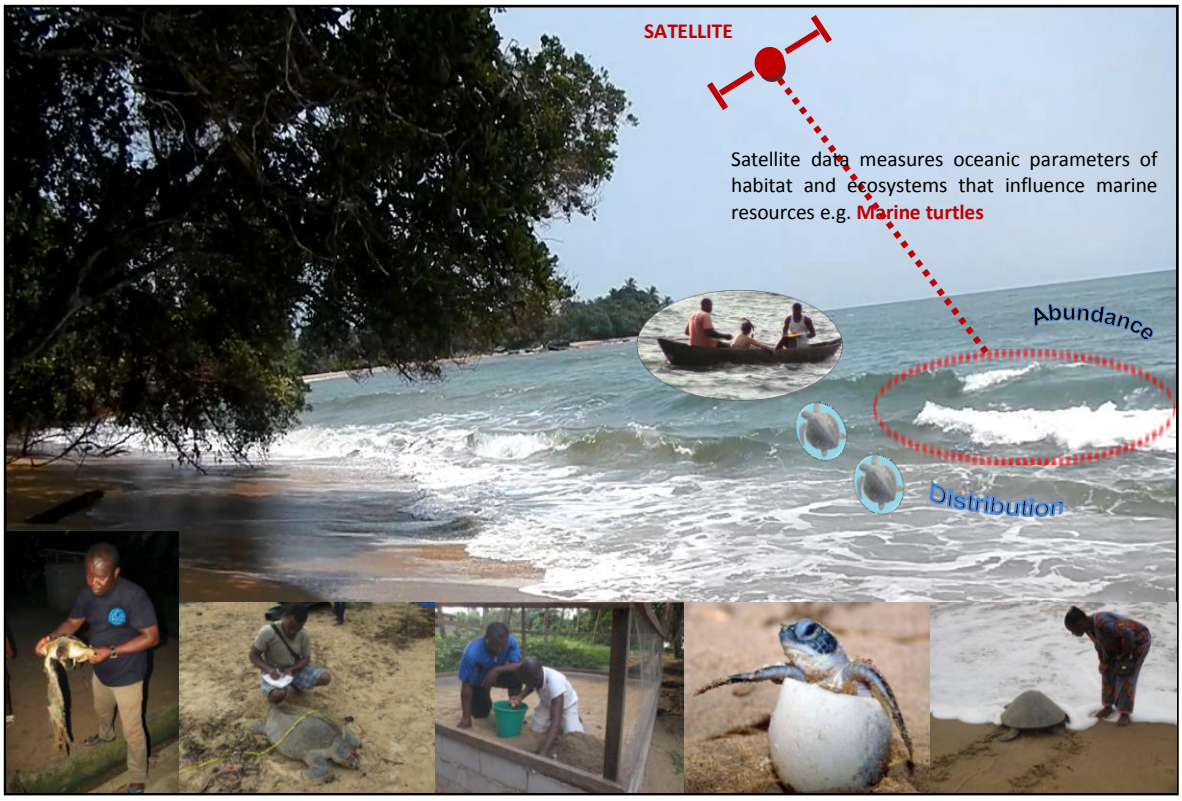
Evolutionary ecology of marine turtle species in the face of artisanal fishing and climate change in the Atlantic coastline of Ebodje, Cameroon

ID: 17450-1

Mid-term Report for 2015-2016

By

Abi Henry Nibam
Tube Awu Association
South Region, Cameroon
Email: henrynabi@yahoo.com



Introduction

This update represents midterm report of the various conservation activities carried out by our team over the past 6 months; from June to December 2015. The project made progress by successfully adhering to it baseline timetable. In this report, you will learn of the range and extent at which activities are being carried out to further our mission: *to increase populations of the different turtle species by improving levels of protection through estimating the various aspects of the species life-history.* Our 2015/2016 work plan focused on the following objectives to help achieve our mission:

- describe the species and abundance of marine turtles present in Ebodje;
- collect nesting location, nesting success and hatching success information for the species;
- collect biometric information (carapace curve-line length and width, head width, body depth and plastron length) and GPS points will be obtained for the species;
- impact assessment of poaching and fisheries bycatch on the species; and
- provide environmental education to local communities, fishermen and school to increase awareness, knowledge, management and conservation of turtle populations.

In a nutshell, fieldwork for this study is being carried out in two major phases; nesting monitoring surveys of turtle species visiting coastline beaches, and an in-water population study to monitor green turtles migratory routes and foraging grounds in their marine coastal space. Added to our scientific research on the species, we were also involved in education/awareness campaigns of locals in order to achieve lasting conservation of the species.

The research is focusing on the evolutionary ecology and conservation management of the species. We sought to identify various changes in resident turtles in Ebodje caused by anthropogenic disturbance (artisanal fisheries and poaching), and climate change (global warming) in their ecosystem. Through this we seek to find out how evolutionary processes are affecting life-history traits of the species as they evolve to become adapted to their physical environment and interact with members of their own and other species. We will also examining how the selective pressures are imposed by the environment and the evolutionary response to them. This research proposes to mitigate threats facing the species thanks to an understanding of the natural selection and adaptation of the species within lineages and evolutionary mechanisms leading to the evolution of new species through splitting.

Many of the activities you will read about could not have been completed without significant community support. This year recorded a more dedicated core of volunteers that provided us dependable crews for much of our fieldwork.

On behalf of the four endangered marine turtles species in Ebodje we give our thanks to all those who volunteered and are still volunteering to support our work.

It is our wish that this report will be informative and that it will encourage your support for Marine Turtle Conservation in Cameroon. Our appreciation to the Rufford Foundation, UK for the funds.

