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# Evaluation of the green turtles' (*Chelonia mydas*) body conditions found in the Juréia-Itatins Mosaic's conservation units, South Coast of the São Paulo state

# Avaliação das condições corporais das tartarugas-verdes (*Chelonia mydas*) encontradas nas unidades de conservação do Mosaico Juréia-Itatins, Litoral Sul do estado de São Paulo

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**ABSTRACT**
The green turtle (*Chelonia mydas*) is one of the five species that can be found on the Brazilian coast. It has migratory behavior and occurs most frequently in the coastal region of Peruíbe, on the south coast of São Paulo. The body conditions of these individuals are directly associated with the quantity of epibionts, stress, predation and diseases. The malnourished individuals with a poor body condition may be more susceptible to interact with fishing activities. This study had as objective to evaluate the green turtles' body condition found in the Conservation Units Mosaic Jureia-Itatins, in the South

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Coast of São Paulo. The data analyzed were collected from October 2018 to October 2019, with the monitoring of the beaches and the study of eight specimens found dead. The biometric procedures were performed to evaluate the growth stage, the body condition and to observe the presence of injuries, parasites and epibionts. All individuals found were juveniles, with carapace curvilinear length of 38.57 cm and body mass of 5.877 kg. Of the specimens analyzed 62.50% had “good” body condition evaluation and the remaining individuals had fair and poor body condition. The individuals presented high incidence of barnacles and injuries in the head, carapace and plastron from interaction with anthropic activity. It was possible to conclude that most individuals had adequate developmental stage and the species represents an important biogenic substrate for symbiotic organisms, whose barnacles are the most incident. When the individual's condition is not “good”, the epibionts can cause injuries, thus changing their ecological interaction. The incidence of individuals with injuries related to fishing and tourism activities shows that anthropic activities may be negatively impacting the populations of this species in the study region and evidenced the need to develop work aimed at preservation and environmental education.

**Keywords:** Ecological interaction, Epibionts, Fibropapillomatosis, Symbiosis, Algae.

**RESUMO**

A tartaruga-verde (*Chelonia mydas*) é uma das cinco espécies que podem ser encontradas na costa brasileira possui comportamento migratório e ocorre com maior frequência na região costeira de Peruíbe, no litoral Sul de São Paulo. As condições corpóreas destes indivíduos estão diretamente associadas a quantidade de organismos epibiontes, estresse, predação e doenças. Os indivíduos malnutridos e com baixa condições corporal podem ser mais suscetíveis a interagir com as atividades pesqueiras. O objetivo deste estudo foi avaliar as condições corporais das tartarugas-verdes encontradas na área das unidades de conservação do Mosaico Jureia-Itatins, litoral sul de São Paulo. A coleta de dados foi realizada no período de outubro/2018 a outubro/2019, com o monitoramento das praias e o estudo de oito exemplares encontrados mortos. Foram realizados os procedimentos de biometria para avaliação do estágio de crescimento, das condições corporais e observar a presença de lesões, parasitas e epibiontes. Todos os indivíduos eram juvenis, com comprimento curvilíneo da carapaça médio de 38,57 cm e massa corpórea média de 5,877Kg. Dos espécimes analisados 62,50% obtiveram avaliação de escore corporal “bom” e os demais tinham condição corporal regular e ruim. Apresentaram alta incidência de cracas e ferimentos tanto na cabeça, quanto na carapaça e plastrão provenientes de interação com atividade antrópica. Foi possível concluir que a maioria dos indivíduos apresentavam estágio de desenvolvimento adequado e que a espécie representa um importante substrato biogênico para organismos simbiontes, cujas cracas são as mais incidentes. Tem-se que quando o escore do indivíduo não é “bom”, os epibiontes podem provocar lesões, mudando assim a sua interação ecológica. A incidência de indivíduos com ferimentos relacionados as atividades de pesca e turismo mostram que as atividades antrópicas podem estar impactando negativamente as populações desta espécie na região de estudo e evidenciou a necessidade de desenvolver um trabalho voltado à preservação e educação ambiental.

**Palavras-chave:** Interação ecológica, Epibiontes, Fibropapilomatose, Simbiose, Algas.

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## 1 INTRODUCTION

Sea turtles are Testudines reptiles that develop an important ecological role in the marine ecosystem, as they reach several levels in the trophic chain and participate in various ecological interactions such as controlling populations of various organisms, including the seaweed, porifers and cnidarian; act as substrate for epibionts and parasites; as dispersers of various organisms such as barnacles, tunicates and mollusks. In addition, they contribute to nutrient recycling within and between ecosystems, considering the large amount of waste excreted by all its representatives worldwide (BJORNDAL, 1999).

