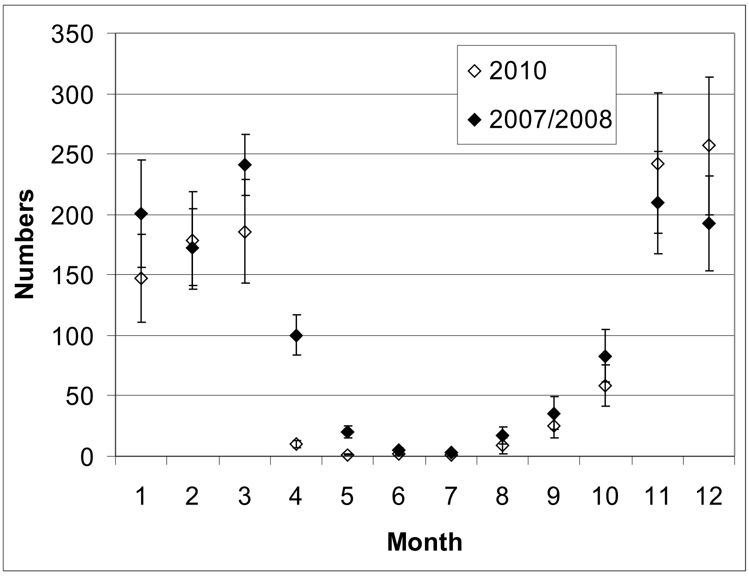

Figure 34. Comparison of March 2007-April 2008 SB crab plover counts with those of 2010. No data are available between May 2008 and January 2010.

