Annual report of nesting activities of sea turtles in Pacuare beach, Costa Rica. Season 2017.

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Abstract

Since February 27th until October 31th, the nesting activities of Leatherback turtles (*Dermochelys coriacea*), Green turtles (*Chelonia mydas*), Hawksbill turtles (*Eretmochelys imbricata*) and Loggerhead turtles (*Caretta caretta*) were recorded in Pacuare beach, In the season 279 Leatherback nests, 72 Green turtle nests, 10 Hawksbill nests and one Loggerhead nest were registered. Two hundreds nests were relocated in the hatchery, 19 were incubated *ex situ* and eight were relocated in a safe place at the beach. The emergence success of the nests of Leatherback turtle was 58.77% (SD = 24.77, n = 162), 71.1% (SD = 23.92, n = 53) was for Green turtle, 71.9% (SD = 23.74, n = 8) for Hawksbill turtle and the only Loggerhead nest had 61.53%.

From all the saved nests, a total of 12,591 neonates were released, which 7,349 were from Leatherback turtle, 4,262 were from Green turtle, 900 were from Hawksbill turtles and 80 were from Loggerhead. The number of neonates could be higher but the number of illegal extracted nests, the high number of poachers at the beach, the extension of the beach and the lack of resource to bring more volunteers ad workers.

LAST recommended to keep operating in Pacuare, to get enough data in order to estimate the dynamic of sea turtle population and create more conservation tools to support the recovery of the populations in the Caribbean Coast of Costa Rica. The nesting of *C. caretta* is a good indicator of the recovery of the population of sea turtles.

Keywords : Dermochelys coriacea, egg collection, leatherback turtle, nesting, tag returns, trend, conservation volunteer, alternative livelihood, Costa Rica, WIDECAST, LAST.

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1. INTRODUCTION

The sea turtle nesting in Costa Rica Caribbean coast has been described since the 70´s mainly in Tortuguero beach (Troëng and Rankin, 2005). Long ago humans have been using sea turtle products and by-products, mainly as a food resource but also for the confection of handicrafts´ (Chacón, 2002). Now as a result of the demographic increase of Costa Rican´s population, the pressure on sea turtle species has intensified, increasing the demand in the black market along the country, targeting eggs and meat from the sea turtles.

To reduce the threat and help to reestablish sea turtle population, a large number of conservation projects has been implemented on the Caribbean coast of Costa Rica; Pacuare Beach Project is one of them. LAST (Latin America Sea Turtles) in association with WIDECAST and the Asociación para el Ambiente de Nuevo Pacuare established the project in 2012.

This Project involved part of the community in conservation activities, such as to guard the hatchery or working as a research assistant on beach patrols. The community of Pacuare is located in a remote and rural area of the country. The community members do not have paid jobs so they are completely vulnerable to consume and traffic drugs. During sea turtle season, homeless people arrive to the beach and dedicate to the illegal extraction of the eggs and slaughter of the marine turtles, increasing the pressure on the species present at Pacuare Beach.

Conservations activities of this project are highly important to protect and restore the population of the four species that nest on this area, which are hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), green sea turtle (*Chelonia mydas*) and loggerhead sea turtle (*Caretta caretta*). The first specie is considered as critically endangered, green turtle and loggerhead turtle are classified as endangered (IUCN, 2014). Leatherback was cataloged as a Critically Endangered species but at the last convention of the Sea Turtles Specialist Group of UICN now is classified as vulnerable.

Since February to October, daily patrols were organized, to monitor the nesting activities on the 7.1 km that LAST-WIDECAST administer. National and international volunteers are involved in date recording, measurements of the nesting females and hatchlings, relocations of the nests and the hatchery maintenance. The hatchery is one of the strategies used in several beaches where the incubation of the eggs in situ is not an option because of erosion or poaching activities at the beach. All the activities in which volunteers help, are under the supervision of a trained LAST member of the project, to reduce errors in data recording. Volunteers are trained upon arrival.

The main objective of Pacure Project is to improve the conservation status of species in the area of study by working with the community and governmental agencies. Helped with institutional agreements to allow the standardization of the conservation activities, which will help with the protection of the females during the nesting and the reproductive success of the sea turtles. The success rate of the project is linked with the number of volunteers on the beach in order to compensate the number of poachers in the place. National and international volunteers provide help in assisting in data recording, beach and hatchery maintenance which is not manageable with a team composed only with the resident biologists and two international assistants. Volunteers make a significant contribution to the project, they are an important workforce and guided by an experienced scientific, volunteers could make contributions to the scientific knowledge (Foster-Smith & Evans, 2003).

2. Methodology

2.1 Studying area

Pacuare beach (10°18’48.66’’N, 83°21’17.25’’O – 10°13’25.37’’N, 83°16’47.12’’O) is located in Bataan´s district, within the Canton of Matina, in the province of Limón, Costa Rica. The area of study is 7.1 km of beach, it starts at Parismina River mouth and finishes at Pacuare River mouth.

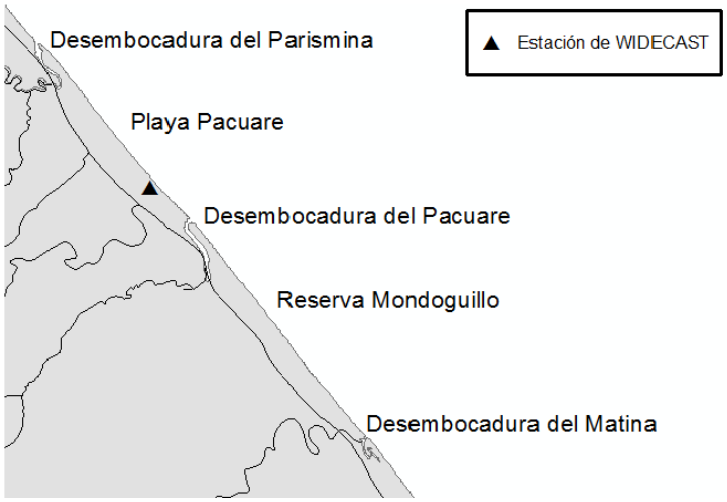

Figure 1. Location of Pacuare Beach and LAST research station.

2.2 Beach preparation

The beach was divided every 50 meters following a parallel line to the ocean, this was to facilitate the location of the nesting activities. On every site, a wooden mark with a number and reflective tape on it, was placed. The numeration was done from North to South, starting at Parismina River mouth, and ending at Pacuare River mouth.

The beach was divided in three sectors in order to organize nightly patrols. Sector A runs from #0 to #51, sector B from #79 to #52 and sector C from #78 to #144.

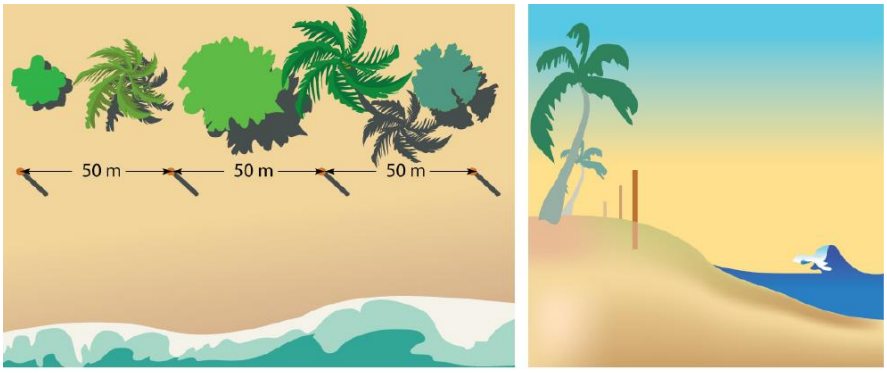

Figure 2. Spatial distribution of the wooden markers.

2.3 Nightly patrols

Patrols were guided by a national or international research assistant or the resident biologist. With an average of four hours depending the nesting activities at the beach, 10 km were covered on each patrol.

Every day, patrols started at 19:00 and the last patrol left at 00:00, no more than five volunteers were on each patrol, with that, volunteers could participate completely in the activity. They were never left as observers. Volunteers had to walk parallel to the sea, just behind the guide in order to do not be left apart on any activity. Only red light and dark clothing was allowed to use during the recording of the biometrics, tagging the nesting females, relocation of clutches and release of neonates.

If a poacher was seen with the turtles, the patrol´s leader decided if the patrol would wait after the ovoposition to take the data of the female or would keep going to try to find more turtles.

