



## An Updated Systematic Review: The Distribution Dolphin Spinner (*Stenella Longirostris*) In Indian Ocean

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### ABSTRACT

This study was conducted with the aim of summarizing papers related to the distribution of the Dolphin Spinner (*Stenella longirostris*) in the Indian Ocean waters that had been discovered previously. The focus of the papers is to examine the distribution of *S. longirostris* with survey method data collection techniques. The existence of *S. longirostris* in the Indian Ocean waters is characterized by low levels of predation. The appearance of *S. longirostris* in Indian Ocean waters is located around the shore which is rich food sources at a depth of 0 - 250m. The data obtained shows in which years the distribution points in the Indian Ocean. The results obtained indicate that *S. longirostris* appears in the Indian Ocean almost every year.

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### 1. INTRODUCTION

The Indian Ocean is a body of water with an area of about 70,560,000 km<sup>2</sup> and covers 20% of the world's territorial waters (Sari et al., 2020). The western part of the Indian Ocean is directly contiguous to the African continent, the East with the Australian continent, the north with some Asian countries, and the southern part which is adjacent to Antarctica. Several countries directly border with the Indian Ocean waters, such as Indonesia, Australia, Yemen, Tanzania, Kenya, Mozambique, Saudi Arabia, Mauritius, Madagascar, Reunion, Egypt, Sudan, Comoros, Mayotte, Bahrain, and Qatar. The territorial waters that are also part of the Indian Ocean include the Java Sea, the Savu Sea, the Strait of Malacca, the Timor Sea, the Bay of Bengal, The Great Australian Bay, the Gulf of Aden, the Mozambique Channel, the Gulf of Oman, the Andaman Sea, the Red Sea, and the Persian Gulf. The waters of the Indian Ocean have a high diversity of coral reefs, mangroves, and crustaceans. So, there are many different marine species that inhabit these waters (Maulana Awangga, 2019).

The Indian Ocean is one of the areas where many marine mammals are found, one of which is *Stenella longirostris*. The existence of *S. longirostris* almost detected in all water areas of the Indian Ocean. *S. longirostris* actively travels in which wandering from one place to another to find food or just exploring in a water. This activity is easily observed because this traveling activity is characterized by the appearance of some or all parts of the body of *S. longirostris* at sea level. (Rossi-Santos et al., 2008) This makes the existence of

*S. longirostris* is easy to find without having to dive or use certain detection devices (Rotstein et al., 2010; Tyne et al., 2016)

*S. longirostris* is one of the marine mammals with a high level of abundance in the world. Despite its high abundance, this species is categorized in “The IUCN Red List of Threatened Species”, because it is often hunted for its dorsal fin and snagged by the fisher nets. *S. longirostris* or by another name as Spinner dolphin or Hawaiian Spinner Dolphins, including mammals that can almost be found throughout the subtropical tropical region both coastal and offshore (Gruden et al., 2016; Lammers & Au, 2003). *S. longirostris* is found in deep and shallow waters both in pelagic or offshore areas (McElligott & Lammers, 2021). The purpose of this study is to determine the distribution of *S. longirostris* in the Indian Ocean water by collecting the papers using survey methods from 2000-2021.

## 2. RESEARCH METHOD

This study used qualitative research type. Data collection technique used secondary data obtained from various sources of research journals, books, and media information.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Distribution of *S. Longirostris*

#### a. Tanzania

Distribution and some cetacean surveys, include *S. longirostris*, has been recorded in the coastal waters of Zanzibar (Unguja and Pemba Islands) as well as Tanzania. On the research by Braulik et al., (2017), *S. longirostris* was found at a depth of about 457m (71-1100m) with the highest encounter rate compared to the other 10 species, which was 17 times. It is known that coral reefs in Tanzanian waters are located along the Tanzanian continent of 600 km long with a width of 8-10 km. In Zanzibar, Pemba and Mafia islands are mostly surrounded by fringing reefs (Wagner, 2004). On the western side of Unguja, between Ras Nungwi and Menai Bay, there are a number of reef patches and reef-fringed islands (Maulana Awangga, 2019). Zanzibar is estimated with 1100 km of coral reefs, representing about 45% of Tanzania's coral reefs (Maulana Awangga, 2019). Coral reefs become a gathering place for diverse animals, such as fish, shrimp, and molluscs (Olii et al., 2014). The existence of coral reefs as a home for reef fish, crustaceans, and other creatures that are the food of *S. longirostris*. This situation makes coral reefs an indicator of the existence of *S. longirostris* (Tyne et al., 2016).

