Monitoring of marine turtles reproductive activities in Juan de Nova, Eparses Islands, South Western Indian Ocean, based on tracks count and width

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Introduction

The Eparses Islands group is composed of four groups of islands (Europa, Juan de Nova, Glorieuses archipelago [main island named Grande Glorieuse] and Tromelin) and one atoll (Bassas de India) scattered across the south-western Indian Ocean. In the 1970s, the Eparses Islands were identified as nesting sites for green turtles in the region (Hughes, 1973; Frazier, 1975). They were poorly known, but interest in monitoring nesting activities grew to supply the green turtles ranching on Reunion in a first place, and then for conservation perspectives (Le Gall, 1986). In fact Tromelin, Glorieuses archipelago and Europa were all stated as 'natural reserve' in 1971, effective in 1975, thus forbidding exploitation of the natural resources. Hence, Grande Glorieuse and Europa's nesting populations have significantly increased, while Tromelin's has remained stable or in a slight annual decrease since the last 20 years (Lauret-Stepler *et al.*, 2007). The monitoring programme established by French Research Institute for Exploitation of the Sea (IFREMER) in the 1980s comprises a 20-year dataset of daily track counts. These data allow an overview on the seasonality and the trend of the population at Tromelin, Grande Glorieuse and Europa (Lauret-Stepler *et al.*, 2007).

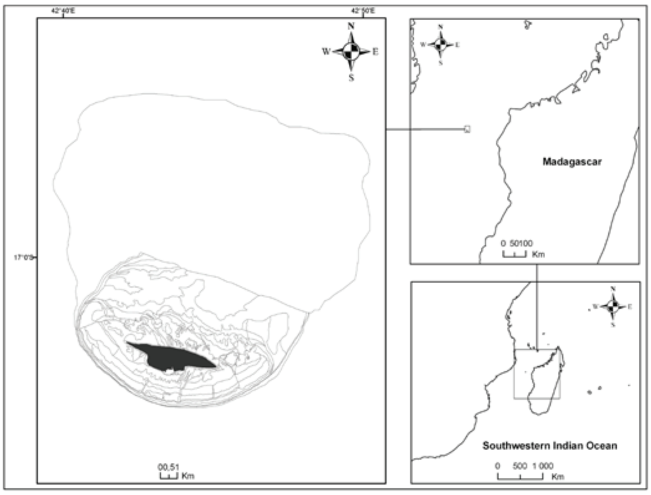

Figure 1: Juan de Nova in the Mozambique Channel. (Source: IFREMER/Kélonia TORSOOI, 2009)

Juan de Nova is located in the middle of the Mozambique Channel (17°03'S, 42°45'E), and is a small island 6 km long with a maximum width of 1.6 km (Figure 1). Its tropical weather has two distinct seasons: a dry season from April to November, and a wet season from December to March (DIREN, 2003) (Figure 2). It had undergone several human colonisation attempts since its discovery in the 16th century (Hoareau, 1993). But most attempts had failed due to the small size, difficulty of access and lack of freshwater. However, Juan de Nova has been the most impacted by human activities of all Eparses Islands. Historical tales report the regular presence of fishermen from mainland Madagascar on Juan de Nova in order to use the natural resources among them marine turtles during the

19th century (DIREN, 2003). At the beginning of the 20th century, guano exploitation based on phosphate extraction offered the possibility for workers to settle on the islands for over six decades. It induced modification on the island with house building, vegetable gardens, and fruit, casuarina and coconut tree planting. In the early 1920s, the guano exploitation could produce up to 50 000 tons of guano (DIREN, 2003). In 1968 the phosphate crash in the Stock Market caused the closure of the guano exploitation on Juan de Nova. In 1973, a weather station was installed as well as a military detachment, like on Glorieuse and Europa. The last workers left the island by 1975.

