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The Survival of a Flukeless Juvenile Dolphin (*Tursiops aduncus*) in the Wild

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Marine mammals are subject to external injuries from natural and anthropogenic sources. Among the leading causes of severe external injuries are vessel collision and fishing gear entanglement (Byard et al., 2012; Dwyer et al., 2014). Some individuals show remarkable recovery from these severe external injuries through rapid healing and behavioral adjustment (Elwen & Leeney, 2010; Maze-Foley & Garrison, 2020). External injuries caused by fishing gear (e.g., ghost nets and lines) can be critical as they may cause whole body entanglement or amputation of important body parts such as the dorsal fin, pectoral fins, and fluke (Nery et al., 2008). Partial mutilation of body parts or total amputation of the dorsal fin is rarely fatal for wild individuals (Wells et al., 2008). In contrast, complete amputation of the fluke is considered life-threatening and would require intervention for survival. Herein, we report on the survival of a wild, young Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) with a complete fluke amputation and discuss the implications for long-term injury adjustment as well as conservation concerns.

Surrounding Jeju Island, Republic of Korea, there is a small but relatively stable population of Indo-Pacific bottlenose dolphins, with ~100 individuals observed in the island's coastal area (< 2 km), their home range (Choi et al., 2009; Kim et al., 2015). On 19 June 2019, tourists on a dolphin-watching yacht in the Kimnyeong District, northeast of Jeju Island (Figure 1), witnessed a young dolphin without a tail. A passenger recorded a 3-s video showing the dolphin bow-riding a yacht, but identity was not confirmed via the dorsal fin or other natural marks (Jang & Kim, 2019). Eyewitnesses saw the flukeless dolphin once but saw no other individual or group of dolphins in visible proximity to this dolphin throughout the day. We searched for this flukeless dolphin from land in the Kimnyeong District for two consecutive days (20 & 21 June 2019) without success.

Other studies have highlighted the importance of the carangiform locomotion in allowing dolphins to swim with a semi-lunate tail (Fish & Hui, 1991; Li et al., 2018). Two cases of dolphins without tails at aquariums have reported decreased swim speed and efficiency as the individuals adjusted their movement from an up-down to a side-to-side motion (Ueda et al., 2013; Clearwater Marine Aquarium, 2021). Therefore, survival of this young dolphin observed near Jeju Island was not ascertainable on first sighting. However, the same flukeless dolphin was observed again about 4 months later on 8 October 2019 near the Daejeong District. It would seem that this individual traveled at least 80 km along the shoreline from where it was first observed (Figure 1).

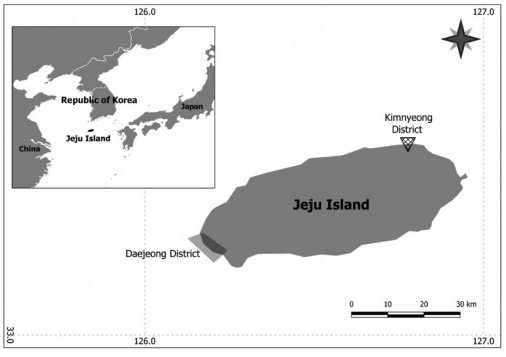

Figure 1. Map of Jeju Island showing the Kimnyeong District where the flukeless individual was first discovered (marked with a grey triangle) and the Daejeong District, which was the main study area (marked with a grey rectangle)

This individual's overall health was monitored from 8 to 11 October from a small boat (6 m, 115 hp rubber boat) and from land. Land monitoring with the naked eye or binoculars consisted of photographic surveys (Nikon D850, with Nikkor 200-500 mm), unmanned aerial vehicle surveys (Mavic Pro; DJI), and video surveys (Canon EOS-1DX Mark II). A boat survey consists of a photographic survey, an underwater video survey (GoPro4), and acoustic recording (TASCAM HD-P2, Hydrophone AQH-200, Aquafeller IV [AQA-004], Aqua-Sound). Although there are no boat regulations for dolphin watching or research in the Republic of Korea, the boat maintained a slow speed (< 5 kts) and remained at least 50 m away from the dolphin. The flukeless dolphin's close activity was recorded while the boat remained idle. The underwater video provided crucial data about how this dolphin swam and allowed for a detailed examination of the individual's injury, sex, and approximate age class. The cut shape suggests that the amputation was most likely caused gradually by entanglement in fishing lines or nets, which rules out sharp objects like blades or boat screws as a potential cause (Figure 2A & B). The amputation may have occurred by infection or natural causes; however, there was no preceding observation of severe infection in the skin layer of dolphins in this population that could cause amputation. Therefore, the injury was most likely caused by fishing gear, though a definitive cause is not possible to determine.