2.4 Nests protection

Because of the constant pressure from poaching in Pacuare, a few number of nests were relocated in a safety place around the beach, other nests were incubated *ex situ* and the majority of the nests were relocated in the hatchery in order to prevent that someone could steal the eggs.

The nests are divided into four categories, *in situ* or natural, relocated at the beach, *ex situ* and relocated into the hatchery.

The nests *in situ* are the nests that are left in the place selected by females at the time of the ovoposition. In Pacuare Beach the nests *in situ* are the result of nests that could not be found by the research assistants. In that case, patrol members camouflaged the tracks to confuse poachers and enable them to localize the eggs later on.

The nest relocated at the beach are the nests that were collected and removed from the place that the turtle selected to a safety place at the beach (safe from erosion or poaching). In Pacuare, the relocated nests at the beach were the nests saved at the beginning of the season when the hatchery was not completely done.

The nests incubated *ex situ* are the nests removed from their original place and incubated in cooler boxes or styrophone boxes into the station, those nests belong to the first nests saved by LAST. At the beginning of the season the number of volunteers was low and the hatchery took longer to be finished, the number of volunteers was not enough to guard the nests at the hatchery as well.

The nests relocated at the hatchery are the ones removed from their original locations and transferred into the hatchery. This one was built in the wooden mark #104, on the vegetation line, in an area submitted to little erosion and without inundation risks. The hatchery was delimited by a metallic fence of 1.5 meters to evade the intrusion of predators or turtles.

To build the hatchery, the entire sand was removed up to a meter depth in a whole, in the area were removed roots, wood and other elements that could damage the eggs.

Later on, sand from the low tine line (naturally sterilize by the salt water of the sea) was filtered and added in the selected area. The hatchery was divided in 50cm width squares, getting a total number amount 210 squares.

Figure 3. Extraction of the sand in the area receiving for the hatchery in Pacuare beach.

2.5 Collected of clutches

When the patrols found a turtle without a poacher, the patrol leader approached to the turtle and decided the correct moment when the group could approach without scaring or interrupting the nesting process. When the turtles finished digging the eggs chamber, carefully, a sterile plastic bag was put into the hole to collect the eggs while the turtle was laying. During that process, measurements of the depth and width of the nest were recorded.

Once the turtle started to cover the nest, the egg bag was pulled out of the hole gently and located in a safe place, with that the other volunteers had enough space to take the measurements and recorded the data.

Figure 4. Oviposition of a Leatherback turtle, *Dermochelys coriacea*, in Pacuare Beach (Chacón *et al*., 2007)

2.6 Biometrics

Measurement of width and length of the females is taken only after de ovoposition, in order not to interrupt the process. The carapace of the turtles needed to be cleaned of sand, each measurement is repeated three times and dictated clearly to the volunteers who are in charge of writing down the data.

2.6.1 Curve Carapace Length (CCL)

The CCL is taken from the border of the carapace, just behind the neck, on the right side of the central ridge till the end of the peduncle. If the turtle has an uneven peduncle, the measurement must be taken on the longest part.

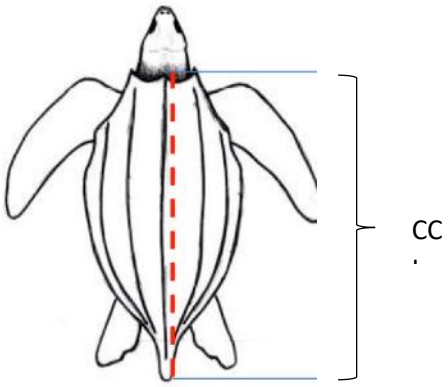

Figure 5. Measurements of CCL of *Dermochelys coriacea* (Chacón *et al*., 2007).

2.6.2 Curve Carapace Width (CCW).

The CCW is taken from the left ridge till the right ridge or vice versa, always measuring the widest part of the carapace.

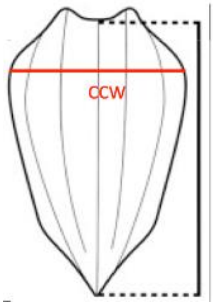

Figure 6. Measurement of CCW of *Dermochelys coriacea* (Chacón *et al*., 2007)

2.7 Tagging

To tag the females that do not have metal tags or were about to lose them, tags Monel #49 and #56 (leatherback turtle) were used and Pit´s (Passive Integrated Transponders) were used for the internal tags.

Before tagging, the turtle is thoroughly inspected looking for Evidence of Previous Tags (EPT) and all the information is recorded on the data sheets according with the protocol described in the R-055-2007 SINAC.

All tagging techniques were completed by a trained staff with a valid scientific passport delivered by the MINAE (Ministry of Environment of Costa Rica).

Figure 7. Placement of the metal tags in the uropigeal area of Leatherback Turtle. (Chacón *et al*., 2007)

Figure 8. Passive Integrated Transponder (PIT) and applicator.

Figure 9. Revision of a Leatherback turtle to check the presence of a PIT tag. (Chacón *et al.*, 2007)

2.8 Transport and relocated of the clutches

Once the clutches were collected, the patrol walked back to the hatchery to relocate the nest. When transporting the egg bag it was handled steadily in order to avoid movements that could damage the eggs and cause the abortion of the embryonal development.

The hatchery is divided in squares where nests are placed, and it is a rule that next to each square in which there is a nest it must follow an empty one, it helps to avoid nest damages from each other such as: low /high temperature, excess of / lack of humidity, lack of oxygen or infections. Volunteers on shift chose an empty space by following the rule empty-nest-empty.

O = Nest
X = Empty
Nest Code = C3

	1	2	3	4
A	O	X	O	X
B	X	O	X	O
C	O	X	O	X
D	X	O	X	O

Figure 10. Example of the mapping of sea turtles hatchery.

Normal eggs were placed and counted first into the nest followed by the yolkless eggs or infertile egg.

A mesh basket was put on top of the nest to avoid the introduction of predators and contained the neonates at their emergence.

Figure 11. Panoramical view of the hatchery. Each nest is located under the mesh basket.

2.9 Neonates

Hatchery shifts lasted six hours maximum at night and two hours during daytime. The nests were checked every 15 minutes to remove crabs, flies and ants but also to checked if any hatchling emergence. To check the nests, volunteers needed to walk on the empty spaces, in order not to compact them.

Neonates were released at different parts around the beach, to not create feeding areas for predators that could be just waiting for the hatchlings. The hatchlings were released at a minimum distance of 10 meters from the high tide line so they could fulfill their imprint mechanism.

During nighttime release, it was preferred to not use any light to avoid the disorientation of the neonates, and during daytime, hatchlings were kept until 17:00 (when temperature was lowering) unless the weather was cloudy or rainy, daytime releases were allowed if the temperature was low enough to not damage the hatchlings.

From every nest, 15 hatchlings were randomly chosen and both length and width of the carapace were measured with a caliper. The weight was recorded with a 50 g pesola (± 0.3 %, PESOLA Swiss Made Company). To manipulate the hatchlings, were required latex gloves and as gentle as possible handle in order to not stress and disorient them.

Figure 12. Measurements in Leatherback neonates

2.10 Exhumations

After the emerged of the nests, the exhumations were done to evaluate the percentage of hatching and emerged, each exhumation was made within 24 or 48 hours after the first emergence or 70 days after the nesting date (in case than no emerged was observed).

From every nest, the number of the eggs shell, live neonates and dead neonates were recorded on the data sheet. The eggs that did not hatch were also opened to estimate the embryonal development. The development stages are classified according to the space used by the embryo into the egg, and they are divided into four categories:

I) Embryo use 0 to 25 % of the space into the egg
II) Embryo use 26 to 50 % of the space into the egg
III) Embryo use 51 to 75 % of the space into the egg
IV) Embryo use 76 to 100 % of the space into the egg

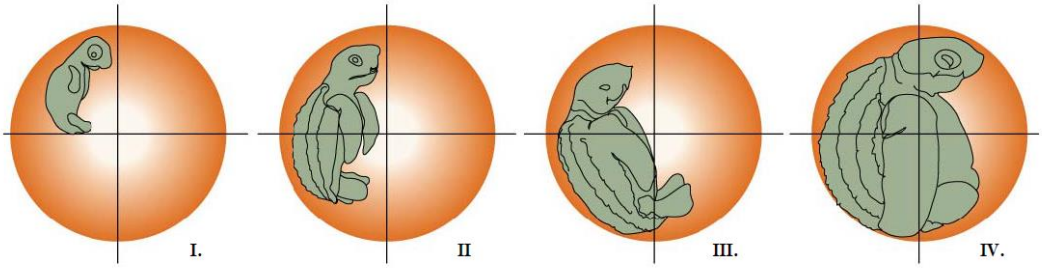

Figure 13. Development stages of the embryos in non-hatched eggs (Chacón *et al*. 2007).

