

## A case of stranded Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) with lobomycosis-like skin lesions in Kinko-wan, Kagoshima, Japan

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**ABSTRACT.** Lobomycosis is a chronic fungal disease caused by the etiologic agent, *Lacazia loboi*, in the skin and subcutaneous tissues in humans and dolphins in tropical and transitional tropical climates. An Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) stranded in Kagoshima, Japan, had severe skin lesions characterized by granulomatous reactions and hyperkeratosis that were similar to those of the lobomycosis, but no fungal organism was observed in the skin lesion. In this paper, we report a stranded Indo-Pacific bottlenose dolphin with lobomycosis-like lesions based on pathological examinations in Japan.

**KEY WORDS:** dolphin, fungal disease, lobomycosis

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Lobomycosis is one of the chronic fungal diseases in the skin and subcutaneous tissues that occurs in humans [20]. It was first described in 1931 in Recife, Brazil, by the dermatologist Jorge Lobo [9, 10]. The etiologic agent, *Lacazia loboi* [5], is a 6- to 12- $\mu$ m yeast-like organism that is found richly within lesions [20] and has never been cultured *in vitro* [5]. Infection results in dermal and subcutaneous granulomas [2]. The disease has also been reported in dolphins, including the bottlenose dolphin (*Tursiops truncatus*) [1, 11, 13], Indo-Pacific bottlenose dolphin (*T. aduncus*) [7] and Guiana dolphins (*Sotalia guianensis*) [23]. The skin lesions in dolphins are characterized by grayish to slightly pink, verrucous lesions, often in pronounced relief, that may ulcerate [20]. The disease was not known in the Pacific region until recently, but two cases were reported in captive bottlenose dolphins (*Tursiops truncatus*) [21]. In Japan, resident populations of Indo-Pacific bottlenose dolphins (*T. aduncus*) have been seen around the Izu and Bonin islands including Mikura Island [6, 8] and Amakusa [19]. In addition, smaller populations have recently also been found in Kagoshima Bay (ca. 50 animals) and Nanao Bay (8 animals) [12]. Recently, a sighting record of possible lobomycosis-like disease was reported in an Indo-Pacific bottlenose dolphin (*T. aduncus*) in Amakusa area [22].

An Indo-pacific bottlenose dolphin was stranded in Kinko-wan, Kagoshima Prefecture, Japan, on 15 May 2013. The animal was a large male with a total body length of 2.7 m and was identified as a member of the Kinko-wan *T. adun-*

*cus* population (Fig. 1). The animal was sent to the National Museum of Nature and Science by refrigerator truck at 4°C and was necropsied about 30 hr after death. After necropsy, organs and tissues were collected, embedded in paraffin, and stained with hematoxylin and eosin (HE), periodic acid-Schiff (PAS) and Grocott stains. PCR analysis was also performed to detect viruses including Pox and Papilloma viruses, the purpose of which was to check for the possibility of viral skin diseases. This is the first pathologically investigated case of a free-ranging dolphin with lobomycosis-like skin lesions from the seas around Japan.

In gross examinations, the animal was found to be moderately emaciated. Heavy serpiginous and coalescing, raised, ulcerated to papillary nodules were observed in the skin from the top of the melon to the blowhole (Fig. 2), on both flippers (Fig. 3) and extending ventrally to the anal-genital region. Other gross lesions included severe suppurative bronchopneumonia with a large amount of pus in the right lobe (Fig. 4) and systemic lymphadenopathy including the cervical, pulmonary marginal and rectal lymph nodes. The rest of the organs showed no significant changes. Histopathologically, various degrees of hyperkeratosis were observed in all skin sections (Fig. 5a). Multifocal dermal and subcutaneous granulomas composed of macrophages, lymphocytes and a small number of plasma cells were also present in skin sections (Fig. 5b). No fungal organism was detected in the skin samples from the affected regions stained with the HE, PAS and Grocott stains. The lung demonstrated severe suppurative bronchopneumonia consisting of marked neutrophil, macrophage and lymphocyte infiltrations surrounding the necrotic parenchyma, with many lumps of bacteria. *Enterobacter cloacae*, *Klebsiella pneumoniae* and *Aeromonas hydrophila* were identified in the right lobe by bacteriological cultures. The animal presumably died due to suppurative bronchopneumonia. The result of the PCR analysis for viral skin diseases was negative.

Lobomycosis was originally reported in humans in tropi-

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Fig. 1. Left side of Indo-Pacific bottlenose dolphin. Male and 270 cm in body length.



Fig. 2. The skin includes numerous serpiginous and coalescing, raised, ulcerated to papillary nodules on the top of the melon to the blowhole.

