



Diversity, ecology and threats of loggerhead turtles nesting in the Cape Verde Archipelago

Executive Summary

Monitoring the consequences of changing Oceans and biodiversity are major goals of modern conservation biology. Cape Verde supports the third largest population of endangered loggerhead sea turtle worldwide; for which effective conservation rests on ever innovative approaches.

In the last 8 years, we have built a large research programme based on three research strategies: 1. Determining the adaptive genetic potential of the Cape Verde rookery with regard to global challenges, 2. Determining the feeding strategy of the turtles, as key parameters for sustained growth and effective reproduction and 3. Identifying areas of particular protection needs based on turtles' movements.

In 2017, we continued sampling genetic material of nesting turtles across 9 islands of the Archipelago in cooperation with national and international NGOs. Here, we further offered to deploy new miniaturized tagging technologies to identify the whereabouts of the turtles during the nesting phase and identify resting/feeding areas. We further deployed satellite tags to track turtles in their post-nesting phase.

We deployed 20 daily diaries across the islands of Boavista and Maio, two islands with high turtle density and facing intense poaching as well as interference with fisheries. While much remains to be explored, we retrieved 16 devices. This exceptional recovery rate was possible thanks to the tight links with NGOs and the resulting intense beach coverage.

1. Research Activities

A. DNA sampling

Our early results (Stiebens *et al.* 2013) demonstrated that contrary to expectations, the Cape Verde rookery is composed of multiple small nesting aggregations which deserve local management. Furthermore, this study demonstrated that while Boavista supports the largest aggregation, the smaller nesting groups on the Western part of the country hold a different genetic diversity which must be protected.

Based on this early results, the genetic survey needs to continue to provide long term understanding of the effects of poaching, fisheries bycatch and climate change on the population. For the first time since 2010, our national survey included the island of Sal thanks to the new collaboration with Sal Biodiversidad led by Mr. Albert Taxonera and Ms Berta Renom. This collaboration was also rendered possible by the interactions generated by the *Explorations of Monaco* which supported synergy across islands of the Archipelago. With this new collaboration, INDP and QMUL have shared a standardized protocol which covers almost entirely the distribution range of the loggerhead turtle in Cape Verde. We are now in position to monitor accurately changes in the population.

Overall, we collect 1528 samples (Table1). They will now be processed in the laboratory for genetic analyses, specifically we will test for:

1. Possible change in genetic diversity across the islands taking advantage of our time series since 2010.
2. Stability of gene flow across islands to test for the resilience of the population in the face of environmental change.

Table1: Numbers of samples collected during the nesting season between July 3rd and October 25th in Boavista, Maio and and Sal and between August 1st and September 15th on the other islands.

<i>Island</i>	<i>Boavista</i>	<i>Fogo</i>	<i>Maio</i>	<i>Sal</i>	<i>Santa Luzia</i>	<i>Santiago</i>	<i>Santo Antao</i>	<i>Santo Nicolao</i>	<i>Sao Vicente</i>
Number of Samples	657	29	337	356	34	23	41	30	21

Noteworthy, samples will further be analyzed for nitrogen and carbon isotopes to determine the feeding ecology of the turtles, their stability and to get proxies about the habitat used by the turtles during their feeding migrations. This work will complement the movement ecology devices.

B. Deployment of daily diaries.

For this proposal, we offered to deploy daily diaries (hereafter DD) in two different islands: Boavista and Santo Antao. Because of logistic constrained associated with the retrieving of the tags, they tags were deployed on the island of Maio, where threats on turtles are intense varying from poaching to fisheries. We deployed 20 DDs purchased with the support of the *Explorations of Monaco* (**Figure1**) and retrieved 16 of them. To retrieve the data, an intense beach coverage is needed. This was possible with the support of [*Turtle foundation*](#) on Boavista and [*Foundation Maio Biodiversity*](#) on Maio.

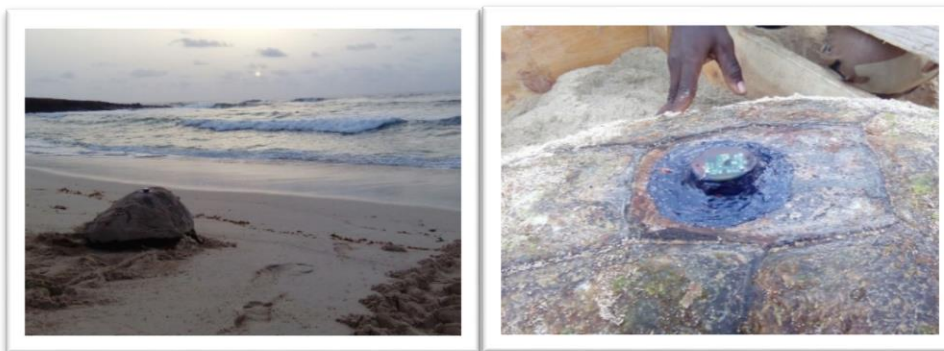


Figure1:
Daily diaries deployed on loggerhead turtle on the island of Boavista

All of the data could be downloaded successful what represents ibillion measure for each DD. Scripts are currently being written to determine the whereabouts of the turtles, the interference with human activities as well as the behaviours of the turtles in the different activities they undergo during the interesting phase.

