Nesting Sea Turtle Population Trends Based on the Application of Saturation Tagging Efforts at Playa Tortuga, Ojochal the Osa, Costa Rica.

Oscar Brenes Arias
Sea Turtles Conservation Program,
Reserva Playa Tortuga.
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INTRODUCTION

Identifying sea turtles by applying flipper tags and/or Passive Integrative Transponder (PIT), is considered a useful tool to describe some aspects of the nesting behavior, due to the possibility of identifying each turtle individually; but to execute an effective identification of the nesting individuals, a "saturation tagging "must be performed, by covering all the nights during the nesting season, to tag all the turtles arriving on the beach to lay eggs (Eckert and Beggs, 2006).
The use of the tags in nesting females has been a common practice among Costa Rican sea turtle nesting beach projects over the last 60 years, Archie Carr being the pioneer at the Tortuguero National Park in 1955(Silman *et al.*,2002).
Despite this, not all sea turtle nesting beach tagging projects have been executed with the necessary effort and consistency to accurately represent all aspects of the nesting population, such as number of individual females, nesting frequency, and remigration intervals (Chacón *et al.*, 2007).
The objective of the study is to show that, with the application of an intensive sampling method on a beach with a similar length and nesting density as Playa Tortuga, it is possible to obtain a much more representative sample of the nesting population during one specific season.
Due to the low nesting density registered along the seasons for the two other species of Tortuga beach, *Dermochelys coriacea* (n=one nest) and *Chelonia mydas* (n=10 nest), the study was performed based on the nesting population of ***Lepidochelys olivacea*** **(Fig. 1)**.

Figure 1.
Photograph of an Olive Ridley Sea Turtle (*Lepidochelys olivaceae*).
This is the most common specie in Tortuga beach laying from 66 to 102 nest by season.

METHODS

A nesting monitoring of the *L.olivacea* has been executed since 2011, from July 15th to December 30th covering a total of 153 days per season at Tortuga Beach (Fig. 2).

During two seasons (2011-2012), the nighttime beach monitoring was conducted based on tidal phase, patrolling both three hours before and three hours after high tide. Beginning in 2013, patrols were conducted every night independently of tidal phase, from 18:00 until 05:00 hours.

Figure 2.
Study site.Tortuga Beach has an extension of 1 km, and is located in Ojochal de Osa (83°40'3.36" W, 9°4'32.16" N), Puntarenas, Costa Rica.

The females observed were identified by means of application of Inconel® metal tags (Fig. 3) in their rear flippers once the individual finished laying eggs or it was observed returning to the sea.

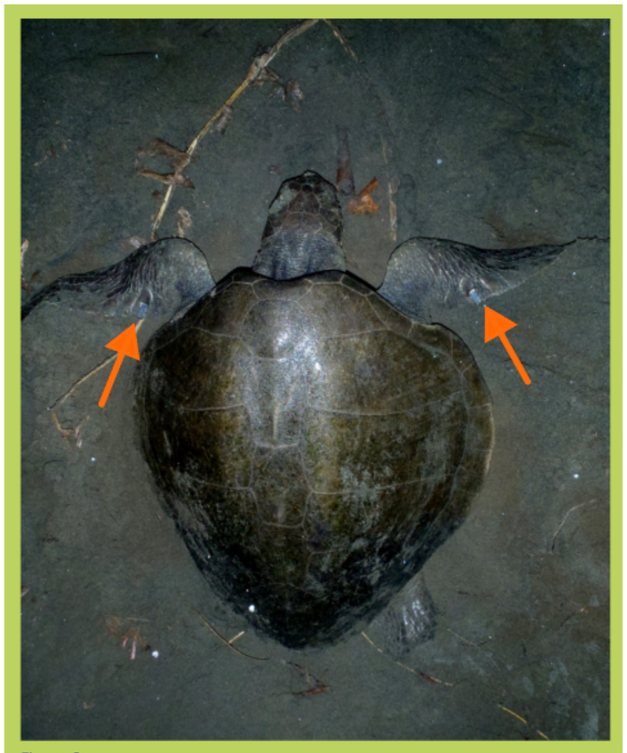

Figure 3.
Nesting Olive Ridley with tags. The marks (orange arrows), were applicated over the second scale from the base of the limb.

The date, the hour and the total of nesting events (all nests found with or without the turtle present and false crawls) were registered.