The percentage of hatching and emergence are calculated with the following formula:

$$PE = \frac{C}{N} \times 100$$

$$PEM = \frac{C - TM}{N} \times 100$$

Where: PE = percentage of hatching, PEM = percentage of emergence, C = shells, N = total number of eggs and TM = number of dead neonates present in the nest or surrounding.

2.11 Research permitions

On February 18th, 2017 the scientific permitions to monitor the four species of sea turtles nesting in Pacuare were delivered under the resolution **SINAC-ACLAC-PIME-R-003-2017** and signed by Jorge Arturo Gonzáles Villalobos.

2.12 Trainings

The training of the local research assistants took place in the first week of March, research assistants participated in lectures of biology, ecology, threats, identification of the species, conservation strategies and monitoring protocols on nesting beach. All lectures were coordinated into the biological station of LAST. Also, they received a practical training about tagging, data recording and relocation of the nests.

During the season, volunteers were trained by the resident biologist and international research assistants. On patrols, the data collection and activities were supervised by a trained professional.

Figure 14. Theorical training –Lecture on Sea turtle ecology and biology.

Figure 15. Practical training – Data and nest collection during patrols.

3. Results and discussion

3.1 Leatherback turtle

3.1.1 Nest and false crawl activity

From February 26th to August 16th a total of 487 nesting activities were recorded at Pacuare Beach, 279 of those activities were recorded as successful ovopositions. The remaining 208 are classified as false crawls, i.e. the females emerged from the sea but the activity did not end in a successful nest.

In comparison to the five previous seasons where LAST has monitored the beach, the 2017 season is quite below to the average (Figure 16) but it corresponds to the inter-annual fluctuations described by several authors (Troëng *et al*.,2004 y Chacón-Chaverri y Eckert, 2007).

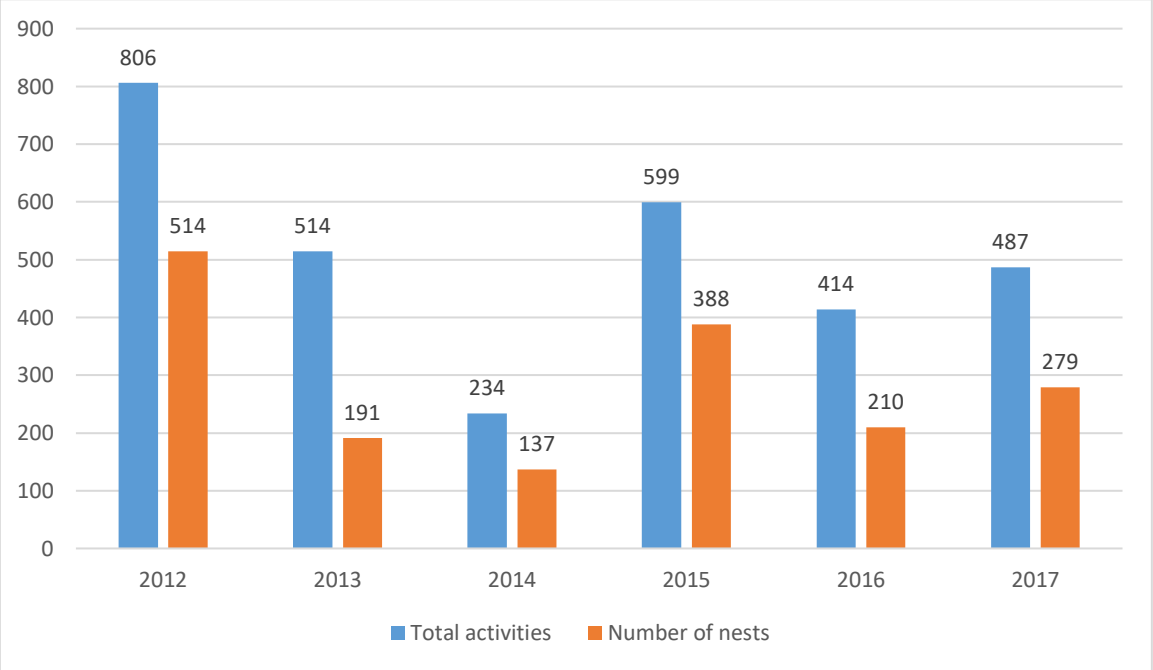

Figure 16. Number of nests and nesting activities recorded at Pacuare Beach since 2012.

3.1.2 Seasonal distribution

The months in which there was more nesting activity were April and May, respectively, 81 and 127 nests (Figure 17). February and August corresponded to the beginning and end of the season in which there was one nest per month. On March there were 22 successful ovopositions, On June there were 41 and on July there were only 6 nests. This pattern was similar to the one described seasons before (Chacón-Chaverri y Eckert, 2007, Fonseca y Chacón, 2012, Marion y Chacón, 2013, Fonseca y Chacón, 2014, Marion, 2014).

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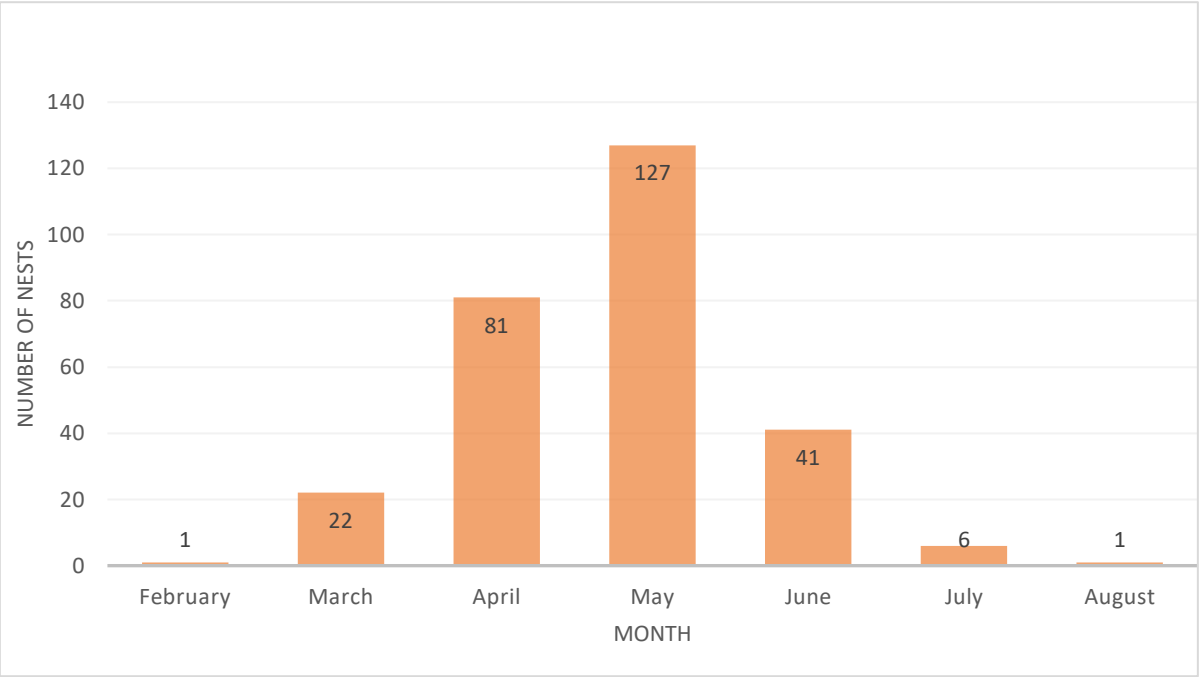

Figure 17. Seasonal distribution of the nesting activities for leatherback turtle (*Dermochelys coriacea*) at Pacuare beach, Costa Rica during the year 2017.

3.1.3 Spatial distribution

During 2017 nesting season, the nesting activities were recorded in all the area of study. But most of the activities were recorded in sectors 11-20, 51-60 and 71-80 (Figure 18). Due to the spatial distribution around the entire beach, the protection of the nests is a logistic challenge since it requires personnel present on the seven kilometers of the beach. To ensure an efficient coverage of the beach a minimum of eight patrols are required to cover the completely area during all night, unfortunately the average of patrols was six.