May – June 2015

Foraging ground surveys

Initial in-water foraging ground assessment were conducted in *Talla* and around *Manyangue* both about 50 – 100 m offshore from Ebodje, and at shallow waters (<6 m), hard bottom coastal habitats made mostly on sea grass beds (**Figure 1**). Through the use of snorkeling, transect strip line counts and capture-mark-recapture as well as remote sensing techniques of ocean color were used. These were meant to provide more insight in the migratory pattern and habitat preference of the species in their marine space. In addition to these in-water surveys, netting technique were done. The purpose of these snorkeling surveys is to tag, sample and measure individual turtles, and to establish catch-per-unit effort measures of turtle abundance. These exercises were a means of designing a marine turtle foraging ground survey protocol in which some prior insight of marine habitat were evaluated. Information on typical marine condition were noted; habitat types, bathymetry, sea surface temperature, visibility, depth, GPS points, time, date, personnel, diving speed, turtle occurance etc. Traditional canoe-based turtle sightings were also used to provide good insight into the types and extent of potential turtle habitat within a given area.

Figure 1. Principal investigator during an in-water population survey in Ebodje.

Since marine turtle tend to assemble where conditions are best, finding their foraging areas will require greater densities of their population, and good in-water observation experience. Thus, engaging local fishermen and recreational divers can bring in a significant contribution to in-water turtle surveys. Our capacity to carry out these assessments was increased by the presence of a certified SCUBA/Snorkeling diver; a French Master 1 student on internship with our association.

This In-water survey was meant to assess the population abundance of green turtles in foraging grounds of *Talla* and *Manyangue* (Ebodje). A full protocol from this in-water inventory has been developed and we are now ready for this exercise in January or February when the water turbidity will be calm.

June 2015

The Ebodje community celebrates the natural environment

Tube Awu Association celebrated World Environment Day- WED (June 5th) with fishermen, poachers and schools in the local community of Ebodje (**Figure 2**). At the eve of the day, celebrations were marked by film shows projected on a giant screen (**Figure 3**) and the erection of two new metallic sign-post; one at the entrance to the village and the other beside our office- *Maison de Ndiva*. The various activities organized in the day proper included quiz competition, children's turtle drawing and race competition, fun challenges, PowerPoint presentation and promotion/awareness speeches. Dozens of villagers and school kids, pupils and students jam-pack the museum to capacity. The purpose of inviting schools to this celebration was to promote conservation ethics in young people. The use of art and film show tools were to raise awareness of endangered marine turtle and the threats to the marine

Figure 2. Family photo with local community members at the Ebodje beach during the celebration of WED 2015.

environment. On reaching out to these students, it is believed that their parents and families will equally be reached and be inspired to involve in conservation efforts.

Also in attendance, were the representatives of the Environmental Club of Government Bilingual High School in Campo and WWF Campo. The activities for the day were part of our community awareness programme, through which community members and visitors are informed about the plight of the marine turtles and how they can utilize the beaches without disturbing turtles and nests. The awareness meeting involved a range of topics including marine turtle biology, conservation, sustainable fishing practices and nesting beach management etc. The occasion was a great opportunity for Tube Awu to distribute T-shirts, caps, posters and hand-bills amongst selected individuals in the crowds to raise awareness of human impacts on the marine environment. In each speech and PowerPoint presentation, the speakers acted as resource persons in throwing light on the sustainable utilization of marine turtles and the dangers of their extinction.

Figure 3. Film show with fishermen, poachers, school children and other local community members in the eve of WED 2015 celebration.

<u>September 2015</u>

Nesting Beach Clean Activity

In order to prepare a good start of the 2015/2016 marine turtle nesting season, beach cleaning activities were carried out in September 2015. Fallen trees on beaches make turtle habitat unsuitable for nesting and our goal was to clean and make them safe for nesting (**Figure 4**).

Increase in beach erosion and degradation as a result of sea level rise due by climate change are causing the falling off of coastal beach vegetations, hence making it impossible for turtles to reach nesting areas. We used an engine saw to cut off these falling trees to ensure marine turtle easier access to nesting site. It is worth mentioning here that this beach cleaning events took place with the active participation of volunteers and women who used the wood to smoke their fishes. The cleaned beach paved path for nesting without any hurdle in movement of turtle.


Figure 4. Engine saw operator cutting off fallen trees on beaches

<u>October – November 2015</u>

Marine-turtle nesting relocation and hatchery management

In October 2015, we rehabilitated our old hatchery and constructed a second hatchery thanks to the financial support from IRAD Kribi. These were meant to improve on the incubation and hatchling success of species in the season. These hatcheries are positioned in an area which provides a range of microhabitats and in a favorable temperature regime utilized by nesting turtles. The surface of the hatchery site is located at about 1 m vertical distance above the level of the highest spring tides to prevent underground flooding of the eggs. To discourage crabs and other small burrowing predators from entering the enclosure, a chain link fence, wire mesh or barbed wire is enclosing the hatchery (**Figure 5**).


Figure 5. Eggs transplantation in the hatchery of a clutch brought from Ipenyendje.

At the Ebodje beach where individual nests are at risk from threats such as erosion, inundation (sea level rise), or unintentional human disturbance (poaching), threatened egg clutches are selectively relocated to safer points along the beach or to enclosed hatchery. Ideally, hatchlings should not be dependent on people for their release. To help ensure a natural sex ratio of males and females, eggs destined for the hatchery need to be obtained throughout the nesting season in numbers proportional to the amount of nesting that occurs each month for each species.