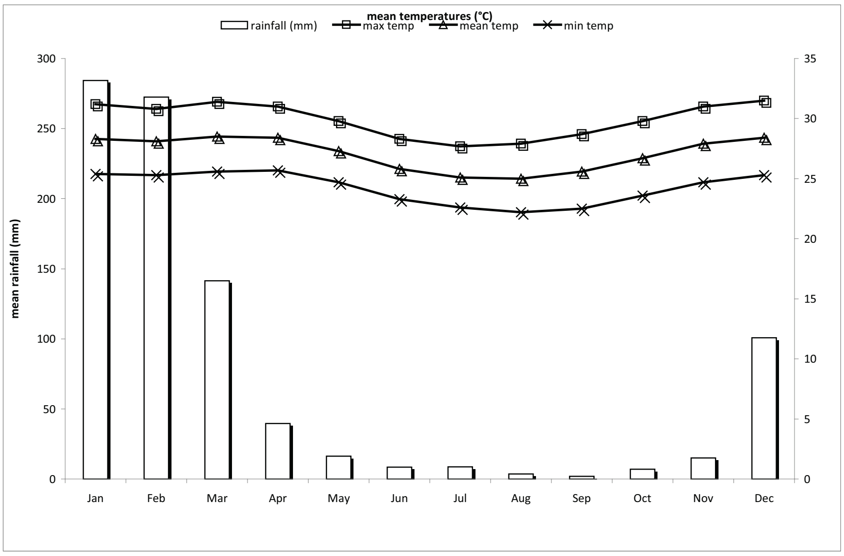

Figure 2: Average rainfall (mm) and temperature, max and min (°C) on Juan de Nova. (Source: Météo France)

Two species of marine turtles (*Chelonia mydas* and *Eretmochelys imbricata*) are known to nest on Juan de Nova, but the abundance of these is not well known due to a lack of data. The daily track count monitoring started in 1987 on Juan de Nova. It follows the same procedure as the other islands (Lauret-Stepler *et al.*, 2007). Every morning, the brigade counts the tracks of the nesting females and marks them with a cross to avoid double-counting. Counts can be missing during detachment rotation, which takes place every 45 days, or when the weather does not allow it. However, sampling effort has been less consistent on Juan de Nova than on the other islands, which created lots of gaps that make analysis sometimes difficult to perform. From 2003, track counts (Figure 3) became more consistent with an effort of more than 80 % of days monitored within a month.

Track width measurement was initiated in December 2006 in order to estimate the abundance of both species nesting on the island. Track width can be used for species differentiation considering the literature on morphology of green and hawksbill turtles (Pritchard & Mortimer, 1999). Data on track width have been continuously collected since December 2006 and 455 tracks were measured from December 2006 to July 2009.

Nesting activity

Because 25.8% of the data from 1987 to nowadays was missing, nesting activity was analysed with complete years of data (N = 10: 1992, 1995, 1996, 1997, 2003 to 2008 included). Average monthly number of tracks is low on Juan de Nova compared to the other islands in the Eparses Islands (Lauret-Stepler *et al.*, 2007). Marine turtles nest year round on Juan de Nova (Figure 3), with a marked peak in summer (October - March) and a less important peak in winter (May – August). Nesting also occurs year round for the other sites of the south-western

Indian Ocean (SWOI), but with one clear peak through the year at different seasons depending on the island: austral summer period for Europa and Tromelin, and austral winter period for Glorieuse and Mayotte (Bourjea *et al.*, 2007; Lauret-Stepler *et al.*, 2007). In fact, it has been shown through the SWIO that seasonality varied among sites genetically or geographically close (Bourjea *et al.*, 2007; Lauret-Stepler *et al.*, 2007). For example, Tromelin and Grande Glorieuse are part of the same genetic stock and yet showed inverse pattern of seasonality (respectively summery and wintry). Europa, the most southern of the islands, has a nesting seasonality similar to Tromelin, and yet they are from different genetic stocks.

