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Cutaneous lesions and body traumata observed in humpback whales (Megaptera novaeangliae) off northern São Paulo state coast, Brazil, 2016-2020: everything is not alright

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ABSTRACT

The Brazilian coast is occupied every year by humpback whales (*Megaptera novaeangliae*) from the breeding stock A "BSA". Their presence peaks from August to October and then migrate to feed off South Georgia and South Sandwich Islands, in subantarctic waters. The coast of São Paulo state, southeastern Brazil, receives a portion of this migrating contingent, where humpback whales were recently observed in apparent feeding events and with negative interactions with fishing gear. The purpose of this document is to present evidence that some humpback whales can be affected by the poor water quality present along the heavily polluted coast of São Paulo state. They may be immunosuppressed, and this condition may favor the rapid development of bacterial and fungal infection on skin (and probably other organs), as the photographs indicate. Other data on epibiosis and abnormal hypopigmentation and traumata are also presented. Further studies on the etiology of the skin condition are highly required and could elucidate the causes of these disorders.

INTRODUCTION

The Brazilian coast is occupied every year by humpback whales from the breeding stock A "BSA" (Zerbini et al., 2004). Their presence peaks in August, September and mid-October and then migrate to feed off South Georgia and South Sandwich Islands (Zerbini et al., 2006; Zerbini et al., 2011). The coast of São Paulo state, southeastern Brazil, receives a portion of this migrating contingent, where humpback whales were observed in apparent feeding events and with negative interactions with fishing gear (Siciliano et al., 2019). The purpose of this document is to present evidence that some humpback whales can be affected by the poor water quality present along the heavily polluted coast of São Paulo state. They may be immunosuppressed, and this condition may favor the rapid development of bacterial and fungal infection on skin (and probably other organs), as the photographs indicate. Further studies on the etiology of the skin condition are highly required and could elucidate the causes of these disorders.

MATERIAL AND METHODS

Study area

The sighting cruises were conducted around the Archipelago of Ilhabela and along the coast of São Sebastião (Lat. S23.5 to S24.8 and Long. W45.2 to W44.3) (Fig. 1). This area is characterized by the occurrence of the warm waters of the Coastal Current and Brazil Current and the cold waters of the South Atlantic Central Water (SACW), rich in nutrients. The Coastal Current, the most predominant, receives the continental discharges, which are higher during the rainy summer months. This fact associated to the periods of occurrence of the SACW in the Spring and Summer increases the local primary productivity, affecting the trophic web.

