Lobomycosis-like disease in Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) from the southwest Indian Ocean

Jeremy KISZKA [1, 2, 3 *] and Marie-Françoise VAN BRESSEM [4]

[1] *University of La Rochelle. LIENSS (Littoral, Environnement et Sociétés). UMR 6250 CNRS-Université de La Rochelle. 2 rue Olympe de Gouges, 17000 La Rochelle, France.*
[2] *Direction de l'Environnement et du Développement Durable, Conseil Général de Mayotte, BP 101, 97600 Mamoudzou, Mayotte, France.*
[3] *Past affiliation: Observatoire des Mammifères Marins de Mayotte (Office National de la Chasse et de la Faune Sauvage, Direction de l'Agriculture et de la Forêt). BP 103, 97600 Mamoudzou, Mayotte, France.*
[4] *Cetacean Conservation Medicine Group (CMED), CEPEC, Museo de Delfines, Pucusana, Peru.*

[*] *Contact: Jeremy Kiszka (jeremy.kiszka@wanadoo.fr)*

ABSTRACT

Lobomycosis is a chronic mycotic disease of the skin and sub-dermal tissues caused by a yeast-like organism known as *Lacazia loboi.* This disease has been identified in humans and Delphinidae i.e. *Tursiops truncatus* and *Sotalia fluviatilis.* It is endemic to South America and Florida. Here we report the first case of lobomycosis-like disease in Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) from the tropical lagoon of Mayotte, in the southwest Indian Ocean (12º50'S, 45º10'E). From July 2004 to June 2006, daylight boat-based surveys were conducted in the territorial waters of the island, including in the 1,100km² closed lagoon where Indo-Pacific bottlenose dolphins are resident. During the surveys, at least 45 dolphins were photo-identified. Among them, 6 had skin lesions very similar to lobomycosis. However, no histological investigations confirmed the clinical observations. This is the first report of lobomycosis-like disease in *T. aduncus* from this region of the world.

***Keywords*:** Indian Ocean; Mozambique Channel; Indo-pacific bottlenose dolphin; *Tursiops aduncus*; epidermal lesions; lobomycosis; clinical observations; photo-identification.

INTRODUCTION

Skin lesions have been described in cetaceans worldwide (Caldwell *et al.*, 1975; Frasca *et al.*, 1996; Wilson *et al*., 1997, 1999; Van Bressem *et al*., 1994; Van Bressem & Van Waerebeek, 1996; Reif *et al.*, 2006; Brownell *et al.*, 2007; Van Bressem *et al.*, 2007; Flach *et al*., 2008; Siciliano *et al*., 2008; Mouton *et al*., 2008). They may be caused by viruses, bacteria, fungi and protozoans (Van Bressem *et al*., 2008a). Their emergence and severity may be associated with natural and anthropogenic factors (Wilson *et al.*, 1999; Reif *et al*., 2006; Van Bressem *et al*., 2007).
Lobomycosis is a chronic mycotic disease of the skin and sub-dermal tissues caused by *Lacazia loboi*, an uncultivated pathogen that belongs with the other dimorphic fungal pathogens to the order Onygenales (Herr *et al*., 2001). The disease has been identified in humans and Delphindae i.e. *Tursiops truncatus* and *Sotalia fluviatili*s from the US Atlantic coast, Brazil and Europe (Caldwell *et al.*, 1975; Symmers, 1983; Simões-Lopes *et al*., 1983; Reif *et al.*, 2006). In South America, several cases highly reminiscent of lobomycosis were observed in free-ranging coastal *T. truncatus* and *S. guianensis*. In the absence of a histological diagnosis, the disease was called lobomycosis-like disease (Van Bressem *et al*., 2007, 2008b). Lobomycosis and LLD have been mostly observed in tropical and equatorial areas, such as in Florida and South America. The habitat of the organism is believed to be aquatic or associated with soil and vegetation. The dermal lesions in dolphins are similar to those described in humans, but are more extensive covering in some cases very large areas of the body (Reif *et al.*, 2006; Simões-Lopes *et al*., 1983; Van Bressem *et al*., 2007; Moreno *et al*., 2008). Recently, lobomycosis seemed to have taken epidemic proportions in the Indian River Lagoon of Florida and in Brazil (Bossart *et al.*, 2003; Reif *et al.*, 2006; Van Bressem *et al*., 2007; Moreno *et al*., 2008). The reasons for this are unknown but may be related to a changing environment.
Here we report on LLD in Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) from the tropical lagoon of Mayotte, in the Mozambique Channel (SW Indian Ocean). Recent surveys and the collection of photo-

