Insights into the dynamics of green turtle fibropapillomatosis: case of study: Puerto Rico

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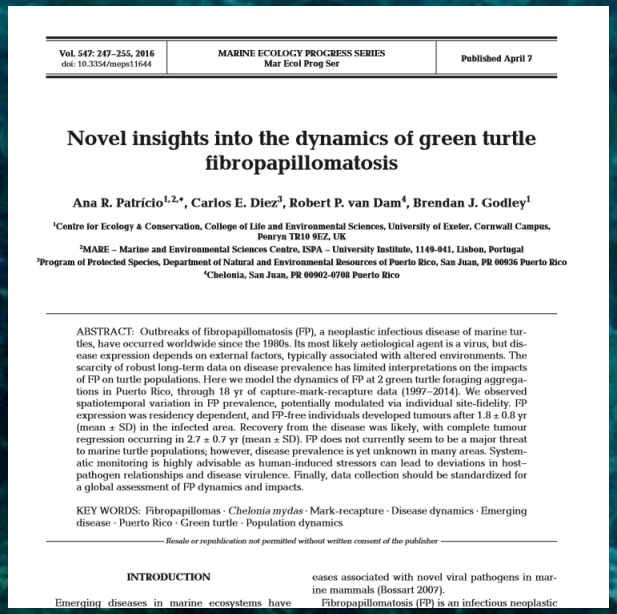

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Novel insights into the dynamics of green turtle fibropapillomatosis

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ABSTRACT: Outbreaks of fibropapillomatosis (FP), a neoplastic infectious disease of marine turtles, have occurred worldwide since the 1980s. Its most likely aetiological agent is a virus, but disease expression depends on external factors, typically associated with altered environments. The scarcity of robust long-term data on disease prevalence has limited interpretations on the impacts of FP on turtle populations. Here we model the dynamics of FP at 2 green turtle foraging aggregations in Puerto Rico, through 18 yr of capture-mark-recapture data (1997–2014). We observed spatiotemporal variation in FP prevalence, potentially modulated via individual site-fidelity. FP expression was residency dependent, and FP-free individuals developed tumours after 1.8 ± 0.8 yr (mean ± SD) in the infected area. Recovery from the disease was likely, with complete tumour regression occurring in 2.7 ± 0.7 yr (mean ± SD). FP does not currently seem to be a major threat to marine turtle populations; however, disease prevalence is yet unknown in many areas. Systematic monitoring is highly advisable as human-induced stressors can lead to deviations in host–pathogen relationships and disease virulence. Finally, data collection should be standardized for a global assessment of FP dynamics and impacts.

KEY WORDS: Fibropapillomas · *Chelonia mydas* · Mark-recapture · Disease dynamics · Emerging disease · Puerto Rico · Green turtle · Population dynamics

INTRODUCTION

Emerging diseases in marine ecosystems have eases associated with novel viral pathogens in marine mammals (Bossart 2007).