The percentage of the nesting population identified by season or tagging accuracy (Ta) was calculated as:

$$Ta = (TTn+TTe)/(e+n)*100$$

where, ***TTn*** is the number of nest from the tagged turtles, ***TTe*** is the number of nesting events from the tagged turtles , ***e*** is the total number of nesting events and ***n*** is the total number of nest.

The accuracy of the two monitoring methods by comparing the values obtained from the seasons 2011-2012 against the data of 2013 -2014, was analyzed using a Kruskal-Wallis median test.

$$matp - mast = 0$$
$$matp - mast < 0$$

The number of nesting turtles per season was estimated using two methods. First the indirect estimation method of Alvarado and Murphy (2000), dividing the total number of nest between the average nest frequency. Two values of nest frequency were used for this method; one (two nests per season), frequency reported for the specie by Chacón *et al.*(2007) and two the nesting frequency calculated for Tortuga beach. The second method multiplies the number of tagged turtles by a hundred, divided between the tagging accuracy values obtained in each season. An ANOVA test was performed to detect differences between the methods.

The kruskal- Wallis and the ANOVA were performed using STATGRAPHICS Centurion. A significance level of P< 0.05 was considered for all tests.

RESULTS

After the implementation of the saturation tagging method, the monitoring effort increased by 80%, covering 1683 hours per season instead of the 918 hours covered in the past two seasons (2011-2012).

The 2013 season having 30% less nesting events than in 2011, the monitoring effort allowed to identify 46 nesting females, this number of tagged turtles was superior to the one reported in 2012. In 2013 the number of recaptured nesting females was higher than the one obtained during the years 2011 and 2012. The 2014 season showed the highest data of tagged and recaptured turtles compared with all seasons (Fig. 4).

Based on the number of tagged and recaptured turtles (individuals observed more than once) per season, the nesting events where an identified individual participated were estimated (Fig 5).

The tagging accuracy calculated per season determines that when the tidal phase method was performed (2011-2012) on average 54% of the turtles that came to Tortuga beach were identified. With the saturation tagging method (2013-2014), the average percentage of indentified turtles represented 83% of the nesting population, 2014 being the most succesful year, tagging 90% of turtles with a recapture accuracy of 51%.(Fig.6)

The Kruskall-Walis test determinated that the accuracy of both methods had a significant difference with P= 0,02. The Hypothesis test showed the saturation tagging method as the most accurate with a P= 0,0001.
Using the number of nests laid by the tagged olive ridley´s, the nest frequency calculated for this specie at tortuga beach was 1,313 +/- 0,076 nest/season (Fig.7).

The ANOVA test found significant differences between the population estimated using two days for nest frequency with the results obtained using the tortuga beach nesting frequency and the tagging accuracy values. No differences were found when the other two variables were compared (Chart. 1)

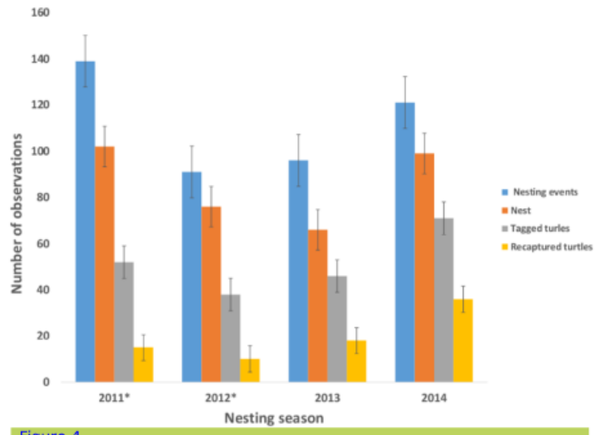

Figure 4.
Number of nesting events, nest, tagged and recaptured turtles, recorded for *L.olivaceae* during four seasons, after apply two monitoring methods. Tidal phase * seasons and Saturation tagging seasons at Tortuga beach Osa, Costa Rica.