These individuals can be colonized by epibiotic organisms at all stages of development (LORETO & BONDIOLI, 2008). There is a variety of fouling organisms and epibionts that can be found in symbiosis relationships as can be cited: the cirripeds, trematodes, algae, polychaete worms and amphipods (HIRTH, 1997; LORETO & BONDIOLI, 2008; HAYASHI & TSUJI, 2007). Many species can be fixed in the larval phase, using marine animals as substrate, and choose positions with less flow of movement as in the posterior regions of the body, but the entire body of the animals can be colonized. Other associated factors are abrasion, contact with fins, harder materials (stones), sea currents and dissection (RODRIGUES, 2009).

The body conditions of sea turtles are directly associated with the amount of fouling and epibionts, because of the low mobility and the weakness increase the incidence of colonization (RODRIGUES, 2009). Other related factors such as stress, predation and disease also contribute to variation in the composition of the encrustation in sea turtles (FRICK et al., 2000).

Evaluate the animal´s clinical condition and to verify if the individual has “good” body conditions (poor, fair and good) can assist in defining the therapy to be used in animals received for rehabilitation (JUNQUEIRA et al., 2005; THOMSON et al., 2009). According to Uzai (2016), malnourished individuals with a poor body condition may be more susceptible to interact with fishing activities, and their results indicate that this interaction can be considered higher with lower weight and worse body condition. The author also proposes that individuals found stranded have less rehabilitation capacity when compared to individuals found alive trapped in a fishing net, because when the animals are stranded on the beach, they were probably dragged by the current which may be associated with the hypothesis that they have worse health conditions which consequently reduces the chances of success in the rehabilitation process.

The fishing gear that most impacts turtle’s life is trawls and waiting nets, due to incidental catches (MARCOVALDI et al., 2006). They can also become entangled in nets, ingest hooks and lines, in addition the boats can also cause injury and lead individuals to death (ÓROS et al., 2004).

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In the Brazilian coast can be found five species of marine turtles: Dermochelys coriacea (Dermochelyidae family), *Caretta caretta, Chelonia mydas, Eretmochelys imbricata* and *Lepidochelys olivacea* (Cheloniidae family) (MARCOVALDI et al., 2011). The green turtle is found in regions near the coasts (foraging or feeding areas), in tropical and subtropical seas, usually between 40ºS and 40ºN (ALMEIDA et al., 2011; HIRT, 1997). It has a highly migratory behavior, with seasonal movements in search of food and females can move up to 1500 km between feeding and breeding areas (ALMEIDA et al., 2011; MEYLAN; MEYLAN, 1999). It is the species that occurs most frequently in the Peruíbe´s beaches, south coast of the state of São Paulo (LOPES et al., 2018 e 2019).

The survey of biometrics and body condition of green turtles can provide the study of parameters that enable management and conservation plans to be made; assist in assessing the health and integrity of individuals; estimate the amount of anthropogenic impacts on the marine ecosystem related to this species; to provide knowledge about the organisms that can live associated, creating specific communities and another relevant factor linked to the associated fauna. Because these marine reptiles swim over long distances between feeding and breeding areas, they serve as potential dispersers of introduced species, which are currently considered the second largest cause of biological diversity.

This study had as objective to evaluate the green turtles' (*Chelonia mydas*) body conditions found in the Conservation Units Mosaic Jureia-Itatins, in the South Coast of São Paulo.

## 2 MATERIAL AND METHODS

The project was developed by the Institute of Marine Biology and Environment (IBIMM), which executes preserving programs of the sea turtles, based on the "Projeto SOS Tartarugas Marinhas". This study was approved by the Ethics Committee on The Use of Animals (CEUA/IBIMM) n°. 008/18 and by the Biodiversity Authorization and Information System (SISBIO/ICMBio/MMA) n°. 50132. The research was conducted with the monitoring of the beaches and study of the collected animals.

### Study Area

It was realized a beach monitoring program in Peruíbe´s coast. The city is in the south coast of São Paulo and situated among the cities of Iguape, Itariri, Itanhaém, Pedro de Toledo. The city is 140 km from the state's capital. It has an altitude of 5.88 meters, predominantly coastal plain, 32 km

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of beaches and the islands of Queimada Grande; Queimada Pequena; Guaraú, Grande, Boquete and Guararetama (GOV, 2018).