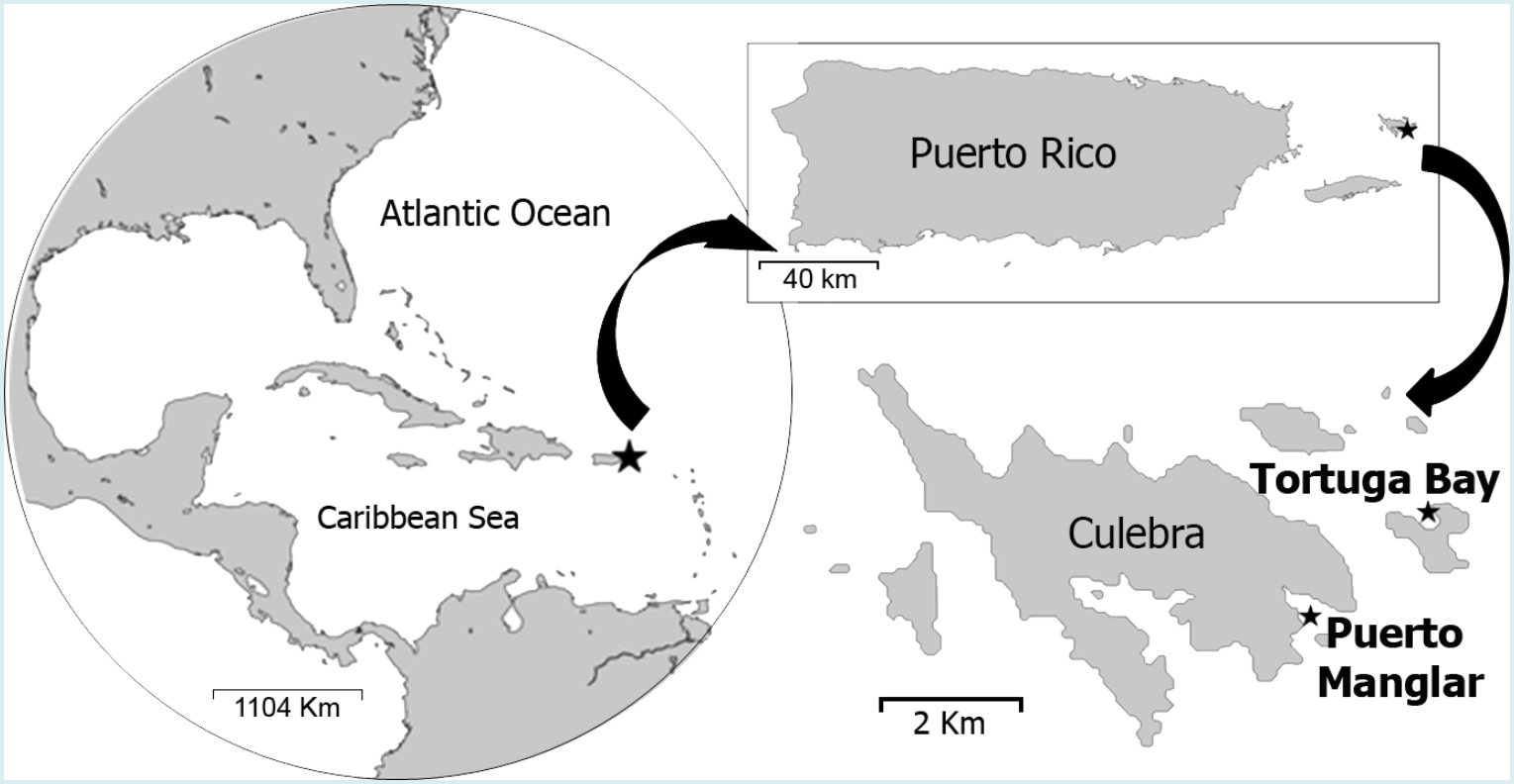
Fibropapillomatosis (FP) is an infectious neoplastic

What is Fibropapillomatosis(FP)?

- Herpesvirus
  - Alphaherpesvirinae (dsDNA)
    - Human herpesvirus 1 (herpes simplex)
    - Human herpes virus 3 (varicella-zoster)
    - Gallid herpesvirus 2 (Marek's disease)
  - General characteristics:
    - Frágil en el ambiente
    - Transmisión contacto cercano
    - Infección Persistente/latente
      - Ganglia sensorial

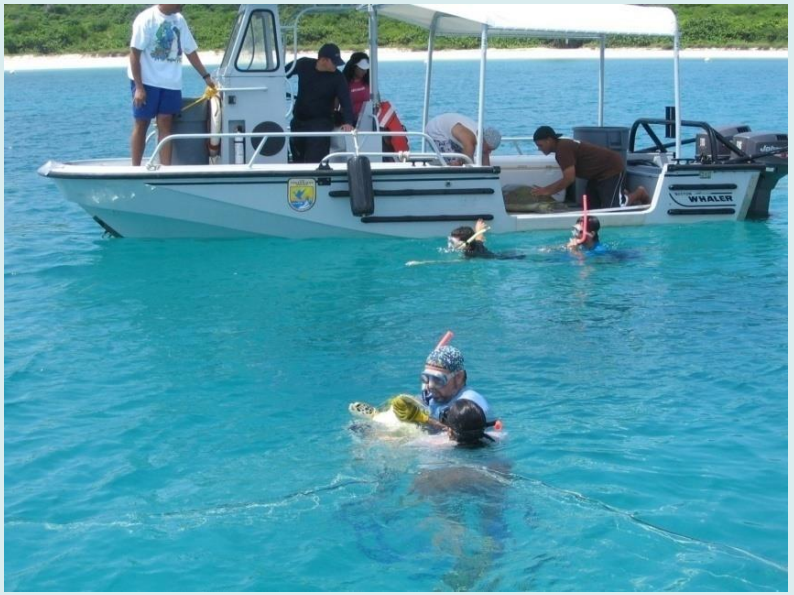
Case Study:

Long-term study of FP incidence on green turtle aggregations at Culebra Archipelago, Puerto Rico, 1997 to present



Methods

net-assisted turtle capture



- turtles are tagged, measured, weight

Photo identification

Physical examination

Greenblatt, *et al*. 2005. Geographic variation in marine turtle fibropapimallotosis. Journal of Zoo and Wildlife Medicine.36(3): 527-530.