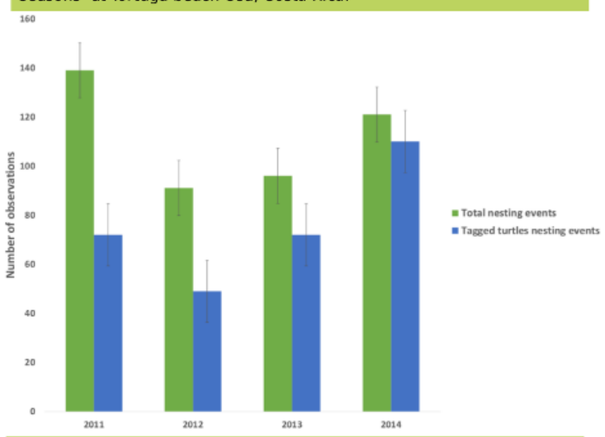

Figure 5.
Comparison between the nesting events by season and the number events where the turtle was identified. During the seasons where the saturation tagging was performed,(2013 , 2014), the relation between the total nesting events and the tagged turtles events was nearly equivalent, this relation was more clear in the data from the season 2014. The same behavior was observed when the total number of nest and the number of nest laid by the tagged turtles were related.

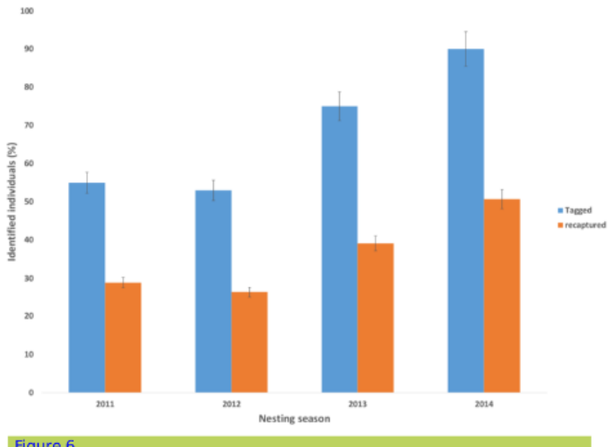

Figure 6.
Percentage of indentified individuals from the total number of nesting events recorded by season at Tortuga beach. The tagging accuracy calculated by season , showed that more turtles were indentified during the years where the saturation tagging was performed(2013-2014), the same behavior was observed with the number of recaptured individuals.

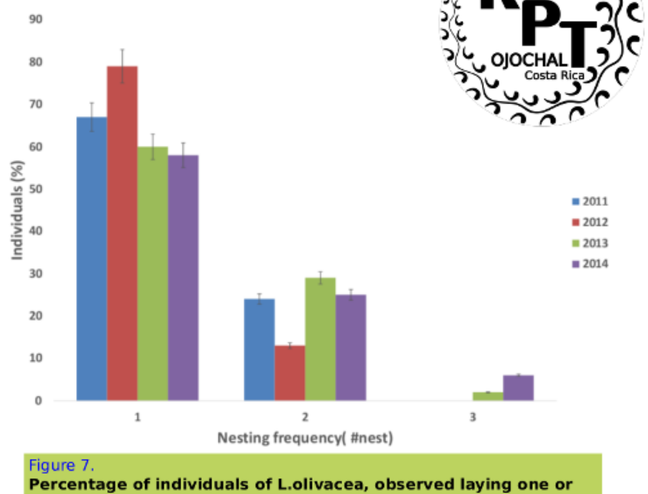

Figure 7.
Percentage of individuals of L.olivacea, observed laying one or more nest by season at Tortuga beach , Ojochal de Osa , Costa Rica. Compared with 2011, 2012 , during the seasons 2013 , 2014 less turtles nested once , and more were observed nesting twice. In addition, in this period were registered the first females nesting three times.

Chart 1.
Number of nesting turtles estimated by two methods for each season at Tortuga beach, Ojochal Osa Costa Rica.

Season	# individuals (1)	# individuals(2)	# individuals(3)
2011	51*	78	96
2012	38*	58	72
2013	33*	50	58
2014	50*	75	79

* Denotes significant differences with the values of the other columns, P<0,05.

The number of individuals (1) and (2) were estimated using the indirect method of Alvarado and Murphy (2000), for (1) was used a nest frequency of two nest /season and for (2) the nest frequency for tortuga beach. The values of the third column were calculated based on the tagging accuracy percentage of each season.

DISCUSSION

The nest and females monitoring on nesting beaches, has been an important tool for the evaluation and knowledge of the tendencies from the sea turtles populations(Chacón et al., 2007), where the use of tags works as the ideal complement to obtain information about aspects of the sea turtles reproduction as the nesting frequency, re-migration intervals , movement patterns and others (Eckert and Beggs, 2006).