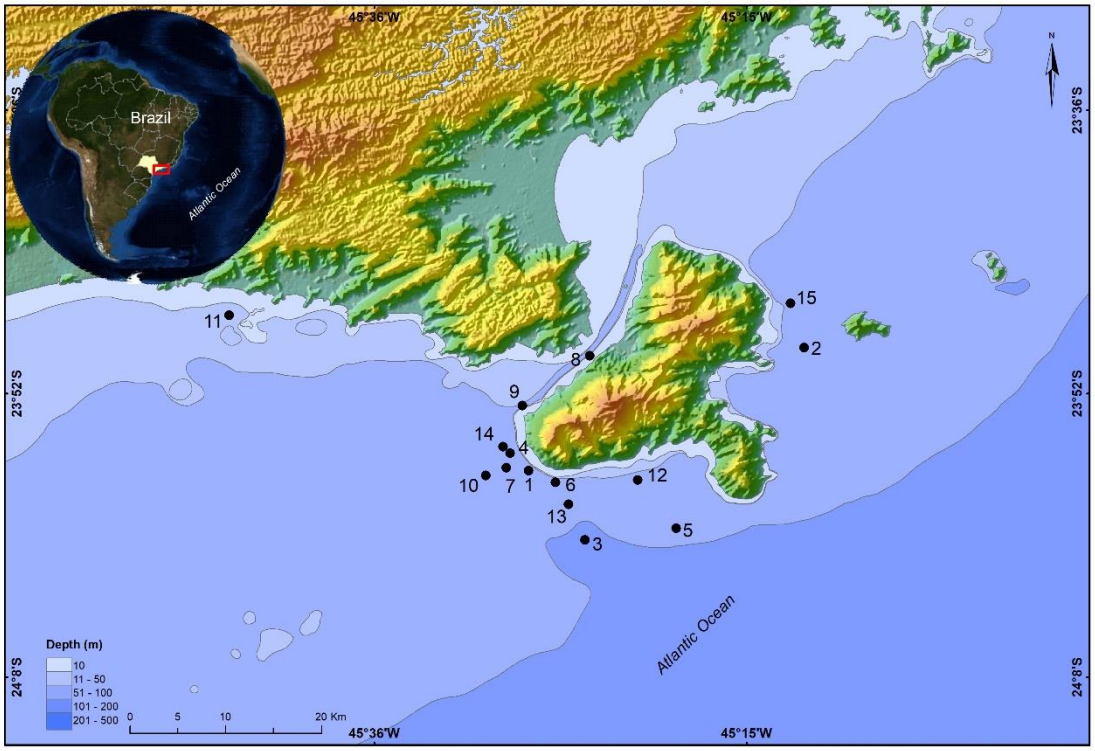


Figure 1. Locations of humpback whales (*Megaptera novaeangliae*) with skin lesions, barnacle (*Coronula* sp.) or whale lice (*Cyamus* sp.) infestations, and other anomalies (hypopigmented or traumata) observed off Ilhabela, northern São Paulo state Brazil, 2016-2020. Numbers 1 – 15 refer to locations of humpback whales sighted with skin lesions, epibiosis, hypopigmentation and traumata referred to in this document.

Sea surface temperatures usually range from 19° to 29°C and the prevailing winds are northeast trade winds. January to March is the rainiest period showing a maximum average of pluviosity of 300mm/month compared to the minimum average of 160mm/month during the drier months (Cavalcanti et al. 2009, Rossi-Wongtschowski & Madureira, 2006, SIGAM, 2021a, SIGAM, 2021b**).** Among several cetacean species recorded during the PROBAV cruises, humpback whales have been sighted every season since 2016, during its reproductive migration along the Brazilian coast. Three motorboats were used alternately in the cruises (Ballerina - Ferretti 16.2 m, Kavala 1 – 9.8 m, Cetacea – 9 m), and the trips lasted an average of eight hours. Table 1 provides a list of Projeto Baleia à Vista (PROBAV) sighting cruise effort from 2015 to 2020.**Data collection**

The Project Baleia à Vista (PROBAV) has carried out cetacean sighting cruises, since 2005 on the state of São Paulo northern coast, Brazil. PROBAV is a citizen science project involved in promoting public awareness about marine mammals' conservation. From 2015 on, a greater effort was made on cruises, totaling 653 cruises, 2568 navigated hours and 30732 navigated nautical miles (nm) (Table 1).

Table 1. Projeto Baleia à Vista (PROBAV) sighting cruise effort from 2015 to 2020.

Year	No. of cruises	Navigated hours	Navigated nm
2015	52	159	1900
2016	60	328	3900
2017	110	527	6300
2018	190	635	7620
2019	123	528	6320
2020	118	391	4692

Boat-based photo-identification was carried out whenever the weather and sea conditions permitted. The whales were approached respecting the distance of 100 m between the boat and the whale. At each sighting, the navigation route, the sea current speed and the whale position were recorded using a Raymarine Chartplotter/GPS. Depth and sea surface water temperature were recorded by a Raymarine Sonar.

Data about pod size and composition, presence of calves and behavior were recorded by video cameras and digital photographs were taken of the lateral body, tail flukes, flippers, head, dorsal fin, ventral surface, distinctive marks, and skin lesions. Images of medium to high quality were examined for the presence of skin disorders or pathological conditions (skin lesions, pigmentation anomalies, deformities, epibiosis).

Individuals were classified into size categories (based on body length) and kind of skin disorder.The pictures were taken using a Nikon D4S (300-mm lens FX) and a Nikon D 850 (80-400-mm FX lens) and a Nikon D500 (70/200 FX lens), with a high-speed of 1/1250 fps and openings varying between f/4 and f/8 due to the amount of light and Direction.

We classified the skin disorders and other traumata in the following categories and subcategories: 1) Skin lesions 2) Epibiosis; 3) Miscellaneous traumata and other 'disorders'; 4) Entanglement in fishing gear and related traumata.