5.5 Madagascar Pond Heron (MPH)

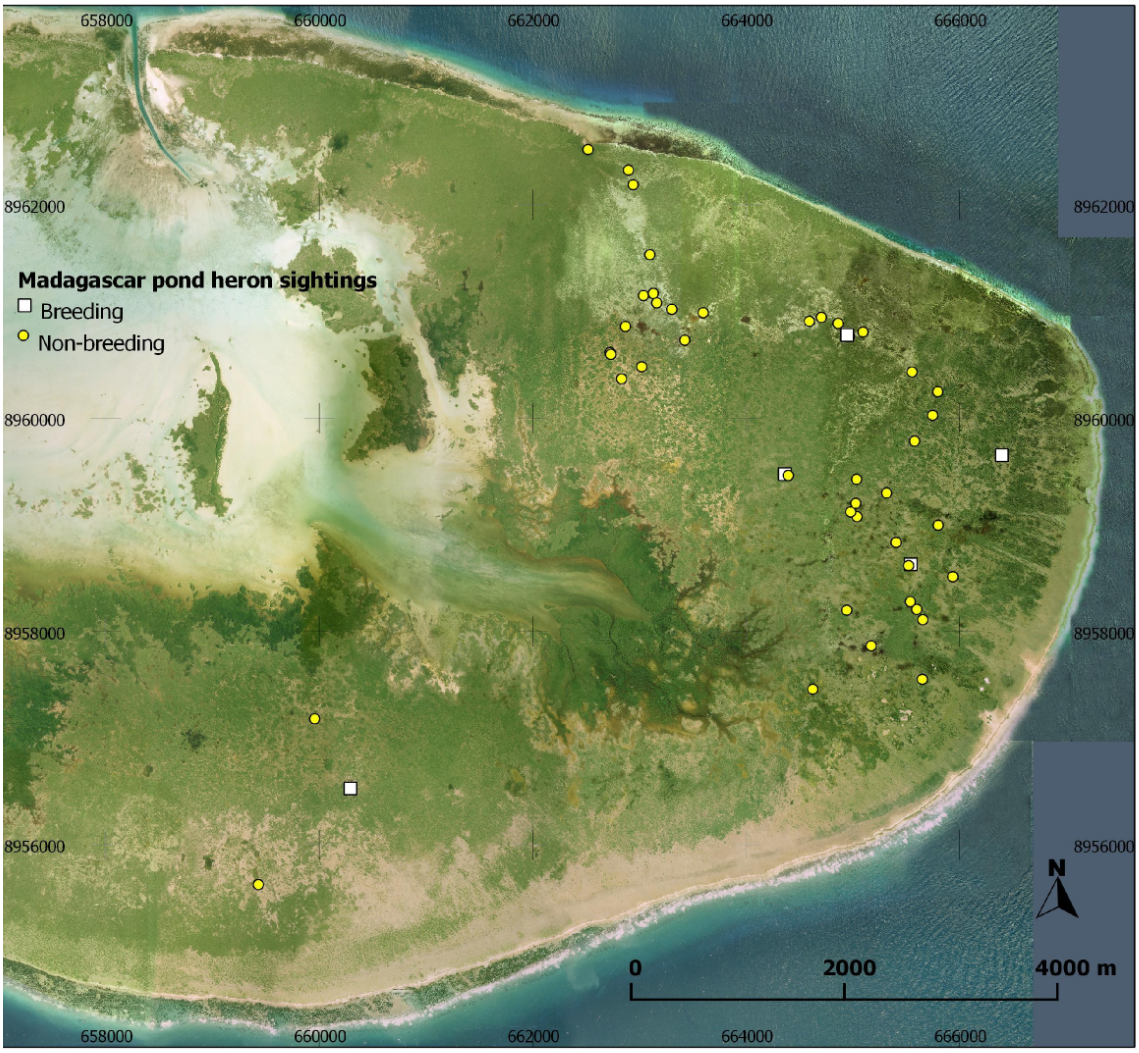

Figure 35. MPH sightings on eastern Grande Terre during 2010. Birds seen in non-breeding plumage are represented by yellow circles and those in breeding plumage by white squares.

Opportunistic sightings of MPHs were recorded on Aldabra throughout 2010 totalling 63 records. All records were accompanied by a GPS coordinate if possible and the 54 records for which such coordinates were available are plotted in Figure 35. The vast majority of birds were judged to be adults, with only two sightings of suspected sub-adults which were made at Bassin Lebine and Bras Takamaka respectively (without GPS coordinates). Six of the 63 sightings were recorded as displaying breeding plumage, one of which was located on the DDM inland transect.

5.6 Flamingoes

Only a handful of trips to CC were routed via the CC landing during 2010 and there was not a dedicated trip to search for flamingoes. Five sightings of flamingoes were recorded for 2010, all except one were from the mudflats south of the CC landing stage, with the remaining sighting recorded from the CC Coco transect. The counts ranged between 3 and 53 individuals and all were recorded to be adults.

5.7 Caspian Terns

During 2010, 64 sightings of Caspian terns were recorded on Aldabra between April and November 2010. No further sightings were made after 18 November. There might well have been unreported sightings previous to April 2010, but no data could be found. Subadults were noted (usually together with one or two adults) 11 times, all of them in August or September.

5.8 Vagrants

Table 13. List of vagrants that were reported on Aldabra during 2010.

Species	Date	Person Reported	Location
Northern wheatear	14/01/2010	Sam Balderson	Old Settlement
Longtailed cormorant	16/02/2010	Sam Balderson	Cinq Cases area
Sand martin	07/10/2010	Sharon Drabsch	Settlement Beach
House martin	28/11/2010	Michal Šúr	Settlement Beach
Whiskered or White-cheeked tern	05/12/2010	Michal Šúr	West Channels
Red-throated pipit	12/12/2010	Michal Šúr	Old Settlement
Eleonora's falcon	28/12/2010	Michal Šúr	Settlement Beach

5.9 Land Bird DNA Samples

The visit by Nancy Bunbury at the end of November re-initiated collection of land bird blood samples for DNA analysis, which were continued by Michal Šúr after she left. Eight rails were caught, measured and ringed, of which six were successfully bled for DNA blood samples. In addition a nightjar chick and a fody were also bled and ringed. Two of the rails were from Malabar, while the remaining birds were caught on Picard.