Each time news is being received of a nested marine turtle, they are immediately approached and the eggs relocated to the hatcheries. The first batch of eggs expected to be hatched early February 2016, and the second batched of hatched eggs by late February.

October – Present

RESEARCH AND CONSERVATION ACTIVITIES

Nesting Beach Monitoring

The prospected sites for the third nesting monitoring survey of this project was carried out unevenly in 8 sites; Bekoka, Bouandjo, Ipenyendje, Lolabe, Talla, Likodo, Ebodje and Campo presenting a 10,44 km stretch. Each of the selected beach was visited disproportionately to monitor / measure annual fluctuations in nesting activity. These sites were characterized by the presence of disparate sandy embankment, rocky areas and mouths of rivers. According to survey from these 4 sites (from May 7th 2015 to December 12th 2015), a total of 42 female turtle species were recorded among which two were by-caught in artisanal fisheries.

Turtle nesting activity for the 2015/2016 nesting season was first registered on October 21st, when a ridley turtle nest was discovered at the Ebodje beach (**Table 1**). The first leatherback nesting of the 2015/2016 season was killed in fishing net while making its way to nest at the Ebodje beach on October 30th. A first of its kind nest found at Ebodje beach on November 16th marked the start of nesting for green turtles.

Table 1. Number of turtles going up on the beach per month / site from May 7th 2014 to December 12th 2015

Month	Site								Total
	Bekoka	Bouandjo	Ipenyendje	Lolabe	Talla	Likodo	Ebodje	Campo	
May	0	0	0	0	1	0	2	0	3
June	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	1	0	1
August	0	0	0	0	0	0	1	0	1
September	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	1	11	0	12
November	1	0	0	1	0	0	9	1	12
December	1	2	3	0	0	1	5	1	13
Total	**2**	**2**	**3**	**1**	**1**	**2**	**29**	**2**	**42**

As at the time of this midterm report, a total of 22 ridley, 3 leatherback and 2 green turtles have been recorded to make climbs on beaches for nesting, with the months of October and

November showing the greatest nesting activity, whereas turtle by-catch in artisanal fisheries was dominated by green turtles followed by ridley turtles were their accidental predominance in fishing nets were also active in October and November.

Table 2. Number of turtles going up on the beaches or by-caught in artisanal fisheries per month

Month	Beach climbs			By-catch		Total
	Leatherback turtle	Ridley turtle	Green turtle	Ridley turtle	Green turtle	
May	0	0	0	0	3	**3**
June	0	0	0	0	0	**0**
July	0	0	0	0	1	**1**
August	0	0	0	1	0	**1**
September	0	0	0	0	0	**0**
October	1	5	0	0	6	**12**
November	1	7	1	2	1	**12**
December	1	10	1	0	1	**13**
Total	**3**	**22**	**2**	**3**	**12**	**42**

Preservation

Protecting females that have just nested

The patrols carried out by our team not only permitted us to collect biological data but also occupied the beaches where poachers could try to capture turtle or poach nests. These patrols were strengthened by the use of local volunteers and by Cameroonian and French students who increased our team abilities.

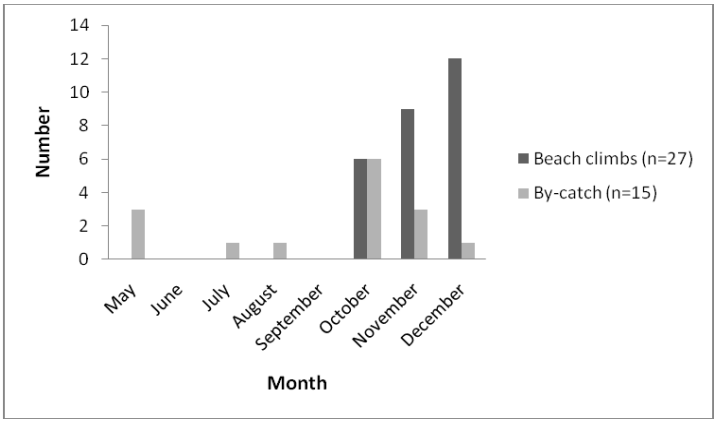


Figure 6. Temporal distribution of marine turtle beach climbs and bycatch per month in the 2015/2016 nesting season.

COMMENTS

By reading the above tables and graph that summarize the collected data, one can immediately draw several conclusions. There is a very clear rise of turtles going up on the beach as from September with a peak in December (**Figure 6**). There is slightly a higher number of turtles going up on Ebodje and Ipenyendje beaches, thus making these beaches the most busy sites for nesting turtles. It must be noted that these sites are represented by more committed resident marine ecoguards in the whole prospected area. Despite the limited turtle bycatch data recorded, It is likely that artisanal fisheries pose a serious threat to marine turtle mortality.

Biometry

Concerning the three most popular species that climb the beaches/by-caught, we found the biometry results in the table below (**Table 3**).

Table 3. Biometry results for Leatherback, Ridley and Green turtles

	Leatherback turtles		Olive ridley turtles		Green turtles	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
CCL	150	132	73	63	84	27
CCW	97	97	72	61	80	23
Mean CCL	141		66.88		49.69	
Mean CCW	97		65.94		45.54	

NB/ Curved Carapace Length (CCL, cm), Curved Carapace Width (CCW, cm)

Leatherbacks were larger than olive ridley and green turtles. The table showed the maximum and minimum of the season's populations and an average species size of the nesting populations as of December 12th, 2015. The mean carapace size did not very much differ from the sizes of other nesting populations around the world. No significant changes were found compared to previous years of surveyed data.