Page-Karjian, A., Torres, F. Zhang, J., Rivera, S., Diez, C., Moore, P., Moore, D. and Brown, C. 2012. Presence of chelonid fibropapilloma-associated Herpesvirus in tumored and non-tumored green turtles, as detected by polymerase chain reaction, in endemic and non-endemic aggregations, Puerto Rico. *SpringerPlus*, *1*(1), 35.

Objectives:

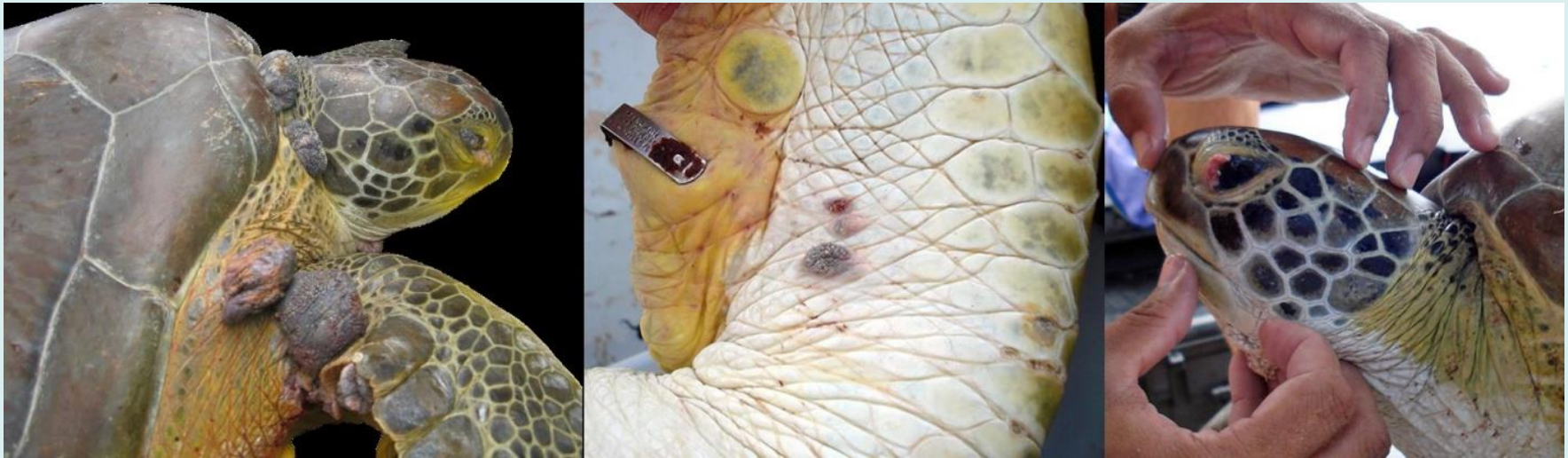
1) Location of tumors on turtles (eyes, flippers, cloaca)

