Seychelles Islands Foundation

Aldabra Research Station

Research Officer's Annual Report

January – December 2004
Compiled by Rainer von Brandis

List of Tables and figures

1. Introduction

This annual report is limited to the research and monitoring activities carried out during 2004 and does not include departmental and managerial topics. My lack of presence on the atoll during 2004 does not allow me to report on such issues accurately (I was only present between July and September). There is no chapter regarding the eradication of goats, cats and rats as there is nothing report for 2004 except that 5 goats were shot (after which there were no more bullets). There are also no chapters describing marine or vegetation monitoring as there is very little to report. This report does not include monitoring methodologies and the reader should consult the SIF management plan for more detail. Where giant tortoise and turtle monitoring results are concerned, I have attempted to include results from preceding years to provide the reader with a comparative analysis over a longer timeframe.

Recently, I have created a query-based self-analysing database for subsistence fishing records (see file on this CD). The database allows the reader to view a selection of results and rather than publishing the results here, the reader is urged to view the results directly from the database.

The tortoise and land bird transect databases for 2003 and 2004 are unique in that they represent the first successful completion of the monthly monitoring programs since their conception at Aldabra. It is of utmost importance that this effort is maintained in the future (especially the tortoise transects). Both survey techniques utilize very small sample sizes and the elimination of even one monthly survey could reduce the statistical integrity of the results by as much as half.

2. Turtles
2.1 Turtle tagging
2.1.1 Nesting turtles

A total of 206 nesting green turtles were encountered on the beaches around the atoll (table 1.1). Of the 50 'already tagged' individuals located, 21 turtles were tagged in previous years (table 2.1). As usual, most turtles showed high fidelity to their nesting beaches. Nonetheless, one turtle that was tagged on the settlement beach was seen ashore at Anse Malabar only a week later (20km away).

Almost a quarter of the turtles were encountered on the 2km long settlement beach (figure 1.1) where they were seen in increasing numbers with an increasing distance from the station.

The number of untagged turtles encountered versus tagged individuals has remained fairly stable over the years (figure 1.2).

One nesting hawksbill turtle was tagged at beach 50c in December.

Table 1.1: The number of turtles handled in 2004

	Total handled	Total tagged	Total old tags
Nesting green turtles	206	156	50
Nesting hawksbill turtles	1	1	1
Juvenile green turtles	162	105	57

Table 2.1: The number of recaptured turtles tagged prior to 2004

1997	1998	1999	2000	2001	2002	2003
5	4	2	5	5	0	0

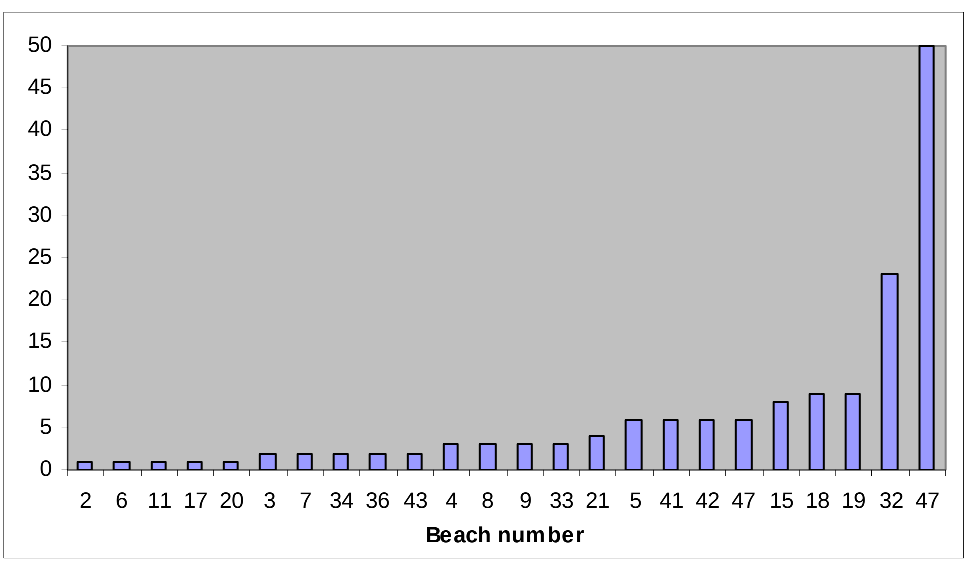

Figure 1.1: The number of nesting green turtles tagged at various beaches in 2004

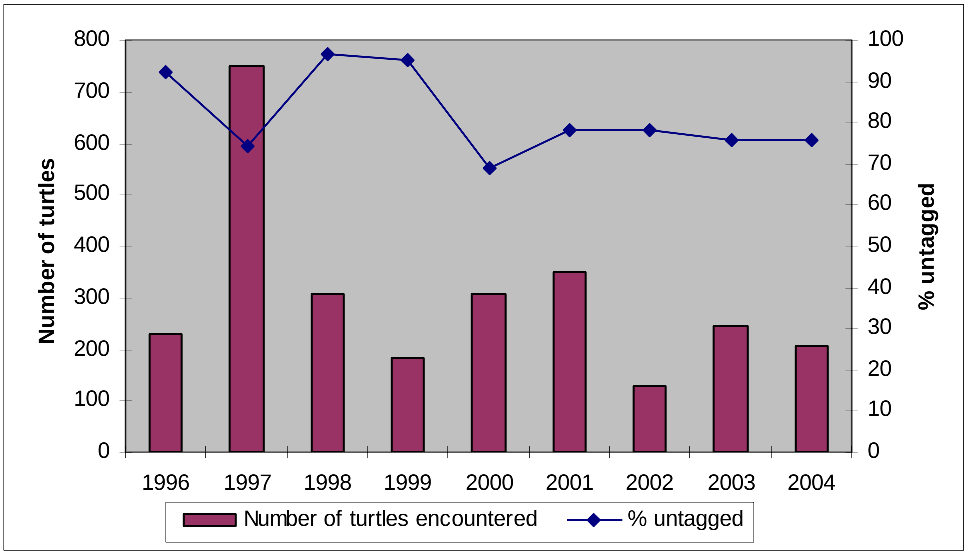

Figure 1.2: The number of turtles encountered and the corresponding percentage of untagged individuals over the years

2.1.2 Juvenile green turtles

Of the 57 recaptured juvenile green turtles, one was tagged in 2001, one in 2002 and 18 in 2003. The large majority (65%) of the turtles were captured at Ile Moustique. The shallow, clear water and sandy conditions around this lagoon island are favourable for rodeo activities. Even though so many turtles were tagged around Ile Moustique, the percentage of untagged individuals between the capture locations is fairly constant (figure 1.3). This suggests that juveniles move between these locations indeed, a few turtles that were captured at Ile Esprit were recaptured at Ile Moustique (and vice versa).

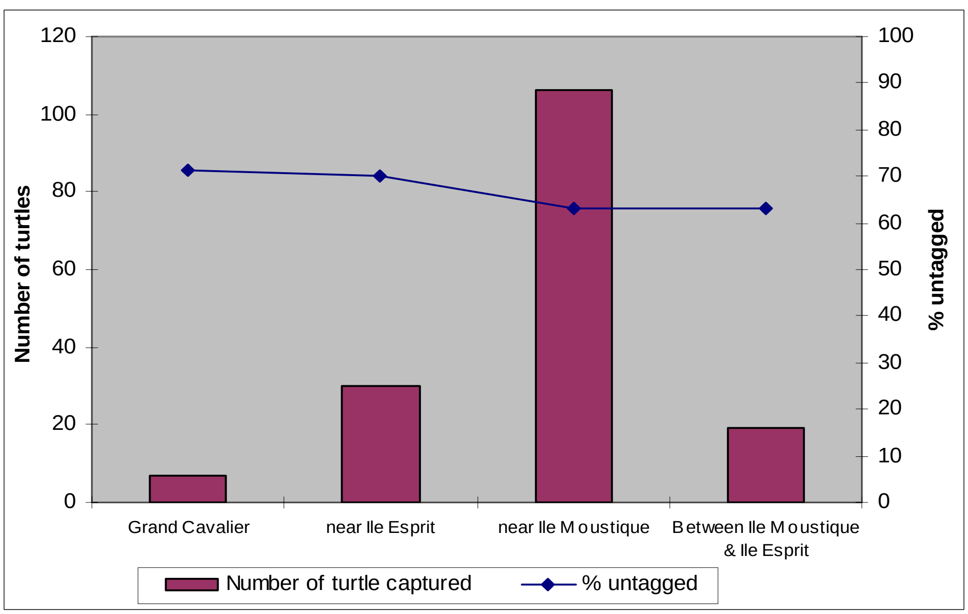

Figure 1.3: The number of juvenile turtles captured at the various rodeo locations and the corresponding percentage of untagged individuals over the years

2.1.3 Inaccuracy of morphometric measurements

On inspection of the tagging data, it was noted that a high degree of inaccuracy between morphometric measurements of the same individuals was evident. In order to test this assumption, measurements of turtles that were measured more than once during 2004 were compared. An 'inaccuracy index' was calculated through the division of the difference of like measurements by the larger of the two measurements.

Specifically: **inaccuracy index = (x^1 - x^2 / x_{max}) * 100.** The 2003 data was dealt with in the same manner in order to facilitate a comparison between the two years. For nesting green turtles a 186% increase in *inaccuracy* was found from 2003 to 2004. In other words, tagging personnel were three times less accurate when measuring turtles in 2004. Figure 1.4 shows that the 'tip to tip' and 'width' measurements were taken with particularly poor accuracy (see figure 1.6 for description of measurement parameters). For juvenile turtles, an increase of 48% in inaccuracy was found (i.e. measurements in 2004 were half as accurate as in 2003). From figure 1.5, tagging personnel were particularly careless with both the 'over the curve' and 'straight line' width measurements.

It must be noted that this is not attributable to a lack of training as accuracy improves dramatically when some supervisory pressure is applied. I believe that these shortcomings and the majority of other careless errors are based on a lack of concern rather than a lack of adequate training.

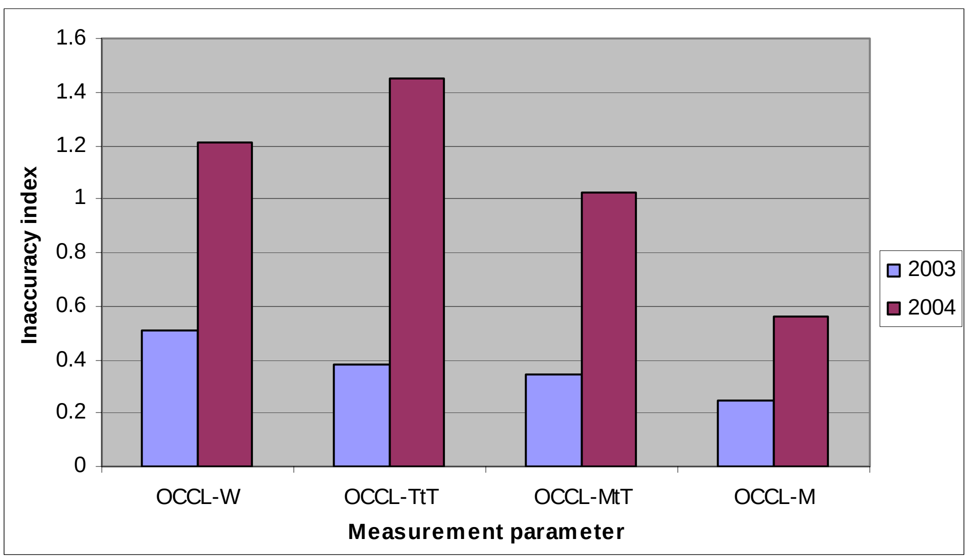

Figure 1.4: Mean inaccuracy indices for nesting green turtle carapace measurements in 2003 and 2004 (OCCL = 'Over the curve')