6. INVASIVE SPECIES

6.1 Mammals

Goat Eradication Program

The GEP entered its fourth year in 2010. In late 2009, the collars fitted in 2007 were running out of battery power. Tom Smith, a Canadian hunter was recruited for the job of darting and re-fitting the JGs (Judas goats) with new collars and he fortunately managed to re-collar one of the six JGs (namely J10) in December 2009. In March 2010, the Aldabra team comprising of Rangers and a Volunteer managed to surround a group of goats on the edge of the coastline, thereby managing to shoot two non-Judas goats (NJs) and to dart and fit a new collar to a second JG (J1). The third (J12) and fourth (J8) JGs were then darted and re-collared in May and October 2010 respectively. No further NJ was seen throughout the remainder of 2010, despite monthly trips during which the

JGs were successfully tracked and seen. With four of the six JGs carrying 'new' collars with working batteries, which are supposed to last for about two years, one should be able to track these JGs until at least early 2012. The aim for 2011 is to continue re-collaring efforts, but to prioritise the removal of any NJ if one is encountered. Another important priority, which was commenced with in 2010, is to search the remaining goat-favoured habitats which have not been covered by the JGs since at least 2008, for any signs of goat activity. As can be seen in Figure 36, the JGs seem to have remained in the north-east parts of eastern Grande Terre, not covering the southern Takamaka region (since 2008), nor the extreme north-western Passe Houareau area. These two areas, marked with red circles in Figure 36, both supported goat populations in 2007. With the last two NJs shot in March, and thereafter none encountered throughout the remainder of the year, the GEP is showing promising signs of approaching a successful end.