3) Temporal and spatial differences on the prevalence of FP

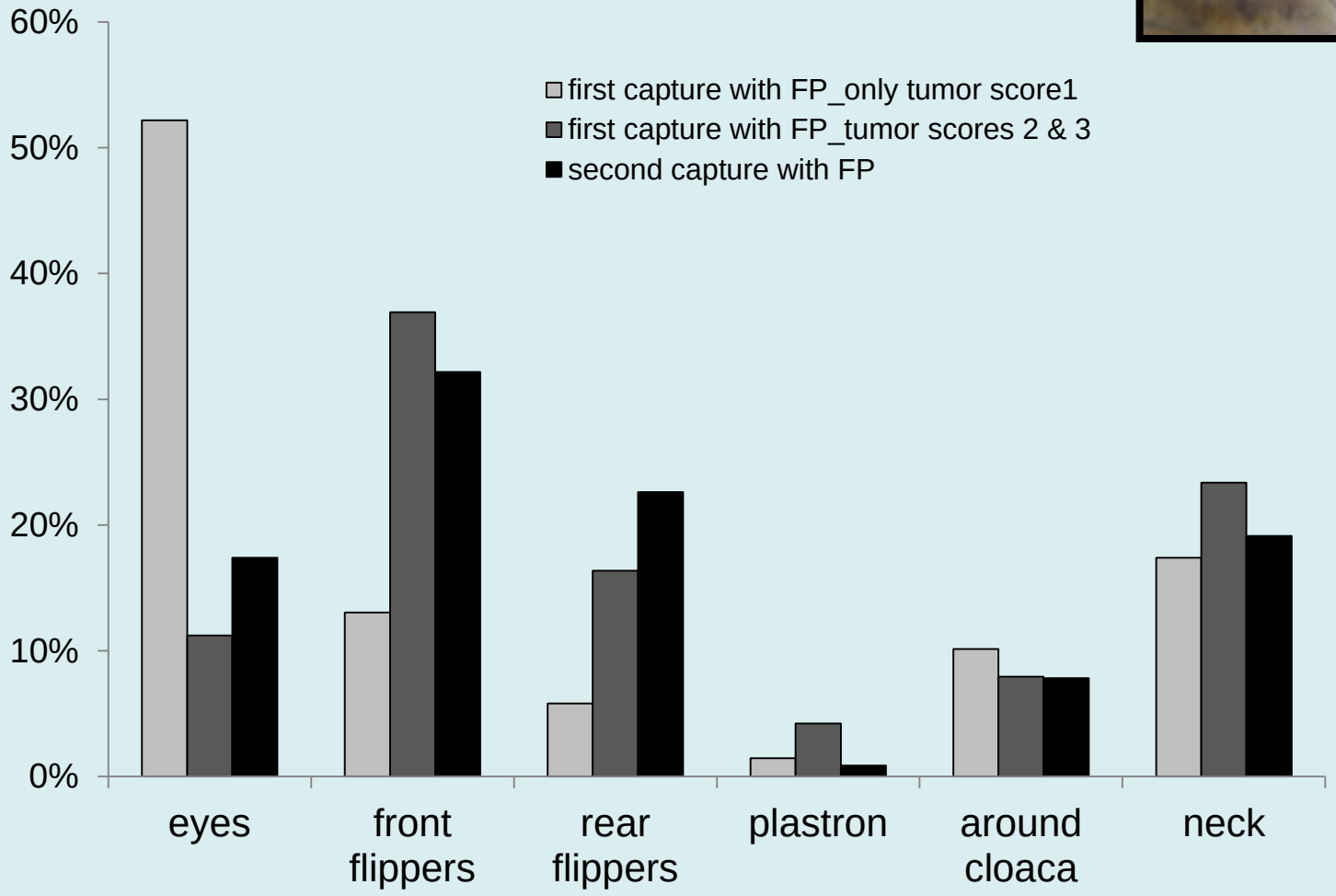
4) Expression of FP by sizes class

4) Length of time from expressing FP to complete recovery

5) Effect of FP on population dynamics



RESULTS:



Location of tumors in the body of the turtles

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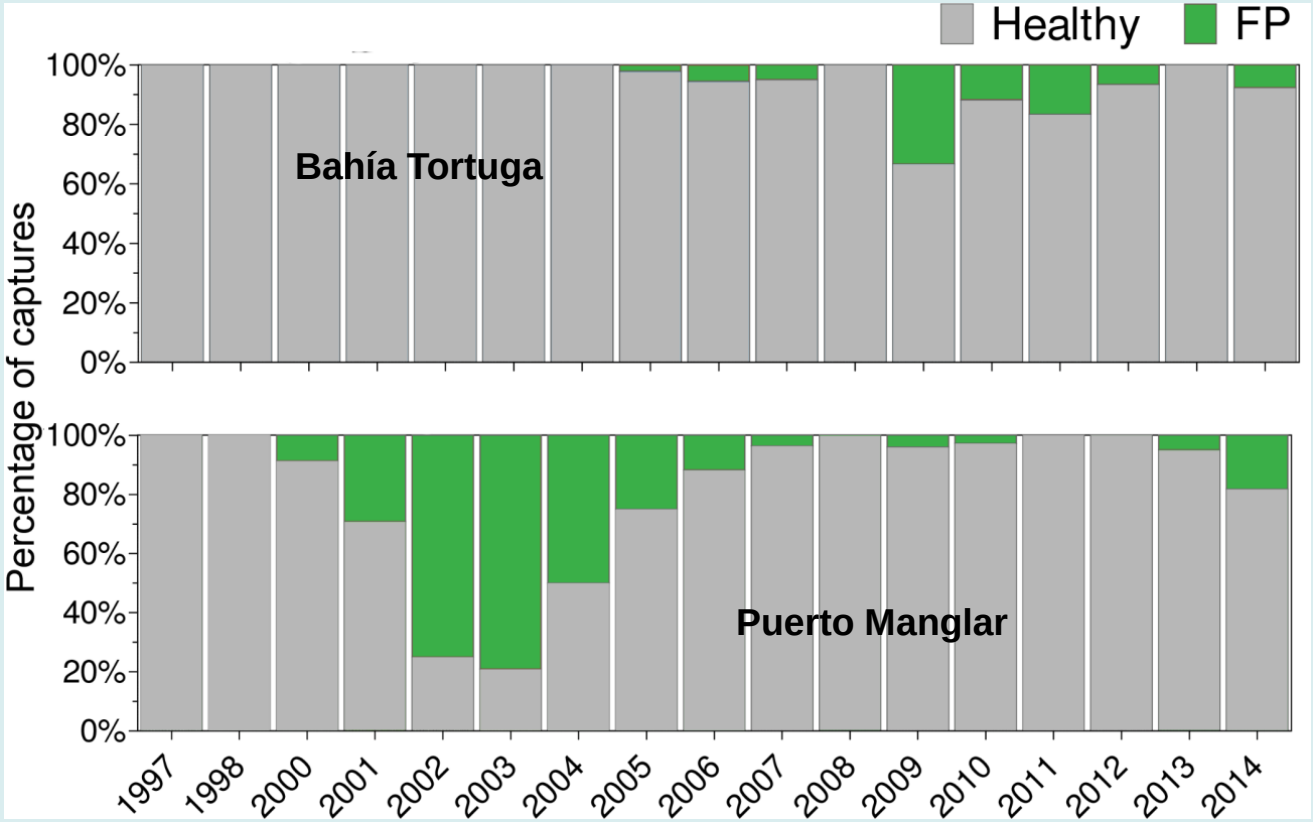
Temporal y spatial prevalence on FP