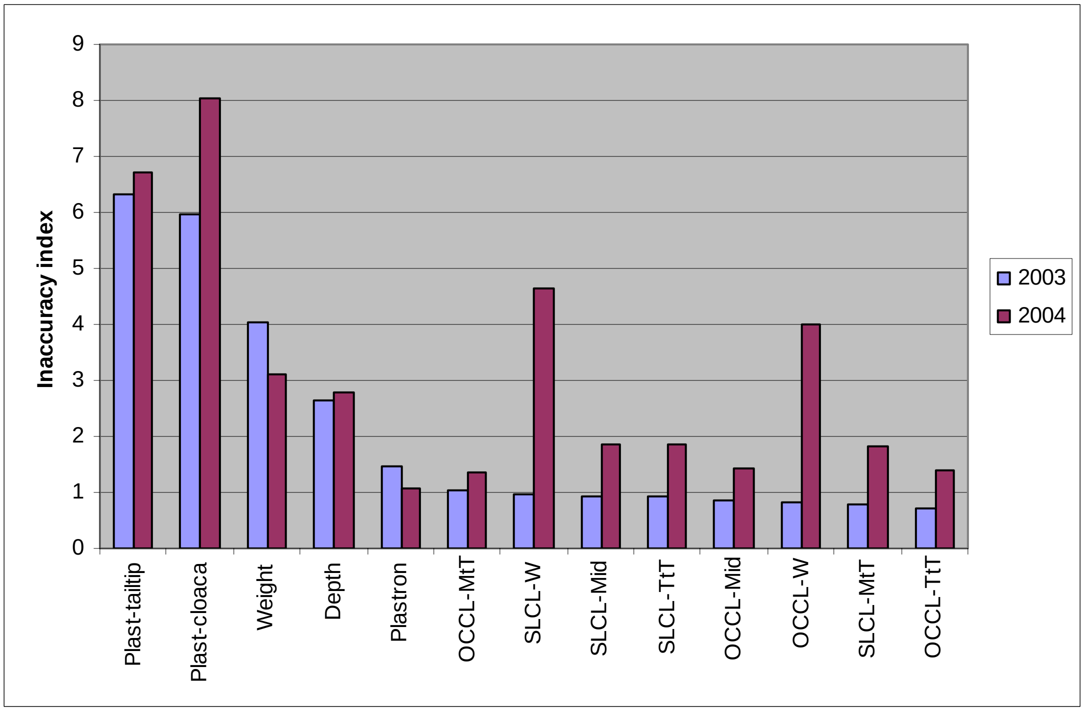

Figure 1.5: Mean inaccuracy indices for juvenile green turtle morphometric measurements for 2003 and 2004 (OCCL = 'Over the curve length', SLCL = 'straight line length')

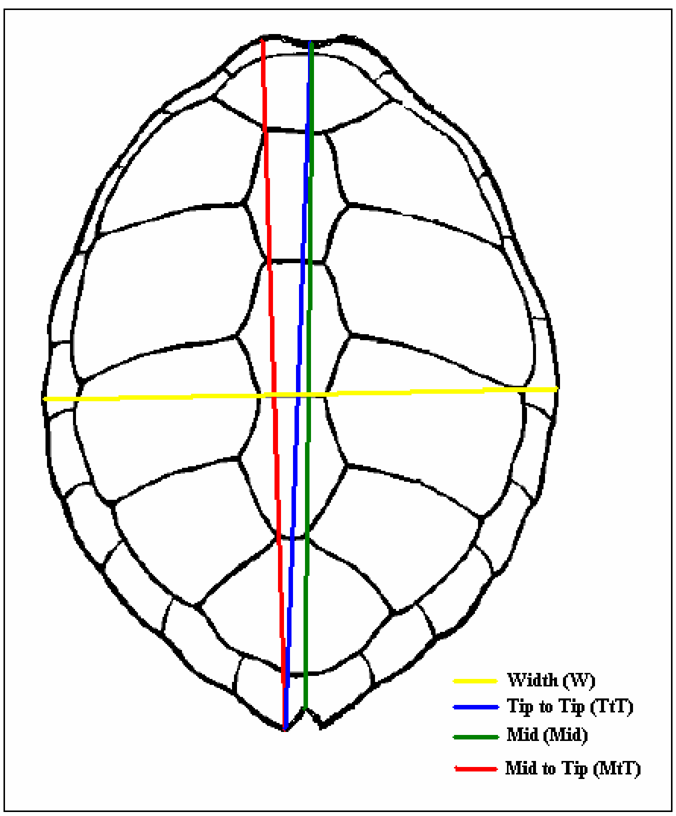

Figure 1.6:Carapace measurements of nesting and juvenile green turtles (nesting turtles only OCCL, juvenile turtles OCCL + SLCL)

2.2 Track counts

Figure 1.7 shows the number of track counts conducted at each of the 47 'outer rim' beaches in 2004. The frequency of counts is roughly in line with the required minimum (Mortimer 1997). Extrapolating from the sum of the settlement beach and West Grande Terre counts, 2004 provided average numbers of nesting green turtle emergences (in relation to the last 6 years). The high numbers of turtles recorded in 2001 is yet to be surpassed. Only 3 Hawksbill tracks were recorded on lagoon beaches.

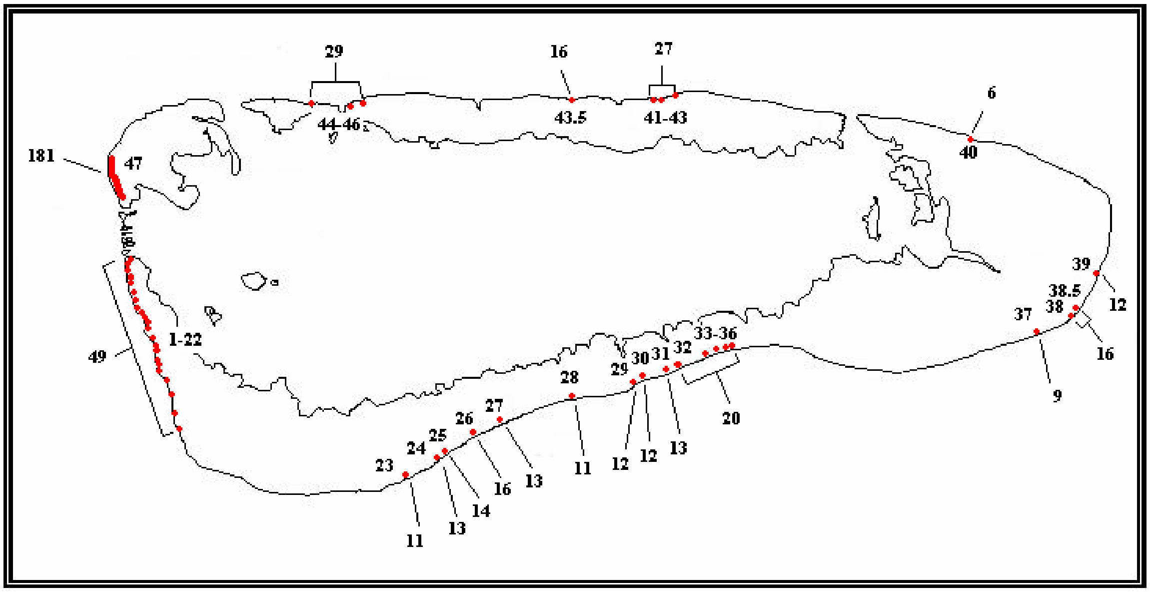

Figure 1.7: The number of track counts conducted per beach. 1-22, West Grande Terre; 23-27, Dune D'Messe region; 28-36, Dune Jean Louis region; 37-39, Cinq Cases region; 40, Anse Cedres; 41-43.5, Anse Malabar region; 44-46, Gionnet region; 47, settlement beach

At the settlement and West Grande Terre beaches, nest site selection has followed similar annual patterns. At the settlement beach, nesting frequency increases with an increasing distance from the station and at West Grande Terre, turtles favour the larger and more stable beaches (figure 1.8).

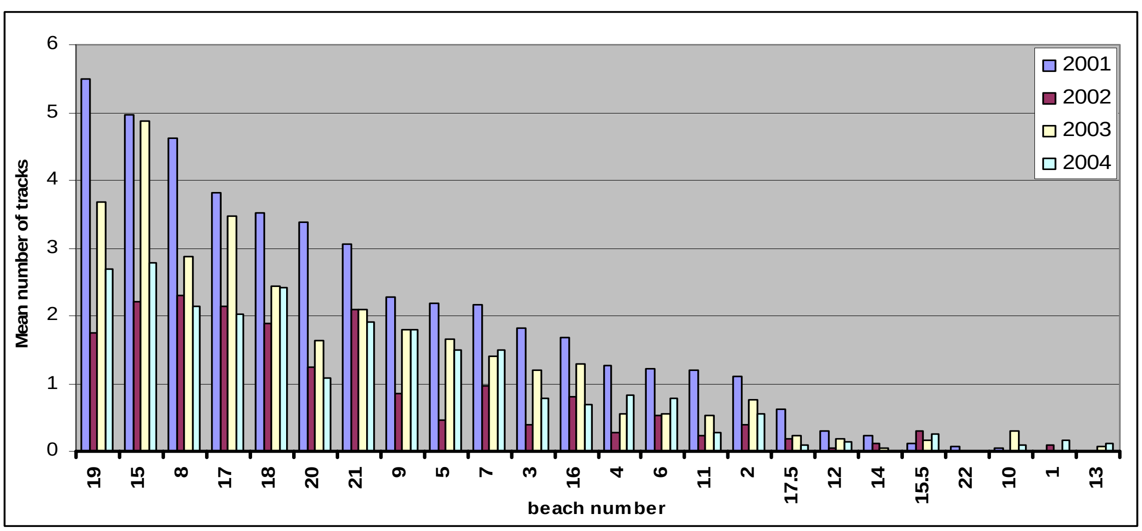

Figure 1.8: mean number of VF tracks per beach 2000 - 2004

Over the last 6 years, nesting seasonality has not followed the bi-modal pattern as reported in earlier years (Mortimer *et al*). At the settlement beach a single peak during March/April has been evident since 1999, (with the exception of 2000 where no seasonality occurred) confidence intervals show that this seasonal pattern is well established (figure 1.9). The West Grande Terre beaches show more variability in annual nesting seasonality. Nevertheless, at least the last two years seem to be conforming to the single March/April peak pattern (figure 1.10).

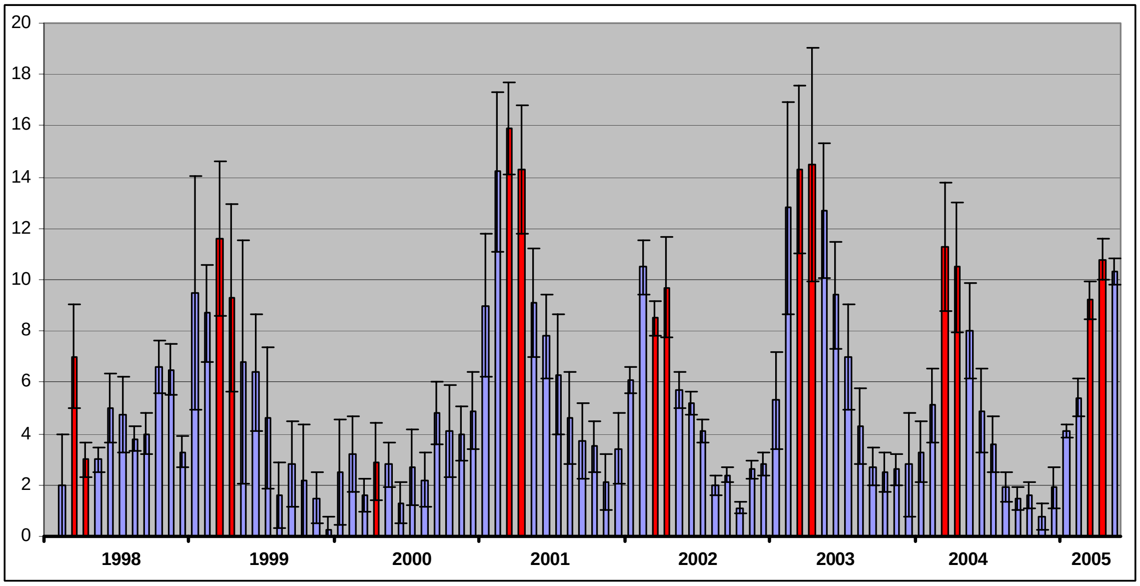

Figure 1.9: Monthly mean numbers of VF tracks on the settlement beach between 1998 and May 2005 showing 95% confidence intervals. Red columns represent the months of March and April.