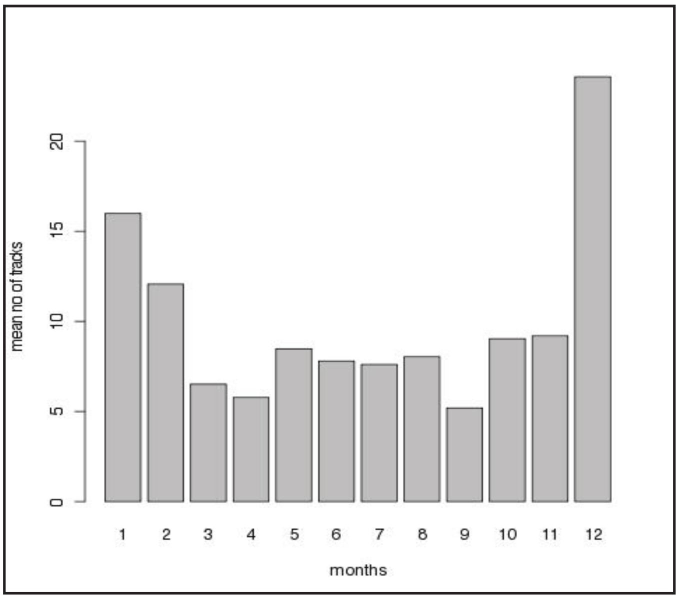

Figure 3: Mean seasonality of marine turtles nesting on Juan de Nova; N = 10 for each month. On the x-axis, month 1 = January, month 12 = December.

The two main genetic stocks of the SWIO were found in equal proportion on Juan de Nova (Bourjea *et al.*, 2007). Bourjea *et al.* (2007) showed how the oceanographic conditions of the Mozambique Channel could have contributed to the constitution of the genetic stocks of the SWIO marine turtle nesting population. In fact, oceanic movements separate the Mozambique Channel in two parts. The two distinct genetic stocks characterising the population of the SWIO, the North Mozambique Channel (NMC) and the South Mozambique Channel (SMC), fit the oceanic pattern of the region. Interestingly, Juan de Nova is located at, what seems the frontier of these two oceanic zones, and has both genetic stocks in equal proportion (Bourjea *et al.*, 2007). Since the presence of two species of marine turtles have been reported, it would be interesting to see how the presence of these two genetic stocks influences the seasonality pattern highlighted here.

Species seasonality

Because on Juan de Nova, track width is measured without species identification, we differentiate between green and hawksbill turtles at this site using width track characteristics. Pritchard and Mortimer (1999) state that hawksbill turtles track width ranges between 60 and 85 cm, while green turtles tend to have wider tracks, usually wider than 100cm - but variable. To confirm this, in May 2007, we measured width of 128 tracks on Itsamia (Moheli – Comoros Union), where only green turtles nest. Our study indicated that width of green tracks range from 88 cm to 131 cm at this location (Figure 4a).

The same study was implemented with tracks and female identification (n=99) on Nosy Iranja, where both hawksbill and green turtles nest. We obtained a comparable result for green turtle tracks: from

91 to 134 cm (Figure 4b). For hawksbill tracks, the result is in conformity with the literature: from 66 to 84 cm (Figure 4b).

Based on these results we assume that at Juan de Nova any track width 85 cm or under is from a hawksbill, and anything over 85 cm is from a green turtle. The observed track width distribution range of 60 to 125 cm, confirms that both hawksbill and green turtles nest on Juan de Nova (Figure 5). Assuming that size species limit is 85 cm, 151 tracks can be considered to be hawksbill, and 304 to be green turtles.