identification data allow documenting the emergence of the disease in this area where lobomycosis has never been observed previously.

MATERIALS AND METHODS

Study area

Mayotte (12°50'S, 45°10'E) is located in the northern Mozambique Channel between Madagascar and the African mainland (Figure 1). The island is made up of two major parts: the main island of Grande Terre where most of the population lives (approximately 360km²), and the smaller Petite Terre (approximately 13km²), which is embedded in the barrier reef (Quod *et al.*, 2000). Mayotte is almost entirely surrounded by a 197km long barrier reef, with a second double-barrier in the southwest. Adjacent to the northern extent of the lagoon, is the immerged reef complex of Iris Bank (approximately 215km²). The inner lagoon ranks among the largest lagoons of the world (1,500km²; Quod *et al.*, 2000), averaging 20 meters in depth with deeper waters reaching 80 meters in the west. Numerous deep passes are present in the barrier reef, many of which are the beds of old rivers. The main island is surrounded by a discontinuous fringing reef (195 km) where river mouths are present. Some 20 small islets are present in the lagoon, measuring from 1 to 242ha, and surrounded by fringing reefs. Approximately 670ha of mangrove forests occur around the main island, especially in protected bays (Quod *et al.*, 2000).

Photo-identification

From July 2004 to June 2006, small boat based surveys were undertaken in the surrounding waters of Mayotte by the *Observatoire des Mammifères Marins de Mayotte* (Marine Mammal Observatory), co-ordinated by the *Direction de l'Agriculture et de la Forêt* and the *Office National de la Chasse et de la Faune Sauvage*. Surveys were conducted throughout the study period during daylight hours, i.e. between 0700h and 1800h, in sea conditions not exceeding Beaufort 3. Survey vessels did not follow pre-defined transects but every attempt was made to sample each habitat type within the surrounding waters of Mayotte (Figure 2). Observation effort concentrated mostly on the lagoon, and over the insular slope. From July 2004 to June 2006, a total amount of 875 hours were spent actively searching marine mammals around Mayotte (133 days). Effort varied according to months, with a stronger effort during the austral summer (both years). For each sighting, the species, group size (maximum, minimum, best estimate), geographic position and primary behaviour activity were recorded. When bottlenose dolphins were encountered, the following information was collected: group size, geographic position, activity (travelling, resting, foraging/feeding, socialising, milling, play), group classification on the basis of relative size of individuals (adults, sub-adults, calves), research boat disturbance (bowride, approach, avoidance, no response) as well as group formation (tight, loose, dispersed, variable, convergent) (Shane, 1990; Würsig *et al*., 1998).

During each sighting, attempts were made to photograph all individuals present in the group. Colour photographs were taken with a digital 35mm camera equipped with 100-300mm lenses. All pictures were analysed regarding photographic quality, and only good quality pictures were considered in the analyses (good focus and perpendicular to the photographer).

Diagnosis

All good quality pictures of bottlenose dolphins taken during the surveys were analyzed and every photograph with individuals presenting skin lesions was extracted. Two types of lesions were defined: 1- lobomycosis-like skin lesions; 2- other skin lesions. The diagnostic of lobomycosis-like disease followed Caldwell *et al*. (1975), Simões-Lopes *et al*. (1983), Reif *et al.* (2006) and Van Bressem *et al*. (2007), i.e. multiple, firm, whitish to slightly pink nodules often in pronounced relief, that may ulcerate on the dorsal and pectoral fins, head, flanks, belly, back, flukes and caudal peduncle.