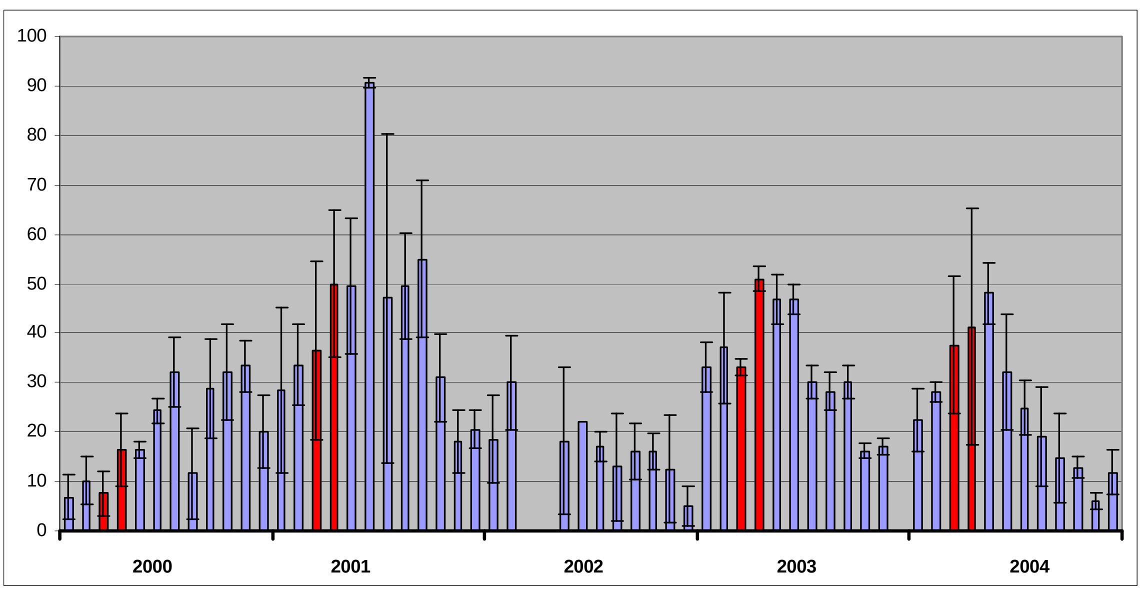

Figure 1.10: **Monthly mean numbers of VF tracks along West Grande Terre beaches between 2000 and 2004 showing 95% confidence intervals. Red columns represent the months of March and April.**

3. Tortoises

3.1 Introduction

All tortoise transects were completed on a monthly basis and seeing that the rangers were unsupervised for the majority of the year, this is a commendable feat and the rangers should be congratulated for their effort and planning. As has been stated before, **it is of utmost importance that this effort is maintained in the years to come**. The omission of only one transect count per annum can dramatically reduce the statistical integrity not only of the results for that year, but the database as a whole.

Two population models were introduced to standardise data entry and reporting formats, one model was developed by David Bourn (david.bourne@ntlworld.com) and the other was developed by me (holdevb@mweb.co.za). Strictly speaking, both programs are better described as 'self-analysing databases' as the term 'model' usually refers to a system that includes some form of predictive output. Neither Bourn's nor my 'model' makes predictions; they simply provide a simple system of data entry and automatic analysis of data. Nevertheless -for the sake of continuity and simplicity- I will continue to refer to both programs as 'models'.

The major difference between the models is that Bourn's model derives actual *population estimates* whereas mine uses an *index of tortoise numbers* to describe *trends*. In Bourn's model, tortoise population estimates are generated for each vegetation type by multiplying the average density of tortoises found in all sampled sections of that vegetation on an island over a specified period of time, by the total area of that vegetation (Bourne & Goodridge 2004). There are two considerable, and possibly detrimental, **assumptions** to this approach namely: 1) that transects are representative samples of the various vegetation types on the atoll and; 2) that tortoises are evenly distributed throughout each vegetation type. **It is unlikely that assumption 1 holds true** as all transects (except for those situated in naturally open areas) have, to some degree, been cleared of vegetation to create a passage for observers to move along **(see adjoining pictures on this page)**. This has created favorable, artificial habitat for tortoises and has undoubtedly resulted in a misrepresentation of actual numbers in the corresponding vegetation types. For instance, in the Pemphis vegetation it is virtually impossible to move about without clearing the way with a machete. Much of the larger Pemphis stands around the atoll have exceedingly low tortoise densities. However, because an artificial path has been created for the tortoises, numbers are probably overestimated in this vegetation type. Indeed, Bourn's estimates in the Pemphis vegetation between 1998 and 2003 range between 7000 and 12000. Even though actual population estimates are more 'meaningful' to the reader at first glance, it may not be the best approach.

My model has one major (and possibly detrimental) **assumption** namely that shifts in tortoise numbers along transects represents actual shifts in the population on that island as a whole. Fundamentally, this assumption correlates with Bourn's however, **the assumption that the vegetation along transects represents actual vegetation types on that island, is eliminated**. My model was created not with the intention of providing population estimates, but rather to *identify and describe trends in numbers along transects*. Transect sections are not divided into their various vegetation types and used for extrapolation, rather, each transect is treated as a 'stand alone' unit. **A 'threshold of potential concern'** was applied with the intention of providing managers with a threat analysis based on the *consistency*, *degree* and the *reliability* of potential declines in annual tortoise numbers along each transect. For instance, a continuous decline in tortoise numbers along all six transects on Grande Terre would exemplify a high level of concern whereas poor similarity in trends would suggest the opposite. Further information regarding model development and functioning can be obtained from the SIF on request.

As far as the actual **software** is concerned, we have not been able to generate population estimates or routine reports from Bourn's model. Apparently multiple copies of the program were transferred between computers (Station staff *pers. comm*.) and it is likely that an internal link between files has been broken. Nonetheless, graphs depicting monthly and quarterly results per transect are still displayed (but cannot be exported in report format) and show identical results to that generated by my model. Both models are therefore sorting and analyzing data correctly at the bottom end (this is important because an error at the bottom end of the analysis is detrimental to the final results). Since I am not able to generate reports from Bourn's model, I was not able to include the results in this report. All results displayed below are copied directly from my model which has been functioning without incident. A complete copy of Bourn's model findings will be forwarded to the SIF as soon as the software is repaired. Bourn's model provides excellent reporting procedures and it will take a matter of a few minutes to generate the report and send it to SIF.

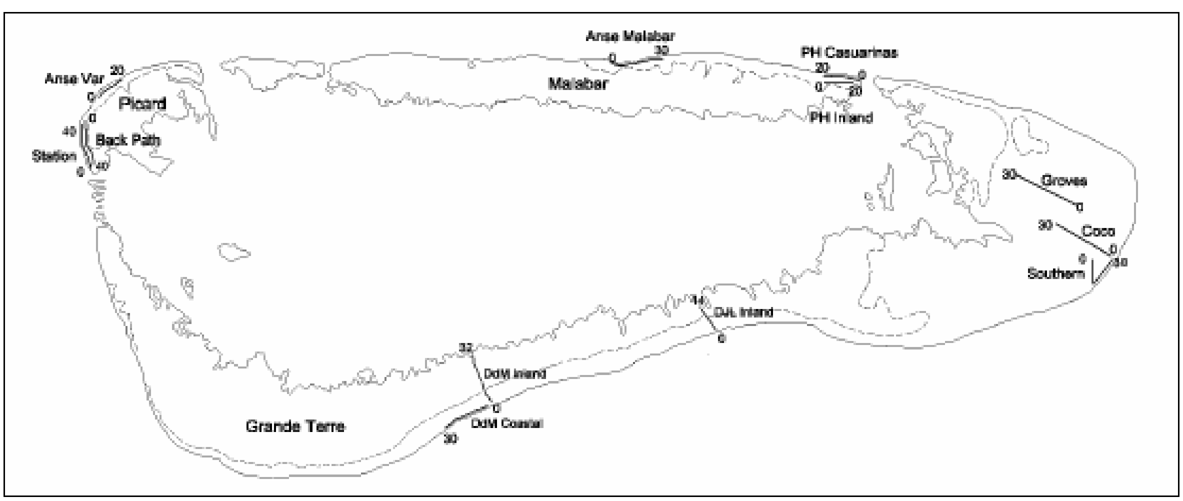

Figure 2.1: The location and relative length of tortoise transects around the atoll (from Bourne 2004)

3.2 Model results –threat analysis and annual trends per transect

Due to the high volume of tables and graphs displayed by the model, only selected material is displayed in this report. Furthermore, seasonal patterns in numbers and other well established demographical phenomena will not be revised here. A copy of my full model will be forwarded to the SIF in digital format as an addendum to this report. Readers wishing to view query related results directly form the model should request a copy of the digital version from the SIF.

3.2.1 Grande Terre

3.2.1.1 Groves transect

Tortoises numbers along the groves transect seem to be oscillating smoothly between 200 and 350 tortoises per annum. In 2000 the threat analysis tool assigned a level 1 concern to the declining trend and then returned to a 'threatless' situation in 2001 when the trend was reversed.

Table 2.1: Threat analysis –Cinq Cases Groves

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	YES	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

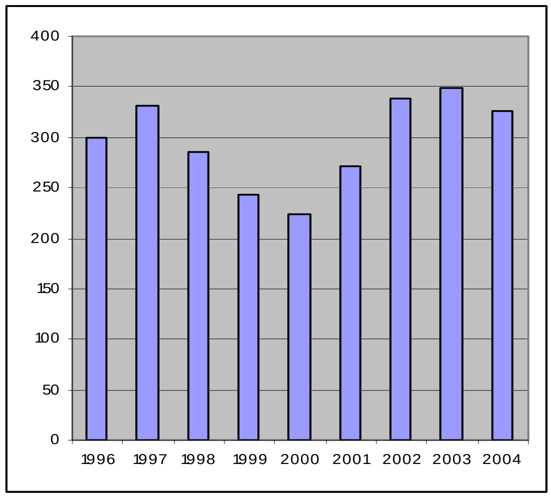

Figure 2.2: Annual trend in numbers –Cinq Cases Groves

3.2.1.2 Coco transect

Similarly to the Groves transect, numbers showed a slump in 2000 followed by a gradual recovery. Monthly tortoise counts followed the usual seasonal pattern (peak in summer and low in winter).

Tortoises on the Coco transect

Tortoise turf on the Coastal transect

Table 2.2: Threat analysis –Cinq Cases Coco

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	YES	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

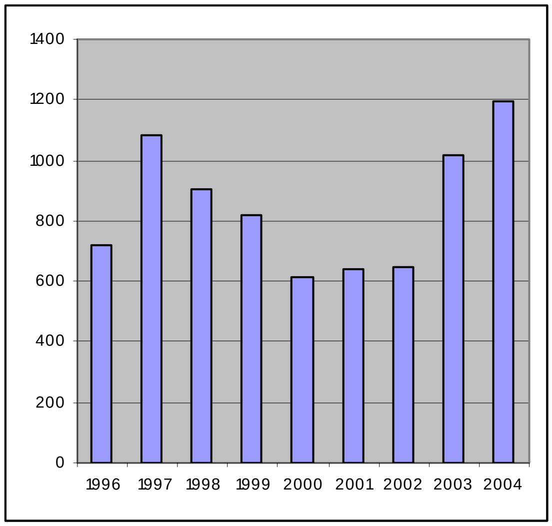

Figure 2.3: Annual trend in numbers –Cinq Cases Coco

3.2.1.3 Coastal transect

Annual trends have fluctuated strongly ($r^2 = 0.28$). The 2004 data shows a continuation of the current upward trend. In 1998, just less than half the tortoises encountered in the preceding year were recorded (level 1 concern).