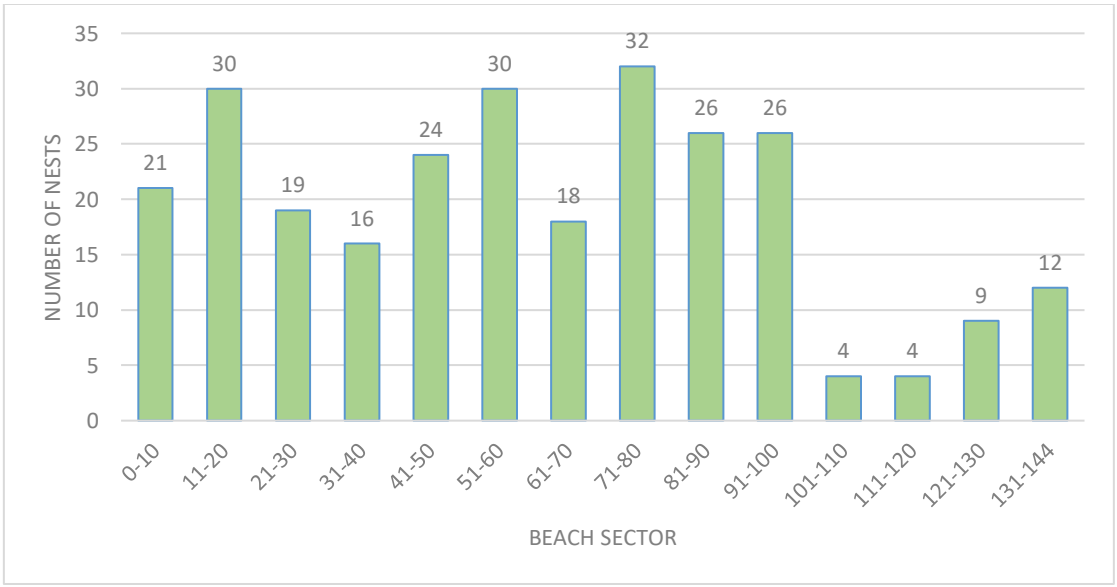

Figure 18. Spatial distribution of leatherback (*Dermochelys coriacea*) nests at Pacuare beach, Costa Rica, in 2017.

3.1.4 Number of females registered

Nesting females are classified as neophytes and remigrants. A neophyte turtle is the one that is in her first reproductive season. It is very difficult, without an internal laparoscopy, to determine at the first-time breeding capabilities. For tagging and releasing programs, neophyte term is usually used for females without tags or evidence of previous tags on their flippers and for those which have not been recorded on that place. Once tagged and seen repeatedly nesting in the same season, the turtle is referred as a renesting or interseasonal turtle.

Remigrants turtles, are those that have a tagging history of two or more seasons recorded at the same program or at multiple locations.

In this season a total of 158 nesting females were recorded. 23 were classified as neophytes, 124 were seen just one time, 27 were observed nesting twice, four females were recorded three times and three females were registered four times (Figure 19).

This phenomenon could be explained by the fact that Pacuare is part of a beach complex where females nest. The genetic pool of the Western Caribbean (Dutton *et al.*, 2013) runs from the South of Nicaragua until the North of Colombia. So females return to nest in areas where LAST do not operate.

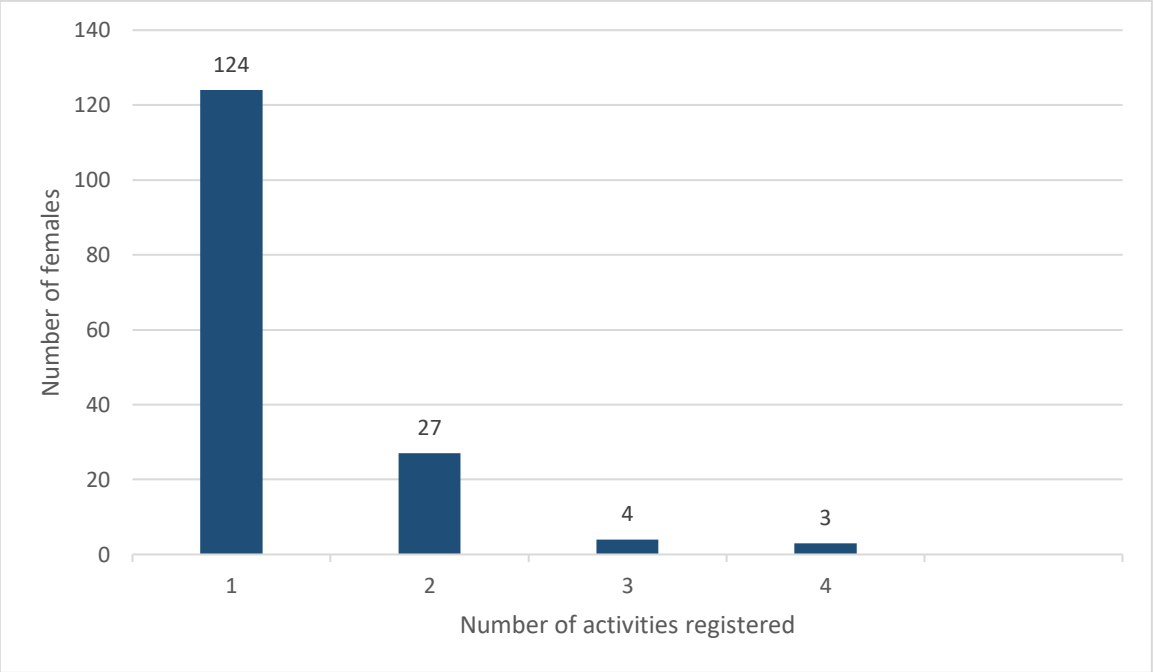

Figure 19. Number of returning Leatherback females registered in Pacuare beach during the year 2017.

3.1.5 Biometrics

The average of the curve carapace length (CCL) of the measured females in Pacuare was 150.79 cm (SD = 7.16, n = 150) and the curve carapace width (CCW) was 112 cm (SD = 7.06, n = 149). These measurements are similar to the ones recorded in Gandoca Beach between 1990 and 2010 (Chacón-Chaverri y Eckert, 2007, Fonseca y Chacón, 2010) and Tortuguero (Harrison y Troëng, 2003).

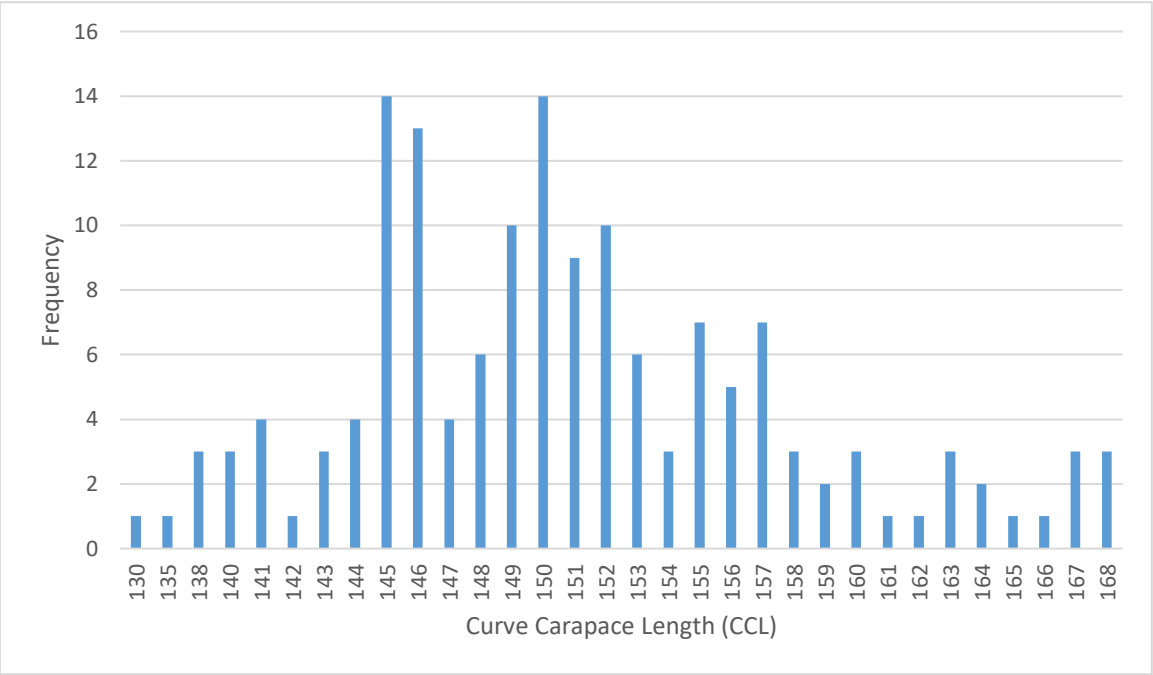

Figure 20. Distribution of the curve carapace length found in *Dermochelys coriacea* , Pacuare beach, 2017.