**Collection Procedures**

The data collection was performed on a beach monitoring program in Peruíbe´s coast from October 2018 to September 2019, searching for stranded turtles. In this period time, eight (8) specimens of *Chelonia mydas* were found and sent to the IBIMM Research Center.

They were submitted to the biometric procedures according to the methodology proposed by Lopes et al. (2018) and Wyneken (2001) from the external examination of the specimens. It was verified the body mass and growth stage according to the size defined from the carapace curvilinear length measurements (CCL) and curvilinear carapace width (CCW) that were obtained using a flexible measuring tape.

The body condition was evaluated featuring the animal's physical condition that could be classified as “good”, “fair” or “poor”. In the condition considered “good” the plastron is convex, with the presence of adipose tissue in the neck region and in the axillary and inguinal areas. In the “Fair” the plastron is flat, with the few presence of adipose tissue surrounding the muscles of the neck area and in the axillary and inguinal areas and “poor” when the plastron is extremely concave, neck area without the presence of tissue surrounding fat and very thin axillary and inguinal areas (THOMSON et al., 2009).

Lastly, it was verified the existence of injuries, parasites and epibionts in all the individuals’ body (carapace, plastron, fins and head) and when possible, they were collected with tweezers and sorted according to type and frequency.

The qualitative and quantitative analysis were made with the characteristics observed (types and frequency). Tables and graphs were developed using the Microsoft Excel Software program.

**3 RESULTS**

All green turtles (n =8) sampled in the foraging site were classified as juveniles, according to Almeida et al. (2011), with CCL between 26 and 44.5 cm (average of 36.33 cm). The biometrics data, the strands (place of collection), the measurements of CCL, CCW and the body mass are shown in the table 1.

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Table 1 - Size – CCL/CCW (cm), weight (kg) *C. mydas* sampled in Peruíbe´s coast of São Paulo.

| Sample | Collection site | Weight (kg) | CCC (cm) | LCC (cm) |
|---|---|---|---|---|
| **T1** | Guaraú Beach | 4,400 | 38 | 36,2 |
| **T2** | Guaraú Beach | 5,300 | 39 | 35 |
| **T3** | Guaraú Beach | 4,428 | 35,5 | 32,5 |
| **T4** | Guaraú Beach | 3,968 | 33 | 31 |
| **T5** | Guaraú Beach | 1,602 | 26 | 25 |
| **T6** | Guaraú Beach | 7,852 | 44,5 | 39,4 |
| **T7** | Guaraú Beach | 6,500 | 40 | 35 |
| **T8** | Guaraú Beach | 11,488 | 52 | 48 |
| **Average** | -- | 5,877 (+/- 380g) | 38,57 (+/- 0,39 cm) | 35,13 (+/- 0,34 cm) |

The analysis of the individuals' body condition five had "good" ratings (62.50%) that were within the observed parameters, one had "poor" ratings (25%), one could not be rated due to advanced decomposition stage dead (12.50%) consequently their body mass was not representative and one had fair rating (12.50%). The individuals with "fair" and "poor" evaluation are, consequently, the T8 that presented many epibionts that demonstrates low motility, besides that it presented low body fat and the T5, which had advanced malnutrition stage, which can be observed by plastron that was extremely concave and around the neck area without the presence of adipose tissue (Figure 1).

In the biometric procedure, was observed the fish net marks and fibropapillomas like injuries (external alterations) and the Ozobranchus sp. which is a genus of leeches (ectoparasites) that feed exclusively turtles' blood, and the epibionts found were seaweed and barnacles. It was analyzed the frequency of each item on Table 2 and Table 3 and graph 1 that represents the frequency in relation to individuals.

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Figure 1 - Example of malnutrition observed in individual T5 (Author's Photo).