#### b. Kenya.

In 2011, the existence of *S. longirostris* in Kenya coast was recorded at 25 out of a total of 301 sightings and *S. longirostris* was the 4th most commonly seen on the Kenya coast. On the territory of the Kenya, the locations are found in Kwale, Malindi, Kilifi, Mombasa, Lamu, and, Tana River. According to research between 2011-2019, there were 32 total occurrences. *S. longirostris* found in the offshore area. Coral reefs in Kenya waters can be found in almost all coastal areas of Kenya. Thus coral reefs stretches from the North to South and are not so evenly distributed in northern waters. There are over 250 coral reefs types found in Kenya waters. The highest diversity is found in the southern regions of Shimoni and Kisite. Coral reefs can be found in the 1-20 m (at low tide) (Teucher et al., 2020).

#### c. Mozambique

Comoros island is located at the northern end of the Mozambique Strait, between Madagascar and Mozambique. The Comoros officially consists of 4 islands, namely Mayotte, Great Comoros, Anjouan, and Moheli. *S. longirostris* is found around the Mayotte waters which is more precisely on the north side of the Mozambique Canal (Stephenson et al., 2021). *S. longirostris* inhabits the Mayotte waters in open offshore areas at depths greater than 100m. Not many published data related to the distribution of marine

mammals, including *S.longirostris* in Mozambique, there is still a lack of information related to the distribution, population, and other information. Besides, *S.longirostris* has also been noted to appear frequently in the inshore waters of Juan de Nova and Glorieuses (Gobush et al., 2021).

d. La reunion

Reunion is an island in the Indian Ocean, exactly located east of Madagascar and 200 km southwest of Mauritius. In 2008, recorded *S.longirostris* was a common species found in the coastal waters of La Reunion. *S.longirostris* discovery in La Reunion island is supported of previous research by Estrade, (2017), which found the position *S.longirostris* the S 21O 3" 37 " and E 55O 11'53", which is 2.5 km from the West Coast of Reunion at a depth of 60m.

e. Madagascar

*S.longirostris* is a marine mammal that is sometimes seen far from the coast around Madagascar. Razafindrakoto et al., (2004) in Braulik, (2018) stated that *S.longirostris* often found in Madagascar. *S.longirostris* is also found around the Mauritius island which is located in the south western Indian Ocean, approximately 900km east of Madagascar. Corbett (1994) in Webster (2020) pointed out that *S.longirostris* was found near the coast and most common among other marine mammals (51.3%). Recorded from 2008-2014, the total of *S.longirostris* was 743 individuals. This shows that the activity to the sea surface was often done by *S.longirostris* in the Mauritius waters.

f. Indonesia

Distribution of *S.longirostris* in Indonesia is quite a lot because *S.longirostris* almost encountered in all Indonesian waters, such as: for the first time found Rudolph et al., (1997) in Lamera, Lembata Island in 1993. Then, around Komodo Island (Lammers et al., 2001) located in the Pantar Strait between Kepa Island and Sawu waters Pantar Island (Mustika, 2006); (Dharmadi et al., 2010; Rante et al., 2021), Lovina Beach Buleleng Bali (Kamal, 2014); Raja Ampat waters (Kahn, 2007; Borsa and Nugroho, 2010). Then, in the waters of Kiluan Bay Lampung (Siahainenia and Isnaniah, 2010; Sijatmiko and Putri, 2015; Hibatullah et al., 2021); Savu sea National Marine park (Mujiyanto, et al., 2017), Pieh Island Prairan tourist area (LKKPN, 2016); Sambas waters of West Kalimantan (Punomo, 2015). Indonesia is an archipelago with the name of the heart of the world's Coral Triangle (Handayani, 2016), with 5,8 million square kilometers of water in the Coral Triangle. So, almost 31 types of cetaceans are found in Indonesia (Coral Triangle Initiative, 2009). *S.longirostris* in the waters of Raja Ampat are found between the islands of Batanta, Salawati, and Misool. However, it is also found several groups of this species around the island of Waigeo (Ender et al., 2014). As well as some found around the Fam Island and its surrounding (Kahn, 2007).

g. Australia

*S.longirostris* includes species that are often found in Australia, especially visiting the zone near the coast. In Australia, *S.longirostris* is between extending north from Bunburry in Southern Western Australia around Australia to northern New South Wales (DEWHA 2008 in RPS Woodside, 2012). *S.longirostris* is classified as protected and priority to manage in Australia, especially in the western Kimberley region (Browse Basin waters), Pilbara, around James price Point (in 2009 found about 26 groups consisting of 189 individuals) and many also found the southern region (RPS Woodside, 2012). In the Australian coral reef area, there are about 100 individual dolphins. Australian waters affected by currents Leeuwin (Western Australia) create the movement of food sources that affect the *S.longirostris* movement in daily swimming. Not only that, these currents also affect the habitat of *S.longirostris*. Flow creates a pattern where *S.longirostris* during the day moves to offshore to feed on prey species and towards the surface at night to travel. Population estimates in Australian waters have not known for certain, but *S.longirostris*

can swim in groups and do bowriding about 250. Moreover, *S.longirostris* can even appear in the thousands.