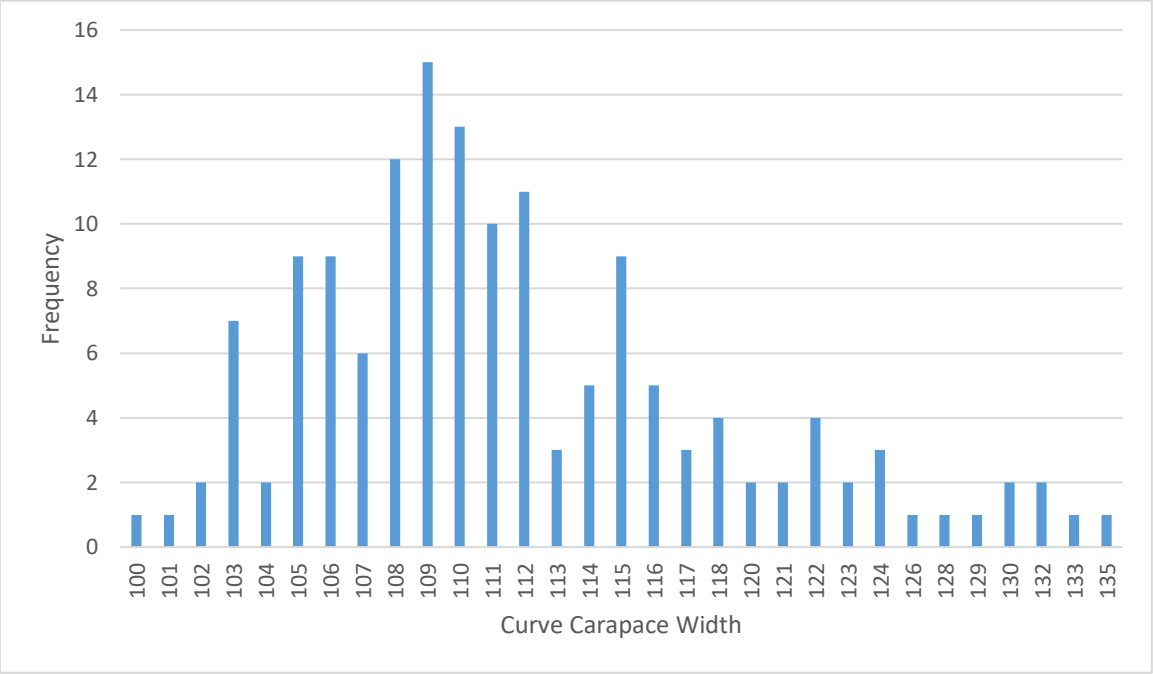

Figure 21. Distribution of the curve carapace width found in *Dermochelys coriacea,* Pacuare beach, 2017.

3.1.6 Fate of the nests

During the 2017 season, the percentage of nests that were illegally collected was 41.94%, this percentage is the lowest registered since LAST started monitor at 2017 (Figure 22). The mainly reason could be that during the

sporadic patrol of the coastguard, five poachers were arrested and taken to trial as a result, poachers were out in the beach just a few hours during the night.

From the nests saved by LAST, the 48.38% was relocated in the hatchery, 6.81% was incubated *ex situ* and the 2.86% was relocated in a safe place at the beach. It is notorious that the majority of the saved nests were relocated in the hatchery because Pacuare is highly frequented by turtle poachers and none of the nests can be left *in situ*. The nests incubated *ex situ* were the first nests of the season, when the hatchery was being built and the number of the volunteers were not enough to guard the nests at the hatchery.

There is also a correlation between the number of poached nests and the global nesting activity, a higher number of nesting activity means that patrols are busy collecting clutches or relocating the eggs and cannot reach the limits of the beach, leaving some areas unpatrolled for a long time, enough for poachers to get some nests.

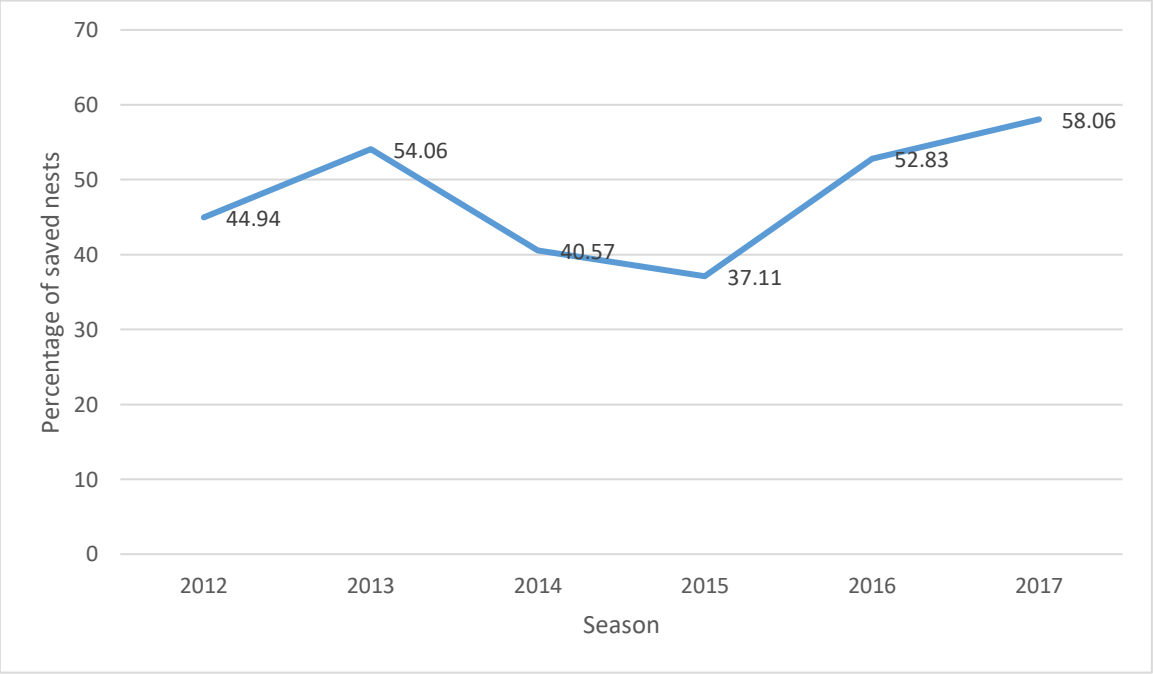

Figure 22. Percentage of saved nests of leatherback turtles in Pacuare beach since 2012.

3.1.7 Hatching and emergence success

The emerge success of the nests relocated at the hatchery is 63.92%, this percentage is higher than the percentage registered in Gandoca (Chacón & Eckert, 2007) and Tortuguero (Troëng *et al*., 2007) where the emergence success was respectfully 11,6 - 39,4 % and 42,6 ±35,14 and is the second highest percentage since LAST started at 2012 (Figure 23).

An estimate of 7,349 neonates were released in Pacuare beach during 2017 season.