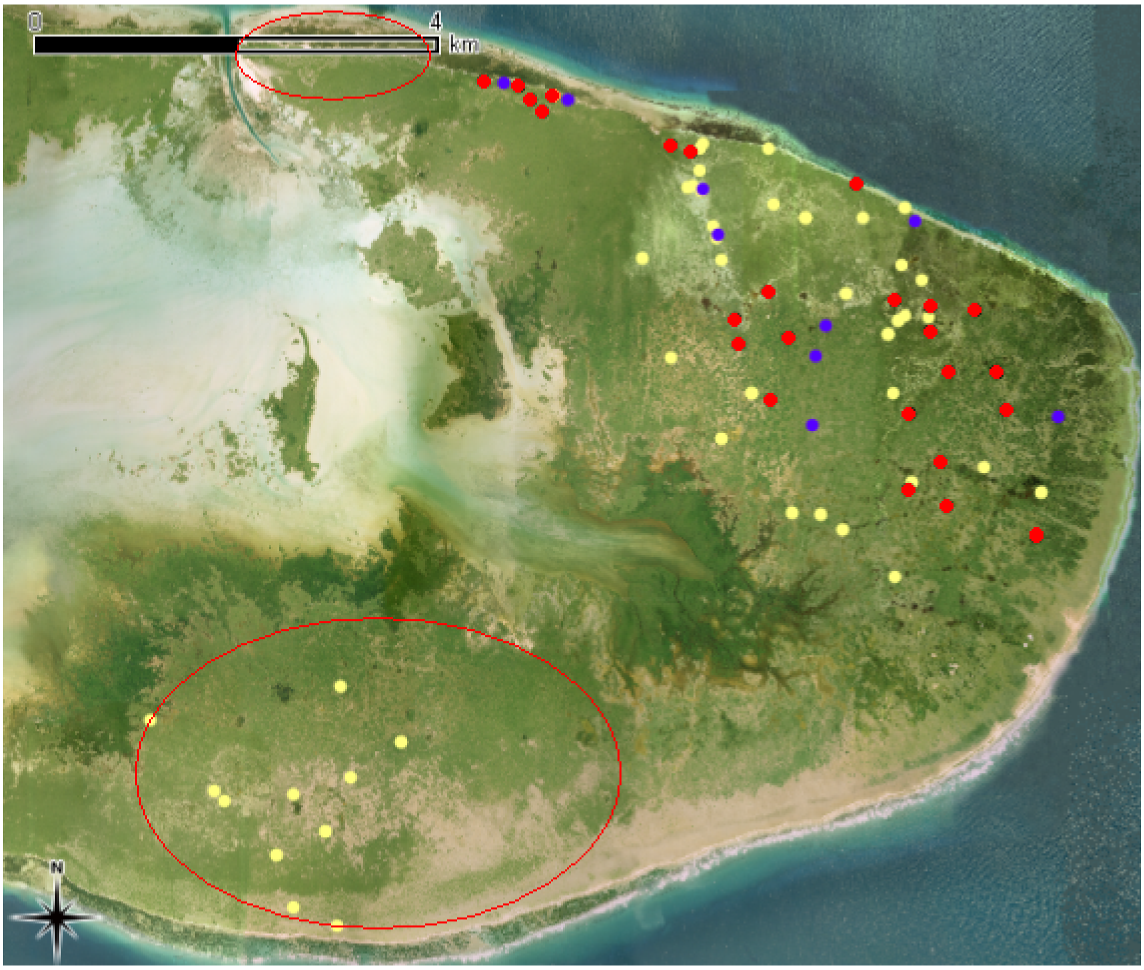

Figure 36. Map of GEP JG sightings during 2008 (yellow), 2009 (blue) and 2010 (red)

Rat DNA Study

In anticipation of rat eradication experiments and hopefully efforts to up-scale these to entire islands on Aldabra in future, an effort was initiated in September 2010 (requested by Nancy Bunbury and spearheaded on the ground by Sharon Drabsch) to collect rat tail samples in order to assess the origin, population structures and connectivity among the rat populations on Aldabra (which are present on all major islands). The goal is to collect 30 tail samples from each island making up the atoll. By the end of 2010, the tally of samples collected was 32 from Picard, 11 from Malabar and 3 from Grande Terre. These sampling efforts are ongoing and take place opportunistically when staff are at camp and rats are trapped.

6.2 Vegetation

Agave sisalana is a prodigious invader in many parts of the world, including other Indian Ocean islands and Southern Africa. The EC-funded project on invasive species awarded to SIF in 2010 includes a component on assessment of sisal and feasibility studies for eradication. The project will include mapping, phenology monitoring, and low-level control for 1-2 years before more intense activities are initiated. A note from 2005 left by former RO, Rainer von Brandis, about a sisal stand off Back Path on Picard was also rediscovered on the RO computer in September. In October, the area (as identified by GPS position) was revisited and roughly 50 plants were seen, most of which were small (leaves about 20-30 cm long), but some of which were large individuals that had taken root again after having been severed in 2005. The largest of these plants are now monitored for signs of flowering, on a monthly basis. The remaining small individuals were to be removed at an opportune time. These plants were checked each month and further discussion about eradication methods ensued, including whether a herbicide would be required or not. A search of the bush around beach 41 (Anse Badamier) was conducted in early October, as there is a record of plants having been removed there in 2005 also, but no evidence of these was found. A substantial stand is known to be growing on the northern edge of Ile Michelle, which will require large efforts to remove and will hopefully be tackled under the EC project. No further action was taken in 2010.

7. DEPARTMENTAL ISSUES

As there was a change-over in RO at the end of April 2010, most of the below pertains to the time after this.

7.1 Staff

On 3 April, a boatful of Somalis washed ashore on SB, claiming to be fisherman, but suspected to be pirates who had abandoned their mothership when this came under fire. They were unarmed and exhausted from a lack of food and having spent several days adrift. They were tied up and transported to Assumption the next day, where the Seychelles army took custody of them. This event caused a disruption to April monitoring activities, partly because staff did not feel safe to work in the field thereafter and some staff refused to go on camp. Following the incident some staff left the atoll at the next opportunity on 20 April and the research department was generally understaffed to accomplish monitoring requirements between May and October 2010, the start of which coincided with the arrival of a new RO. As a result of the understaffed situation, consultation with Head Office was initiated as to the monitoring priorities and certain fieldwork had to be cut back on during this time. Between May and October, the composition of the research team varied (apart from the RO), between two rangers (one of whom was not willing to go on camps) in the worst situation, and one ranger, two trainee rangers and a volunteer during the best situation. In the optimal situation, the research team should consist of at least five individuals and the RO, so that two pairs can be sent into the field independently, with the option of forming a third pair (or four in one team) if needed, besides having a replacement to make up two pairs whenever someone might get injured or ill.

After the departure of Wilna Accouche in early January, the Assistant Research Officer post remained vacant throughout 2010, as SIF could not attract a suitable candidate from within the Seychelles. This position is of great importance to the efficient running of the Aldabra research department and its vacancy puts great strain on the RO, as they are essentially required to do both jobs during such times.