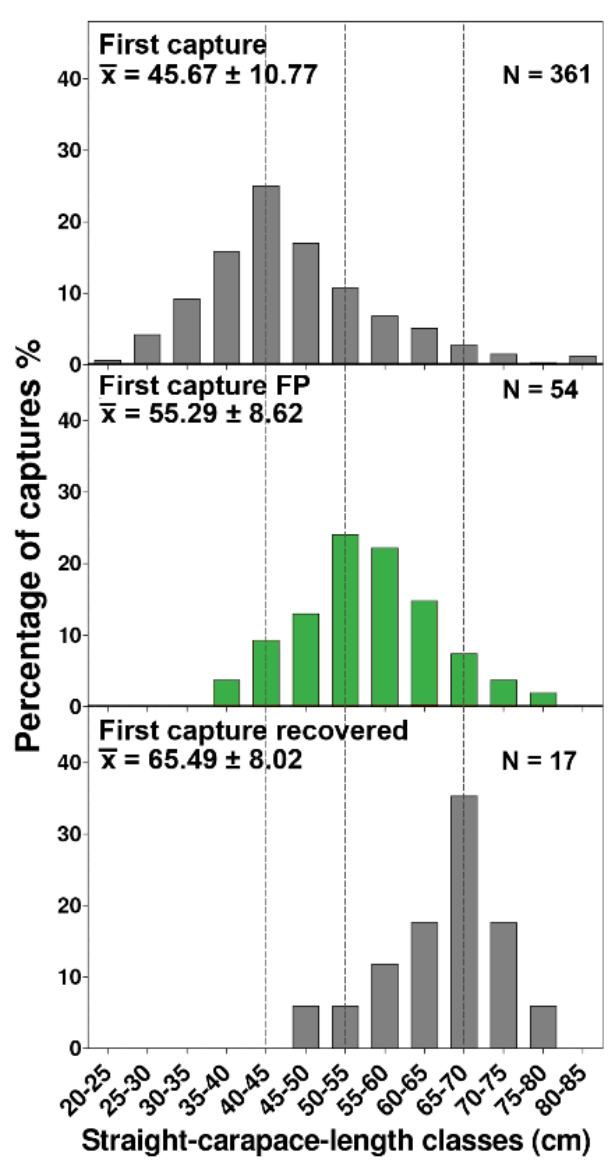


Total individuos= 143
FP= 9
6%

Total individuos= 218
FP= 45
21%

Maximum prevalence of FP at Tortuga Bay: 33% on 2009.
Máximum prevalence of FP at Puerto Manglar: 79% on 2003.