The 2015/2016 nesting season has this far presented a new observation in Ebodje, the first ever recorded. Two individual of green turtles respectively with tag numbers KUD-10485 and F3853 successfully nested in Ebodje and Ipenyendje. They each presented reasonable sizes of carapace hump measuring 84cm CCL and 80cm CCW for the Ebodje species and 99cm CCL and 56cm CCW for the Ipenyendje species.

Nests

Observed nests

For all the patrols carried out during this nesting season, a total of 20 nests were counted (**Table 4**). Out of these numbers, 2 nests were visited by poachers.

Table 4. Conditions of observed nests by species

Observations of nests		Green turtle	Leatherback turtle	Ridley turtle	Total
Observed nests	Bad condition	1	1	0	2
	Poached nests	0	0	2	2
	Good condition	1	1	16	18
No nest at the end of tracks due to attack		0	1	2	3
Total number of nests		**2**	**3**	**20**	**25**

Number of eggs per nest

The counts from the identified eggs gave a large variability of eggs numbers; 124, 86, 89, 127, 70, 105, 51, 60, 60, 102, 100, 110, 140, 109, 156, 94, 123, 65 (**Figure 7**).

These eggs ranged from 51 to 156 with a mean of 98.39 ± 29.52 and it showed variations.

Figure 7. Pictures of a nesting ridley turtle

Eggs' transplantation

As at the time of this midterm report, a total of 1771 eggs, coming from 20 clutches; 16 from olive ridley, 2 from leatherback and 2 from green turtles were transplanted in the hatchery in *Maison de Ndiva* station, in Ebodjé or in a safe location at the beach for proper follow-up (**Figure 8**). Please watch out for nesting success results after two months of transplantation. After hatchling emergence, hatching success rate for the season will be deduced and compared with other seasons. Effects of increased temperature, sea level rise and cyclonic activity on marine turtle nesting sites and reproductive output (egg laying, egg incubation and hatchling success phase) are expected to reveal the species vulnerability to climate change.

Figure 8. Transplanting ridley turtle eggs in a safe place at the beach.

Comments

For ridley turtles, their cycle is annual for 60 % of the observed cases, every 2 years for 29 % of them and every 3 years for 11 % of them. They typically nest twice during a season with a renesting interval of 12 to 36 days (Fretey 2005). For this period, ridley turtles nested an average of 97±29.5 eggs (usually between 51 and 156 eggs). For *L. olivacea*, a very small number of eggs, such as in our Cameroonian data (51, 60, 65, 70), may be because the turtle was interrupted while evacuating eggs by its cloaca since it was disturbed or it may be the sign that it is the last nesting of the season.

For leatherback turtles, the annual cycle is rare. The cycle is usually 2, 3, 4 or 5 years. Leatherback turtles nest an average of 87±18.9 eggs for each clutch. According to age, size, health condition for each female leatherback turtle, the number of clutches per season can vary between 7 and 12 (Fretey, 2005).

Although green turtle species are not confirmed to nest on the Ebodje coastline in the past, it is however regularly seen today not far from the coastline (mostly juveniles) and are often captured accidentally by fishermen. Also, records of this year's nesting monitoring survey have successfully registered a first of its kind observation of the species nest in Ebodje and Ipenyendje.

One attempt to poach a leatherback turtle nest in the Likodo beach by locals was interrupted on December 4th, 2015 by the timely arrival of Ministry of Forestry and Wildlife (MINFOF) patrol team from Campo, who reached the 'crime scene' at 8 am while the illegal tying and digging was carried out. Luckily one of our patrol team members is a former poacher turned patroler (Paul MANGA), who approached the poachers and interrupted their actions, and immediately made phone calls to the rest of our members. The attacked turtle was released and it went back without laying; measuring 150 cm CCL, 97 cm CCW, 47 cm of Head width, Colon: 7 and Track size- 104,4cm. This incident was duly reported to the Chief of Ebodje Village and the poachers were identified through the photographic evidence taken by the MINFOF patrol team. This oncemore call for the need to strengthen the capacity of wildlife laws and enforcement in the area.

Ocean color remote sensing application

Ocean color remote sensing application technique is being used to assess the species distribution and behaviour (dispersal in hatchling) due to changes in oceanography condition

(temperature and chlorophyll) and ocean currents. Moderate-resolution Imaging Spectoradiometer (MODIS) satellites imagery will be used to provide composite images of Chlorophyll and sea surface temperature (SST) that will be correlated with areas of bycatch of green turtles. All information that will be obtained from these tracking datasets will be compared with fisheries datasets (e.g. effort, catch, and bycatch data) to predict areas of fisheries-turtle interactions. This information will provide an impetus for focusing future conservation efforts within *C. mydas* internesting behaviors, migration corridor, and its spatio-temporal distribution in the coastal ocean. The mark and recapture methods (tagging) and remote sensing techniques will permit us to be able to understand the thermal ecology, sex ratio, habitat use, navigational abilities, growth rates and fecundity of individuals. Hence, providing insights on their evolutionary mechanisms which generate and maintain morphological, genetic and behavioral diversities in the wild. Important factors such as anthropogenic disturbance from humans (e.g. poachers, local fishermen and port operations) and climate change have been reported to cause these variations. Tagging of the species is expected to reveals their movement, behavior, and distribution. These expected results will enhance marine turtle conservation in the area by mobilizing fishermen and forming registered fisher groups. A central theme of this research component is thus based on the analysis of in-water data to study the regular breeding migrations and habitat selections of juvenile green turtles.