Classification of skin disorders and other traumata

1) **Skin lesions**
a. Severe whitish velvety skin lesions, covering more than >50%) of the body
b. Extensive whitish velvety skin lesions, covering less than <50% of the body
c. Irregular whitish skin lesions
d. Ulcerated skin lesions

2) **Epibiosis**
a. Extensive whale lice (*Cyamus* sp.) infestation
b. Extensive barnacle (*Coronula* sp.) infestation
c. Extensive barnacle (*Coronula* sp.) infestation with multiple associated ulcerations

3) **Miscellaneous traumata and other 'disorders'**
a. Fluke laceration
b. Hypopigmentation

4) **Entanglement in fishing gear and related traumata**
a. Recent entanglement (whale carrying gear)
b. Past event (scar associated)

Results and Discussion

Skin lesions

Skin lesions have been observed in eight humpback whales, at least, during the migration seasons 2016-2020. These lesions varied a lot in the general aspect, extension of the body, and probably their etiology. For practical purpose we classified them as covering >50% or <50% of the body. Two whales had severe skin conditions, with most of the body covered with whitish velvety aspect (Figure 2A-D). Six whales had

an estimated portion of the body <50% covered with some type of lesion (Figures 3A-I, 4A-F). The general aspect of the lesions varied a lot, mostly whitish irregular, rounded-oval shaped lesions in different sizes, combined or not with ulcerated lesions. It seems that at least some of these lesions are old and may have originated in the Antarctic or sub-Antarctic environment, but may progress while migrating to the tropics as warmer waters could favor fungal and bacterial growth. Some degree of emaciation can be observed in a few whales, as of Figures 4A, B, giving evidence of a weak body condition. It is important to note that these whales (>80%) were observed at the beginning of the migration season (May-July), thus reflecting their condition upon arrival to the tropics.

Figure 2. A, B: HW with severe whitish velvety skin lesions, covering >50% of the body; **C, D:** HW with 'uniformly' whitish velvet skin lesions >50% of the body.

