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Prevalence of epidermal conditions in common bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Ambracia, western Greece

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ABSTRACT

Bottlenose dolphins (*Tursiops truncatus*) of the Gulf of Ambracia are exposed to numerous growing anthropogenic impacts, rendering them more prone to cutaneous changes. The prevalence of skin conditions in this resident population was evaluated based on photo-identification. Five skin lesions previously described in other studies were considered, namely dark-fringed spots, white-fringed spots, orange patch, tattoo-like and white fin-fringe, in addition to a new particularly severe condition named as "white dots" (WD). A 37% prevalence of epidermal lesions was detected on a total of 153 dolphins. The newly identified WD was the skin condition most frequently observed (45%) in the area, showing considerable differences on its severity between individuals. From 29 dolphins affected by WD in 2012, two were severely affected throughout their 10-year photo-id records and all of them either worsened over the years, or maintained their WD condition. No cases were found in which WD resolved over time. The increasingly degraded conditions of the Gulf of Ambracia may be influencing their epidermal integrity or causing them physiological stress. The epidermal conditions here reported, in some cases very conspicuous and relatively easy to monitor over the years, might act as indicators of environmental burden.

1. Introduction

The common bottlenose dolphin *Tursiops truncatus*, hereafter bottlenose dolphin, is the most common cetacean on the continental shelf of the Mediterranean Sea and due to its relatively coastal distribution its exposure to anthropogenic disturbance may be high (Bearzi et al., 2008b). In 2006, the International Union for Conservation of Nature (IUCN) Red List Authority and ACCOBAMS (Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area) agreed to classify the Mediterranean 'subpopulation' of bottlenose dolphins as 'Vulnerable' according to the IUCN Red List criteria and based on a suspected population decline of at least 30% over the last 60 years (Reeves and Notarbartolo di Sciara, 2006). Habitat degradation, and more particularly pollution, is considered to be among the main factors contributing to such decline (Bearzi et al., 2008b).

In wild bottlenose dolphins, as in several other cetacean species, skin diseases have been extensively reported. Many of those studies were primarily based on photo-identification data (Thompson and Hammond, 1992; Harzen and Brunnick, 1997; Wilson et al., 1997a, 1997b, 1999, 2000; Van Bressem et al., 2003; Murdoch et al., 2008; Bearzi et al., 2009; Maldini et al., 2010; Rowe et al., 2010; Burdett Hart et al., 2012), while others relied, at least partially, on capture–release health assessment data (Wilson et al., 1999; Reif et al., 2006; Burdett Hart et al., 2011), or on by-catch or stranding data (Baker, 1992; Van Bressem et al., 2007, 2009c). The impact of skin disorders on the health of populations is largely unknown but there is growing concern about their high prevalence, persistence and extensive body coverage, in inshore and estuarine dolphins (Van Bressem et al., 2012). In the Mediterranean, however, the very few published studies dealing with this subject have relied mostly on the latter method (Melero et al., 2011). Only Wilson et al. (1999) used photo-id to evaluate the prevalence of various skin diseases in bottlenose dolphins in Croatia and several other non-Mediterranean locations and, more recently, Van Bressem et al. (2009c) looked particularly at the prevalence of tattoo skin lesions in their conspecifics of Slovenian waters, as part of a worldwide review for the species, using the same method. The same approach has been used to follow health-related trends, such as incidence of injury or skin lesions in loggerhead sea turtles *Caretta caretta* in Zakynthos, Greece (Schofield et al., 2008, 2013).

Under natural conditions, cetacean skin usually acts as an effective barrier against the environment, as well as against potential pathogenic agents; however, over the last 60 years the frequency of skin disorders reports steadily increased (Mouton and Botha, 2012). This study focuses on the only cetacean species present in the Gulf of Ambracia in western Greece, the bottlenose dolphin. The local dolphin population was estimated to include about 150 individuals with an average density of 0.37 animals km^{-2}, one of the highest observed densities in the Mediterranean for this species (Bearzi et al., 2008a). Based on the extensive photo-id effort carried out on this highly resident population of

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dolphins during 2011 and 2012, we aim to evaluate and describe the occurrence of skin lesions and lesion types present during the most recent and fully analyzed photo-id data set available, as well as to discuss their possible causes and the implications for the conservation of bottlenose dolphins in this increasingly degraded ecosystem. Our findings could also provide a baseline for discussion and collaboration among fellow scientists working with bottlenose dolphins and other small odontocetes in Mediterranean coastal waters and for future monitoring of novel types of skin disorders or changes in overall skin condition prevalence.

2. Materials and methods

2.1. Study area

The Gulf of Ambracia is a shallow and semi-enclosed embayment of 405 km^2, located on the northwestern coast of mainland Greece (Fig. 1). Its only communication with the open Ionian Sea is by the Preveza Channel; a narrow (minimum width of 370 m) and shallow (<5 m at the shallowest point and ~20 m at the deepest) 3 km-long corridor. On average, the Gulf is approximately 30 m (maximum 60 m) deep, mostly consisting of mud or sand (Ferentinos et al., 2010). Due to the isolated character of the Gulf, the water quality is strongly influenced by man-made processes (Friligos et al., 1997; Karras et al., 2007; Tsangaris et al., 2010).