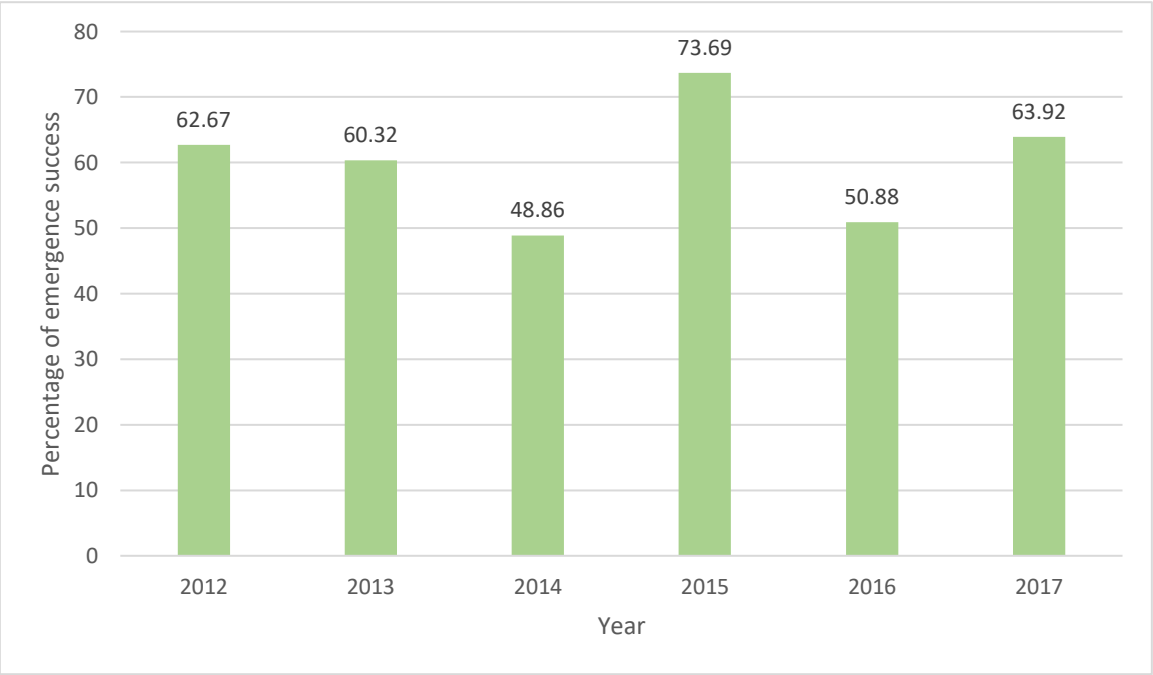

Figure 23. Percentage of emergence success for leatherback turtles in Pacuare beach since 2012.

3.2 Green Turtle (*Chelonia mydas*)

3.2.1 Nesting and false crawling activity

During 2017 season, 175 nesting activities were recorded, whereby only 72 ended up in a successful ovoposition. This is a low number due to the disturbance that turtles are exposed by poachers. The females get scared and return to the sea or are hunted before they finish laying eggs. If we compare 2017 season with previous seasons, this year was on the average (Figure 24). It shows the importance to keep monitoring these reptiles to determine the long-term trend and the accurate strategies to conserve and reestablish the populations of sea turtle.

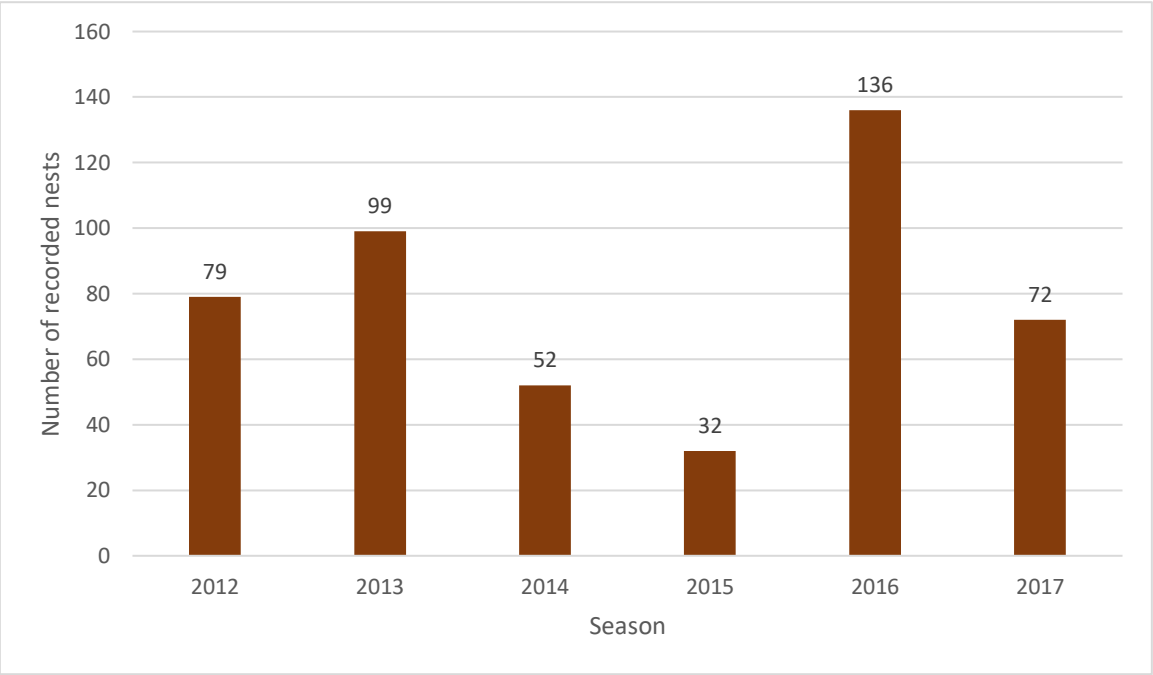

Figure 24. Number of nests of Green Turtles (*Chelonia mydas*) since 2012.

The majority of the nests were registered on July and August with 27 and 35 respectively, on April there were two nests while on May and October there were not any nesting activities. (Figure 25). According to the recorded information of Tortuguero where most of the nests were found during September and October (Gonzáles y Harrison, 2012) the pattern in Pacuare Beach is a little more erratic.

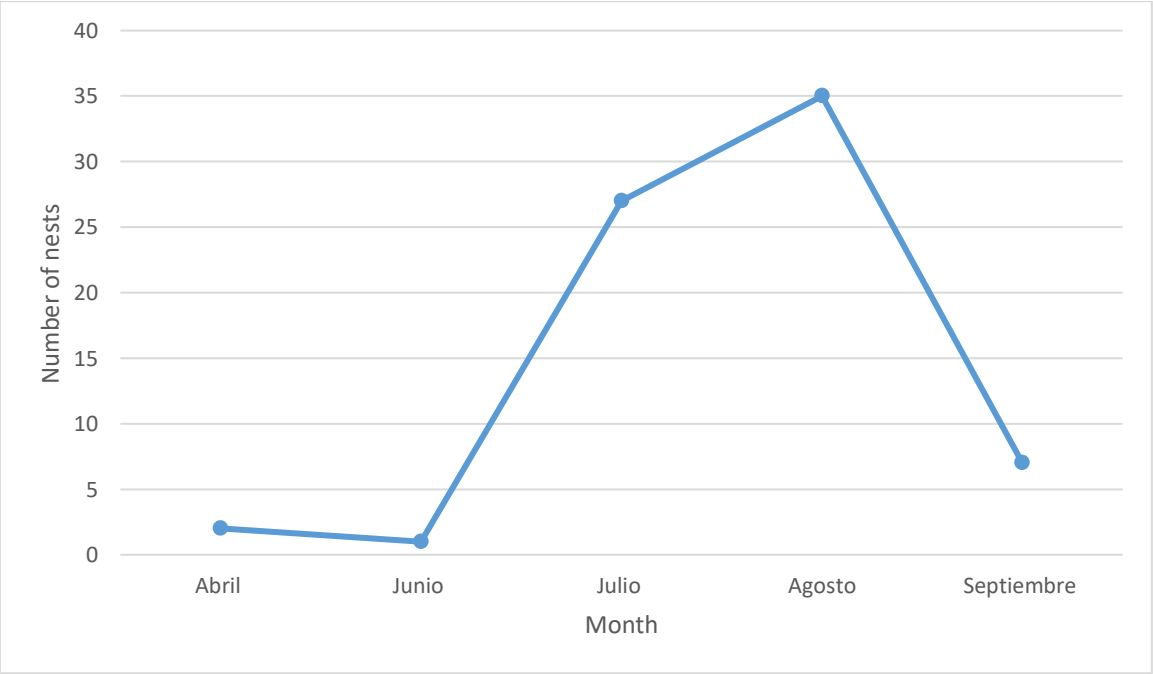

Figure 25. Seasonal distribution of the nesting activity of Green Turtles (*Chelonia mydas*) in Pacuare Beach during 2017.