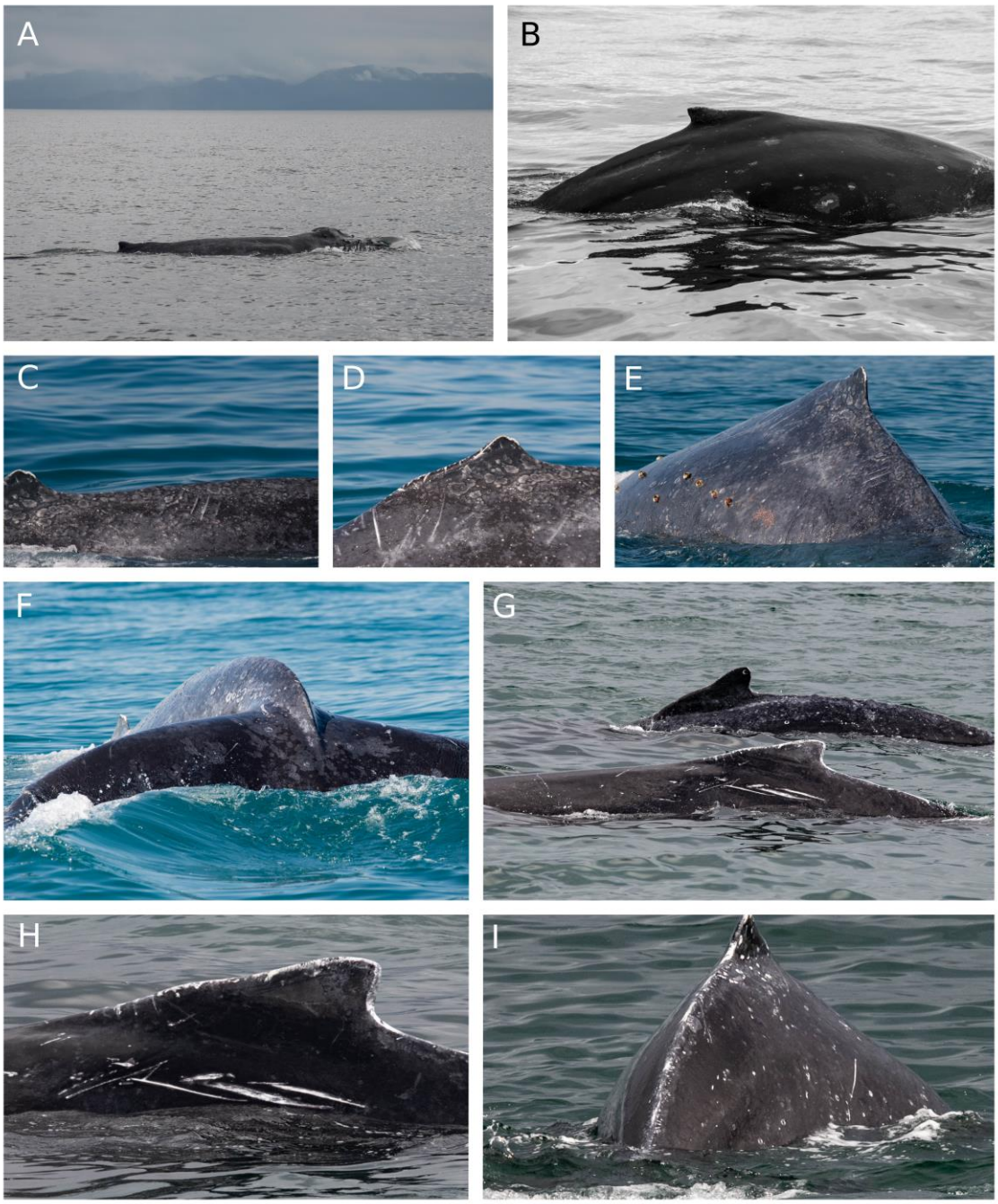


Figure 3. A, B: HW with 'uniformly' whitish velvet skin lesions >50% of the body; **C-F:** HW with extensive whitish velvety skin lesions, covering <50% of the body; **G-I:** HW with skin lesions and ulcerations in <50% of the body.