Differences in size among disease stages



Smaller turtles FP free

FP expression at medium SCLs

Recovery at larger SCLs

SCLs significantly different:
$F(2,407)=43.52$, $p < 0.001$

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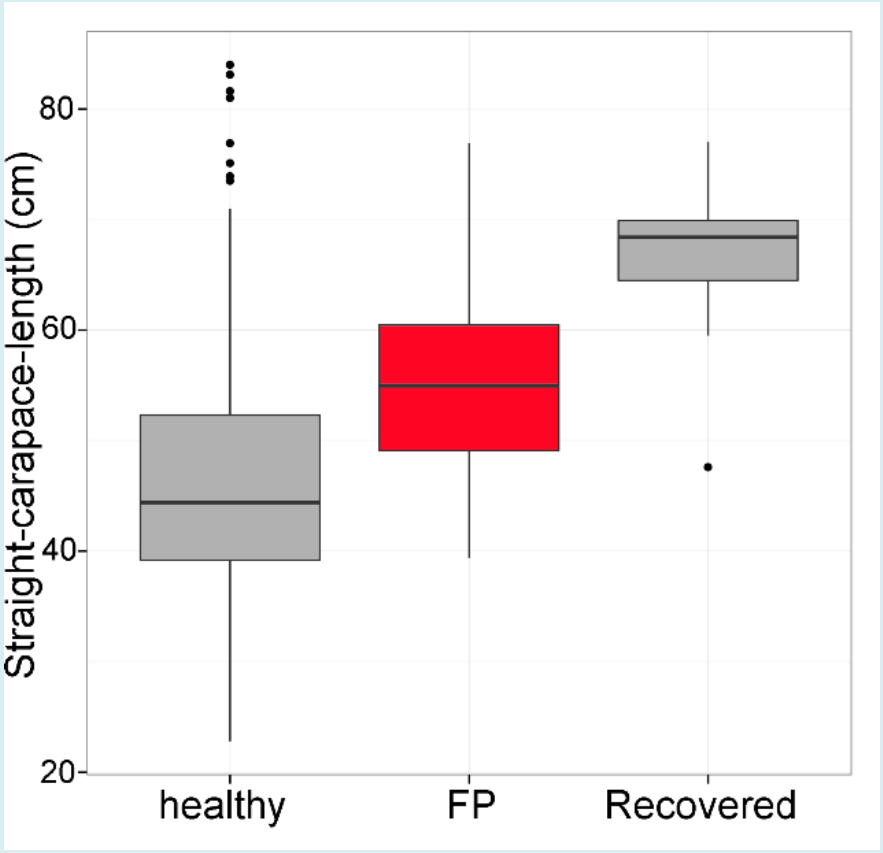
Straight carapace length of turtles with different stages of disease (free, tumors, recovered).



Straight Carapace Length of turtles with different stages of disease (free, tumors, recovered).

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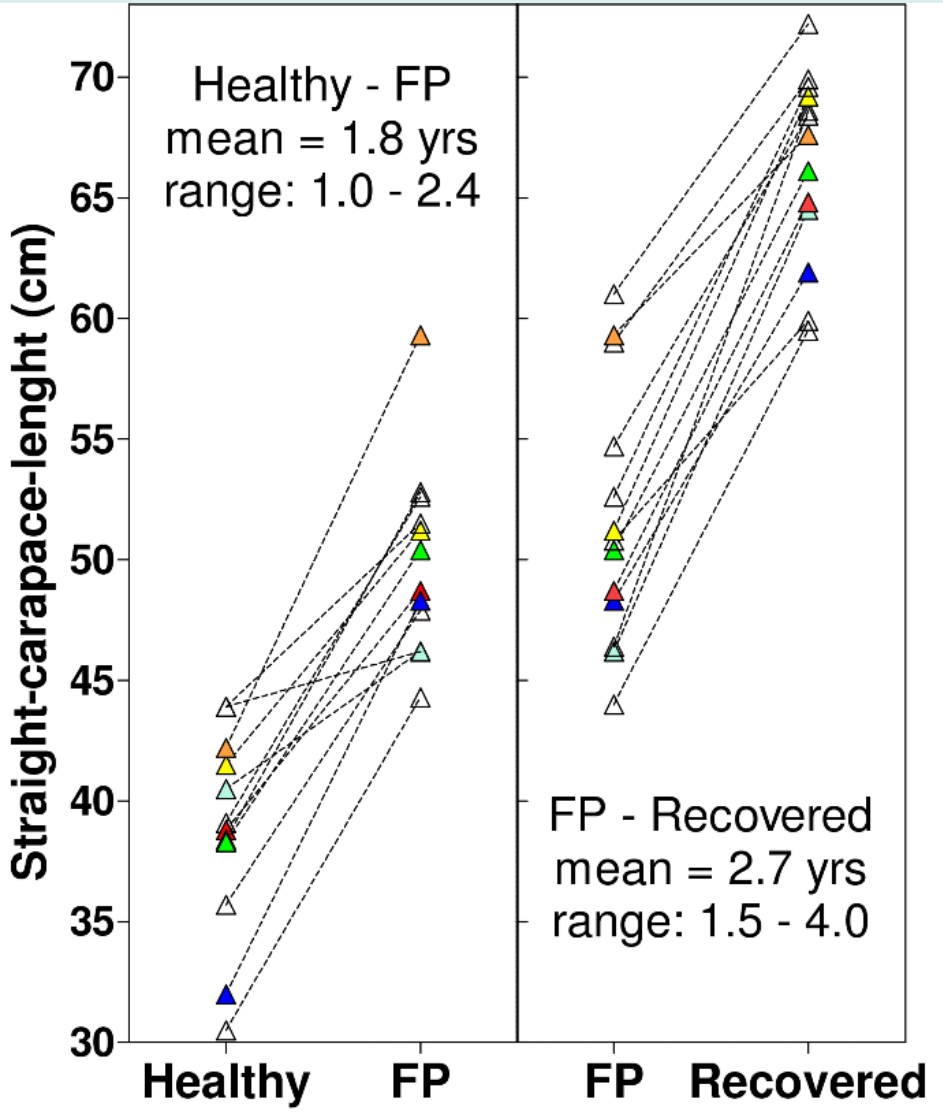
FP expression as a function of residency