7.2 Logistics

On 9 January 2010, the new boat Alkhadra was flooded and sunk by large waves on Assumption, while there for a staff transfer. As a result, the skipper, mechanic and a ranger were stuck on Assumption until mid-February and without these staff and a transfer boat, certain monitoring activities were disrupted in January.

A lack of appropriate small boats suited for use inside the shallow lagoon, hampered the efforts of the research department throughout large parts of 2010. This problem was caused by damage to both aluminium boats, Audubon and Spinner, while Flammant had been out of use for some time.

The problem was somewhat alleviated towards the end of the year, once the fibreglass skiff on which the pirates had arrived, was revamped and put to use. However thereafter skippering staff were still hesitant to use any non-aluminum boats in certain parts of the lagoon.

A lack of atoll-wide communication in the field was an ongoing problem and safety risk for staff going on camp in 2010. Two handheld satellite phones were used as an alternative, although at times when multiple camps and/or camps and crossings to Assumption coincided, these were not always enough to ensure that all staff had a line of communication with the Station. Plans to install a new atoll-wide radio communications system were under way and equipment was purchased in 2010, but the installation thereof had not yet taken place.

8. GENERAL RECOMMENDATIONS

As discussed in detail with Nancy Bunbury and Frauke Fleischer-Dogley towards the end of 2010, one of the main restraints on several of the monitoring programmes has been a lack of a clear and complete monitoring protocol, which defines the methodology and survey areas or boundaries in detail. Plans to amend such gaps were put into a workplan towards the end of 2010 and in future new monitoring programmes should be started only once a complete protocol has been finalised and approved by HO.

As a general database management or design remark, it may be a good strategy to develop a system of data quality flags (consistent and implemented across all monitoring programs), which the RO or other people plotting or analysing the data can assign or adjust. In this way, any data which were collected under abnormal conditions or are suspected of being biased or inaccurate in any way, can be flagged with an appropriate code and thereby easily identified in future (without the requirement of searching for a potentially obscure or non-existant note or comment). Certainly, database design is one of the areas in which SIF and Aldabra need to invest in and in acknowledgement thereof, some positive improvements were started in late 2010 and early 2011. Efficient and well-structured databases should reduce the amount of errors made during data entry, besides allowing easier and more comprehensive and higher-quality analyses to be conducted for reports or papers.

9. REFERENCES

Bourn, D., Coe, M. 1978. The size, structure and distribution of the giant tortoise population on Aldabra. Philosophical Transactions of the Royal Society of London 282:139-175.

Bourn, D., Gibson, C., Augeri, D., Wilson, C., Church, J., Hay, S. 1999. The rise and fall of the Aldabran giant tortoise population. Proceedings of the Royal Society of London 266: 1091-1100.

Mortimer J.A., 1988. Green turtle nesting at Aldabra Atoll- Population estimates and trends. Proceedings of the Biological Society of Washington 8: 116-128.

Swingland, I.R., Lessells, C.M. 1979. The natural regulation of giant tortoise populations on Aldabra Atoll. Movement polymorphism, reproductive success and mortality. Journal of Animal Ecology, 48: 639-654.

10. APPENDIX A

10.1 GPS Turtle Track Errors

Error and Correction Statistics:

- A total of 4785 turtle tracks were recorded along Settlement Beach in 2010.
- At least a third of these data had data entry errors associated with them (for example digits swapped around in manually entered GPS coordinates).
- Date errors: 300 records (6.3% error rate). About 80% of these are likely related to different

regional and date settings on different computers.