This flukeless individual was categorized as a juvenile male based on the lack of speckles on the belly (Figure 2; Krzyszczyk & Mann, 2012; Yagi et al., 2021). We analyzed the whistles recorded when the individual was alone to obtain its dominant whistle (Figure 2C). The dorsal fin was also photographed for future reidentification, The individual was cataloged as JTA137 in the *2019 MARC Fin Book*, which was created by the Marine Animal Research and Conservation organization (Figure 2D). During the four continuous days of close monitoring, this dolphin did not seem emaciated, with the collective evidence supporting this individual's ability to survive in the wild. Thus, it was believed that he was not in urgent need of rescue.

We analyzed this dolphin's swim sequences from underwater videos. Similar to previously reported swimming patterns of fluke-amputated dolphins in an aquarium (Ueda et al., 2013; Clearwater Marine Aquarium, 2021), he moved his peduncle left and right while moving dorsoventrally. When observed from the posterior, the peduncle's tip moved as if it was tracing an infinity symbol by twisting the peduncle upward while moving it to the other side (Figure 3; Supplemental Video: 00:20 to 00:24; the supplementary materials for this paper are available in the "Supplemental Material" section of the *Aquatic Mammals* website: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147). Respirations were identified from drone footage: the dolphin surfaced in the horizontal plane then twisted his body to the right using his pectoral fins to dive back into the water. This caused a splash near the peduncle every time he took a breath—behavior which could be seen with the naked eye from land (Supplemental Video: 00:00 to 00:19).

The well-developed shoreline roads allow land monitoring of continuously moving dolphin groups around the island. Since 2014, we have conducted observations of surface behavior and movements via visual survey with the naked eye and with binoculars while constantly conducting focal group follows of dolphins from an automobile. The 2019 field research period consisted of monitoring 9.36 km of shoreline (< 2 km out from land) in the Daejeong District, which is the core habitat of this population (Kim et al., 2015; Jang et al., 2019). There are 18 inland aquacultures along this shoreline with direct pipelines to the sea that regularly discard waste, including unmarketable fish. We monitored this area over 10 days between 11 October and 26 November 2019 and observed the flukeless dolphin nine times (Table S1). This dolphin was mainly traveling but was once seen feeding on a farmed halibut in an aquaculture area (33° 15' 09.3" N, 126° 11' 36.8" E). This specific area is commonly used by the other dolphins to scavenge on discarded prey items from aquacultures, and it may have provided the flukeless dolphin with more accessible prey items. Such prey availability might have been a crucial element of survival for this flukeless individual.

Our 2020 field season started on 5 May with no observations conducted during the winter (December 2019 to April 2020). Still, the flukeless dolphin was observed in the area within a group on 13 May. Throughout the field season (through 10 November), this dolphin was not frequently observed in the Daejeong District as compared with the previous year (6 out of 16 d in 2020). However, when he was observed in the district, this dolphin was swimming more skillfully; the splash made by the peduncle during respirations had decreased when returning to the water (Supplemental Video: 00:25 to 00:32). In 2020, this individual was always within a group that exhibited foraging, traveling, and socializing behaviors while matching the group's speed, indicating that he had adjusted to life without a tail. During the summer months of 2020, two strong typhoons (Bavi at 155 km/h [950 hPa] and Maysak at 175 km/h [935 hPa]) passed over Jeju Island, which caused concern that the individual would not survive due to his