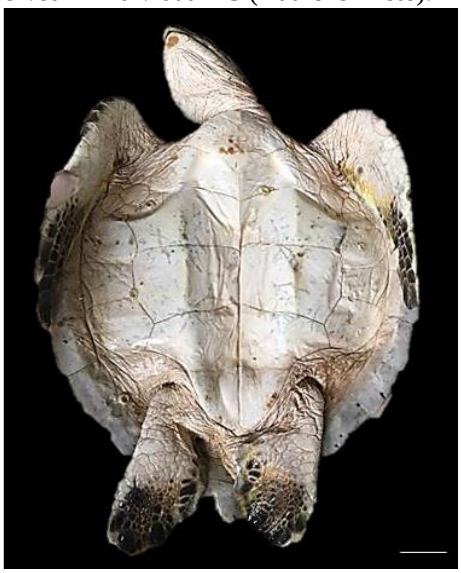

Table 2 - Characteristics analyzed in biometric measure – Epibionts and parasites: Algae ((Presence/Absence), Barnacles (number and location), Ozobranchus sp. (Presence/Absence and number/location).

| Sample | Algae | Barnacles | Ozobranchus sp. |
|---|---|---|---|
| **T1** | Absence | 14: Carapace, Plastron and Fins | Absence |
| **T2** | Filamentous greens and reds | 7: Carapace, Plastron and Fins | Absence |
| **T3** | Absence | 17: Carapace, plastron e fins | Absence |
| **T4** | Absence | Absence | 1: plastron |
| **T5** | Filamentous greens and reds | 49: Carapace and Plastron | Absence |
| **T6** | Absence | 7: Carapace and Plastron | 3: plastron |
| **T7** | Absence | 1 Barnacle carapace | 5: plastron |
| **T8** | Filamentous and foliate greens; filamentous red | 107: presence in the whole individual | Absence |

Table 3 - Characteristics analyzed in biometric measure: Diseases and injuries - Fibropapillomas (Presence/Absence and number/location) and fishnet marks ((Presence/Absence).

| Sample | Fibropapillomas | Fishnet marks |
|---|---|---|
| **T1** | Absence | Absence |
| **T2** | 16: Dorsal and ventral fins | Absence |
| **T3** | 40: Dorsal and ventral fins | Presence |
| **T4** | 4: Dorsal and ventral fins | Absence |
| **T5** | Absence | Injury and lesion in carapace |
| **T6** | Absence | Injury and lesion in carapace |
| **T7** | Absence | Presence |
| **T8** | Absence | Presence |

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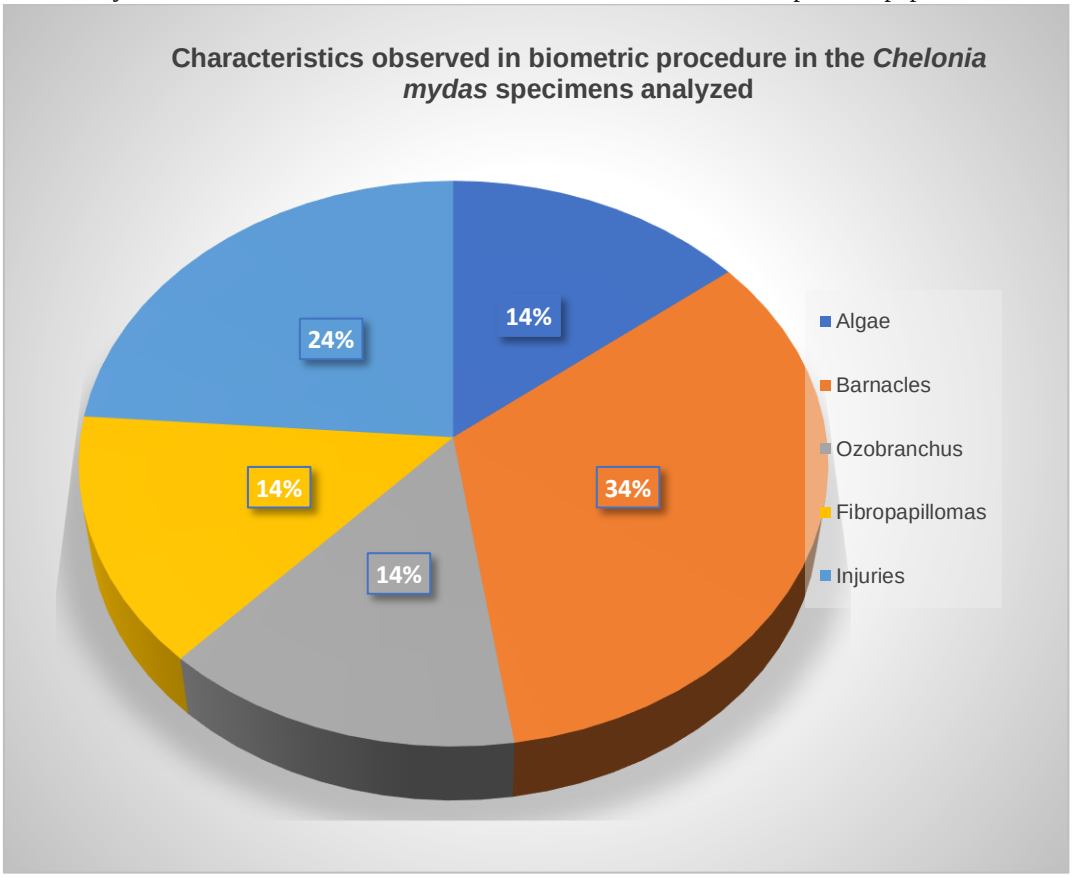
Graph 1 - Items analyzed in biometric measure: Seaweed, Barnacles, Ozobranchus sp., Fibropapillomas and injuries.