RESULTS

T. aduncus encounters and photo-identification

From July 2004 to June 2006, 65 encounters with Indo-Pacific bottlenose dolphins were made. Group composition was variable: mixed groups (adults, sub-adults and calves, 31%) and groups formed by mother-calf pairs (19%), sub-adults (6%), adults (31%) and adults with sub-adults (13%). *T. aduncus* was the second commonest species in the waters around Mayotte (15.9% of all cetacean encounters). Thirty-five photo-

identification sessions were undertaken (54% of encounters) and 42 adult individuals were identified. The level of markings among individuals was highly variable and 66% of the individuals were considered sufficiently marked for PI purposes. The discovery curve (Figure 3) shows the rate at which new individual dolphins were identified. A significant increase of PI was observed in mid 2005 (25th session), where many new individuals were identified during the winter. Sixty-four percent of individual dolphins identified were recaptured at least twice (Figure 4).

Prevalence and individual characteristics

Of the 42 individual adult bottlenose dolphins photo-identified around Mayotte from July 2004 to June 2006, nine showed skin lesions of varying extent. Both sexes were affected. In addition, the calf of one of these individuals also showed skin lesions. Of these, 6 had LLD including the mother-calf pair (Figure 6). The prevalence of LLD is 14%. The disease has been first seen when the surveys started. A single individual showed no apparent signs of skin lesions in 2004 and 2005, but was seen with emerging lesions around the blowhole in early 2006.

The lesions in the other three dolphins consisted in 1- a large, semi-circular, white scar that may be the remain of a shark bite; 2- several healing wounds and scars on the right side and dorsal fin, some of which were apparently infected and were reminiscent of whitish velvety lesions (Flach *et al*., 2008) and 3- skin lumps that may be the beginning of LLD or another mycotic disease (Van Bressem *et al*., 2008b; Shirakihara *et al*., 2008) on the back.

Extent and body distribution of skin lesions

The extent of LLD was highly variable. In one adult male the skin sores covered around 70% of the body. This proportion was less than 5% in one case in another, apparently newly infected individual of unknown sex. The lesions in the calf also covered a large proportion of the body (>50%). Lesions were distributed near the blowhole, in the peduncle region, the flanks, and dorsal fin.

DISCUSSION

Photographic evidence indicates that LLD is circulating among *T. aduncus* from the lagoon of Mayotte. Histological investigations should be carried out to confirm the presence of lobomycosis in this species when possible. This is the first documented case of LLD in *T. aduncus* from the Indian Ocean.

Prevalence of the disease is relatively high (14%) and comparable with prevalence levels seen in *T. truncatus* from the Indian River Lagoon, Florida, and from the Tramandai and Mampituba Estuaries in Southern Brazil (Reif *et al*., 2006; Van Bressem *et al*., 2007; Moreno *et al*., 2008; Siciliano *et al*., 2008).

The presence of lobomycosis, especially in humans, has never been reported in the southwest Indian Ocean and the origin of the disease in *T. aduncus* from the Mayotte Lagoon is unknown. There is a fast-growing urbanization and increasing cultures on the island and freshwater runoffs are released untreated all around the island. Besides, in the northeast of the island, the harbor has also been developing fast and could have modified the biological and chemical composition of the adjacent marine environment. The emergence of lobomycosis, LLD and other mycotic diseases in cetaceans worldwide in the recent years with apparently no previous records in well-studied populations (Van Bressem *et al*., 2007; 2008b; Moreno *et al*., 2008; Siciliano *et al*., 2008; Mouton *et al*., 2008; Shirakihara *et al*., 2008) is worrying and should be further studied. Lobomycosis and LLD may cause mortalities in extensively affected small cetaceans (Simoes-Lopes *et al*., 1993; Reif *et al*., 2006; Van Bressem *et al*., 2007; Bermudz-Villapol *et al*., 2008; Moreno *et al*., 2008) and may have a significant negative impact on small, isolated coastal populations.