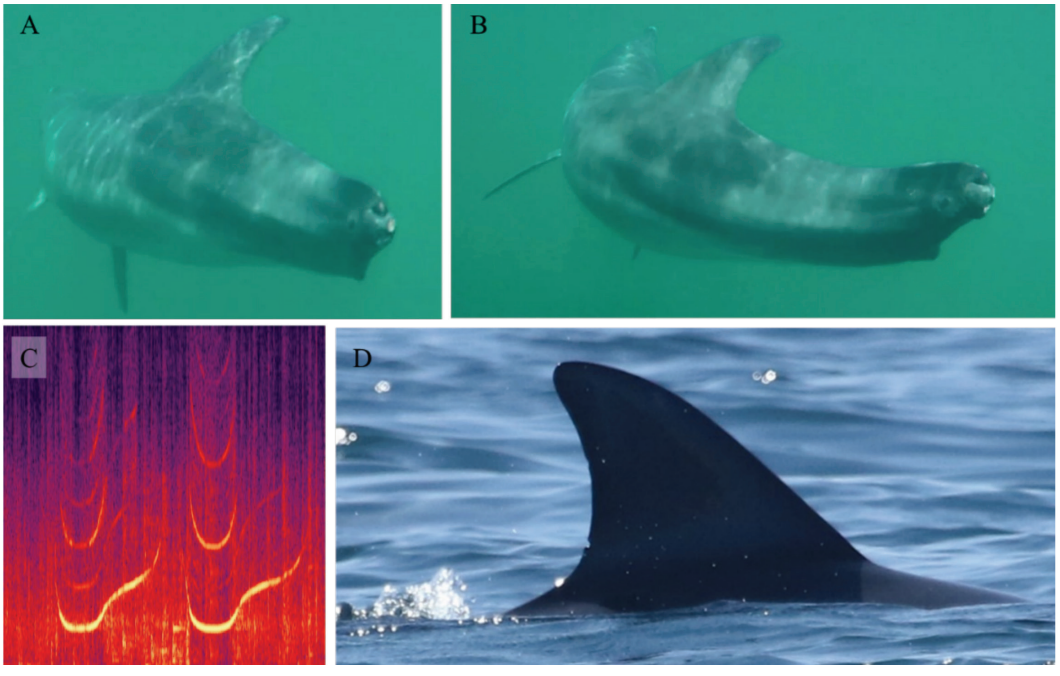

Figure 2. Images of the flukeless individual and his individual identification markers: (A) cut section, (B) left side view of the cut, (C) dominant whistle, and (D) dorsal fin (right side)

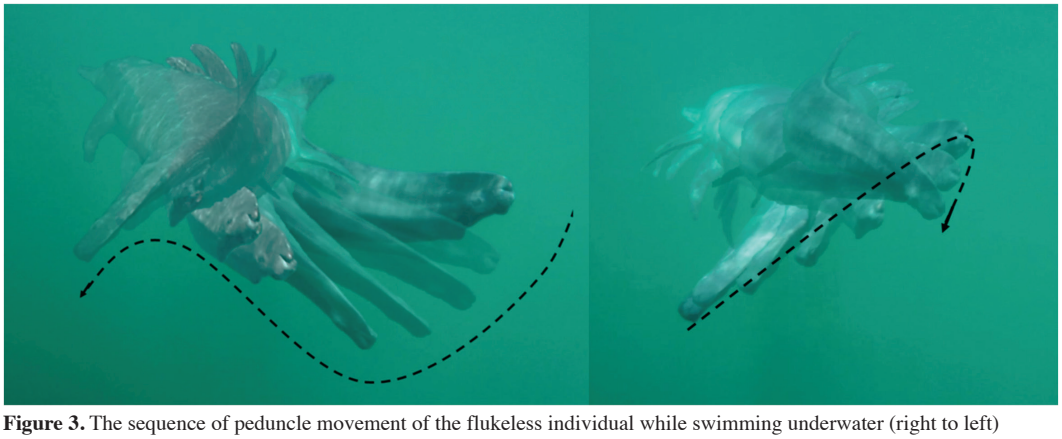

Figure 3. The sequence of peduncle movement of the flukeless individual while swimming underwater (right to left)

disability. However, he was recorded on surveys conducted after each typhoon.

When we observed his general body condition from all of the drone observations in 2019, the morphological measures, including body length, did not seem to have noticeably changed. There was no extra muscle growth or abnormality in the peduncle area. He conceivably invested most of his energy in surviving rather than growing or maturing. The assumption is that the individual consumed a similar amount of prey items to others of similar age in the group. He used most of his energy to sustain vitality while using an inefficient swimming style. If this situation continues, the lack of nutrition needed to grow during early life could decrease this dolphin's overall health.

This report reflects the importance of long-term monitoring for an accurate understanding of severe injury and the extent that unassisted recovery is possible. Since the first observation, this flukeless dolphin has been observed for 34 months in the wild. He survived, steadily regaining swimming ability and

interacting with other individuals. In the encounter by a documentary team in 2022, this dolphin participated in a four-individual group social-sexual behavior, swam among a group matching their speed, and leaped out of the water (Supplemental Video: 00:45 to 01:18). In addition, the individual foraged on a small group of sardines and, on a separate occasion, fed on a broken-up fish (Supplemental Video: 01:18 to 01:34), demonstrating remarkable rehabilitation success. This is the first report on the survival of a dolphin with a complete tail amputation in the wild. Furthermore, the remarkable unassisted survival of this flukeless dolphin in the wild has implications for conscientious decisions concerning potential anthropogenic interventions towards severely injured Indo-Pacific bottlenose dolphins.

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