The results show that three individuals (37.50%) presented epiphytic seaweed in the carapace, belonging to the groups Chlorophyta and Rhodophyta, being possible to identify only by morphology. In one individual, besides the filamentous green and red seaweed, there was also the presence of foliate green seaweed.

The barnacles were found in 85.50% (seven individuals) and were in both the carapace (back) and the plastron. In addition, the T8 specimen had many barnacles in whole body, as shown in figure 2.

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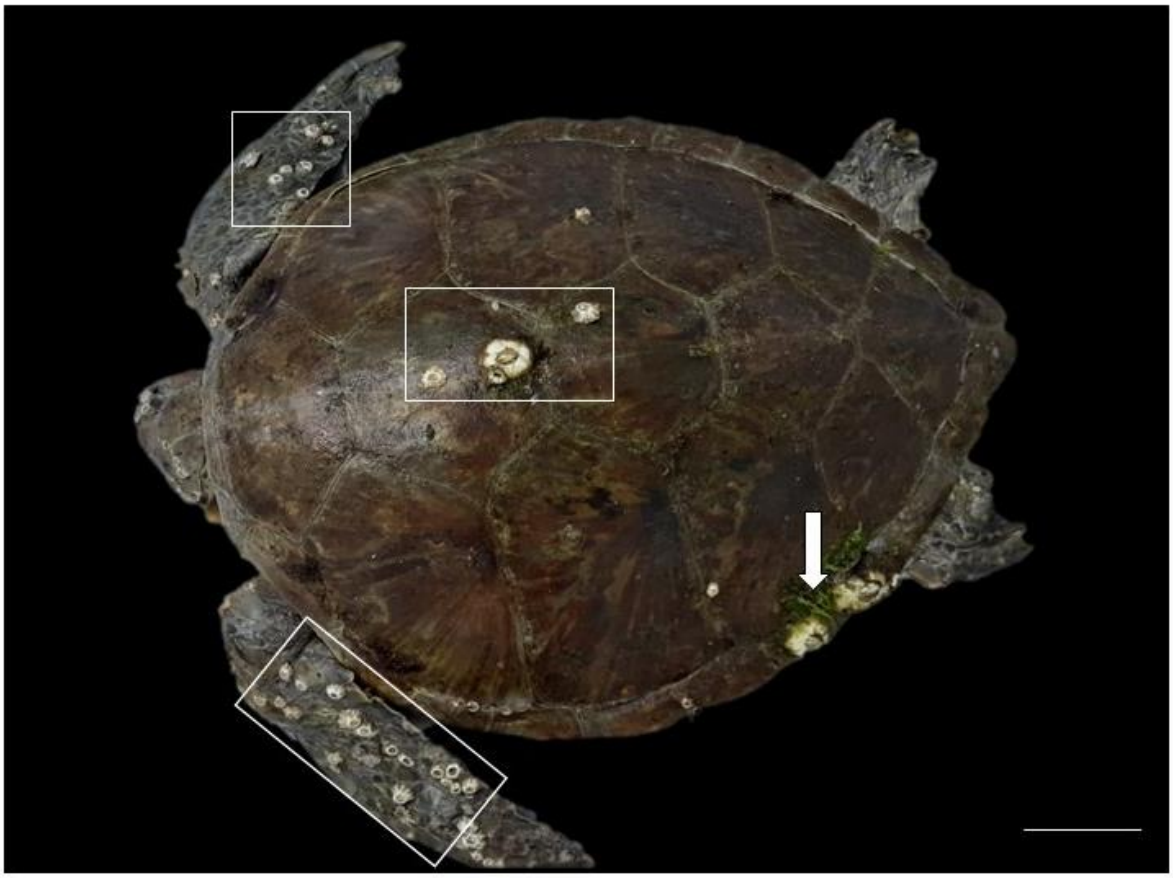
Figure 2 - Individual T8 (Abundance of barnacles and seaweed) - The red and yellow arrows show the frequency of barnacles and seaweed respectively (Photo by Edris Queiroz Lopes).