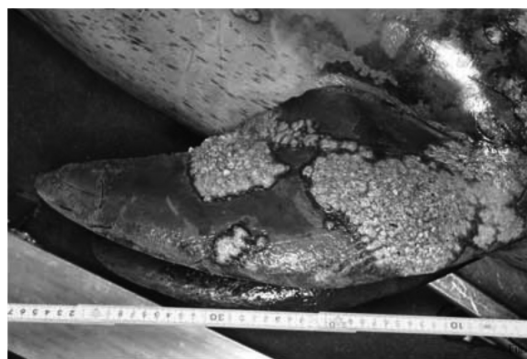


Fig. 3. External appearance of the flipper is the same as that of the blowhole.

cal climates [5, 10]. The fungi were 6- to 12- $\mu\text{m}$  yeast-like bodies connected in chains by small tubules [2]. Infections have been also reported in dolphins in transitional tropical [1, 4, 13] and tropical climates [23]. Kagoshima Prefecture has a belonging to transitional tropical climates according to GOES-R (<http://www.goes-r.gov/>). Although the fungal organism was not found in any skin sections stained with the HE, PAS and Grocott stains in the present case, the external and histopathological findings of the skin lesions made us suspect that this was a case of lobomycosis. Because no fungal organism was confirmed in the skin lesions, it might be appropriate to diagnose the present case as a case of lobomycosis-like skin lesions. Many of the cases reported as “lobomycosis-like disease” [1, 7, 23] were reported with no pathological examinations or no proof of fungal bodies and only external observations of the skin lesions. On the other hand, in the cases in which the fungal organism was identified in the skin lesions, it was appropriate to diagnose lobomycosis in the dolphins [2–5, 11, 13–18, 20]. As the present case does not match any descriptions in previous reports of “lobomycosis” or “lobomycosis-like diseases”, it was considered to necessary to document it sufficiently as an exceptional case of lobomycosis subjected to pathological examinations in free-ranging dolphins of Japan. Bermudez, *et al.* [1] mentioned that whether the poor health status of an animal favored wide dissemination of “lobomycosis-like



Fig. 4. Severe bronchopneumonia with a large amount of the pus in right lobe.

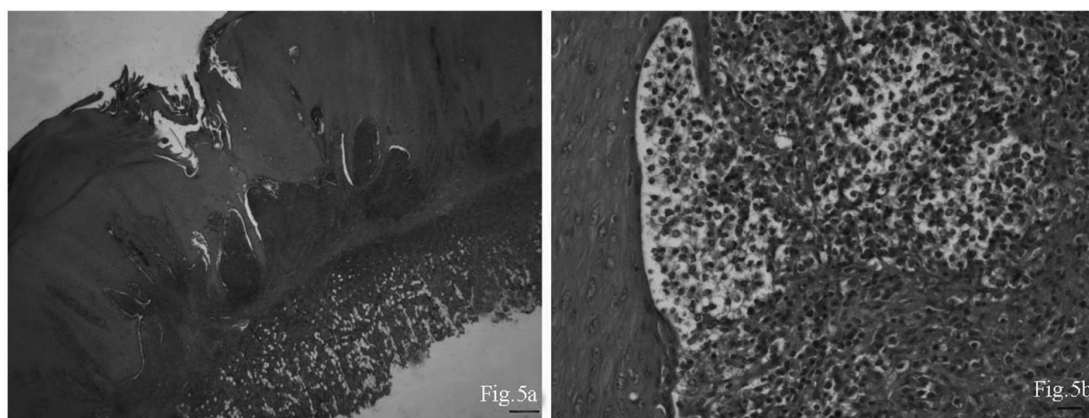


Fig. 5. a: Hyperkeratosis in the skin. Bar is 500  $\mu\text{m}$ . b: Dermal and subcutaneous granulomas composed of numerous phagocytic cells, lymphocytes and plasma cells were present. Bar is 20  $\mu\text{m}$ .

disease” or whether “lobomycosis-like disease” was the primary undermining factor remains unknown. Spread by the lymphatic system has been reported [14], and hematogenous spread and contiguous spread have not been excluded as causes of propagation [18]. In addition, a decreased lymphatic population, which indicates decreased immune function, has been observed in animals with lobomycosis from the Indian River Lagoon compared with noninfected cohorts in capture and release studies [17]. Two dolphins with lobomycosis from North Carolina [18] showed *Toxoplasmosis*-like protozoal infection. The authors suggested that the presence of the fungi predisposes animals to infectious processes and lowers immunity. Severe suppurative pneumonia was also found as the cause of death in the present case. It may be possible to better understand this process through long-term capture and release studies in areas where the fungal disease is endemic and where data may be available from animals before and after infection. If the number of infected animals increases in the Kinko-wan *T. aduncus* population, data from these animals should be accumulated and compared with data from other areas to understand the prevalence and potential sources of infection. Many aspects of the transmission and pathogenesis of lobomycosis have not been clarified sufficiently in lobomycosis in dolphins. Transmission of lobomycosis among dolphins might occur by contact in bottlenose dolphins and possibly from the mother to calf in Indo-Pacific bottlenose dolphins [8, 23]. The disease signs and pathological changes are similar in humans and dolphins [1]. In humans, lobomycosis is associated with an apparent partial deficit of cell-mediated immunity and no alterations of humoral immunity [15]. In dolphins, the disease is related to a substantial decrease in CD4+ helper T lymphocytes and CD19+ and CD21+ B cells [13]. The skin lesions are similar in humans and cetaceans, although they tend to be more serious in cetaceans [1]. They occur predominantly on the most exposed and colder areas [13, 16], that is, the head, back, dorsal fin, flukes and tail peduncle in dolphins; and upper and lower limbs, outer ears and face in humans. Future research should consider whether this disease is related to

increased bioaccumulation of contaminants and whether environmental changes, such as global warming or red tide, enhance the emergence of diseases including lobomycosis. These things may also represent potential threats to human health.

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