Impact assessment of artisanal fishing on marine turtles

About 15 cases of intentional or accidental catch of marine turtles in fisheries were reported in the coastal ocean of Kribi–Ebodje–Campo stretch. Turtle bycatch has been identified as a source of mortality hence, a primary driver of population declines in marine turtle species (Lewison et al. 2004a). The frequency of interactions (defined as accidental encounters with artisanal fishing gear that can result in injury and possibly death) depends on spatio-temporal overlap between critical habitat for a given species and fishing activities, encompassing a wide range of fishing methods and gear characteristics (Wallace et al. 2008). Information on bycatch rates, the amounts of fishing effort on which these rates are based, and the status of the affected population(s) is crucial to characterizing bycatch patterns and to predicting the potential impact of bycatch (Lewison et al. 2004b; Soykan et al. 2008). In this research study, we will be describing the probable impacts of bycatch on marine turtle populations among region-gear combinations based on inferred reproductive value of bycaught turtles. In analyzing the effects of fisheries bycatch of marine turtles in this study, we will assess two things that are crucial: determine how many individuals are being removed from the population, and then determine the effects of this removal (Lewison et. al. 2004a). The life-history characteristics of marine turtles make their populations particularly vulnerable to collapse. Turtles have a long lifespan and take years to reach sexual maturity. There is a very high rate of mortality among young offspring, and population stability requires a high survival rate for those few individuals which do reach adulthood. Therefore, turtles suffer significant population decline when adult and sub-adult age classes endure higher-than-average mortality: the loss of even a few individuals can have significant effects (Lewison et al. 2004a). Also, in assessing the population level of the bycatch, we will look at the “reproductive value” (i.e., the relative contribution of individuals within an age class to current and future reproduction) of the individuals taken (Wallace et al. 2008). Reproductive values tend to increase from minimum values for small, young turtles to maximum values at the onset of sexual maturity (Heppell et al. 2005; Wallace et al. 2008). Fishing gears such as gillnets and longlines are documented to cause selective mortality among these older age classes in sea turtles (Lewison et al. 2004b).

Most juvenile marine turtles spend much of their developmental years associating with oceanic fronts. These fronts are characterized by rich chlorophyll density caused by the abundance of

phytoplankton in the cold water. Predators are attracted to the rich convergence of the phytoplankton, and a complete pelagic food web develops at these sites. These predators (sponges, jellyfish, snails, worms, and mollusks) are among the staple foods of green sea turtles, giving rise to the theory that oceanic fronts can provided an abundance of resources for turtles in their pelagic stages. Through the use of recently advances in technology; satellite transmitters of marine turtle species in the wide open ocean, records of the depths of species dives will help to understand their involvement and interaction as bycatch at depths of fishing efforts (gears). Also, the satellite tracking studies will show how juvenile turtles in their foraging grounds / post-hatchling migration correlate with sea surface temperature (SST) and areas of high incidence of accidental take of the turtles in fisheries. This will help to elucidate potential areas for mitigating fisheries bycatch interactions that will directly inform ongoing conservation efforts of the species. This information will provide an impetus for focusing future conservation efforts within marine turtles internesting behaviors, migration corridor, and its spatio-temporal distribution in the coastal ocean.

Preliminary accomplishments (Results)

The 2015/2016 night patrols carried out by our team, with the help from volunteers, have already relocated 20 nests to the hatchery and are expected to release about 1600 hatchlings, including 250 endangered baby green turtles. Project component to raise awareness of endangered marine turtles and the threats to the marine environment helped locals, teachers, pupils and students (and through them, their families) not only learn about marine turtles, but to inspire involvement in conservation efforts.

Community members and fishermen who previously did not appreciate the importance of sea turtles; especially the feeding relationship between the marine turtle, jelly fish and fish are now well acquainted with the relationship. They now understand that, more availability of sea turtles is more availability of fishes. This is confirmed by the rise in reported cases of marine turtle by-catch in fisheries. As at the time of this report, there have been 15 reported cases of turtle bycatch compared to only 2 in the previous year.

Furthermore, 10 monitors representing the 10 neighboring village communities have been provided with in-service training, Fliers, T-shirts and face caps to facilitate their work for marine turtle monitoring. Also, a few volunteers participated in the in-service training to enhance their skills and knowledge at work. The volunteers will be working in partnership with our association office. Our efforts to protect marine turtles through awareness campaigns and nesting monitoring surveys were significantly supported by the Chinese company operating at the Kribi Deep seaport project; CHEC Cameroon (financial support of 100,000frs ≈ 110 GBP) and the Cameroon's Government Institute for Agronomic Research and Development; IRAD Kribi (monitoring survey support tools: wellington boots, torch lights, watch and overall coats).

Within our project timeframe, the Principal Investigator also stood as co-supervisor to an intern with our Tube Awu Association in Ebodje- Cameroon. Student-''Master M1 Sciences Pour l'Environnement, parcours écologie littorale, Université de la Rochelle, France pour l'année scolaire 2014-2015''. As co-supervisor, I organized sessions with student on in-water survey design, several field training on index foraging habitat survey; Snorkeling strip transect turtle counts and Capture–mark–recapture (CMR) methods, species capture by tangle net, helped student on how to effectively apply ESRI ArcGIS tools, ocean color remote sensing and other geospatial applications. Also, index calculation to estimate the catch per unit effort (CPUE) was introduced to student. As an outcome from the internship, the student delivered a report titled

‘‘Etude des aires de croissance des tortues vertes juvéniles *Chelonia mydas* et enquêtes sur les pêcheries artisanales sur les côtes atlantique d’Ebodje, Cameroun’’. (*Study of juvenile green turtle (Chelonia mydas) in foraging grounds and an assessment of artisanal fisheries in the Atlantic coastline of Ebodje, Cameroon*).