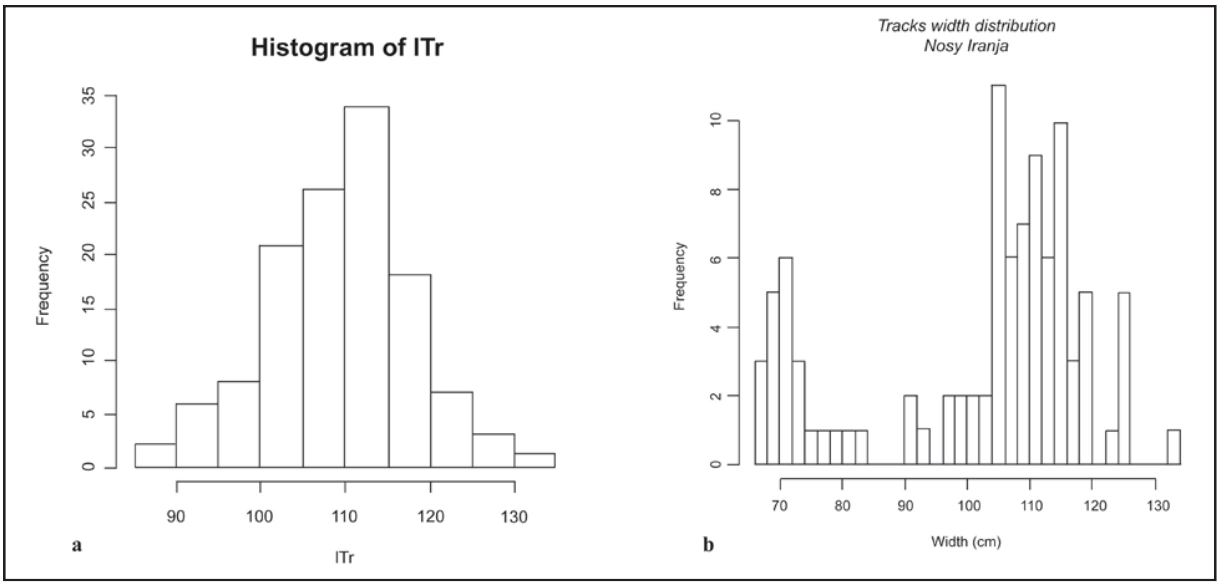

Figure 4 (a & b): Width of sea turtle tracks on a) Itsamia (ITr) Moheli (n=128) from green turtles, and b) Nosy Iranja Madagascar for hawksbill (n=22, range 66 to 84 cm) and green turtles (n=75, range 91 to 134cm).

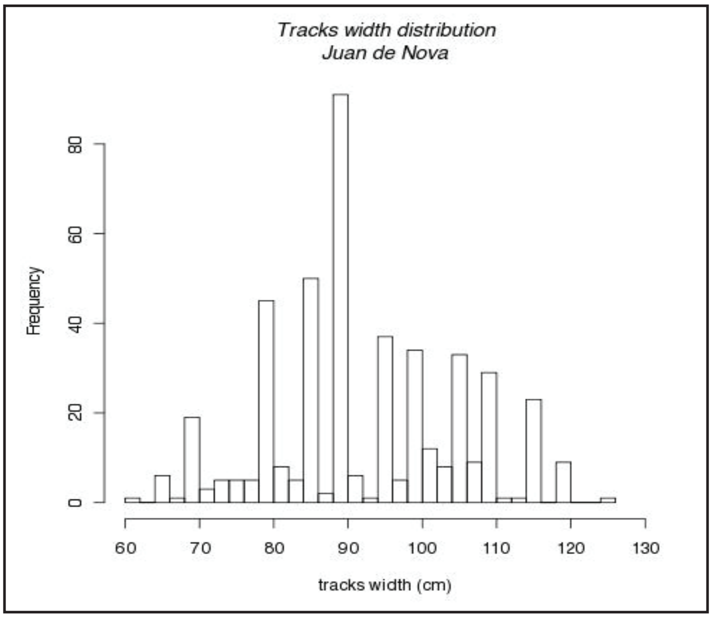

Figure 5: Distribution of marine turtle track width on Juan de Nova – from December 2006 to July 2009 (n=455). On the x-axis, month 1 = January and month 12 = December.

Figure 6 shows that green turtle nesting occurs year round with a slight peak in winter, as it is described for the green turtle nesting sites of the North Mozambique Channel (Bourjea *et al.*, 2007; Lauret -Stepler *et al.*, 2007). Hawksbill nesting is more sporadic, occurring only in summer in 2006/07, and 2007/8. However, continuing through the year 2008, there is a slight nesting activity for this species in winter, and no nesting in summer 2008/09.