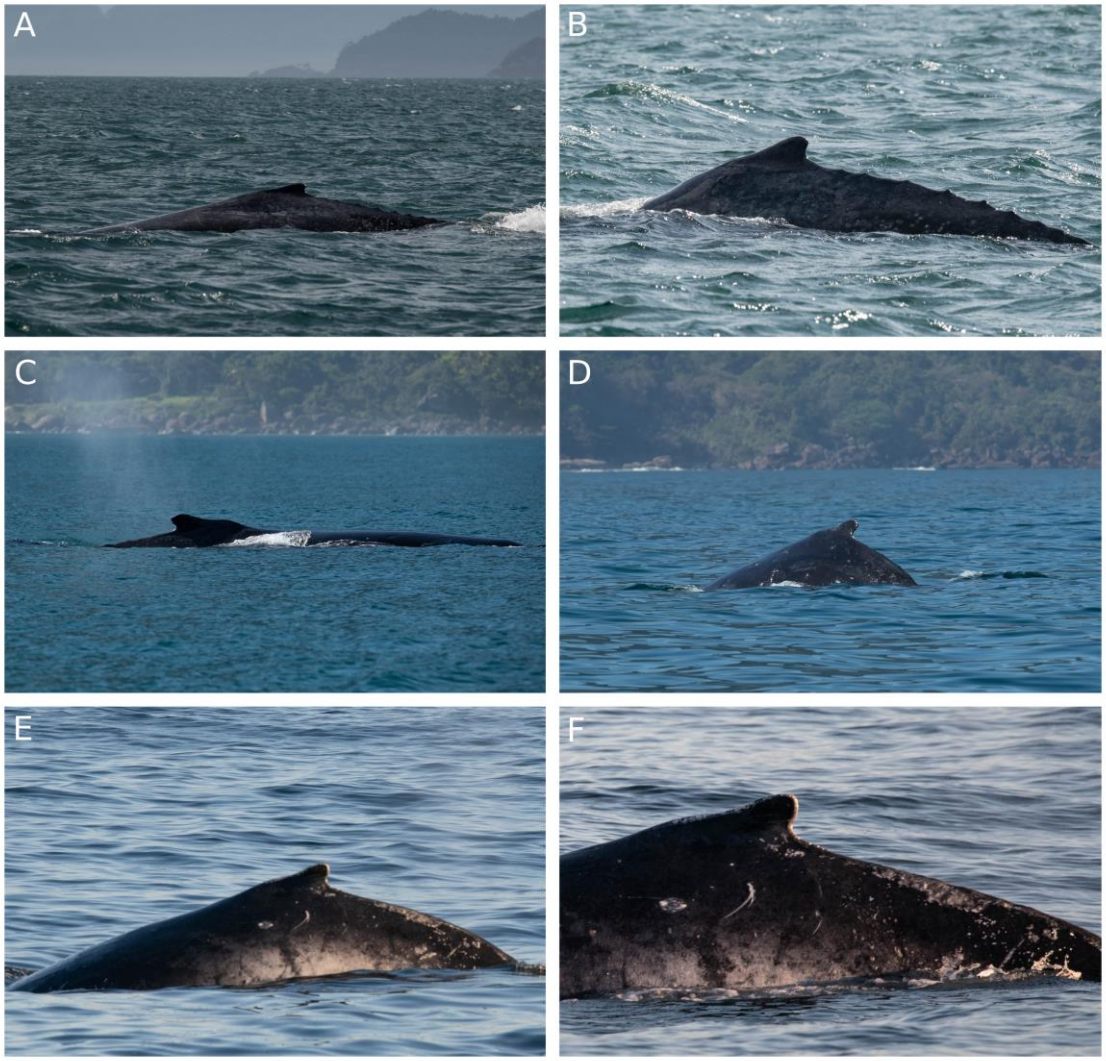
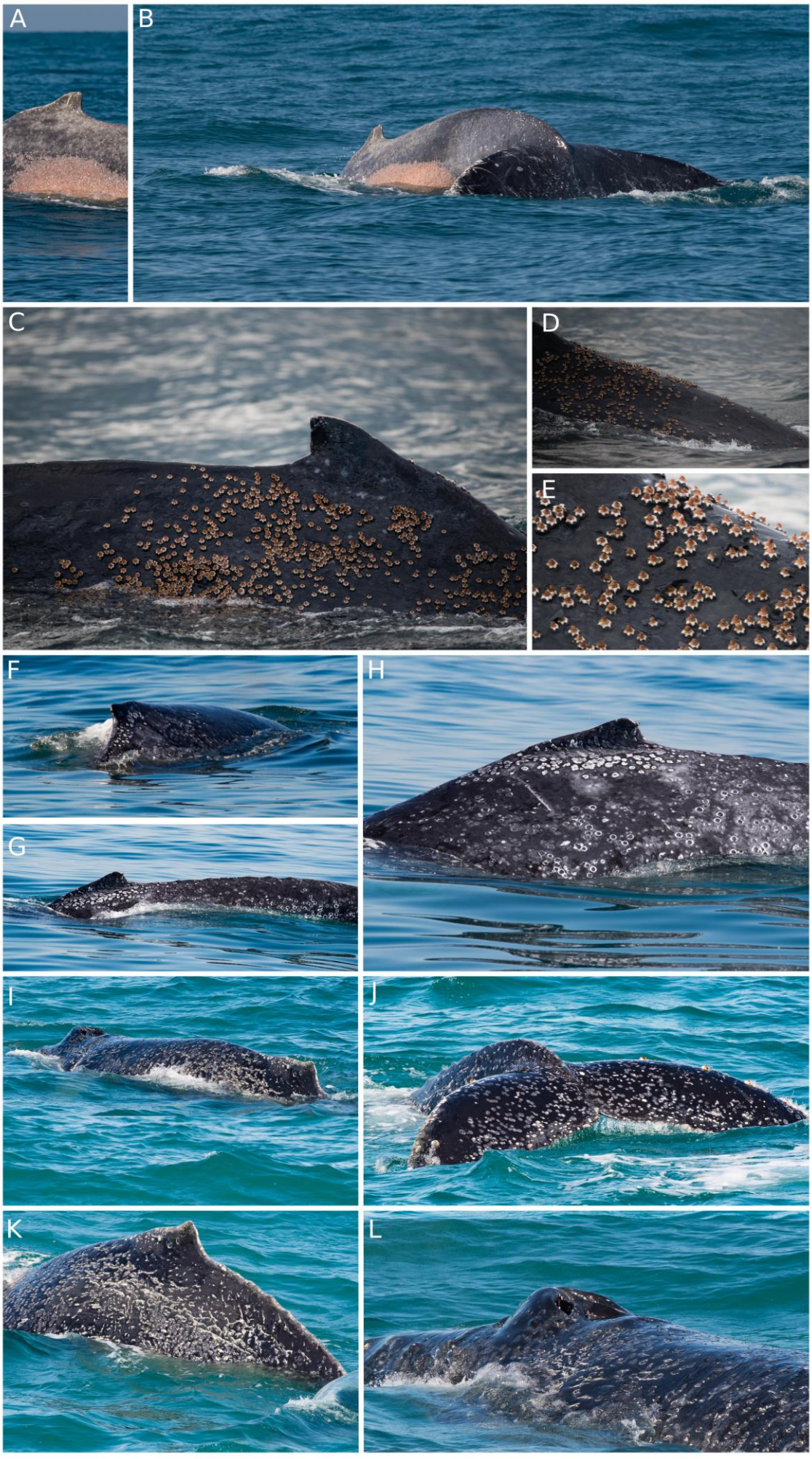


Figure 4. A, B: HW emaciated and skin lesions <50% of the body; **C, D:** HW with skin lesions <50% of the body and evidence of past fishing line injury; **E, F:** HW with large wrinkly areas and skin lesions <50% of the body.