Overall, the project has increased the understanding of locals on marine turtle populations and their habitat and also helped influence local communities action through supporting our efforts by volunteering. This was confirmed by the massive turn out of fishermen families during our beach cleaning exercises. Their actions were compensated by our offer of free gift of wood to help them smoke their fishes.

In-water population survey
According to surveys from both in-water areas, no turtle was caught using net during our surveys thus indicating that either it was off nesting season or there were not enough individuals to consider conducting netting surveys in these areas. Habitat characterization survey indicated the presence of local sea grasses to confirm the findings by Ayissi et al. 2013 (See Appendix 6). Some of the sea grasses showed signs of being cropped thus indicating that turtles if present are feeding on them. Visual canoe-based turtle survey spotted 6 turtle heads at *Talla* and non at *Manyangue*. It is recommended that these in-water surveys be conducted every six months and being careful to record important data such as GPS points, date, time, personnel etc. with the goal of giving reliable information about the presence or absence of marine turtles. This will be used to make strong argument for the species protection. Interviews of local fishermen will continue be part of this collection of data.

Although a few number of individual turtle species were sighted, there was however no captured species per surveyed areas to make better preliminary assessment of our ongoing in-water surveys. There are information both from the surveys and reports made by local fishermen that there are turtles feeding in other specific areas or beaches or even off the coast. The feeding areas are so wide-spread that finding the species foraging hotspots will take a great effort, hence it is not realistic enough to only perform capture surveys for the expected results. Therefore, our teams idea to include two to four transects of snorkeling surveys to our efforts will help count turtles following guided protocols during the assessment. These surveys can be performed once a year repeating transects two or three times (once per day). Information from collected data are used to estimate abundance and trends in feeding turtles in the surveyed areas and thus is a valuable information to be used for conservation purposes but is of major relevance to estimate the long term availability of funding, permits, manpower and logistics before embarking on a commitment to performing index surveys at turtle foraging grounds. Due to the logistics involved in conducting foraging ground surveys, the future availability of supporting boats, related infrastructure and manpower should be critically evaluated and weighed in the selection of the survey sites and surveying methodologies. Hence, training of personnel is vital in ensuring consistency in survey performance.

Meteological data
Data was captured from the *Mini-Meteological Station* in order to provide daily records of external atmospheric temperature, pressure and humidity, and wind speed and direction. According to early analysis, the atmospheric temperature was permanently high and varied between 25°C to 30°C with an average of 28,89°C. The visibility of the marine water was clear in the dry season while in the rainy season, it was very turbid and poorly visible due to the washing / bringing in of coastal river contents.

Problems encountered and lessons learnt

Problems

Species in-water population data and habitat characterization at foraging grounds was a daunting task work when using canoe on roaring waters. Limited coverage of other potential nesting site due to slowness of the canoe was equally a problem. Many potential nesting site were inaccessible due poor water visibility caused by our choice of month to carry out the surveys. We had no sub marine torch light. Accordingly, we plan to use an engine boat or flying boat and other necessary submarine equipment in our next organized in-water research expedition. The team identified two very good swimmers amongst the volunteers who will subsequently be trained in species data collection. Through strict guidance by the team leader, they will occasionally be going to the foraging areas to carry out research work. Interesting is the fact that, records of species were made at that site.

The Last Great Ape Organization (LAGA) is an NGO in Cameroon that assist the government in enforcing the 1994 Law. It participates in fighting against corruption within wildlife law enforcement personnel, sensitization, investigations and arrest of wildlife offenders. With the eradication of corruption in the law enforcement institutions, there will be effective enforcement of the 1994 Law and this will contribute to effective protection of the rich natural resources. Unfortunately, there exist the following enforcement issues: decrees provide protection at a national level, yet a shortage of trained personnel; insufficient capacity and funding to implement policies; poor roads and language barriers (by visiting experts who most often does not understand the local *Iyassa* language) all contribute to derisory nationwide enforcement. At the local level, implementation of the decrees is extremely problematic as stakeholders have not been consulted during the development of these agreements. At the end of this project, local marine turtle ecoguards/volunteers will be empowered with advanced skills to proceed with conservation approaches and will be confident of future attainment.

Most fishermen don't have any formal knowledge on responsible turtle by-catch fishery (sustainable fishing practices). Direct hunting and incidental capture of the globally important, yet marine turtle populations in the region are understudied. Information will be given out on the collection of biological data on the capture and consumption of marine turtle species;

There is no capacity building trainings for rural communities. Such trainings are important as it will provide exit strategies for fishers; adult education and training in alternative livelihoods (e.g. piggery, poultry and bee-keeping) to promote self-fulfillment of rural young people, to develop entrepreneurship spirit and to encourage personal risk and initiative taking. This will indirectly provide institutional integration; building a network connecting rural communities with local, national and international institutions.

Lessons learnt

The project team learnt the following lessons during the first half of project implementation:

1. In-water population surveys with canoes are better during the months when waters are calm. The best to be used is the engine boat.
2. It does not take only funds but also strong local commitment is needed and/or required for intensive consultations and economic-related activities (to gain trust and accelerate the empowering processes)
3. Recognition/adoption of customary regulations and reinforcing self-determination is a key requirement for community collective action especially against violators of wildlife laws.

4. Livelihood supports and capacity building (e.g. skills to increase economic production; and explore ways to resolve limited market access) is very fundamental to getting the rural poor to act.
5. Communities desire a strong and recognized local level ecotourism development system with authority and self management as they proposed among other things will be a source of revenue generation to the village community.

