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VETERINARY MEDICINE
*Students Training in Advanced Research*

# Factors driving anatomic distribution of fibropapillomatosis tumors in green sea turtles in Espírito Santo, Brazil

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## WHAT IS FIBROPAPILLOMATOSIS?

Fibropapillomatosis (FP) is a neoplastic condition affecting sea turtles globally, with juvenile green sea turtles (*Chelonia mydas*) most impacted. FP is caused by *Chelonid Herpesvirus 5* (ChHV5), but other unknown factors are required in order for tumors to manifest. Previous studies have found FP to have a higher prevalence in areas experiencing greater anthropogenic impact, so it is possible environmental factors may be partially responsible for disease onset. While FP tumors are benign, negative health outcomes are common and heavily depend on size and location of tumors, factors which vary from case to case.

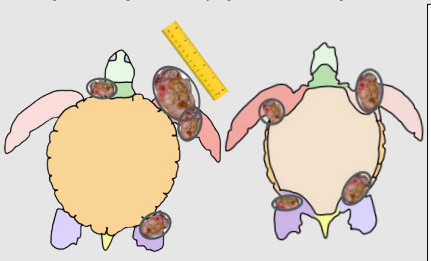
Because green sea turtles are classified as endangered (IUCN red list), it is important to mitigate the impacts of FP for sea turtle populations.

**Green sea turtle with FP**

## OUR STUDY


**Study site:**
Espírito Santo state, Brazil has a relatively high prevalence of FP, with 27.4% of stranded green turtles estimated to be affected. Prevalence in captured green turtles at disease hotspots in Vitória Bay (arrow) has been reported from 34.4% to 75.8%. FP dynamics have been less studied in Brazil, compared to North America, making this an important study site.

**Case evaluation:** We evaluated tumors of 271 green sea turtles with FP from Espírito Santo. During the years 2010-2022, these turtles were either stranded or live caught. Disease severity was scored according to the objective fibropapillomatosis index (FPI) for each anatomic region. This included counting, measuring, and classifying tumors according to size and anatomic position.



**Fibropapillomatosis index (FPI):**

$FPI = 0.1N_A + N_B + 20\,N_C + 40\,N_D$

where Nx is the number of tumors in the x size category.

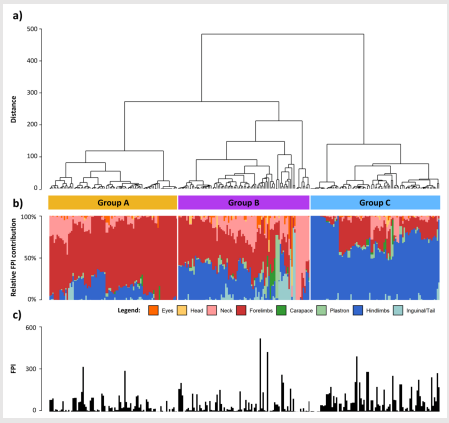
**Tumor size categories:**
A: <1 cm
B: 1 – 4 cm
C: 4 – 10 cm
D: >10 cm

**Data collection**

## ARE THERE DIFFERENT PATTERNS OF FP PRESENTATION?

Three groups with similar FP case presentations were identified using agglomerative nesting analysis (AGNES) to hierarchically cluster turtles according to the relative contribution of each anatomic region to overall FPI.

**Groups with similar FP presentations:**
a) Representation of how turtles are classified into three FP groups based on AGNES
b) Relative contribution of each anatomic region to overall FPI for each individual
c) FPI of each individual

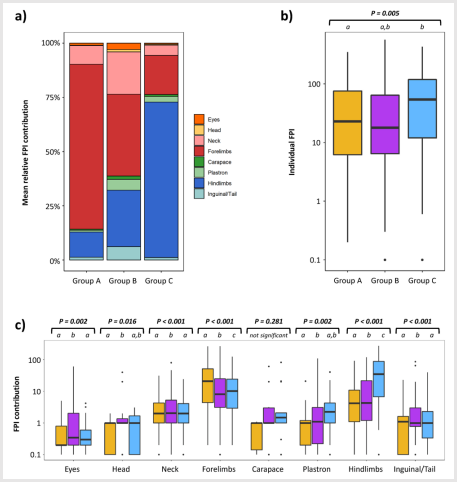



## HOW DO THESE ANATOMICAL PATTERNS PRESENT?

a) Average contribution of each anatomic region to overall FPI
- Group A: tumors predominantly in the forelimbs
- Group B: tumors diffusely distributed among anatomical regions
- Group C: tumors predominantly in the hindlimbs

b) Overall FPI varies across groups
- Group C has more severe FP than group A
- Groups A and B have similar FP severity

c) Contribution of each anatomic region to overall FPI across groups



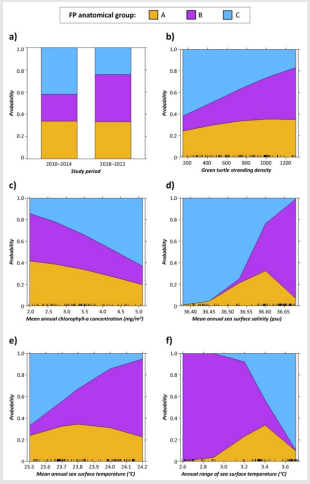

## WHAT IS CONTRIBUTING TO THESE ANATOMICAL PATTERNS?

We tested how these three anatomical patterns of disease presentation are associated with variables pertaining to the individual turtle and the environment in the region of its collection site (using a 10 km buffer).

We found there were associations between each pattern and certain independent variables. The variables included in the final model were:
- Study period
- Mean chlorophyll-a concentration
- Mean sea surface salinity
- Mean sea surface temperature
- Annual range of sea surface temperature
- Green sea turtle stranding density

All aforementioned relationships, except stranding density, were statistically significant.

The following variables were provided in the analysis but were not included in the final model: curved carapace length, turtle collection method, body condition, protected areas, bays, mean human population density, annual range of sea surface salinity, distance to nearest metallurgical plant, distance to nearest river mouth, and continental shelf width.




**Effect of independent variables in a multinomial regression model to predict FP groups**

## SIGNIFICANCE AND CONCLUSIONS

- There are different patterns of anatomic distribution and severity of FP tumors in green sea turtles.
- These patterns have significant associations with predictive variables pertaining to the environment in the region of the turtles' collection site as well as study period.
- These relevant environmental conditions may contribute to a specific FP presentation along with infection with ChHV5.
- This is an important avenue for future research as in the past, FP has been studied as one homogenous disease.
- Understanding the contributing factors of different presentations and severities of FP can inform conservation strategies in the future and may also be of use clinically in rehabilitation.

## ACKNOWLEDGEMENTS

- Financial support was provided by the Students Training in Advanced Research (STAR) Program through the SVM Endowment Funds
- Financial support for travel was provided by UC Davis Office for Global Programs
- Additional thanks to IPRAM (Instituto de Pesquisa e Reabilitação de Animais Marinhos), Projeto TAMAR, and Laboratório de Patologia Comparada de Animais Selvagens, Universidade de São Paulo (LAPCOM-USP)

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