Barnacle and/or whale lice infestation

The only case of extensive whale lice (*Cyamus* sp.) infestation is also associated to a severe body skin condition, with most of the back showing a wrinkly aspect (Figs. 5A-B). There were three cases of humpback whales observed with barnacles (*Coronula* cf. *diadema*) infestation (Figs. 5C-H). Figure 5C-E shows the infestation by uniformly sized small barnacles associated to ulcerated velvety skin lesion. Figure 5F-H shows a severe body condition combined with past barnacle infestation. Figure 5I-L show evidence of a recent infestation of barnacles with severe ulcerated skin condition.

It seems that recent past infestation by barnacles and whale lice may create an area for fungal/bacterial infection, causing multiple and disseminated ulceration and other pathologies on whale body. It may be related to an impaired immune system in humpback whales wintering off Brazil, that could be aggravated in tropical waters due to contaminated coastal waters.


A
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barnacle infestation with mixed skin lesions; **F-H:** HW with skin lesions >50% of the body, combined with extensive barnacle infestation; **I-L:** HW with skin multiple eruptions, recent barnacle infestation and other lesions of unknown etiology >50% of the body.

Traumata and hypopigmented whales

One whale (Fig. 6A, B) has a severe mutilation of half of its fluke. Curiously, it seems to be in good body condition. Other one (Fig. 6C-F) is atypically hypopigmented in the ventral surface of both sides of the fluke but also has some large whitish areas in the lateral of the body, which is uncommon in 'Brazilian' humpback whales. The case of a humpback whale observed carrying a gillnet around the mouth gap, emaciated, and whale lice infestation is noteworthy (Fig. 7A-D). It is obviously in bad shape condition, presenting whale lice infestation in patches of its flank. There is little or no chance of survival for this whale as the net reached deeper into its mouth.