Straight Carapace Length of turtles at first captures a)healthy and with FP, b)with FP and recovered. Six turtles were seen in all stages (colours).

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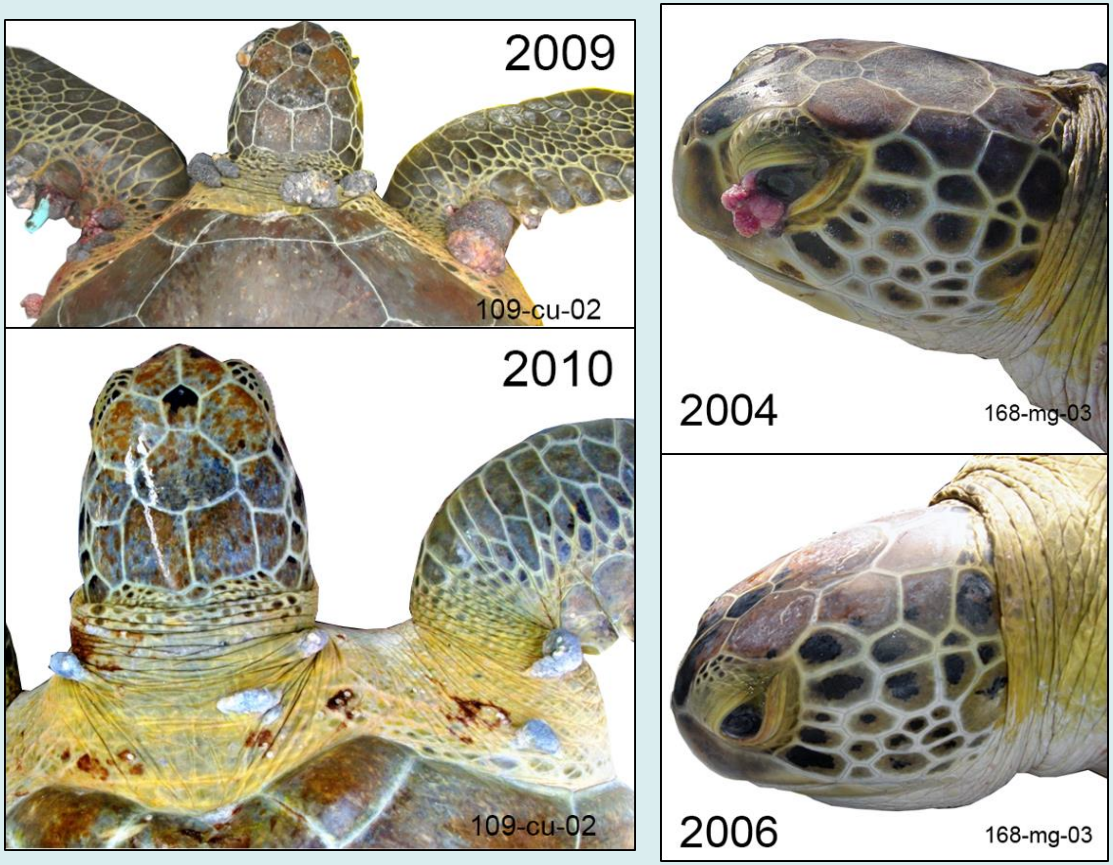
High recovery rates

Puerto Manglar

- **45 FP turtles**
- **15 recovered ~ 33%**

Tortuga Bay

- **9 FP turtles**
- **2 recovered ~ 22%**



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Effect of FP on population dynamics