Conclusion

Three of the four species that nest in Ebodjes' coastline were observed at nesting sites during the 2015/2016 nesting season. Olive ridley was the most observed species with few encounters of leatherback and green turtles. The acquired data from our on-going surveys as well as consultative processes indicate the need for collaborative and/or participatory processes for species status recovery and/or enhancement. A new wave of local interest has been instigated and many locals are currently aware of how turtle populations positively impacts fish yield and catch, and are now in good collaboration with our team. Locals have been empowered to start thinking on how to be engaged with alternative livelihood. Our ongoing nesting monitoring program has demonstrated that effective protection of nesting beaches enables a general increase in nesting activities and a relevant reduction of nest poaching. Many volunteers/fishermen are working with our team in terms of nesting monitoring surveys, reporting of incidence of poaching and turtle bycatch in order to achieve a common goal of species conservation. Additionally, the ongoing project offers training, allowances to local volunteer ecoguard, and other volunteer positions to local and foreign students and research assistants. Different partnership approaches; capacity building, ecotourism development, wildlife law education / enforcement and organizational development have been identified by the project to further engendered changes in community members' attitude towards marine turtle conservation. It is our wish that all stakeholders will be united in our action to help protect endangered marine turtles in the area and Cameroon at large.

Looking forward

During the course of the first half of this project, several issues were identified that require urgent management intervention:

- Empower monitors / volunteers to effectively prohibit harassment and disturbance of nesting turtles and poaching of eggs in the Ebodje spawning zone. This will always make data available for efficient and effective management decisions;
- Initiate discussions with local fishermen to address the issue of turtle bycatch;
- Increased education and public awareness of, and concern for, marine turtle conservation, resulting in increased volunteerism and participation in conservation policy, action and advocacy;
- Provision of training and collaboration opportunities for conservation volunteers and workers that results in increased capacity, locally and throughout the region, for sea turtle conservation efforts;
- Effective management, conservation and advocacy on behalf of marine turtles and their habitats, resulting in improvements in environmental policy, law and enforcement that ensure conservation and recovery; clean nesting sites; and abundant, high quality foraging habitats;

- Development, maintenance, and use of systems and resources that facilitate effective operation of the organization;
- To encourage and expand turtle-based ecotourism in Ebodje and elsewhere;
- To liaise with more bodies in sourcing fund to mitigate threats of fisheries-turtle interaction, and global warming;
- Conduct capacity building trainings on alternative livelihoods for fishermen (e.g. piggery, poultry and bee-keeping). This will to promote self-fulfillment of rural young people, to develop entrepreneurship spirit and to encourage personal risk and initiative taking. This will indirectly provide institutional integration; building a network connecting rural communities with local, national and international institutions.

Satellite tracking

In the near future, fieldwork in the pelagic stage will also include the impact assessment of artisanal fishing on *C. mydas*: Using satellite transmitters fixed on the species carapace to predict areas of fisheries-turtle interactions (bycatch). This will broaden the assessment level of species removal from its population, and then determine the effects of this removal e.g. age and sexual maturity. Also, this will give record of the depths of *C. mydas* dives that will help to understand their involvement and interaction as bycatch at depths of fishing efforts (gears). Also, the satellite tracking studies will show how juvenile *C. mydas* foraging grounds / post-hatchling turtles migration correlate with sea surface temperature (SST) and areas of high incidence of accidental take of the turtles in fisheries. This will help to elucidate potential areas for mitigating fisheries bycatch interactions that will directly inform ongoing conservation efforts of the species.

Genetic analysis- DNA profiling

We plan to collect genetic samples of stranded turtles found on the beaches. This analysis is meant to identify species origin by determining the genetic relationship between the different species in Ebodje and compare them to other genetically identified populations in the region. This will be an introductory data capturing. This component was not possible during the 2015 project period due to financial constraints.

The manner in which genetic material of species are packaged and partitioned can influence individual morphology, physiology, and life history, and affects population dynamics. In order to keep pace with biotic/abiotic environmental changes for the case of this research, we will be interested to use population genomic approach to understand connectivity and abundance of green turtles in the selected sites. A key element used for separating stocks is through genotypic variation. Genetic variations of the stocks are revealing new and important insights about connectivity. The demographic events shaping the population structure and functioning of the turtle species across the different islands could be understood through the use of neutral genetic markers (not driven by selection; markers of gene flow) and adaptive genetic markers (genes of the Major Histocompatibility Complex, MHC). These genes have as primary function to initiate responses to parasites and diseases and their evolution is driven by natural and sexual selection. Through a combination of data from field and lab-based approaches, basic and applied science important research questions will be addressed in the areas of evolutionary ecology and conservation biology for use in management and conservation planning of the species. The objective of this exercise is to determine the genetic relationship between the different species of marine turtles that visit the coastline of Ebodje and compare to other genetically identified populations in the Gulf of Guinea. Tissue samples will be extracted from the posterior edge of the hind flipper of the turtle. The biopsy site and surrounding tissue will be

cleansed with Vanodine solution, applied with a cotton wool, before the sample is obtained. Sterile surgical gloves will be used. The sample will be obtained by holding the tissue to extract with tweezers and removal will be done using a scalpel blades. The sample will be about 1cm^2. Following removal of the sample, the area will be cleaned again with Vanodine, and left to heal by granulation. The sample will be placed inside a vial, which should contain alcohol. Each vial will be labelled with date and tag numbers of the turtle. Care will be taken never to use the same scalpel for different turtles!!! Once the sample collection, the scalpel and cotton wool are disposed in the disposal bag, and the tweezers washed with alcohol.