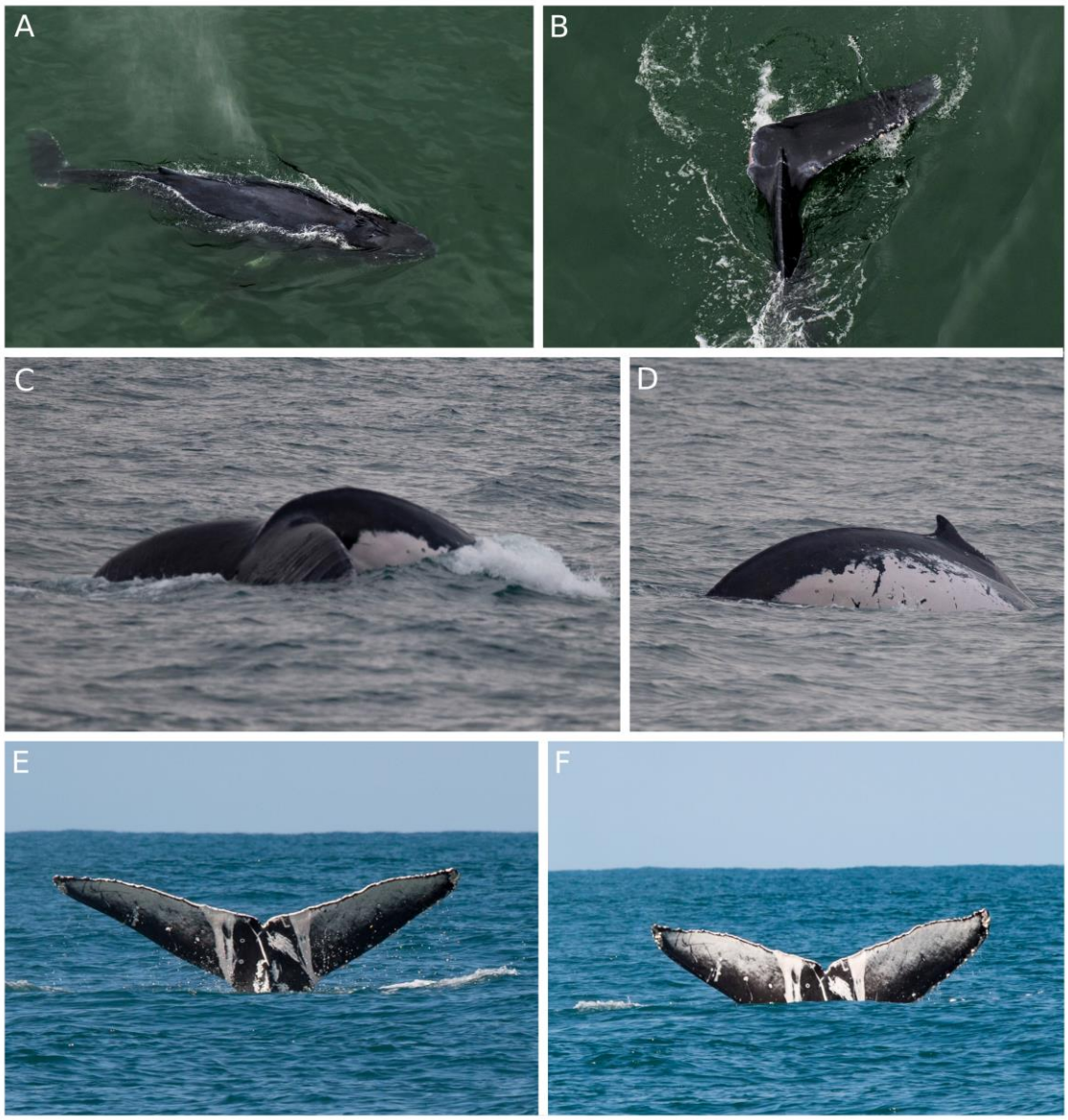

Figure 6A, B: HW with severe mutilation in half fluke; **C-F:** HW with atypical, hypopigmented coloration in the ventral surface of the fluke and body.

Figure 7A-D: HW carrying a gillnet around the mouth gap, emaciated, and whale lice infestation.

DISCUSSION

In this preliminary study, we present evidence of numerous skin disorders of special concern detected in migrating humpback whales off the northern coast of São Paulo state, Brazil. The etiology of these skin disorders is unknown, even their origin or health effects on whales. A wide diversity of microbes may be acting to cause such pathologies (see review by Mouton and Botha, 2012). They seem to be linked to environmental factors, including water salinity and temperature, as well as pollution and eutrophication. The increase of continental discharges on the coast of São Paulo state during the summer is worsened by the access several thousands of tourists in this region, which does not have a suitable sewage system and part of their wastewaters is discarded directly in the local rivers and beaches. Besides, the channel of São Sebastião concentrates the sewage discharges of two towns (São Sebastião and Ilhabela) and the pollution resulting of the commercial port operations and of the Brazilian biggest oil terminal (TEBAR). At Caraguatatuba Bay, situated in the biggest city in the study area, three rivers contaminated by domestic sewages pollute the seawater (SIGAM, 2021b). Other possible source of contamination is the Port of Santos, located 70 miles southward from the study area. Regarding potential sources of pollution, De Mahiques et al. (2016) suggest that anthropogenic chemical contaminants originated from industrial activities of the Port of Santos, such as hydrocarbons and heavy metals released in the continental shelf of Santos, can be reinjected into the water column in different situations: seabed dredging, bottom trawling, benthic activities, and storms. It seems plausible to infer that a significative number of humpback whales show signs of malnutrition, emaciation and are affected by pathological agents of unknown origin while migrating off Brazil. In this context, Moura *et al.* (2013) provided results of a bacteriological survey of Vibrionaceae and Aeromonadaceae agents in three live stranded humpback whales on the Brazilian coast. They suggested that these bacteriological agents may have caused animal impairment that resulted or were associated with the cause of death and stranding events. Infectious disease (septicemia, omphaloarteritis and urachocystitis) and emaciation have been reported in a wide study of pathologies and causes of death in stranded humpback whales from Brazil (Groch *et al.* 2018).

FINAL CONSIDERATION

Our findings, although very preliminary in nature, is of particular concern as our study covers the arrival of whales migrating earlier in the season and probably continue their journey northwards. The role of coastal waters pollution and run-off from the continent should be further evaluated as well as the agents causing these skin disorders.

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