➡ FP no effect on growth rates or in survivorship of green turtles at Culebra

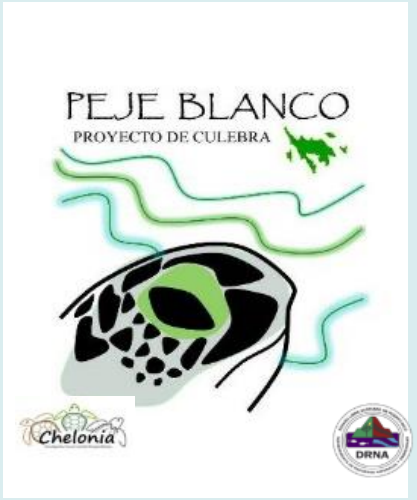
Table 2. Summary of generalized additive mixed modeling (GAMM) analyses to model the relationships between annual growth rates of immature green turtles from Puerto Manglar and Tortuga Bay foraging grounds, Puerto Rico - response variables - and mean straight-carapace-length (SCL), mean growth interval, mean sampling year and fibropapilloma (FP) status (i.e., having or not FP tumors) - predictor variables or covariates. SE: standard error, df: estimated degrees of freedom of smooth term (1 = linear), SCL: straight-carapace-length.

	Tortuga Bay				Puerto Manglar			
Term	Estimate	SE	t	P	Estimate	SE	t	P
Parametric								
Intercept	4.790	0.383	12.49	< 0.001	5.948	0.274	21.682	< 0.001
FP status	-0.630	0.387	-1.63	0.106	0.057	0.345	0.165	0.869
		df	F	P		df	F	P
Non-parametric								
mean SCL (cm)		2.818	23.324	**< 0.001**		1	35.695	**< 0.001**
mean sampling year		6.866	5.766	**< 0.001**		1	1.342	0.249
mean growth interval (yr)		1	0.155	0.695		1	3.114	0.080

Patrício, R. Diez, C. and, & van Dam, R. (2014). Spatial and temporal variability of immature green turtle abundance and somatic growth in Puerto Rico. *Endangered Species Research*, *23*(1), 51–62. doi:10.3354/esr00554

Patricio, A.R.; Velez-Zuazo, X.; Diez, C.E.; van Dam, R.; Sabat, A. 2011. Survival probability of immature green turtles in two foraging grounds at Culebra, Puerto Rico. Mar Ecol Prog Ser. Vol. 440: 217–227

Relevant conclusions:



-FP have no effect on survivorship nor growth rates.

-Spatial variability on FP incidence supports fidelity to each site.

-Recruits FP tumors free, agreeing with genetic studies on the CFPHV.

-High recovery rates on FP turtles, similar to Australia, Florida and Hawaiian foraging grounds.

-Afflicted individuals developed “immunity” and complete FP regression was observed after 1.5 – 4.0 years of tumor expression.

- FP may not be a current major threat to marine turtle populations

1. Globally, FP has long been present in wild sea turtle populations – the earliest mention was in the late 1800s in the Florida Keys.

2. FP primarily affects medium-sized immature green turtles in coastal foraging pastures.

3. Expression of FP differs across ocean basins and to some degree within basins. Turtles in the Southeast US, Caribbean, Brazil, and Australia rarely have oral tumors (inside the mouth cavity), whereas they are common and often severe in Hawaii. Internal tumors (on vital organs) occur in the Atlantic and Hawaii, but only rarely in Australia. Liver tumors are common in Florida but not in Hawaii.

4. Recovery from FP through natural processes, when the affliction is not severe, has been documented in wild populations globally.

5. FP causes reduced survivorship, but documented mortality rates in Australia, Puerto Rico and Hawaii are low. The mortality impact of FP is not currently exceeding population growth rates in some intensively monitored populations (e.g., Florida and Hawaii, USA and Southern Great Barrier Reef stock Queensland, Australia) as evidenced by increasing nesting trends despite the incidence of FP in immature foraging populations.

6. Pathogens, hosts, and potential disease and environmental cofactors have the capacity to change; while we are having success now, there needs to be continued monitoring to detect changes in the distribution, occurrence, and severity of the disease.

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7. While we do not have clear evidence to provide the direct link, globally, the preponderance of sites with a high frequency of FP tumors are areas with some degree of degradation resulting from altered watersheds. Watershed management and responsible coastal development may be the best approach for reducing the spread and prevalence of the disease.

8. Future research efforts should employ a multi-factorial ecological approach (e.g., virology, parasitology, genetics, health, diet, habitat use, water quality, etc.) since there are likely several environmental cofactors involved in the expression of the disease, which is still thought to be caused by a herpesvirus.

9. Minimum FP data collection in new areas should include: individual identification (photo ID, PIT tags, etc.), standard measurements (length and weight), presence/absence of tumors, tumor severity, body condition, oral examination, method of capture, and effort.

Apoyo y financiamiento:

Agradecimiento especial a:
































Y muchos mas