Table 2.3: Threat analysis –Cinq Cases Coastal

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	YES	no	no
1999	no	no	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

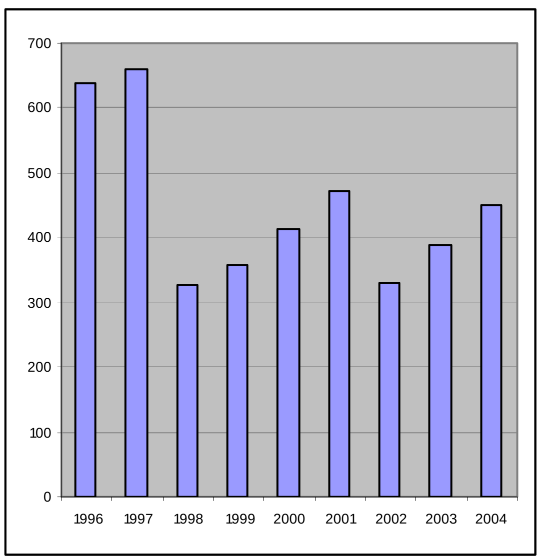

Figure 2.4: Annual trend in numbers –Cinq Cases Coastal

3.2.1.4 Dune D'Messe coastal

Similarly to the Groves and Coco transects, the year 2000 saw a change in the previously declining trend in numbers. As with the abovementioned transects, a level 1 concern was registered by the model in 2000. Seasonal variation in numbers was synonymous with the usual pattern.

Table 2.4: Threat analysis –DDM coastal

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	YES	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

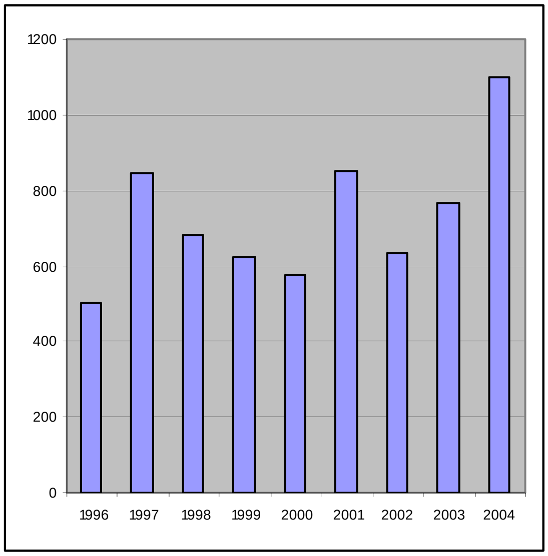

Figure 2.5: Annual trend in numbers –DDM Coastal

3.2.1.5 Dune D'Messe Inland

A strong correlation exists between the trend on this transect and Cinq Cases Coastal ($r = 0.82$, $p < 0.01$). Similarly to the latter, numbers of tortoises have been variable over the years ($r^2 = 0.25$). In 1998 less than half the number of tortoises recorded in the preceding year were counted, hence the level 1 concern. A level 1 concern was registered again in 2001 as numbers fell below that of 1998. However, since then numbers have been on the increase.

Table 2.5: Threat analysis –DDM Inland

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	YES	no	no
1999	no	no	no
2000	no	no	no
2001	YES	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

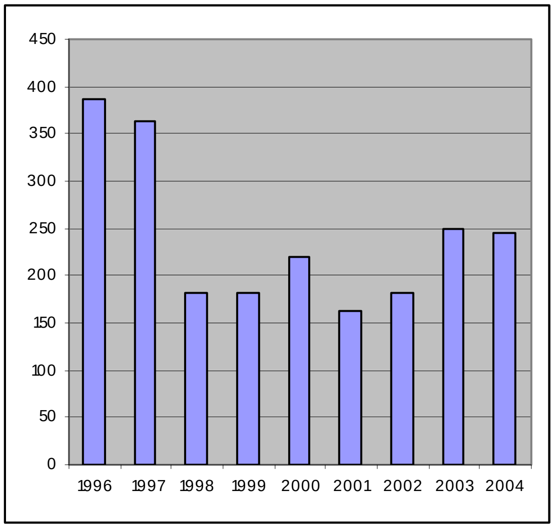

Figure 2.6: Annual trend in numbers –DDM Inland

3.2.1.6 Dune Jean-Louis

Similarly to the Coco, Groves and DDM coastal transects, a change in trend direction was noted in 2000. In this case however, the model assigned a level 2 concern in 2000 because the decline had been continuous for 5 years (rather than 4 –TPC calibration).

Table 2.6: Threat analysis –DJL

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	YES	no	no
2000	YES	YES	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

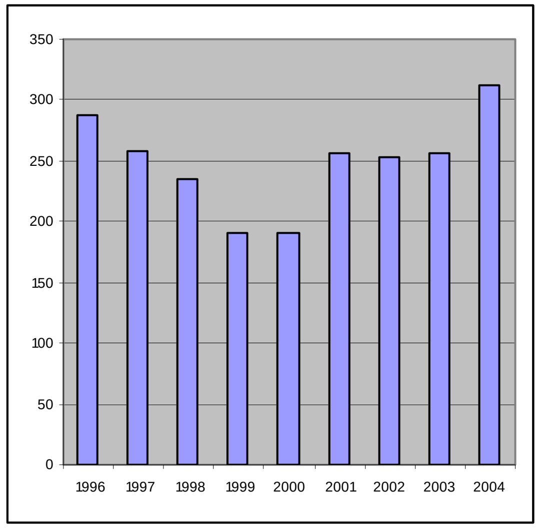

Figure 2.7: Annual trend in numbers –DJL

3.2.2 Malabar Island

3.2.2.1 Malabar transect

In contradiction to most of the Grande Terre transects, the year 2000 represented a peak in numbers. No concerns were computed as the general tendency along this transect is one of increase.

Table 2.7: Threat analysis –Malabar transect

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

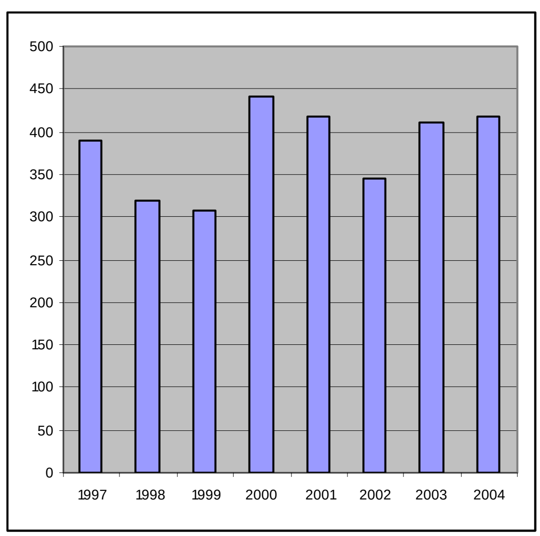

Figure 2.8: Annual trend in numbers -Malabar transect

3.2.2.2 Middle Camp Inland

The peak in numbers in 2000 is synonymous with that of the Malabar transect. No levels of concern have been allocated thus far.

Table 2.8: Threat analysis –Middle Camp Inland

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

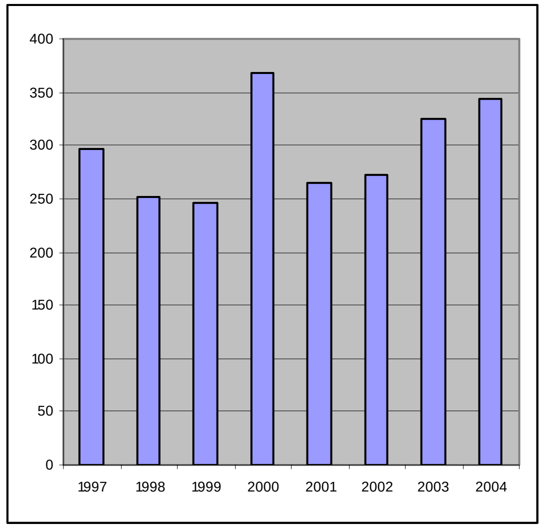

Figure 2.9: Annual trend in numbers –Middle Camp Inland

3.2.2.3 Middle Camp Casuarina

The peak in numbers in 2000 for the Middle Camp Inland and Malabar transects reflect the decrease in numbers along the Casuarina transect in that year. As a result of the emigration from this transect in 2000, a level 1 concern was registered.

Table 2.9: Threat analysis –Middle Camp Casuarina

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	YES	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

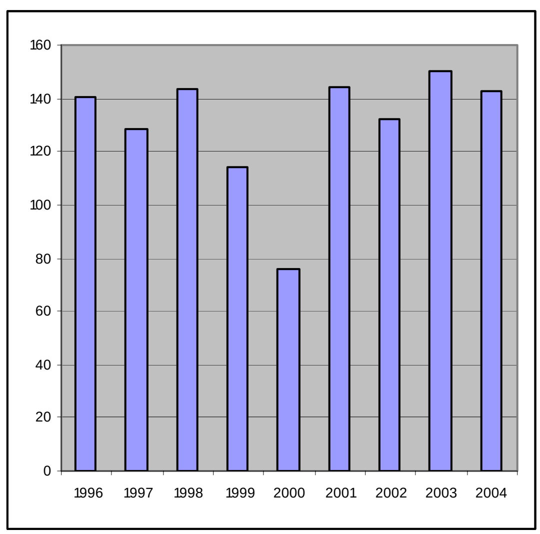

Figure 2.10: Annual trend in numbers –Middle Camp casuarina

3.2.3 Picard Island

3.2.3.1 Coastal

A variable but generally increasing trend in numbers is evident. Seasonal variation during 2004 conformed to the established pattern.

Table 2.10: Threat analysis –Picard Coastal

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

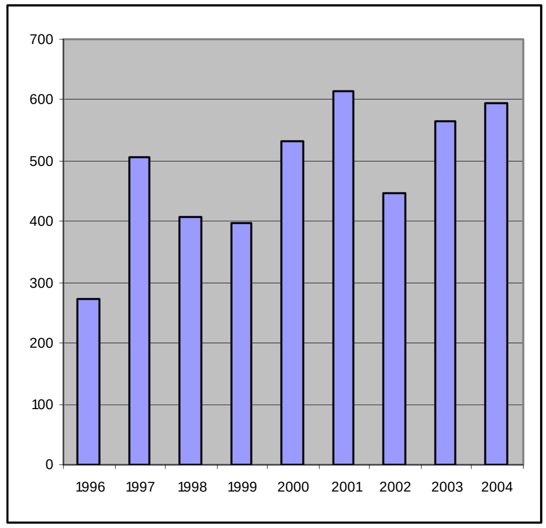

Figure 2.11: Annual trend in numbers –Picard Coastal

3.2.3.2 Back Path

Numbers have been increasing along a more stable linear trend ($r^2 = 0.73$). No reason for concern has been raised at any point.