Chacón *et al.* (2008), mentioned that to obtain information about the nesting population, daily walks have to be performed from 20:00 to 4:00 hours or by considering the tidal phases.

Following this methodolgy other projects from Costa Rica obtained lower or close results of turtles identification than the reported ones for tortuga beach during the period 2011 -2012. In the North Pacific coast of Costa Rica, Solano et al. (2012) observed 151 individuals from 674 nests (22% tagging accuracy) in Buena Vista beach and identified 77 turtles of 145 nests (tagging accuracy 53%) in Montezuma beach. James *et al.* (2013) reported for Drake bay (South Pacific), 45 tagged individuals and 86 recorded nest, having a tagging accuracy of 52%.

The saturation tagging allowed to obtain a more realistic representation of the nesting population in Tortuga beach for the years (2013-2014), by identifying a significan amount of turtles per season compared with the period (2011, 2012). This methodology made the collection of data easier, adding new information to estimate specific values of aspects as the nesting frequency and to determine local or regional movements and reproductive success for Tortuga Beach. Factors as the re-migration intervals for a beach as Tortuga, with a small number of nesting females, require more than 10 years to detect a significant populational tendency (Eckert and Beggs, 2006).

The tagging accuracy and the nesting frequency calculated from the saturation sampling effort, provides better information about the possible number of nesting turtles per season. The average nesting frequency reported for the specie underestimates the value of the number of turtles.

The data collected from the saturation tagging combined with the hatchery work, offers the opportunity to study other variables of the population, as the number of hatchlings contributed by a single turtle, or by comparing characteristics of the clutches from the same female, as size, weight , eclosion success, incubation periods, and sex, in different moments within a particular season.Executing an intensive sampling effort in a site with the same length and nest density as Tortuga beach, turns the tagging records in a representative sample of the population fraction that arrives during one specific season.

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References

Alvarado, J. & T. Murphy. 2000. Periodicidad en la anidación y el Comportamiento entre anidaciones. En Manual de técnicas de investigación y manejo para la conservación de las tortugas marinas, UICN/CSE Grupo de especialistas en tortugas marinas. 270 p.

Chacón,D. Dick,B.Harrison,E.Sarti,L. & M.Solano. 2008. Manual sobre técnicas de manejo y conservación de las tortugas marinas en playas de anidación de Centroamérica. Secretaria Pro Tempore de la Convención Interamericana para la Protección y Conservación de las Tortugas Marinas (CIT), San José, Costa Rica.56pp.

Chacón, D., J. Sánchez,J. Calvo. & J.Ash.2007. Manual para el manejo y la conservación de las tortugas marinas de Costa Rica; con énfasis en la operación de proyectos en playa y viveros. Sistema Nacional de Áreas de Conservación (SINAC), Ministerio de Ambiente y Energía (MINAE), Gobierno de Costa Rica.San José.103p.

Eckert, K. & J.Beggs. 2006. Marcado de Tortugas Marinas. Un Manual de Métodos Recomendados. Red de Conservación de Tortugas Marinas del Gran Caribe (WIDECAST) Informe Técnico Nº2. Edición Revisada,Beaufort, North Carolina USA.40pp.

James R, Varela Murillo, M. Eraso Rodriguez, S. García Solà, A, Cooch, D. & O. García. 2013. Investigation and Conservation of Sea Turtles, Drake Bay, Osa Peninsula, Costa Rica. Technical Report. Corcovado Foundation.81pp.

Silman, R.Vargas,J. & S.Troëng. 2002. Tortugas Marinas Guía Educativa. Caribbean Conservation Corporation, San José, Costa Rica.42pp.

Solano,R. Madrigal,V. Rojas,J. & G.Fallas. 2012. Dinámica de desove de las tortugas marinas en playa Buena Vista, Sámara , Costa Rica. Informe final de temporada 2012. Programa de Recursos marino-costeros ASVO.35pp.

Solano,R. Madrigal,V. Rojas,J. & G.Sibaja. 2012. Dinámica de desove de las tortugas marinas en playa Montezuma, Cóbano, Costa Rica. Informe final de temporada 2012. Programa de Recursos marino-costeros ASVO.39pp.