Input of organic matter and pollutants comes from various sources. The two rivers Louros and Arachthos, found on its northern shore, are the main pathways for agricultural runoff (Karras et al., 2007; Tsangaris et al., 2010). Fish farms, agricultural practices and discharges of domestic sewage from coastal towns and villages further contribute to the nutrient enrichment of its waters, which are rather murky and highly eutrophic with Secchi disk readings often as little as 2 m (Bearzi et al., 2008a). The high concentration of nutrients creates ideal conditions for intensive primary production in the marine environment (Panayotidis et al., 1994), which in turn increases the abundance of primary and secondary consumers such as small epipelagic fish species (Zafiropoulos and Merlini, 2001). Both rivers' high discharges and the high evaporation rate lead to the strong stratification of the water column throughout the year due to either salinity or temperature fluctuations, which in combination with the limited communication with the open sea, result in different spatial and temporal dissolved oxygen distributions. More specifically, the western part of the Gulf is seasonally hypoxic, while the eastern part is seasonally anoxic (Kountoura and Zacharias, 2013).

2.2. Data collection

Boat surveys were conducted from a 5.80 m long inflatable boat with fiberglass keel (Novamarine RH-580) powered by a 100 HP four-stroke outboard engine, between the months of April and September in years 2011–2012, based on predefined routes designed to guarantee a uniform effort coverage of the whole Gulf of Ambracia on a monthly basis. Survey conditions were considered as "positive" under daylight and good visibility, sea state ≤3 Beaufort (large wavelets, crests beginning to break and scattered whitecaps) and with, at least, two observers scanning the sea surface looking for dolphins. When spotted, dolphin groups were approached at low speeds, progressively converging with the routes they followed, and avoiding sudden changes of speed and directionality to minimize potential disturbance caused by the boat. Any photo-id data collected occasionally during *ad libitum* navigation were not included in the analysis.

For each dolphin sighting, a digital SLR camera Canon EOS 7D equipped with Canon EF 70–200 mm f/2.8L USM zoom lens was used to obtain as many good images as possible of every individual present throughout the duration of the observation, avoiding bias toward any particular individuals. All dolphins screened for skin lesions were identified as unique individuals and matched to known animals in a photo-id catalog. Photo-identification was consistently based on distinctive long-term natural marks such as notches and nicks in the dolphins' dorsal fins (Würsig and Würsig, 1979; Würsig and Jefferson, 1990; Wilson et al., 1997a), as well as any additional marks in other parts of the body. Since calves present marginally distinct and/or non-distinct dorsal fins, they were excluded from the analysis.

2.3. Skin conditions detection and classification

The photographic quality of all images available for the screening of each one of the dolphins photo-identified during the study period was scored as: 1) good – in focus, well lit, good angle (i.e., dolphin perpendicular, or almost perpendicular, with respect to the lens) and with at least the entire dorsal fin and the area of the body immediately below visible, therefore providing a high confidence in determining presence

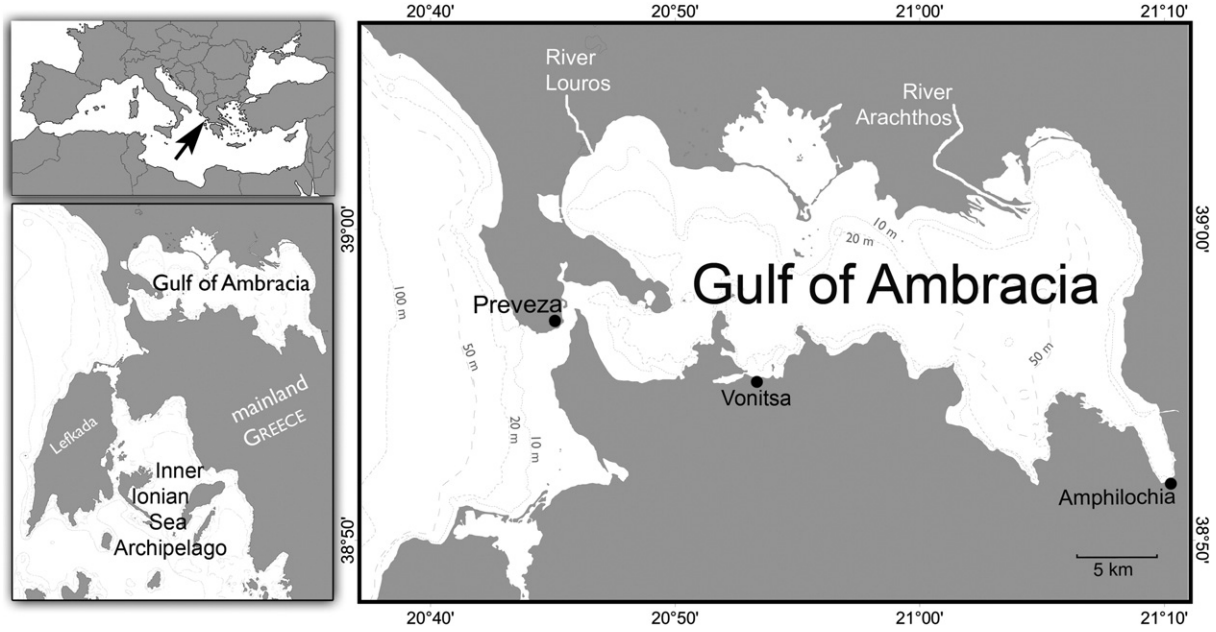

Fig. 1. Map of the Gulf of Ambracia. The Preveza Channel offers its only communication with the open Ionian Sea.