Table 2.11: Threat analysis –Picard Back Path

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	no	no	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

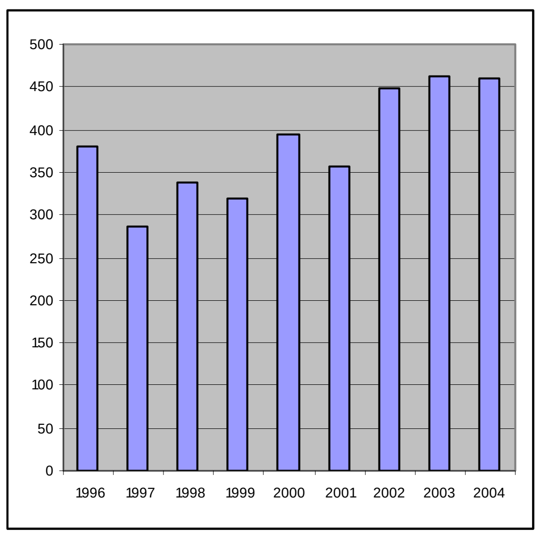

Figure 2.12: Annual trend in numbers –Picard Back path

3.2.3.3 Anse Var

The steep decline between 1996 and 1999 raised a level 2 concern. However, since then the trend seems to have reversed.

Table 2.12: Threat analysis –Picard Anse Var

Year	Concern level 1	Concern level 2	Concern level 3
1996	no	no	no
1997	no	no	no
1998	no	no	no
1999	YES	YES	no
2000	no	no	no
2001	no	no	no
2002	no	no	no
2003	no	no	no
2004	no	no	no

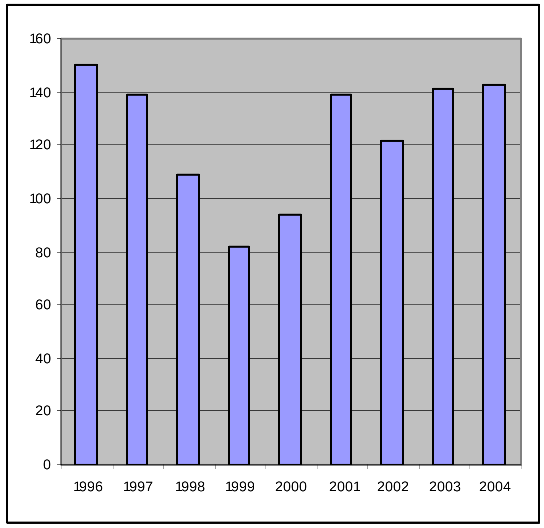

Figure 2.13: Annual trend in numbers –Picard Anse Var

3.3 Discussion and further analysis

3.3.1 Trends in numbers per island with future predictions

3.3.1.1 Grande Terre

Between 1997 and 2000, a significant decrease in population numbers was reported (Bourne 1999). This concern is clearly reflected in figure 2.14. However since 2001, numbers have been increasing to a point were the total number of tortoises counted in 2004 exceeded that of 1997 (figure 2.14). It is believed that the Grande Terre population might be in a state of equilibrium that is cyclic or chaotic (Bourne 1999). This is reflected by the insignificance of the linear trend line expressed in figure 2.14. Consequently, it is not possible to make any reasonable predictions regarding future trends in population numbers.

On four of the six transects, tortoise numbers ‘bottomed out’ in 2000. It is interesting to note that mean annual rainfall over the given period was lowest in 2000 (figure 2.15) and it seems plausible that low tortoise numbers in that year are - at least to some degree - a consequence of poor levels of precipitation. Even though a significant decrease in rainfall may increase adult mortality (an immediate population response), it should have a greater effect on recruitment (delayed population response). It is therefore unlikely that the poor rainfall in 2000 resulted in an actual decrease in tortoise numbers as portrayed by figures 2,3,5 & 7. A more parsimonious explanation may be that, due to the fact that tortoises are less active during dryer periods (Gibson and Hamilton 1983) and because transects are cleared regularly to permit the passage of observers (less shade cover), fewer tortoises were encountered. In other words: tortoises were spending more time in the shady areas away from the more open transects and hence, less were counted. There is no significant data to substantiate this comment and it should be regarded as speculation.

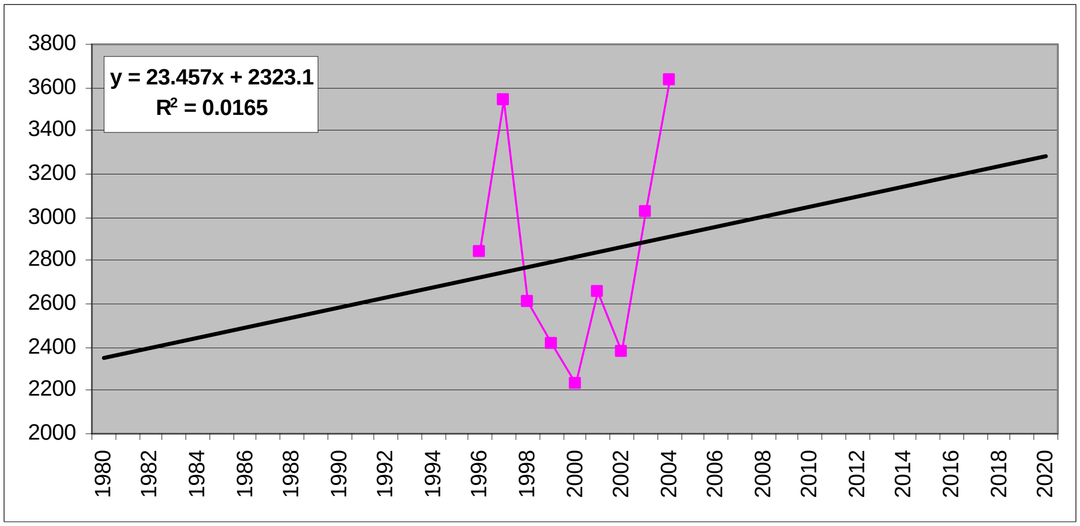

Figure 2.14: Total number of tortoises counted on Grande Terre per annum. Linear trend line is insignificant

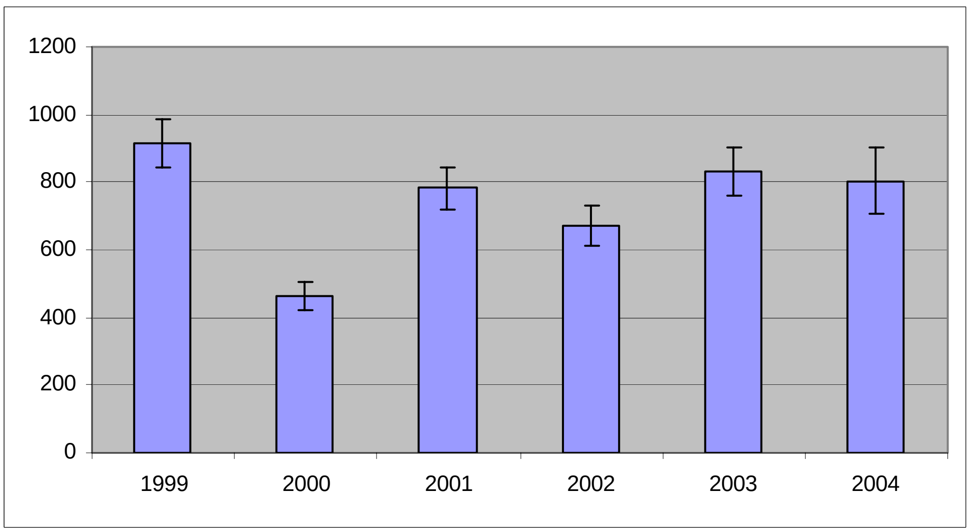

Figure 2.15: Mean annual rainfall at Aldabra. Years 1996 – 1998 omitted due to incomplete records

3.3.1.2 Picard Island

In the past, the tortoise population on Picard was subject to overexploitation and it is quite clear that the population is still recovering. In contradiction to the Grande Terre population, tortoises are nowhere near carrying capacity and are therefore not regulated by density dependent factors. Population growth form in recovering populations should be exponential until density dependent factors begin to level out the trend.

There is a strong correlation between the annual numbers of tortoises counted on Picard and Malabar ($r = 0.85$, $p < 0.01$) (figure 2.16). This is to be expected because both populations are at low densities and are subjected to similar environmental factors within similar habitat types. Furthermore, the exponential trend line on Picard is significant ($r^2 = 0.78$, $p < 0.05$) (figure 2.17) and reflects the previously established increasing trend in tortoise numbers (Bourn 1999). On the basis of the above, it is reasonable to project numbers into the future along the exponential trend line. According to the exponential trend line equation, tortoise numbers on Picard should double by the year 2016. Note that no 95% confidence intervals can be calculated reducing the reliability of the projected trend markedly.

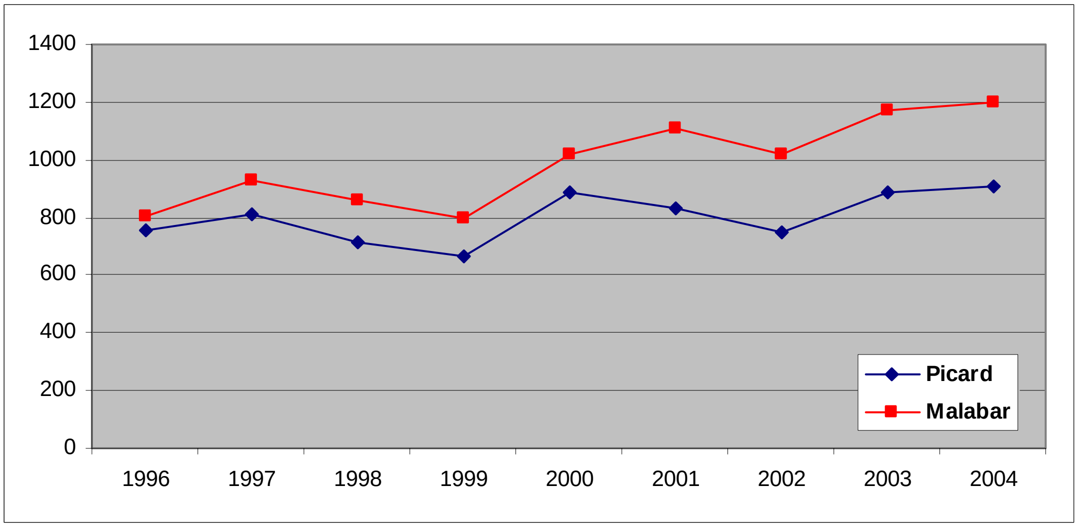

Figure 2.16: Total number of tortoises counted on Picard and Malabar per annum

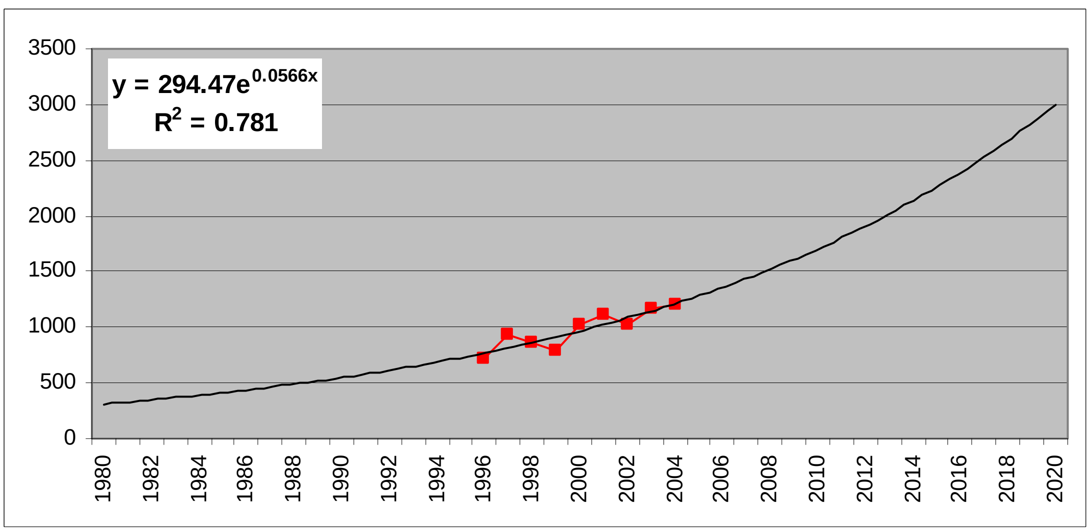

Figure 2.17: Total number of tortoises counted on Picard Island per annum. Exponential trend line is significant

3.3.1.3 Malabar Island

Similarly to the Picard population, tortoises on Malabar also seem to be recovering from previous overexploitation. When an exponential trend line is applied to the Malabar data, an insignificant relationship between time and total number of tortoises counted per annum is recognized. As a result, the exponential trend line depicted in figure 2.18 is insignificant.