In 62.50% of the studied specimens were found injuries to the head, carapace and plastron from fishnet marks, and two of these individuals presented carapace fracture due to interaction with fishing boats.

The ectoparasites of sea turtles of the genus Ozobranchus sp. were found in 37.50% (three) of the individuals and were associated with soft tissues such as neck, tail, fins and the tissue that connects the carapace with the plastron along the extremities of the body and the fibropapilomas observed in 37.50% (three) of the individuals being found mostly in the limbs (fins).

## 4 DISCUSSION

The growth stage of the analyzed individuals verified that the study region is a feeding area confirming the one mentioned by Lopes et al. (2018), so all information obtained regarding the maintenance of these animals favors the preservation of the local ecosystem that is an area of environmental protection (MORAES et al., 2016).

The body condition was evaluated, because the nutritional status of individuals can impact on a variety of behaviors and physiological processes that act directly or indirectly on fitness. In addition

to affecting migration time, reproductive mechanisms and susceptibility to predation that influence population and community dynamics by regulating food supply and modifying spatiotemporal patterns of resource exploitation (THOMSON et al., 2009).

In the biometric procedure it was found epibionts that are organisms that commonly have association with the sea turtle species at any stage of life or development (LORETO; BONDIOLI, 2008). Mention may be made of barnacles, which have been found in carapace and plastron, which are the most commonly found organisms (HIRTH, 1997). On the Brazilian coast, seven species of barnacles that are symbiotic of sea turtles were identified and three of them occur only in *C. mydas* species: Balunus venustus, Conchoderma virgatum and Lepas anatifera (BUGONI et al., 2001).

The algae may be associated with the lethargic state of individuals (RODRIGUES, 2009). Although there are few studies on the taxonomic survey of epizoary algae, the genus that are often found in organisms occur on the coast whose individuals stay longer, usually in the sea middle coastal zone (PEDRINI et al., 2013).

The injuries found in the individuals were fishnet marks and rupture of the carapace, which is a factor associated with fishing activity, incidental capture, which can cause deaths (WALLACE et al., 2010; BUGONI et al., 2001; LÓPEZ-MENDILAHARSU et al., 2005).

The ectoparasites of sea turtles of the genus Ozobranchus sp. which were collected along with the soft tissues of individuals were also observed by Loreto and Bondioli (2008), are often found attached to green turtles, and may be associated with diseases development (ADNYANA et al., 1997).

Finally, fibropapillomas is a debilitating tumor disorder that can lead to death (BAPTISTOTTE et al., 2001). Although its etiology is unknown, it is usually associated with infectious agents such as herpes virus, retrovirus and papilloma virus (JACOBSON et al., 1991; HERBST, 1994). It has a higher incidence in turtles that frequent coastal waters with large human concentrations (GEORGE, 1997). The spread of the virus has been related to increased water temperature, ultraviolet light, ectoparasites (Ozobranchus spp.) and the presence of environmental contaminants / pollutants (KELLER, 2014).

## 5 CONCLUSIONS

It was concluded that the biometrics procedure is a method that evaluates the external body conditions of the individual and can contribute to the clinical history to verify both the health and the stage of development of the studied specimens.

*C. mydas* represents an important biogenic substrate for symbiont organisms, with barnacles being the most common. Thus, it was also observed in the analyzes that as the individual's score is

not satisfactory, the greater the number of barnacles, and some of them may develop to such an extent that may cause injury, thus changing their ecological interaction with the barnacles. Typically, organisms that develop ecological interactions take advantage of turtle movement to capture more food, suffering less from competition as few organisms can survive the conditions of a moving substrate.

In the analysis of the animals studied there was a high incidence of injuries related to fishing and tourism activities and shows that anthropic activities may be negatively impacting the populations of this species in the study region and evidenced the need to develop a work focused on education. and environmental preservation and public policies for better management of the region because it is an area of sustainable environmental preservation.

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