Most of the nesting activity took place in sector 21-30 and 61-70 (Figure 26). In this season 55.5% of the nesting activities were concentrated in the North part of the beach (after the wooden market 50) but also, there was some activity recorded at the South. This distribution pattern is a challenge for the people at the project, in order to protect the nests and the females, it is necessary the presence of people along the entire beach.

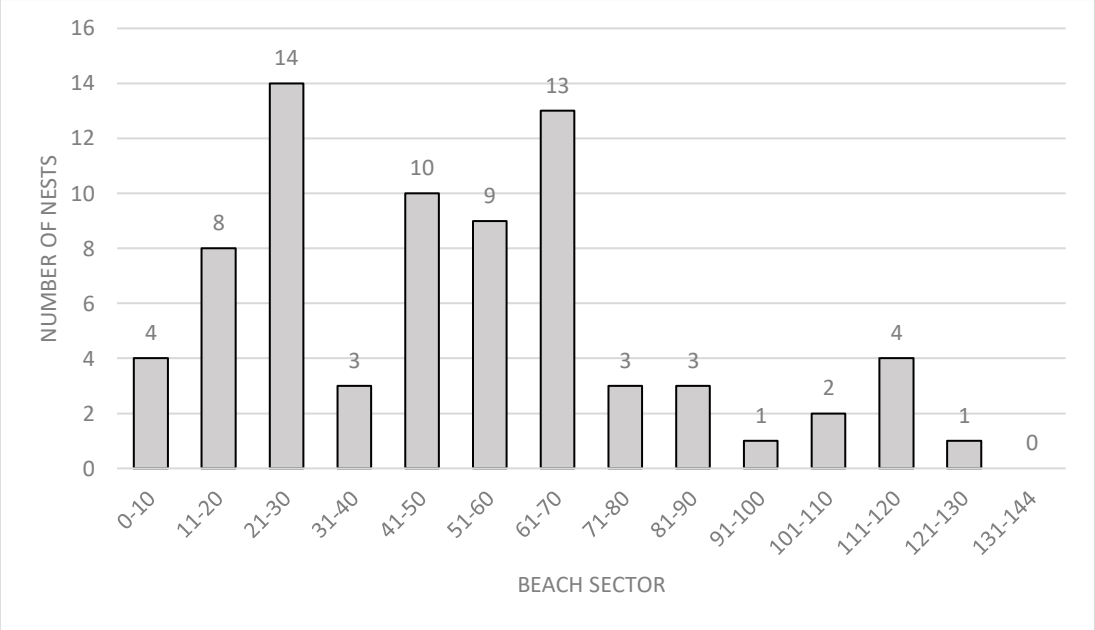

Figure 26. Spatial distribution of the nesting activity of Green turtle (*Chelonia mydas*) in Pacuare Beach, Costa Rica.

3.2.2 Number of females registered

In 2017 thirty-seven nesting females were recorded and thirty-three did not present any tags or evidence of previous tagging

3.2.3 Number of killed females

Unfortunately during this season 10 femes were killed by poachers, but we estimate that the number is even higher because the poachers used a different strategy in which they tied a rope to the turtle and let her return to the water, later on they pulled the turtle to a part of the beach where more poachers were waiting to take the turtle to the vegetation where they killed her.

Despite this, the number of killed turtles is the same or lower than the previous seasons (Figure 27). This fact, plus the number of poached nests reflects that the conservation work in Pacuare requires more years to eradicate these illegal activities. Moreover, most of the people involved in these activities are not permanent residents of Pacuare which diminishes the impact of environmental awareness initiatives. The opening of job opportunities is not a solution unless the community of Pacuare take out the poachers from the area.

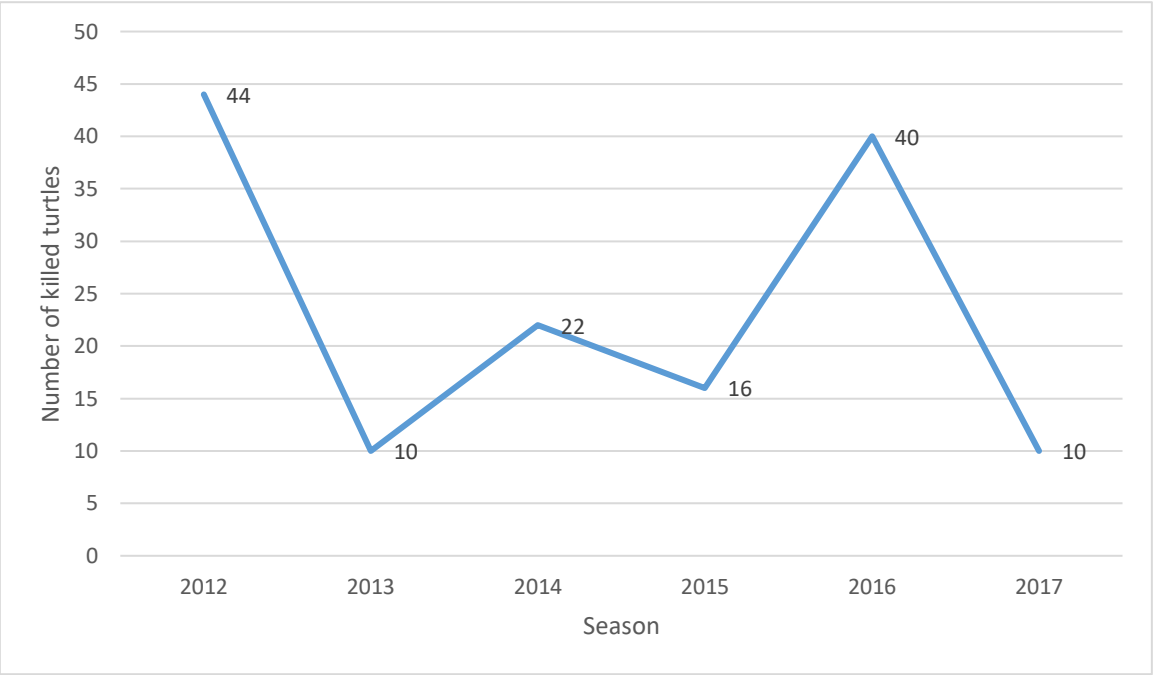

Figure 27. Number of Green turtles (*Chelonia mydas*) killed in Pacuare, Costa Rica since 2012.

In this season the Coastguards went to our constant calls but unfortunately just one female was rescued.

3.2.4 Fate of the nests

A total of 76.38% of the nests were protected in 2017. Fifty-four nests were relocated in the hatchery and one was incubated in a styrophone box. The percentage of rescued nests is an important achievement but is fundamental to reduce the killing of the turtles to obtain better results in long-term conservation.

3.2.5 Hatching and emerged success

The percentage of emergence from the nests exhumated was 71.1% (SD = 23.92, n = 53) releasing an approach of 4,262 neonates, this percentage is the lowest recorded since LAST started in 2012 (Figure 28). The percentage was low because the nests were exposed to different temperature for a long time due the number of hunters on the beach, patrols had to wait until the turtle return safety to the sea, that does it means that the nest was moved to the hatchery after a long time.