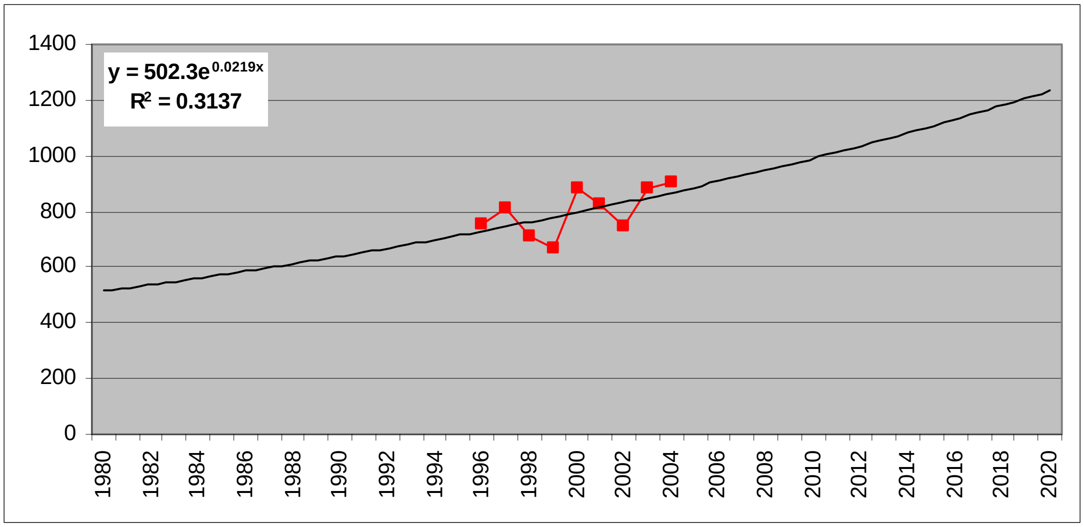

Figure 2.18: Total number of tortoises counted on Malabar Island per annum. Exponential trend line is insignificant

3.3.2 Mean scute size

The curved length of the third dorsal scute can be used as an index of tortoise size (Bourne & Coe 1976). Mean scute sizes calculated by the model are in accordance with the established morphological variation between Islands. Picard Island clearly supports the largest tortoises followed by Malabar and Grande Terre with the latter showing significantly smaller sizes. Large body size is a luxury specific to those tortoise populations that are not regulated by density dependent factors such as the low-density populations on Picard and Malabar. It is postulated that mean scute size should decrease proportionately with a decrease in the availability of food and that in years to come, scute size could offer a potential index of population growth on Picard and Malabar. At this point in time however, mean annual scute size is variable but no pattern can be assigned to the long-term trend (insignificant trend lines). On Grande Terre the Dune Jean-Louis and Dune D'Messe inland transects showed significant variation in annual scute length along significant polynomial trend lines (figure 2.20). Furthermore, there is a strong correlation in pattern between the two trends ($r = 0.95$, $p<0.001$). I am not able to provide a rational explanation for this relationship.

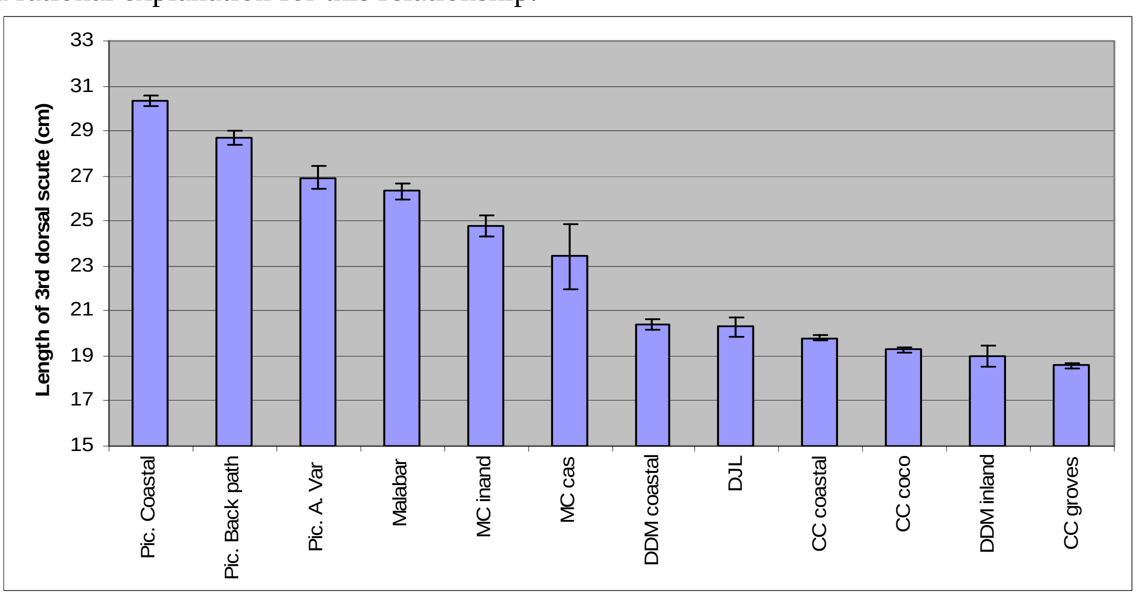

Figure 2.19: Mean scute size per transect (derived from pooled data 1996-2004)

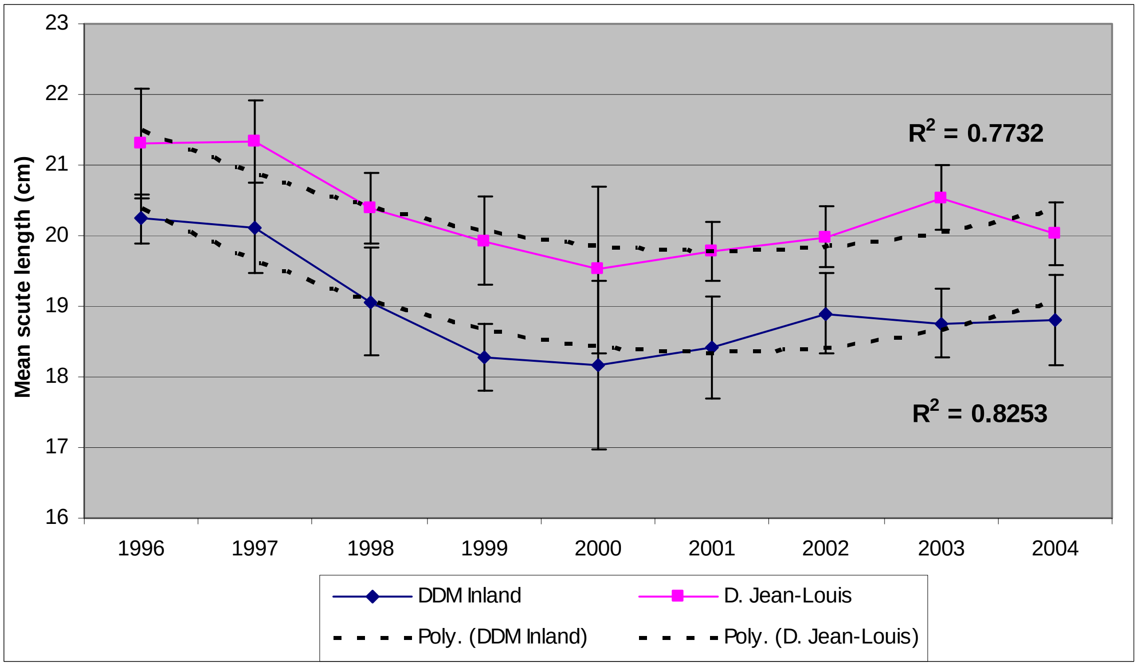

Figure2.20: Mean annual scute length for Dune D'Messe inland and Dune Jean-Louis Transects (derived from pooled data 1996-2004. Polynomial trend lines are significant

3.3.3 Sex ratios

Tortoises with less than 20cm scute length are difficult to sex and are therefore recorded as "unidentified". On Grande Terre, mean scute size ranges between 18.5 and 20.4 cm and as a result, unidentified individuals comprise both adults and juveniles. On Picard and Malabar, where mean scute length ranges between 23 and 30cm, tortoises with less than 20cm scute length can be classified as juvenile. It is interesting to note that on Picard, where tortoise numbers should be increasing at a faster rate than other islands, very few tortoises with less than 20cm scute length were recorded (figure 2.21).

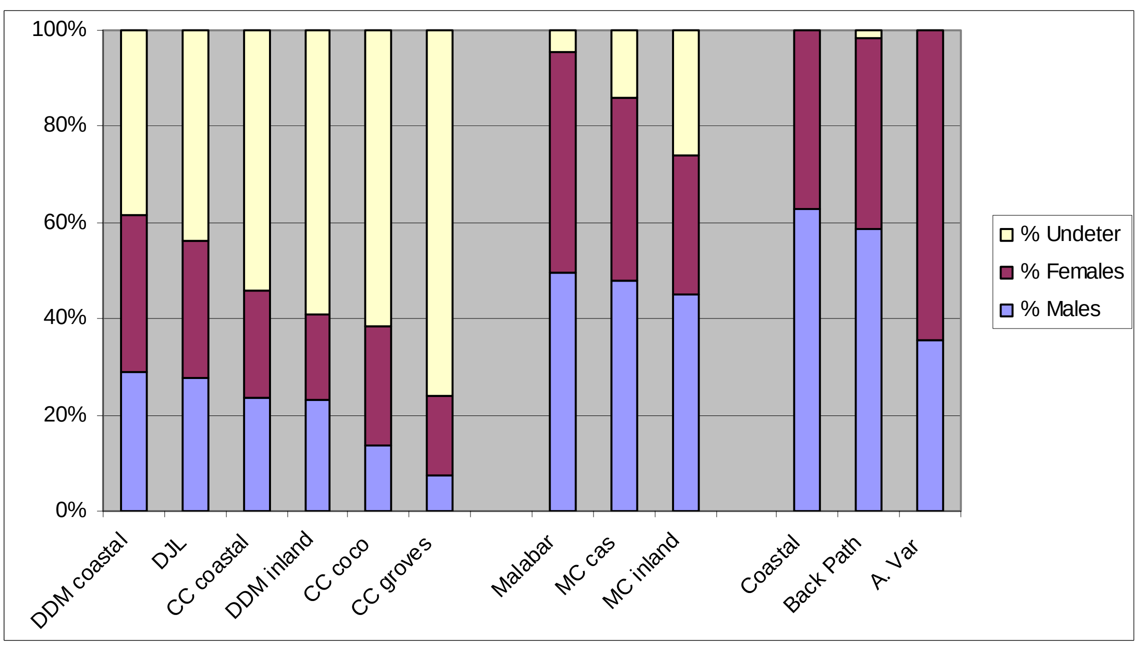

Figure 2.21: Sex ratios on the various transects during 2004

4. Birds

4.1 Land birds

Monthly land bird point counts are conducted along 7 transects around the atoll. Strong correlations between the annual number of sightings per species were found between 2002, 2003 and 2004 (***r* = 9.9, 9.8, 9.9**). A significant increase in land bird sightings in 2004 was calculated (**$F_{2,36}$ = 3.26, P< 0.05**) with the only exception being the Madagascar coucal. Sightings of the coucal during point counts have decreased over the years and even though the significance of this finding is questionable, further investigation may be necessary in the future.