It should be recalled that migratory green turtle species like other species show evolutionary significance of philopatry, and return to a natal site for reproduction, appears paradoxical: they undertake a long and dangerous journey to eventually come back to their place of birth. This behavior may even put whole species at risks of extinction: it creates genetic structure between populations by reducing migrations amongst mating grounds and hence may reduce the adaptive potential of species. As such, genetic research will partly be identifying the molecular basis of such a complex behavior. Combining state-of-the-art molecular techniques with field experiments on turtles nesting on the Ebodje spawning zone, we will be identify the i) genomic regions and ii) methylated genomic sites associated with sites-specific signatures reflecting philopatric behavior. Results from genetic analysis are expected to clearly reveal novel aspects of juveniles' green turtle migration. This will give understanding of the demographic events shaping the population structure and functioning across the different locations in the area through the use of neutral/adaptive genetic markers.

Some cited literatures

Ayissi, I., Aksissou, M., Tiwari, M., and Fretey, J. 2013. Caractérisation des habitats benthiques et ponte des tortues marines autour du parc national de Campo-Ma'an (Cameroun). International Journal of Biological and Chemical Sciences, 7 1820-28.

Fretey J., 2005. LES TORTUES MARINES DE GUYANE, ed. Plume Verte, 192p.

Heppell, S., Crouse, D., Crowder, L., Epperly, S., Gabriel, W., Henwood, T., Marquez, R., Thompson, N., 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridleys. Chel. Conserv. Biol. 4, 767–773

Lewison, R.L., Crowder L.B., Read A.J., Freeman S.A. (2004a). Understanding impacts of fisheries bycatch on marine megafauna. *Trends Ecol Evol* 19, 598–604.

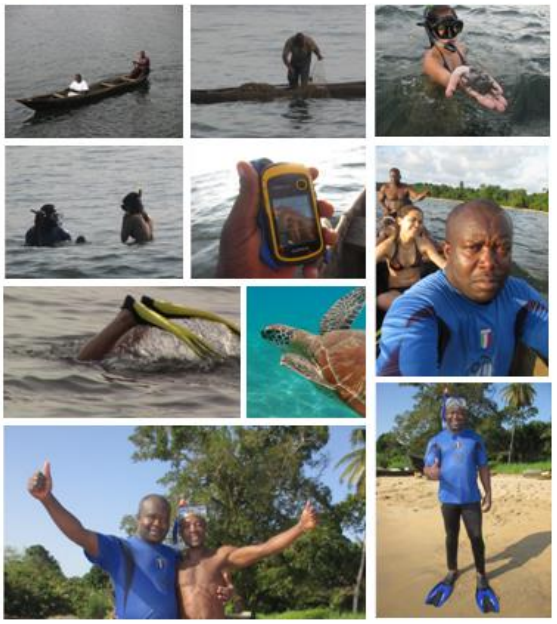
Lewison, R.L., Freeman S.A., Crowder L.B. (2004b). Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. *Ecology Letters* 7, 221–231.

Soykan, C.U., Moore J.E., Zˇydelis, R., Crowder L.B., Safina C., Lewison R.L. (2008) Why study bycatch? An introduction to the Theme Section on fisheries bycatch. *Endang Sp Res* 5, 91–102.

Wallace, B.P., Heppell, S.S., Lewison, R.L., Kelez, S., Crowder, L.B., 2008. Reproductive values of loggerhead turtles in fisheries bycatch worldwide. J. Appl. Ecol. 45, 1076–1085.

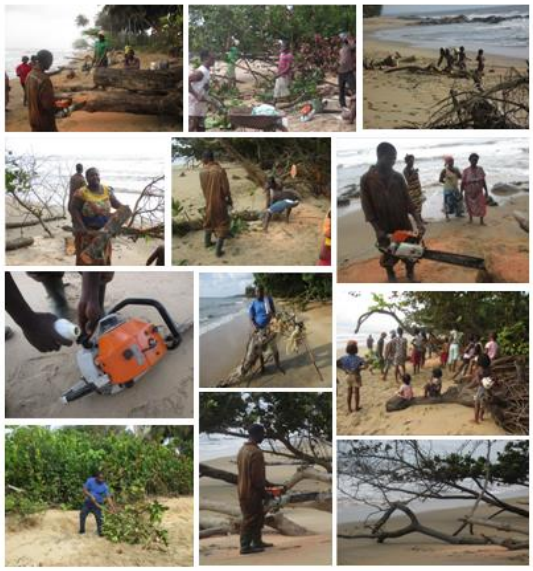
Selected Mission Pictures

Appendix 1



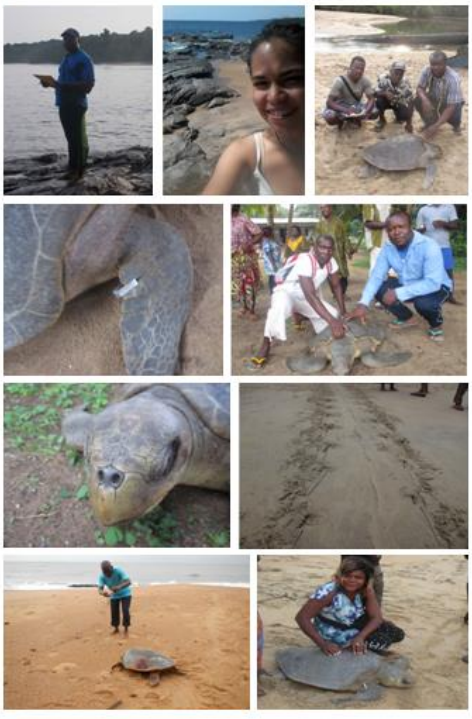
Appendix 2

Appendix 3



Appendix 4

Appendix 5



Appendix 6

Sea grasses during habitat characterization survey at foraging ground in *Talla*, Ebodje