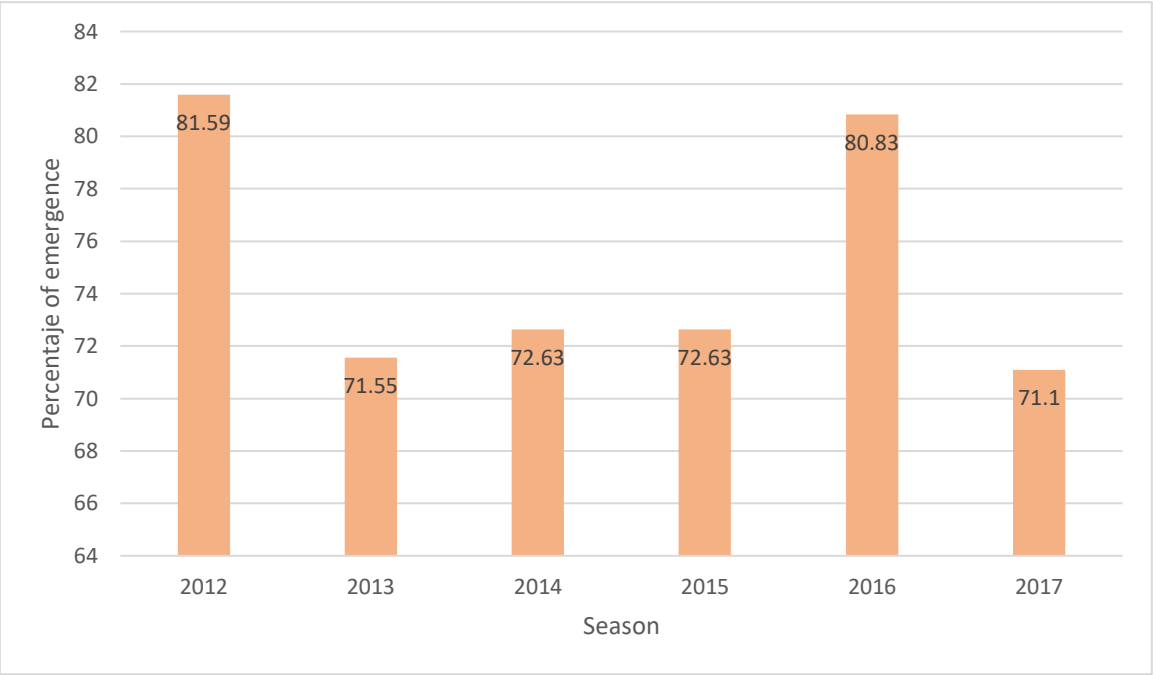

Figure 28. Percentage of emergence from the nests of Green turtle (*Chelonia mydas*) since 2012 in Pacuare, Costa Rica.

3.3 Hawksbill turtle (*Eretmochelys imbricata*)

3.3.1 Nesting and false crawl activities

A long the season 21 nesting activities were recorded, from which 10 were successful, any extracted nests were registered, there was the slaughter of five females. The 10 nests were relocated in the hatchery, the highest number of activities were in July and August with seven and six respectively. The nesting activity in 2017 was similar to the one recorded in 2014 (Figure 29). Also, this year we had the highest number of killed turtles since LAST started in 2012.

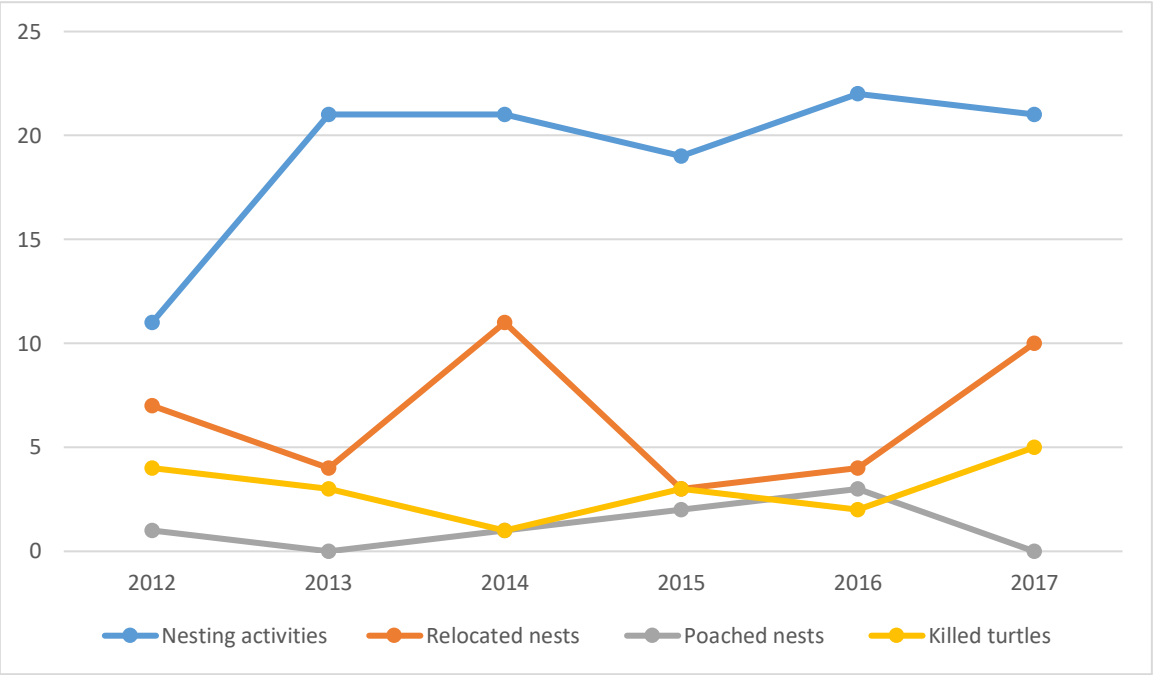

Figure 29. Nesting activity, number of relocated nests and number of poached nests and killed Hawksbill turtles (*Eretmochelys imbricata*) since 2012 in Pacuare, Costa Rica.

3.3.2 Hatching and emergence success

The average emergence success of the exhumed nests was 71.9% (SD = 23.74%, n = 8) releasing an estimate of 900 hatchlings. The highest percentage was from the nests relocated in July with 95.04%, while the lowest percentage was from a clutch relocated on August with 27.35%.

3.4 Loggerhead turtle (*Caretta caretta*)

On July of 2017 season, a loggerhead nests were registered and relocated in the hatchery. After 55 incubation days, the percentage of emergence was 61.53%. Releasing an estimate of 80 neonates.

3.5 Environmental awareness

National and international volunteers also participated in different activities as beach clean ups, every week a group of volunteers guided by an international research assistant or the resident biologist cleaned the beach from solid waste, later on they were separated and transported to a recycling center in Bataan. Along the beach a high contamination by plastic waste is easily observed, the solid waste is brought by the rivers, unfortunately there is not a collection nor recycling coordination of the solid wastes in place for the community, neighboring the mouth of Pacuare River.

Figure 30. An international volunteer picking up trash at the beach.

4. Conclusions and recommendations

A total of 162 leatherback nests were protected and produced 7,349 neonates. The number of rescued nests and released neonates is an important achievement for LAST, because this project has been on function for only six years, and is situated in a place where there is an intense pressure from illegal collection of sea turtle eggs.

The recorded data since 2012 indicates that Pacuare is one of the most important nesting site for Leatherback turtles in Costa Rica. Unfortunately, the number of poached nests is still high every year, it deserves more attention from local authorities, the Ministry of Environment and Energy (MINAE) as well as the Police (Fuerza Pública), to eradicate this problem is not an easy work because the black market moves a large volume of money with the illegal trade of eggs and meat, also most of the people involved in this kind of activities are outlaws or delinquents. The constant of the high percentage of illegal eggs trade is explained by:

- The absence of the authorities in charge of the protection of the natural resources in the area including the National Service of Coastguards (SNG), Instituto Costarricense de Pesca y Acuacultura (INCOPESCA) and the Ministry of Environment and Energy (MINAE).
- The lack of work opportunities in the cantons of Siquirres and Matina, as a consequence, a huge part of the population dedicate themselves to illegal activities such as drug traffic and the illegal trade of eggs and sea turtle's meat.
- The low number of patrols around the beach to cover the seven kilometers efficiently.

If there is not a real compromise from the authorities, the protection of the sea turtles will continue being a fight between the NGOs and local communities versus series of delinquents addicted to drugs and alcohol that sustain their addictions through the depredation of sea turtle populations in the Caribbean Coast of Costa Rica.

We recommend the creation of activities to raise the social and economic status of the community in Pacuare as ecotourism, English lessons to community members and the implementation of a Police station.

La Tortuga Feliz Foundation is a Dutch organization working in Pacuare since 2004 and it has been helping LAST to recruit international volunteers. Both organizations donate part of the income provided by the volunteers to employ local research assistants through the Asociación para el Ambiente de Nuevo Pacuare. A high number of volunteers will employ additional local guides, April is the month when is the beginning of the peak nesting activity, is less frequented by volunteers, there are some nights where the probability to find a nest that has not been poached is extremely low. LAST must keep searching for more financial partners to employ more people from the community. With that, LAST will not be the only to receive help, the community in Pacuare will have a different living.

It is necessary to raise environmental awareness among the population of the providence of Limón, where is an elevate consumption of meat and eggs. With no consumers, there would not be any market, and poached will be completely stopped.

It would be important if the municipality of Siquirres involve in the construction of real properties in the public areas. The majority of the poachers build illegal ranchos without the accurate conditions and the handling of solid wastes and grey water. If the municipality remove those opportunist people, it would contribute to the reduction of the illegal extraction of the eggs and the killing of the females.

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