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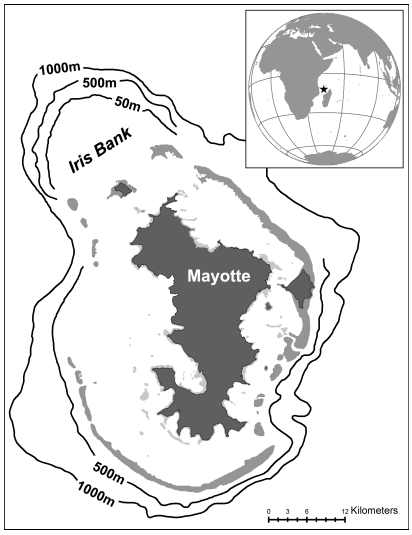

Figure 1: Location of Mayotte, in the northern Mozambique Channel.

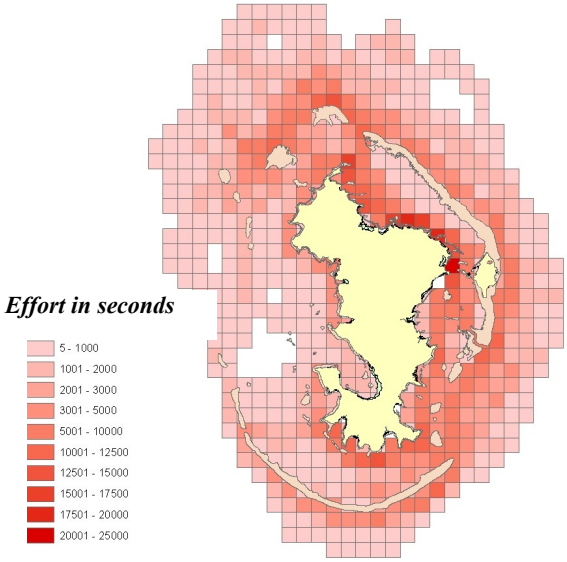

Figure 2: Sighting effort from July 2004 to June 2006.

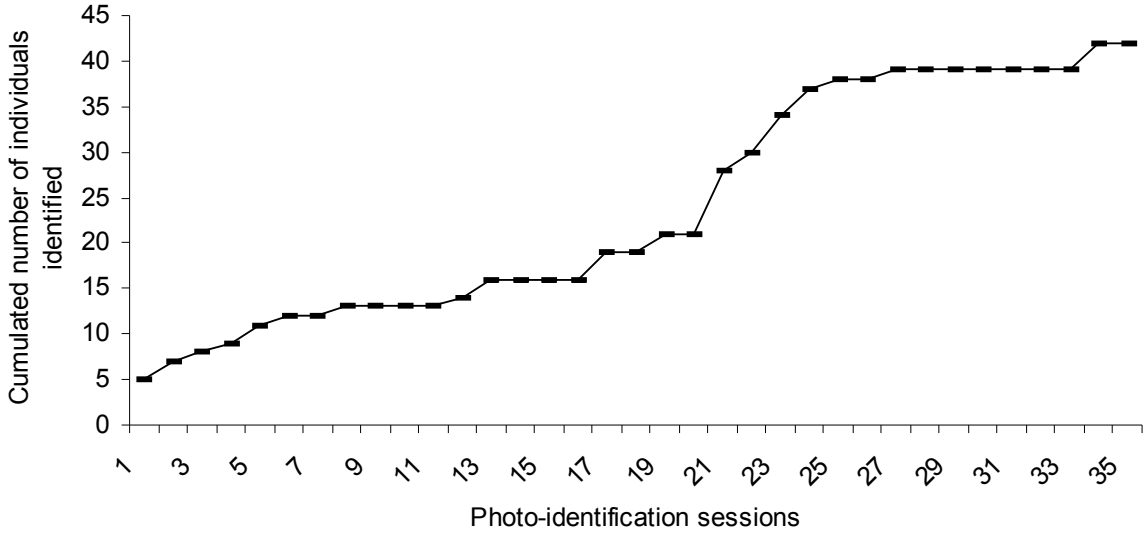

Figure 3: Cumulated curve of adult bottlenose dolphin identifications in the lagoon of Mayotte from July 2004 to June 2006.