Most populations of hawksbill turtles studied through the world exhibit a nesting season in summer (Diamond, 1976; Meylan, 1999; Bourjea *et al.*, 2006), as we found they did at Juan de Nova. However at Nosy Iranja, the 2003 nesting season for hawksbill turtles began as early as September (Bourjea *et al.*, 2006). Exception to the summer dominant pattern has also been found in the Solomon Islands (English overseas territories of the Indian Ocean) (Mortimer, 2002). Within the Solomon Islands, a single genetic stock of hawksbill turtles exhibited a main nesting peak from May to August (SWIO winter) and a smaller peak from November to January (SWIO summer).

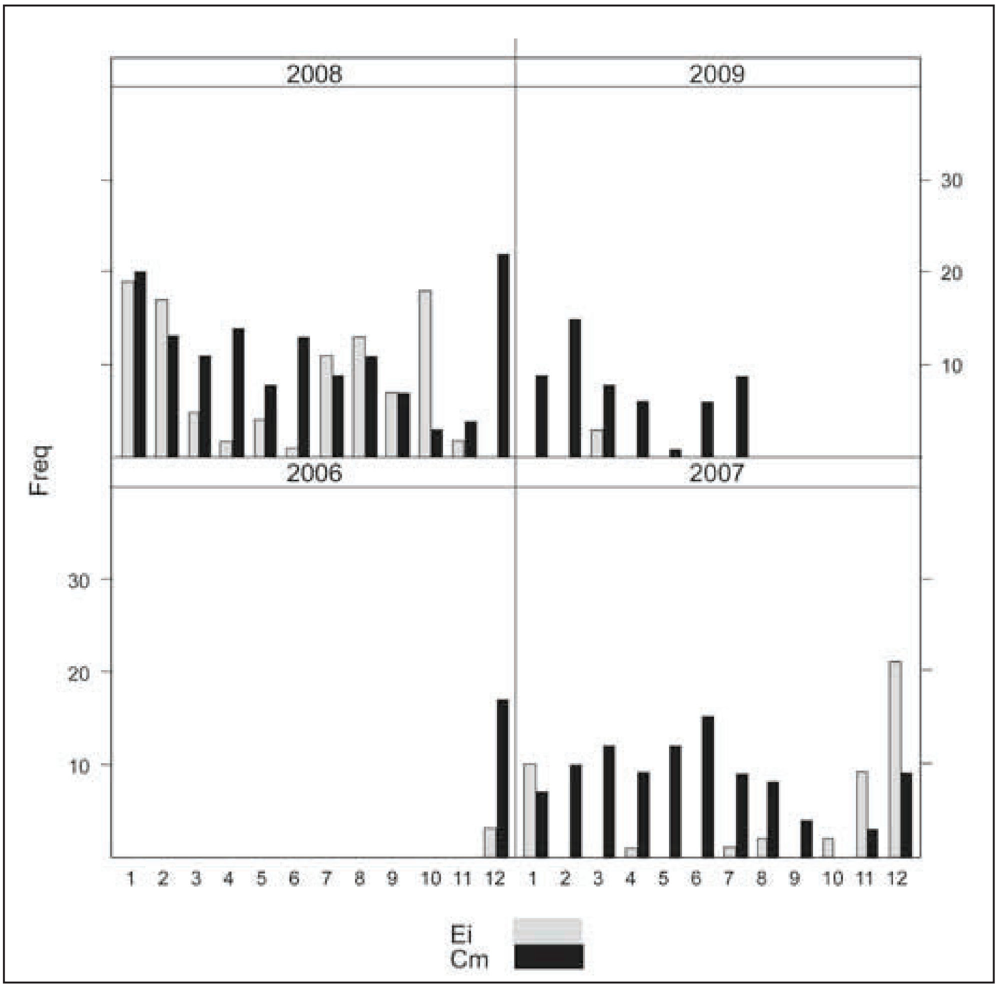

Figure 6: Species seasonality from December 2006 to July 2009, assuming that species tracks width limit is 85 cm. All tracks width less than or equal to 85 cm is considered to be hawksbill turtle, and 86 cm and above it is considered a green turtle. On the x-axis, month 1 = January and month 12 = December.
Ei: *Eretmochelys imbricata*, Cm: *Chelonia mydas*.