Table 3.1: The number of land birds counted per annum

Species	2002	2003	2004
Souimanga Sunbird	1497	1679	2255
Madagascar Turtle Dove	675	683	1016
Madagascar White-eye	536	403	950
Madagascar Bulbul	495	378	497
Comoro Blue Pigeon	269	229	314
Aldabra Forest Fody	108	200	243
Aldabra Drongo	99	110	137
Aldabra Rail	74	67	112
Madagascar Coucal	44	38	13
Pied Crow	45	13	35
Sacred Ibis	34	24	32
Madagascar Kestrel	17	13	24
Madagascar Nightjar	2	1	2
Totals	**3895**	**3840**	**5630**

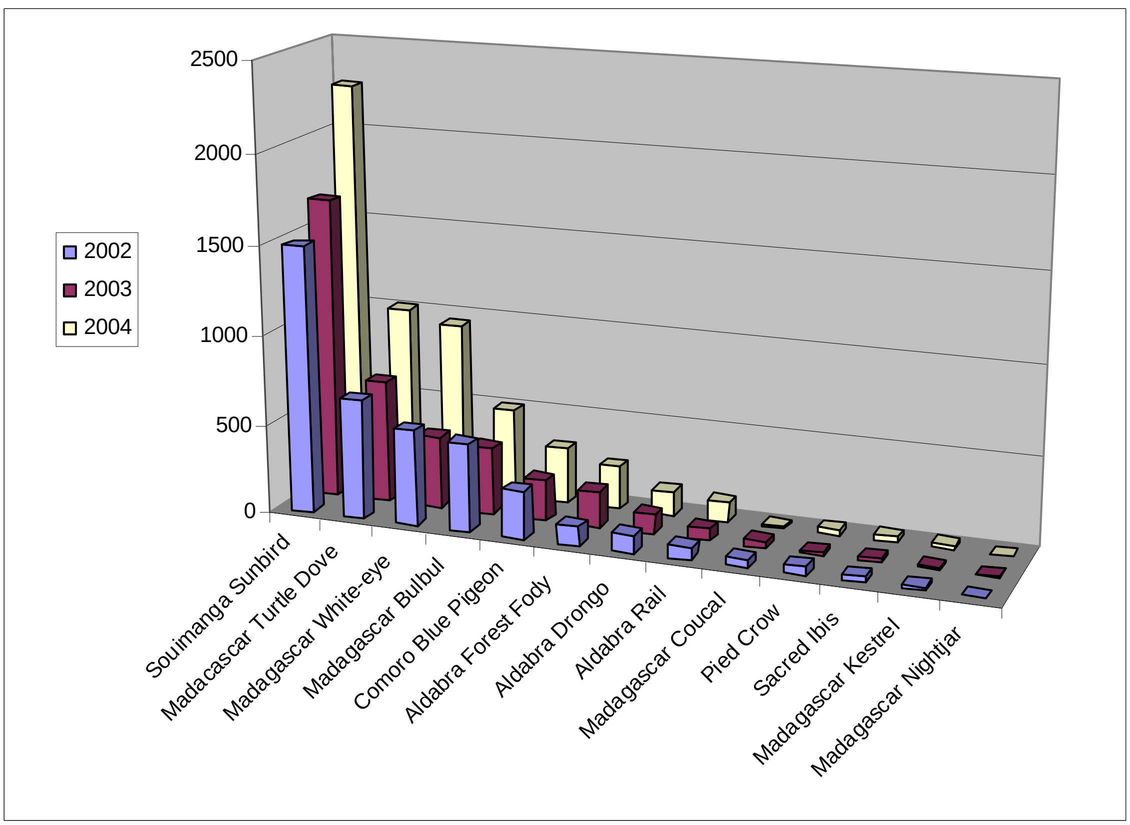

Figure 3.1: Total number of land birds counted per annum

4.2 Rail monitoring

Due to the high variance in previous datasets (see 2003 report), Mr. Ross Wanless suggested that the rail transects are conducted quarterly rather than monthly. There was a suspicion that the birds were becoming accustomed to the voice recordings and becoming less responsive. From table 3.2, it is evident that there is still high variance in the data. The monitoring program is currently under review (see 2005 monthly reports)

Table 3.2: The number of rails counted per transect in 2004

Month	Malabar	Middle Camp	Polymnie	Gionnet
February	24	27	3	8
May	15	24	3	11
September	9	12	3	6
December	8	17	8	14

4.3 Wader counts

At the settlement, wader counts were conducted on a monthly basis (table 3.3). Counts were conducted on days where the low tide fell over the early morning. All birds present on the beach and exposed reef flat were counted between the settlement and the boat shelter at La Gigi. In places were the reef flat is very wide, many birds (especially the smaller less distinct ones) may have been missed and as a result, these counts should not be treated as total counts. Additional variance created in the data is accounted to observer bias, variable weather conditions and the variable percentage of exposed reef flat during each count.

Table 3.3: Number of waders counted along the settlement transect in 2004

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common sandpiper	1											
Eurasian curlew	1											
Whimbrel	2	6	2	2	2	5	1	8	5	2	6	1
Ringed plover	3		1									
Sanderling	3	4	6									
Greater crested tern	4	2	5			2	1	1			3	1
Lesser sandplover	4	8	1				5	2	2		6	5
Grey heron	5	4	4	7	11	8	4	6	5	8	8	4
Lesser crested tern	6		7							1		
Green-backed heron	7	1	11	10	7	4	6	9	7	4	4	6
Greater sandplover	8	10		1	2					8		
Bar-tailed godwit	9	6					1				10	1
Curlew sandpiper	9	2						4				
Grey plover	12	7	6	1			4	2	3	2	8	4
Ruddy turnstone	44	73	47	7	3	4	25	22	83	98	62	75
Crab plover	78	50	37		20	7	35	15	3		72	35
Dimorphic egret	102	152	104	16	81	27	11	40	27	3	60	11
Black-naped tern		8	2		2	1	1	2	2		4	1
Caspian tern			1		1			3				
Greenshank								2				

Wader counts along the Grande Terre coast were more difficult to organize. Counts were conducted during the monthly walk undertaken by rangers between the Dune Jean-Louis and Dune D'Messe camps. The walk is always conducted in the morning and on those days where the high tide fell over the early morning period, no counts were conducted.

Table 3.4: Number of waders counted between Dune Jean-Louis and Dune D'Messe in 2004

Species	Feb	Jun	Sep	Dec
Crab plover	50	20		200
Grey plover	2		5	
Lesser sandplover	60			44
Greater sandplover	120	30	80	35
Whimbrel	2	1	4	7
Curlew sandpiper	6		90	
Ruddy turnstone		4	58	162
Sanderling			2	
Grey heron			7	10
Green-backed heron		2	4	
Dimorphic egret		1	4	2
Greater crested tern		3	3	
Caspian tern		4	2	1
Bar tailed godwit	4			
Little tern				50

4.4 Rare bird sightings

Opportunistic sightings of rare birds were recorded rather haphazardly. Data in the tables 3.5 – 3.16 is displayed as recorded by the various observers.

Table 3.5: Opportunistic sightings of *Little tern* in 2004

Date	Recorders	Location	No.	Notes
19/08/2004	TM/AD/MA	champignon des Os	30-35	resting on champignon/flying
24/09/2004	TM	Cinq case	20	Bch # 38, resting
16/11/2004	CB/AD	DDM	7	Feeding on the beach
18/02/2005	AD/TM/TL/LJ	Settle beach #23	25	Resting on sand bank

Table 3.6: Opportunistic sightings of *Broad-billed roller* in 2004

Date	Recorders	Location	No.	Notes
18/03/2004	AD/US	Station Picard	1	resting in casuarina tree back-path area
15/11/2004	US	Old settlement	2	resting in flame tree near the chapel
18/11/2004	TM	Old Settlement	1	In Indian Almond tree, then being chased by drongos

Table 3.7: Opportunistic sightings of *Brown booby* in 2004

Date	Recorders	Location	No.	Notes
03/09/2004	SY	West Channels	1	Adult sitting on champignon

Table 3.8: Opportunistic sightings of *Curlew sandpiper* in 2004

Date	Recorders	Location	No.	Notes
11/09/2004	TM	settlement beach	1	feeding in seaweeds

Table 3.9: Opportunistic sightings of *Greater Flamingo* in 2004

Date	Recorders	Location	No.	Notes
25/02/2004	US/NJ	Bassin Flamant	9	feeding/airborne on my arrival
23/03/2004	AD/TM	Cinq case landing	3	feeding
24/03/2004	TM/US	cc. south in pools	3	feeding 2 adult,1 juvenile
02/06/2004	PR/AD	cc. coco pts 20	2	flying over head
02/09/2004	TM/AD	Bassin Flamant	1	feeding/ young bird seen
02/10/2004	US,LA,CB	Cinq case landing	3	feeding
01/11/2004	TM/AD/CH	Inland Pool C.Case	21	feeding, preening, 3 juveniles present.
15/12/2004	AD/CB/SR/US	Inland Pool C.Case	9	feeding 1 juvenile present

Table 3.10: Opportunistic sightings of *Caspian tern* in 2004

Date	Recorders	Location	No.	Notes
11/03/2004	US/LA	Ile esprit	2	Get airborne on arrival (nest + 2 eggs)
19/03/2004	TM/US/AD	WGT	2	resting on sand Bch # 3
27/05/2004	US/LA/AD	grand poche	4	resting on beach
17/06/2004	AD	Bch 47 Zone 3	1	resting on sand bank
24/06/2004	AD/LA/SY	Anse Owen	7	resting on beach + 1egg on nest
02/07/2004	AD/TM/CB	grand poche	9	1egg on beach + 1 chick Flying
06/07/2004	AD	DDM around hut	2	flying
07/07/2004	AD/TM	DDM landing stage	3	1chick + 2 adult flying
08/07/2004	AD/TM/CBLA	grand poche	9	flying + 1 chick
20/07/2004	AD	WGT Bch # 6	2	1 adult + 1 chick flying
20/07/2004	AD/TM	WGT Bch # 15	1	adult flying
29/07/2004	AD/LA/CB/PR	Ile Moustique	9	flying
25/10/2004	CB	settlement beach	3	adult flying
16/11/2004	CB/AD	Dune De Messe	1	flying

Table 3.11: Opportunistic sightings of *Greater sandplover* in 2004

Date	Recorders	Location	No.	Notes
03/09/2004	US	beach # 25	50	resting on the dune
28/09/2004	US,LA	beach # 25	50	resting / airborne on our arrival.
29/09/2004	TM/CB	DJL Coast	80	feeding
25/10/2004	CB	settlement beach	4	feeding
26/10/2004	CB/US	settlement beach	9	feeding
09/11/2004	AD/US	settlement beach	2	feeding
25/01/2005	AD/US	settlement beach	1	feeding
07/02/2004	AD	settlement beach	3	feeding at low tide
10/02/2005	US	settlement beach	4	resting on sand bank

Table 3.12: Opportunistic sightings of *Lesser sandplover* in 2004

Date	Recorders	Location	No.	Notes
03/09/2004	US	# 25	30	resting on dunes
13/10/2004	AD/TM	settlement beach	8	feeding
25/10/2004	CB	settlement beach	9	feeding
26/10/2004	CB/US	settlement beach	8	feeding
27/11/2004	CB	settlement beach	7	feeding
28/12/2004	CB	settlement beach	3	feeding

Table 3.13: Opportunistic sightings of *Greenshank* in 2004

Date	Recorders	Location	No.	Notes
13/10/2004	TM/AD	settlement beach	2	feeding along the coast
25/10/2004	CB	settlement beach	7	feeding
26/10/2004	CB/US	settlement beach	1	feeding along the coast
09/11/2004	AD/US	settlement beach	1	fending along the coast
14/12/2004	AD/TL	C.C coco pts # 20	1	feeding inland pool CC coco

Table 3.14: Opportunistic sightings of *Eurasian golden oriole* in 2004

Date	Recorders	Location	No.	Notes
12/03/2004	US/TM/AD	Anse Mais	3	Roosting in casuarina trees
14/03/2004	US/LA/AD	Settlement	1	Roosting in casuarina trees

Table 3.15: Opportunistic sightings of *Tree pipit* in 2004

Date	Recorders	Location	No.	Notes
13/03/2004	US	Old Settlement	1	Feeding in tree (*Permina ceratifolia*)

Table 3.16: Opportunistic sightings of *Sanderlings* in 2004

Date	Recorders	Location	No.	Notes
07/06/2004	AD	settlement beach	1	Feeding ashore
13/10/2004	AD/TM	settlement beach	10	Feeding
25/10/2004	CB	settlement beach	18	Feeding
26/10/2004	CB/US	settlement beach	9	Feeding among seaweeds.
09/11/2004	US/AD	settlement beach	2	Feeding
27/11/2004	CB	settlement beach	10	Feeding
28/12/2004	CB	settlement beach	30	Feeding

5. Climate

During my absence in the first half of 2004, some of the rain-gauge measuring sticks were lost. As a result rangers used some other sticks that are calibrated differently. Unfortunately, both types of measuring stick were used during these months making it impossible to trace which calibration was used at which location and date. For this reason and the fact that there is significant numerical overlap between the two calibrations, it was not possible to identify and convert the incorrect measurements. In addition, some data was lost or not recorded and the Cinq Cases Groves gauge overflowed once (see table 4.1). Outstation rainfall data over this period should be discarded as it is highly counterproductive to use dubious climate data when investigating climate related phenomena.