Tag ID	Deployed	Date of record	Island
A14190	10/07/2017	03/08/2017	Maio
A14184	11/07/2017	04/08/2017	Maio
A14186	12/07/2017	05/08/2017	Maio
A14180	12/07/2017	05/08/2017	Maio
A14181	19/07/2017	12/08/2017	Maio
A14182	19/07/2017	12/08/2017	Maio
A14210	20/07/2017	13/08/2017	Maio
A14212	21/07/2017	14/08/2017	Boavista
A14214	23/07/2017	16/08/2017	Boavista
A14213	23/07/2017	16/08/2017	Boavista
A14206	24/07/2017	17/08/2017	Boavista
A14205	24/07/2017	17/08/2017	Boavista
A14198	26/07/2017	19/08/2017	Boavista
A14177	29/07/2017	22/08/2017	Boavista
A14178	29/07/2017	22/08/2017	Boavista

Table2: Daily diaries deployment and retrieval information. One more tag is so damaged that data have not yet been retrieved,

2. Engagement Activities

A. Engaging with the younger community

Conservation biology is not independent of education and awareness. As with the scientific approach, specific education tools have to be put in place to reduce poaching activities and raise concern about the state of the Cape Verde turtle population and its sustainability. This specific project aimed to reach out the youngest generation by printing specifically dedicated booklet on the threats faced by the turtles.

Reaching younger generations is important for conservation however this is a difficult-to- connect population because often reached through intermediates (e.g. parents or teachers). Here, using a child booklets created in collaboration between *FMB* (Amanda Dutra and Leno Do Passos), a graphic designer (Victor Jimenez) and an author (Sarah Vieira), we raise kid's awareness on turtle protection. Using elegant cartoons and accessible vocabularies in Portuguese, this booklet is an ideal tool to reach out 4-8 years old children.

We have printed 1400 copies of the booklet. It has been distributed across 8 different islands by the different partner organizations. The donation to kids always followed specific events such as beach clean-ups, "School in Nature" or turtle celebration days (**Figure2**). *School in Nature* is an event where kids from the local communities join conservation camps over a night to be given the opportunity to observe turtles and their natural behaviours.



Figure 2: Example of awareness activities with kids across the islands where the booklet was distributed.

B. Bridging Conservation across Islands

In Cape Verde, the loggerhead sea turtle is considered a national heritage and symbol: it is found on the local currency, painted on countless walls and every year attracts an increasing number of tourists. Unfortunately, with Cape Verde still being a developing country, this species faces numerous critical interference points with human threats such as illegal harvest of eggs, of nesting turtles and of turtles at sea (Marco et al. 2012, Taylor & Cozens 2010). Particularly until 2008, not less than 20% of the nesting turtles were found dead on the beach, killed by poachers for their meat (Marco et al 2012). It is therefore not surprising that this population is regarded as endangered by the IUCN red list of threatened species (IUCN 2015). Maintaining a large population of turtles, which will contribute not only to the maintenance of healthy marine ecosystems but also to the development of the country, calls for an urgent need of group effort to guide marine conservation.

In Cape Verde more than 70 % of the turtle nests are laid on the island of Boavista, on the eastern range of the archipelago, with nesting densities decreasing towards the western islands (Marco 2012). Despite numerous laws (in 1987, 2002, 2005) to forbid capture, possession and consumption of adults and eggs, national governance has been weak and mainly relies on NGOs or community work. In 2007 after a large amount of the female turtles that came to land to nest were killed, an international call was made. NGOs responded to this call and implemented a large scale programme: 1) direct protection of nesting beaches using a combination of local rangers and international volunteers, 2) educational outreach in schools, public events and local communities and 3) lobbying through the “Protected Areas of Boavista” (UNDP project) and good relationship to the Ministry of Environment. While NGOs such as *Turtle Foundation* managed to reduce the number of killed turtles to a few percent per year.

Projects of turtle protection in Cape Verde are carried out in a strong network built with the environmental Ministries, Protected Areas Department and local and foreign NGO's. All these have formally created the Turtle Network of Cape Verde (TAOLA) which acts towards: 1. Sharing data, 2. Sharing good practice, 3. Lobbying for enforcement of laws and regulations.



Figure3: Leaders of the diverse organizations involved in turtle conservation across the Cape Verde archipelago before meeting SAS Prince Albert II of Monaco on the Yersin.