- Lacking GPS data: 110 records
- Emergence data entry errors/ambiguities: 45 records (27 pre-April). Missing data: 27 records retrieved from hard copy data
- Incorrect GPS coordinates entry: 273 missing data, 92 northing errors, total errors = 365 (7.65 %)
- 4026 of 4774 points can be used (coordinates plotted) after time-consuming cleaning + fixing process

Recommendations for Data Improvements:

- Dates should be a picked from calendar
- Include a field for species: Default value GT (Green turtle), but optional HB (Hawksbill turtle)
- 'Zone' is recorded as data checking mechanism, however actual zone value is calculated based on coordinates to avoid further mistakes.
- Choose emergence type from drop down menu
- Data to be downloaded from GPSs and checked monthly (manual coordinate entry is NO GOOD!)
- Data collection eventually changed to handheld data recording system and avoid mistakes from manual entry/transfer of data

10.2 Trouble-shooting the Bourn's Model Tortoise Database

The AGTMD (Aldabra Giant Tortoise Monitoring Database) consists of a 'master' database file (Aldabra.mde) and 12 separate files, one for each transect. The 'master' file is the one which collects the data from all the transect files and generates the population estimates. Two problems had to be fixed in order to attain the population estimate in this report:

1) Each time the database files are relocated (either into a different folder or onto a different drive), the links between the master file and the transect files will break. Unfortunately there doesn't seem to be a way of specifying relative paths. To fix this, open the 'Linked Table Manager', select the two links that refer to one of the transect files (e.g. GTECOCO and GTECOCO_Sections) and update them by clicking 'ok', which will then ask you to browse to the appropriate file (which will be the GTECOCO.mde file in which data are frequently entered).
2) Once the above links have been restored, the master file will have access to the transect subfiles, however it will likely have further problems before managing to spit out population estimates. In my case, these problems were caused by badly-entered data or missing data fields in some of the transect files. Things like missing GISveg fields or wrong date formats cause the Visual Basic code to crash. Often by checking the 'debug' message, one can figure out what field (and sometimes which transect) is causing the problem and the solution is just to go to that transect file and try to fix (or remove) the errors. A good strategy is to sort tables by one column/field at a time and then checking the beginning or end of that column, as empty cells or strange text/numbers will often be outside the range of 'normal' values. One problem that needs to be looked out for is if anyone entered the data into the wrong transect file (e.g. GTECOCO data into GTESOUTH) and then tried to copy it across. It is possible to do this in a certain way, however the GISveg codes (which are automatically assigned during data entry, according to the section of the transect) are then not re-assigned to the pasted data and so the GISveg codes will be INCORRECT! To fix this, the person has to go to 'Data Review/Editing Form' and click on each transect section separately, which will cause the program to change the GISveg tag to the appropriate

vegetation code. It is worth warning staff not to copy across data and/or to see the RO if/when they have entered data into the incorrect database file by mistake.

10.3 Phenology Plant Species

Table A1. List of plant species monitored during bi-weekly phenology surveys and the average number of individuals which made up the replicates for each species. Each species is supposed to be represented by six individuals, although occasional plant deaths and/or individuals that could not be located result in fewer samples. One survey in 2010 had to be reduced to three individuals per species due to staffing constraints.

Species	Average N during 2010
Acalypha claoxloides	5.76
Allophylus aldabricus	5.88
Apodytes dimidiate	5.84
Azima tetracantha	5.88
Canthium bibracteatum	5.84
Capparis cartilaginea	5.88
Cassipourea lanceolata (rare)	5.72
Clerodendrum glabrum var. minutiflorum	5.68
Dracaena reflexa	5.84
Erythroxylum platycladum	5.88
Euphorbia pyrifolia	5.84
Flacourtia indica	5.88
Gagnebina commersoniana var aldabrensis	5.88
Grewia picta	5.88
Jasminium elegans	5.80
Lomatophyllum aldabrense	5.88
Maytenus senegalensis	5.92
Mystroxylon aethiopicum	5.84
Obetia radula	5.88
Ochna ciliata	5.88
*Pandanus tectorius**	5.56
Pemphis acidula	5.88
Pleurostelma cermuum	5.60
Polysphaeria multiflora	5.88
Premna serratifolia	5.92
Scutia myrtina	5.80
Sideroxylon inerme subsp. Cryptophlebium	5.88
Solanum aldabrense	5.56
Tarenna supra-axillaris (rare)	5.88
Terminalia boivinii	5.92
*Tournefortia argentea**	5.44
Trianolepsis africana subsp. Hildebrandtii	5.72
Tricalysia ovalifolia	5.84
Overall Average	5.81

**P. tectorius* and *T. argentea* were represented by three and five individuals respectively in December, as more mature individuals of these species have not been found near the survey path.