



Proceeding Paper

# Fibropapillomatosis on Sea Turtles, a Sentinel of Ecosystem Health? †

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**Abstract:** Cutaneous fibropapillomatosis, first reported in green turtles (*Chelona mydas*) in 1930, is considered a global epizootic that affects up to 97% of sea turtles, with major consequences for threatened populations. Although this is a benign tumour that arises on the skin or internal organs, it can have serious and potentially fatal consequences when it compromises critical functions such as swimming, feeding, or breathing. The aetiology of this tumour is not yet well defined, but it has been primarily associated with Chelonide herpesvirus 5. Some studies also highlight exogenous environmental factors such as water temperature and pollutants, which may have caused a host-virus–host imbalance and the onset of the disease. Climate change seems to have a role in the dissemination of this pathology among sea turtle populations. Although not fully understood, the relationship between fibropapillomatosis and the state of environmental health is well recognized. Further research is needed to better understand this disease, which silently devastates entire populations of marine turtles. Daily human activities may have a greater impact on wildlife populations than can be expected. There is an urgent need to reverse human threats to wildlife.



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## 1. Introduction

Sea turtles are large aquatic reptiles that inhabit tropical and subtropical seas. They spend most of their lives on the high seas and do not return to land except for every 2–4 years after reaching sexual maturity [1,2]. The wild populations of sea turtles have been declining in the last decades, due to illegal hunting, ingestion and entanglement of marine debris, marine pollution, artificial lighting of the nidification sites, beach erosion, habitat destruction, invasive species predation, and warming of the oceans due to climate changes [3–5]. In recent years, fibropapillomatosis, a neoplastic disease, has been affecting sea turtle populations throughout the world and contributing to their decline. Little is known about the disease, although recent studies suggest a viral aetiology, linked to environmental factors such as pollution or climate change [6,7].

The first occurrence of skin fibropapillomatosis was reported in a green sea turtle (*Chelonia mydas*) from Florida (USA) in 1930 [8]. Even though the prevalence is higher in *C. mydas*, this disease has also been reported in Loggerhead (*Caretta caretta*), Kemp's Ridley (*Lepidochelys kempii*), Hawksbill (*Eretmochelys imbricata*), Flatback (*Natator depressus*), Olive ridley (*Lepidochelys olivacea*), and the Leatherback (*Dermochelys coriacea*) [7].

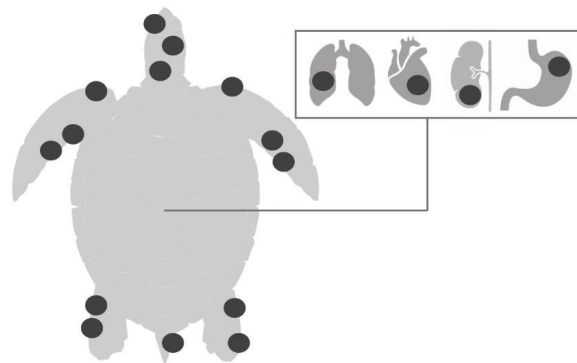
## 2. Etiology and Transmission

The principal etiological agent of fibropapillomatosis appears to be Chelonid herpesvirus 5 (ChHV5), a nonzoonotic agent [9]. Some authors posit that is possible that ChHV5 has existed within turtles for at least 8.9 million years and evolved during this period without harming the hosts [10]. However, exogenic factors such as water temperature and pollutants may have caused a virus–host imbalance and the onset of the disease [9,11]. Recent studies have shown a higher prevalence of disease in areas of highly polluted waters (chemicals, pesticides, algae, and others) [7].

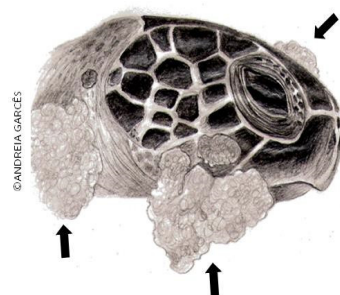
The transmission method of this virus is still unknown since it is hard to culture in the laboratory and almost impossible to study *in vivo* since most sea turtle’s species are near extinction [4,10]. The literature suggests that the virus may be spread through direct contact with infected animals or through contact with virus-containing substrates, horizontally [9,12]. Juveniles appear to be unaffected at birth [10]. Also, mechanical vectors (coral reef cleaner fish, the saddleback wrasse, marine leeches) may have a role in the transmission of the virus [13].

## 3. Clinical Presentation

Skin fibropapillomas in sea turtles present as elevated formations, 0.1 to 30 cm in diameter, well-defined from the surrounding tissues. Neoplasms are usually smooth, firm, and white, but others may be gelatinous and translucent. They are commonly ulcerated or necrotic [10]. These masses are found especially on soft skin but can be found anywhere on the body of the turtle (e.g., flippers, neck, chin, inguinal and axillary regions, and tail). In addition, some animals may develop internal nodules (Figures 1 and 2) [10]. Fibropapillomas can develop all over the body and become large enough to interfere with locomotion and vision (panophthalmia and destruction of the eyeball) and compromise other organic functions, such as feeding [12]. The animals end up dying of starvation and dehydration or secondary infection from ulcerated masses [10,12].



**Figure 1.** Common anatomical location masses on the soft skin of the turtle’s body (flippers, neck, chin, inguinal and axillary regions, tail) and internal organs (heart, lungs, kidney, digestive tract).



**Figure 2.** Sea Turtle Fibropapillomatosis.

#### 4. The Impact of Climate Change

Some studies have shown that water temperature impacts tumors formation and the spread of the infectious agent [7,14]. Some researchers suspect that the increase in water temperature is realizing an excess of chemicals (eutrophication), such as nitrogen, that accumulates in the food of turtles (e.g., algae) and can be a factor that induces the occurrence of the disease [15].

The increase in ultraviolet light (UV) due to climate change is suspected to contribute to the emergence of tumours in ChHV5-infected animals. This is because UVB is associated with damage to DNA and increases its mutation rate, being responsible for the development of tumours in other animals [1].

Experiences with captive green turtles have shown that they develop more tumors during the warmer months. Therefore, the environmental temperature probably impacts fibropapillomatosis occurrence in sea turtles, similar to what occurs in other herpesviruses in other populations [16].

#### 5. Conclusions

Sea turtles should be considered sentinels of ecosystem health, given that they depend directly on the environment for reproduction and development, and the slightest change can have a considerable impact on wild populations [7]. Even if not fully understood, there is a relationship between the development of sea turtle fibropapillomatosis and environmental factors. In the future, better fibropapilloma monitoring is necessary and could serve as a tool for monitoring ecosystem health in nearshore marine habitats and the impact of climate change.

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