Table 4.1: Outstation rain gauge readings. Figures in red are those where it is uncertain which calibration was used. During January to June, no research officer was present

	A.Var	B.Lebine	CC.G	CC.H	DDM	DJL	Gionnet	I.Esprit	MC	Polymnie
January	60	245	o/flow	250	45	45	40	172	20	90
February	60	58	205	240	310	225	230	220	410	120
March	100	140	165	115	55	162	75	135	65	10
April	25	10	23	40	58	55	80	35	85	70
May	12	30	41	55	42	58	lost	5	35	lost
June	50	45	lost	25	40	20	lost	-	5	lost
July	20	28	26	20	12	5	10	55	42	13
August	30	45	54	80	55	60	55	12	30	48
September	1	10	10	12	5	2	16	5	0	15
October	15	15	19	15	97	140	4	3	25	20
November	130	122	111	115	1	14	120	90	112	107
December	30.1	52	30	22	35	31	10	275	5	20

The automatic weather station broke down completely in July. This condition has remained unchanged and as a result, no wind speed and direction data has been recorded for that period.

Manual temperature and rainfall readings have been taken regularly at the station. Mean temperature and rainfall have shown typical patterns (figure 4.1 & 4.2).

Mean rainfall figures for outstations between 1999 and 2004 show significant variation only between the Anse Var and Cinq Cases Groves gauge (figure 4.3). Mean annual precipitation between 1999 and 2004 shows significant variation. The year 2000 shows particularly low precipitation (figure 4.4). The years prior to 1999 were omitted from the analysis due to incomplete records. It must also be noted that values for 2004 are subject to error due to the calibration problems in the first half of that year.

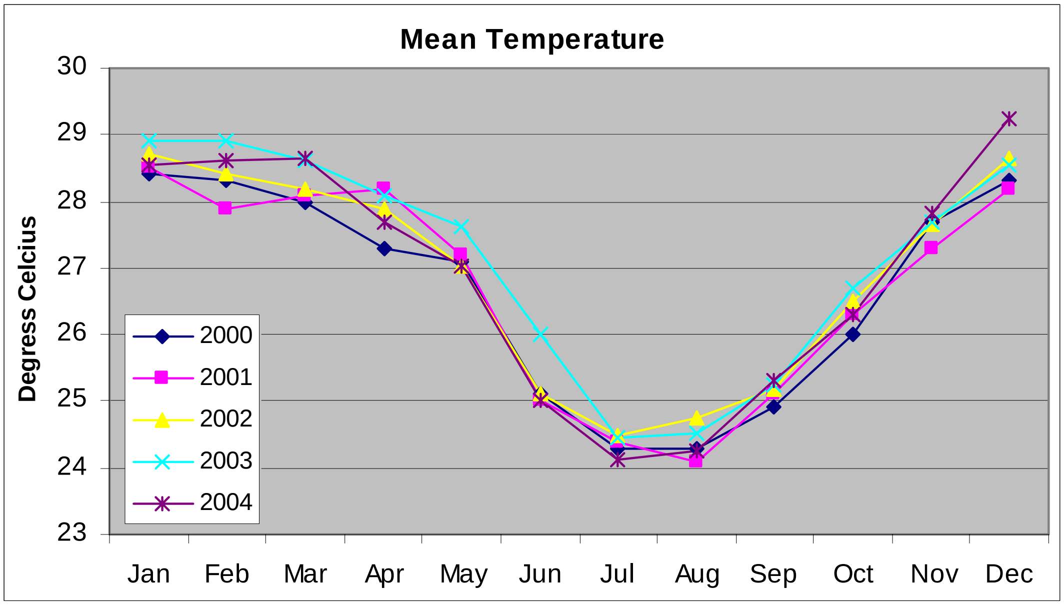

Figure 4.1 Mean dry bulb temperature between 2000 and 2004

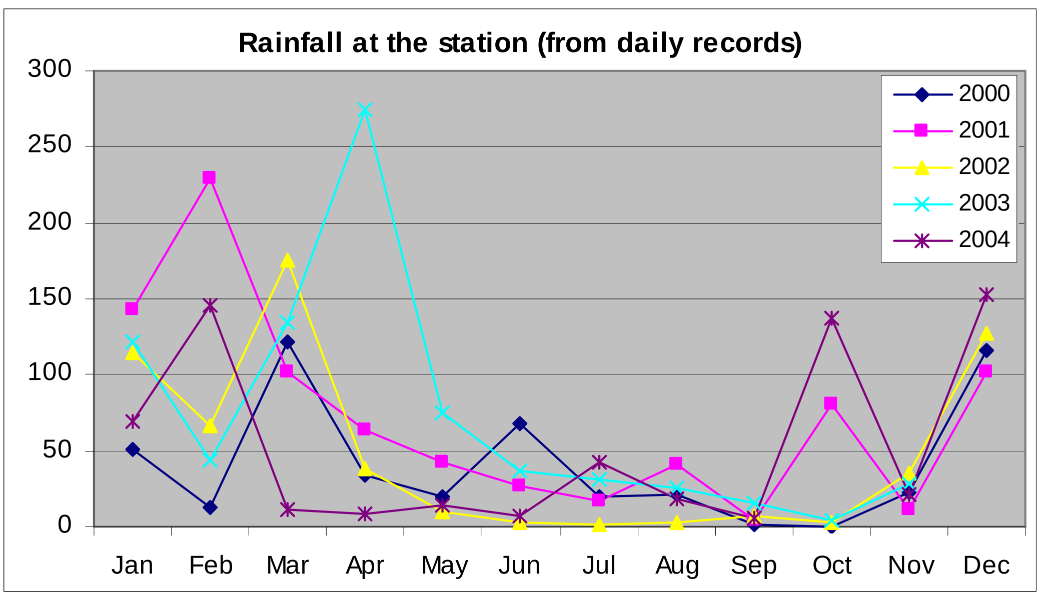

Figure 4.2 Rainfall at the station between 2000 and 2004

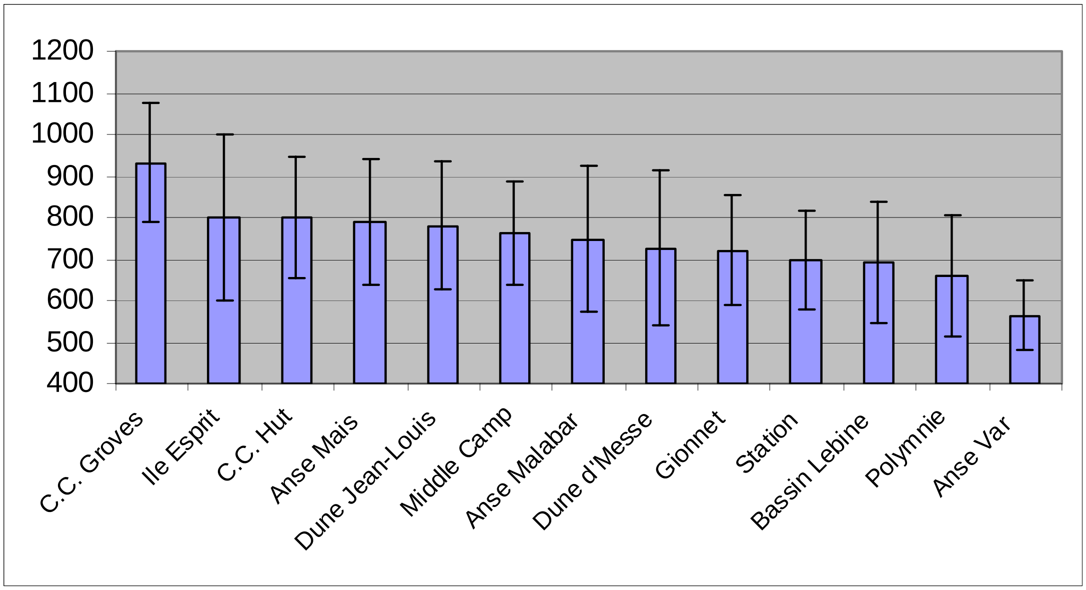

Figure 4.3 Mean precipitation at the various outstations (1999-2004)

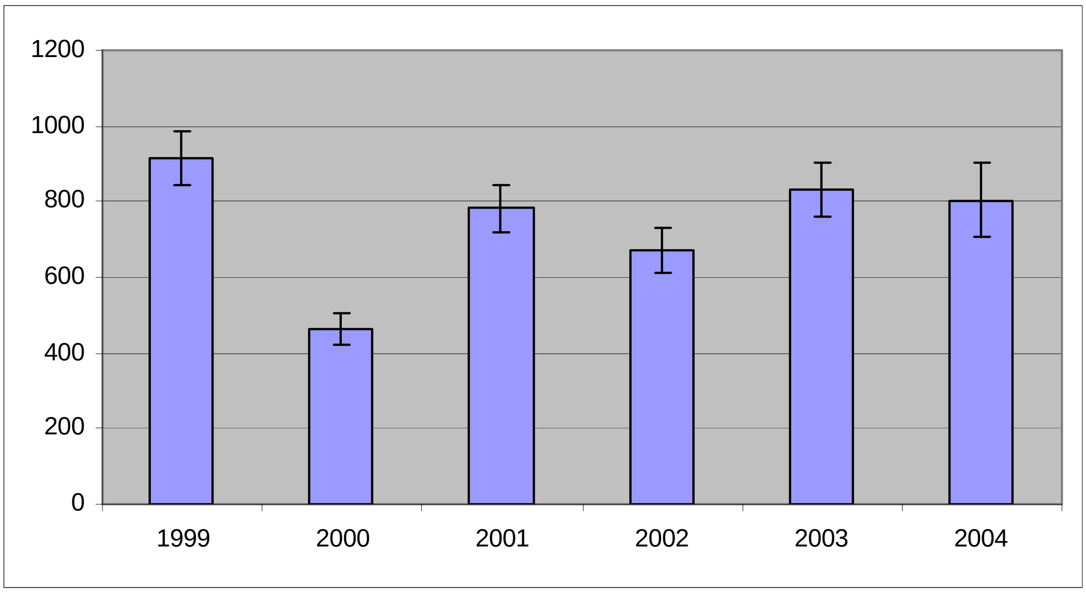

Figure 4.4 Mean annual precipitation at Aldabra (1999-2004)