Thanks to the support of the *Explorations of Monaco*, all organizations working on turtle conservation have come together to discuss the recent advances in terms of protection strategy and research. This meeting took place on the 21st of

September 2017 in the Esplanada, Sal Rei. All organization were represented:

1. **Turtle foundation:** Represented by Euclides Resend, Joana Nicola, & Mr. Cruz.
2. **INDP:** Represented by Sandra Correia and Nelson Lopes.
3. **Foundation Maio Biodiversity:** Represented by Rocio Moreno and Leno dos Pasos.
4. **Projecto Vito Santo Antao and Fogo:** Represented by Gilda Monteiro and Herculano Diniz.
5. **Biosfera1:** Biosfera1 could not join us in the last minute but Silvana Roque, who is the coordinator of the marine protected areas in Santa Luzia shared her experience with turtle protection there with us.
6. **Sal Biodiversidad:** Represented by Albert taxoneira.
7. **Natura2000:** Represented by Maria Medina.
8. **BIOS.CV:** Represented by Pedro Lopez

The meeting was an ideal opportunity to summarize the specifics of turtle protection in Cape Verde. Few general lines of thought can be drawn for the meeting. Firstly, many issues are global issues which need to be addressed at a large scale. They include global change and fisheries bycatch. Secondly, at the Cape Verde level, the primary issues are linked with intense poaching. Should turtle conservation from NGOs cease, poaching would return and amplify, as has been the case on few unprotected beaches of 2017. This clearly raises questions about the efficiency, not of protection, but of local awareness. Targeting the younger generation with awareness programme then seems a suitable approach. Coastal development has also been seen as a major issue and calls for concerted efforts with local authorities. Lastly, discussing the issues at the island level, it appeared that turtles nesting on each island face different sets of combine threats. In some islands, coastal development is the main issue, while on other poaching was identified as of priority concern. This overall means that while a Cape Verde specific conservation programme is need, we need to act at the level of the island to target the local primary cause of threats to turtles.

As a result of the discussions which took place during the meeting, the document below was shared with SAS Prince Albert II as a summary of the situation. This document also includes recommendations on how to have a forward looking view on turtle protection in Cape Verde.

Recommendations: Advancing protection of the Cape Verde loggerhead turtle

Within its exceptional biodiversity, Cape Verde holds the 3rd largest aggregation of loggerhead turtles in the world. This rookery was relatively recently discovered, together with the intense poaching it faced.

Since the alarm bell has been rang, several projects has engaged into protecting turtles on all islands of the archipelago. Together, here we highlight the challenges we face to advance protection and improve the state of the local populations:

1. While poaching has strongly decreased, protecting more beaches around the archipelago is important.
2. Protection does not go without
 - a. community engagement
 - b. enforcement of regulations and legislations: many regulations exist but are not being enforced. This is mostly because the means to fight against illegal consumption / marketing of turtles are too low. Areas which need regulation enforcement:
 - i) punishment of poachers when caught.
 - ii) coastal development / sand mining.
 - iii) circulation on the beach with vehicles.
 - iv) light pollution and recreation activities.
3. Novel problems seem to be linked to mortality in the sea
 - a. direct poaching in the sea
 - b. fisheries by-catch. Since there is no enforcement or legislation of the marine protected areas, actions are restricted.
4. There is a wish to develop environmentally aware tourism.
 - a. should be compatible with turtle protection
 - b. should be coordinated
 - c. should be engaging with communities.
5. There is unfortunately a lack of coordination
 - a. within governmental organizations at the national level but also between national and local level.
 - b. between governmental organizations and local NGOs.

What can we do jointly? The sea turtle conservation organizations of Cape Verde have come together and formed the TAOLA (TArtaruga KriOLA – the creole turtle). This group aims to represent the diversity of project and islands with their specific challenges and solutions for turtle conservation. However we need to build capacity and give legal power to its action.

C. Reconnecting Humanity with the Sea.

On the 22nd of September, all organizations involved in Sea Turtle protection were privileged to meet with SAS Prince Albert II of Monaco (**Figure 4**). The visit was the opportunity for all conservation actors to explain the issues faced by turtles in Cape Verde. The specific take home message is that, while there are shared threats across islands such as fisheries, direct poaching or coastal development, the relative importance of these issues varies. For instance, the island of Maio suffers mostly from poaching, while Sal suffers from uncontrolled coastal development.



Figure 4: Leaders of the diverse organizations involved in turtle conservation across the Cape Verde archipelago before meeting SAS Prince Albert II of Monaco on the Yersin.

The visit of SAS Prince Albert II was split into 3 key times. Firstly, all organizations were invited to discuss on board of the Yersin. During this time, the recommendations made by the NGOs were shared. In a second time, all organization as well as the *Exploration of Monaco* team relocated to visit *Turtle foundation* camp of *Lacacao*. This camp is the main research camp shared by Turtle foundation and Queen Mary University of London. Once there, the QMUL team presented SAS with the newest results on their research. This includes why determining the whereabouts of turtles is important but also why climate change is a strong issue for turtles. Those topics were presented by two PhD students from QMUL, Ms. Emma Lockley and M. Sahmorie Cameron. A third topic was raised with Dr.

Lucy Hawkes explaining why understanding the physiology of turtles provides critical information about the early life stages.

The last highlight of SAS Prince Albert II of Monaco's visit was the introduction to the research hatchery. This in situ nursing places allow organizations to relocate nests which would otherwise be damaged by the sea to safer place. Hatcheries serve as direct conservation measure but also allow to raise awareness in place where tourism is high for instance.

The visit terminated on a final convivial discussion in the camp and a family picture.



All the scientists and conservation biologists engaged in turtle conservation would like to thank the *Explorations of Monaco* for the opportunities created.