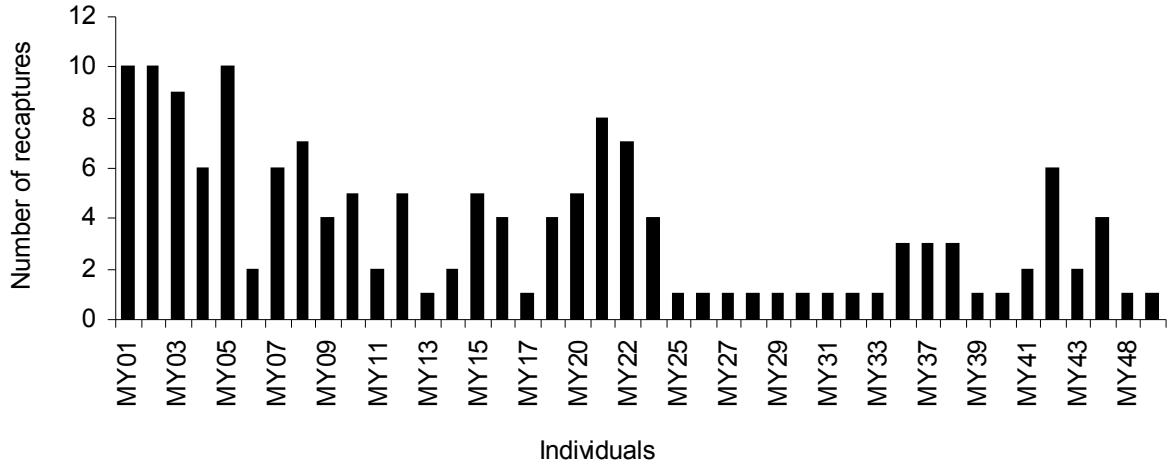

Figure 4: Captures and recaptures of individual bottlenose dolphins from July 2004 to June 2006.

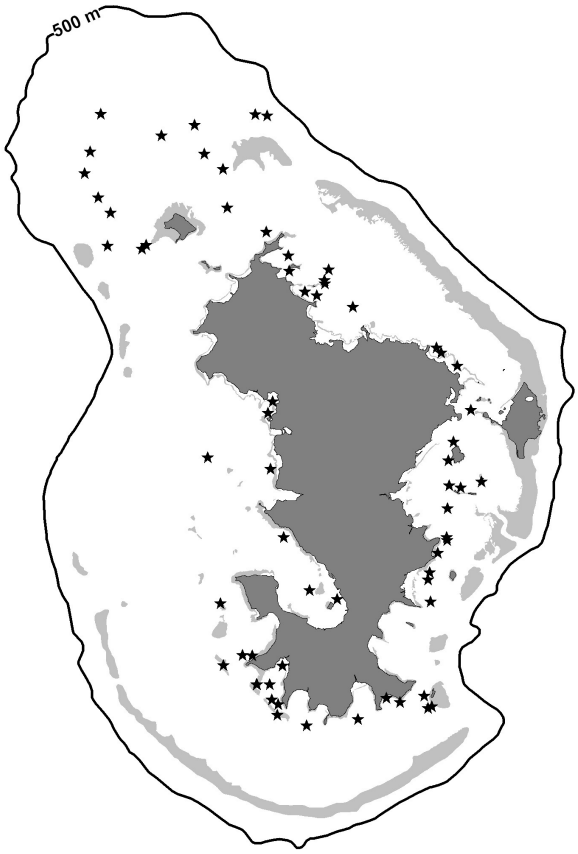

Figure 5: Distribution of Indo-Pacific bottlenose dolphins around Mayotte from July 2004 to June 2006.

Figure 6: Lobomycosis-like disease in Indo-Pacific bottlenose dolphins around Mayotte (Photographs, J. Kiszka & Nils Bertrand).