Conclusion

This study has examined green and hawksbill turtle nesting on Juan de Nova. The fact that hawksbills nested during both winter and summer in at least one year is an interesting contrast to the strongly summer nesting seen on Nosy Iranja (Bourjea, 2006).

Genetic studies on the Solomon Islands hawksbill turtle population show that they are from a unique genetic stock, which is probably not the case for hawksbill of Juan de Nova. Indeed, Bourjea *et al.* (2007) show how the oceanographic conditions of the Mozambique Channel have contributed to the constitution of the genetic stocks of the SWIO marine turtle nesting population. In fact, oceanic movements separate the Mozambique Channel into two parts. The two distinct genetic stocks characterising the population of the SWIO, the North Mozambique Channel (NMC) and the South Mozambique Channel (SMC), fit the oceanic pattern of the region. Interestingly, Juan de Nova is located at what seems the frontier of these two oceanic zones, and has both genetic stocks in equal proportion.

Lauret-Stepler *et al.* (2007) suggest environmental conditions are more likely to affect nesting seasonality than genetics are and the Solomon Islands are closer to the Equator than Juan de Nova. So perhaps the specific oceanographic conditions in the Mozambique Channel (especially concerning sea surface temperature) can help explain variation in nesting season observed in Juan de Nova (Figure 6), and within the islands of the Mozambique Channel, i.e., Europa versus Glorieuses (Lauret-Stepler *et al.*, 2007) or at a shorter distance Juan de Nova versus Nosy Iranja.

Recommendations to come out of the study so far are that in order to gain better understanding of marine turtle nesting seasonality on Juan de Nova it will be advisable to (1) train the beach monitoring brigade in species identification using track patterns, and (2) collect some associate data on Sea Surface Temperature throughout the study period to see how oceanic movement and environmental variation may affect marine turtle nesting seasonality.

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Loggerheads and leatherbacks in the Western Indian Ocean

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Introduction

This is a rare opportunity for me to provide an overview of loggerhead and leatherback conservation in the Western Indian Ocean. Despite the fact that I was personally an integral part of the conservation effort for some 40 years I was not there at the beginning. All credit must go to the late Peter Potter, a senior officer in the then Natal Parks Board, the provincial conservation authority of the then Natal, South Africa, who, in 1963, responded first to complaints about turtles being killed on the beaches of what was then known as Tongaland (it is now known as Maputaland but I shall refer to Tongaland throughout the paper) just south of the Mozambique border. Peter sent a ranger Hennie van Schoor, and two students John Bass (now Dr.) and Humph McAllister and it was their first publication (McAllister *et al.* 1965) that laid a solid and inspiring foundation to the 45 year old programme on loggerheads and leatherbacks in South Africa.

Formal conservation organisations in South Africa were dominated by large mammal issues for nearly 80 years. There was considerable political strength in the promotion of large mammal conservation and this is clear when you consider that the first four formal protected areas set aside for large mammal conservation in Africa took place in Natal in 1895.

It is thus quite remarkable that one of these early protected areas had a marine component, the St Lucia system which, having been static in size for nearly 70 years suddenly started to attract attention (with the turtle programme providing one of the most important and visible catalysts), and over 35 years was expanded to include two marine reserves, several extensive terrestrial areas and is now known as the iSimangoliso Wetlandf Park, South Africa's first World Heritage Site (Natural) declared in 1998. The park now covers 325000 ha with 220 km of coastline including all the turtle breeding beaches.

The localised lack of enthusiasm for the project in the early Sixties led to my becoming aware of political undercurrents within conservation which have proved both supportive and damaging to turtle conservation. The successful protection of the turtle beaches in South Africa has been achieved firstly by fighting entrenched political conservatism, persisting to successful conservation results and then using the successful turtle story to political advantage to enhance protection.