#### h. Papua New Guinea

*S.longirostris* is one of the species identified in the waters west of the Solomon Islands. *S.longirostris* belongs to the dominating Dolphins to be found in the waters of Papua New Guinea (>95%). Habitat of *S.longirostris* for rest in Australian waters is located in the coral lagoon area. According to Kahn (2006), *S.longirostris* will breed stably and live long-term. The area in question includes the Shortlands and surrounding areas of Savo Island. This location is used as a resting place by *S.longirostris*. *S.longirostris* finding around the Fauro islands are also identified in the region of the shortlands Island Group (Kahn, 2006). Research by Kahn (2006) showed that the distribution of *S.longirostris* was found at various points almost throughout the territory of Solomon.

One *S.longirostris* factor inhabits in a water for a long period of time due to the availability of food sources. Types of food sources of cetaceans are of plankton, crustaceans, and reef fish. The waters of the Indian Ocean are rich in coral reefs, which almost half of the 793 species of palactinian corals worldwide are in countries directly adjacent to the Indian Ocean. Countries with the great coral diversity, such as Indonesia (443), Australia (428), and Thailand (238) (Keesing, 2005). As we know, more than 90% of coral reefs along the continental coast of the Indian Ocean are threatened by local or climate-related impacts, and more than a third are believed to be at high or very high risk from local or global threats. This would have considerable negative consequences for species in the ocean that utilize coral reefs in their lifetime (Burke et al., 2011).

The existence of *S.longirostris* is spread around the escarpment with an average depth range of 0-250 m in Figure 2 & Figure 3. Perrin (1998), states that *S.longirostris* eats fish, squid, and mesopelagic shrimp more than 250m a depth. The young *S.longirostris* prefer to dive in depths <50m around the reef and feed on benthic coral organisms (Perrin et al., 2007). Figure 1, shows that the *S.longirostris* distribution from 2000-2021 (differentiated by color). If detailed in Figure 2. and Figure 3, the average distribution of *S.longirostris* is found in almost adjacent locations even the same location. This indicates that the location of *S.longirostris* in a body of water only occupy and explore the territory continuously.

Table 1. Distribution Data of *S.longirostris* in the Indian Ocean

Location	Time	Source
Tanzania (Zanzibar)	Jan & Aug 2003; 1994-2013	O.A Amir <i>et al.</i> , 2005; Kiszka, 2015
Kenya, Union of the Comoros	July 2004-April 2009; 2011-2019	Kiszka <i>et al.</i> , 2011; Mwango'mbe <i>et al.</i> , 2021
Mozambique	July 2004-Aug 2005; July 2004-April 2009; May-October 2013	Kiszka <i>et al.</i> , 2007; Kiszka <i>et al.</i> , 2011; Bonato <i>et al.</i> , 2015
La reunion	March 20, 2016; February 2018 & June 2020	Estrade V, 2017; Martin- Montalvoet al., 2021
Madagascar (Mauritius)	April 2008 & June 2010; April 2008 & Sept 2014	Webster, 2015; Webster et al., 2020

Indonesia	<p><b>(Pantar Strait:</b> May 10-27 &amp; June 22 - 3 July 2010; May 28-29, 2020).</p> <p><b>(Savu Sea:</b> July and December 2005).</p> <p><b>(Lovina, Bali:</b> Nov 2007)</p> <p><b>(Raja Ampat:</b> 15-25 Nov 2007) &amp; (27 Nov-5 Dec 2007: 9-13 January 2006, January 8 and 22, 2006; 4-17 March 2020).</p> <p><b>(Kiluan Bay, lampung:</b> Nov 2007 &amp; May 2018)</p> <p><b>(The Savu Sea:</b> July &amp; Dec 2005; Nov 2015 &amp; March-April 2016)</p> <p><b>(Buleleng, Bali:</b> July-Sept 2017) <b>(Pieh Island TWP:</b> 2016-2021)</p>	<p>Wardianto et al., 2010; Maro et al., 2021; Faizah et al., 2006;</p> <p>Salim, 2011; Kamal, 2014; Siahainenia, 2010; Borsa &amp; Nugroho, 2010; Ender et al., 2014; Naturetrek, 2020; Siahainenia &amp; Isnaniah, 2010; Siahinenia &amp; Isnaniah, 2013; Sujatmiko &amp; Putri, 2015; Hibatullah et al., 2021; Dharmadi et al., 2017; Mujiyanto et al., 2017; Purba et al., 2020; Lkkpn Pekanbaru (2020)</p>
Australia	2009-2011	RPS Woodside, 2012
Papua New Guinea	May 10-June 16, 2004	Kahn, 2006

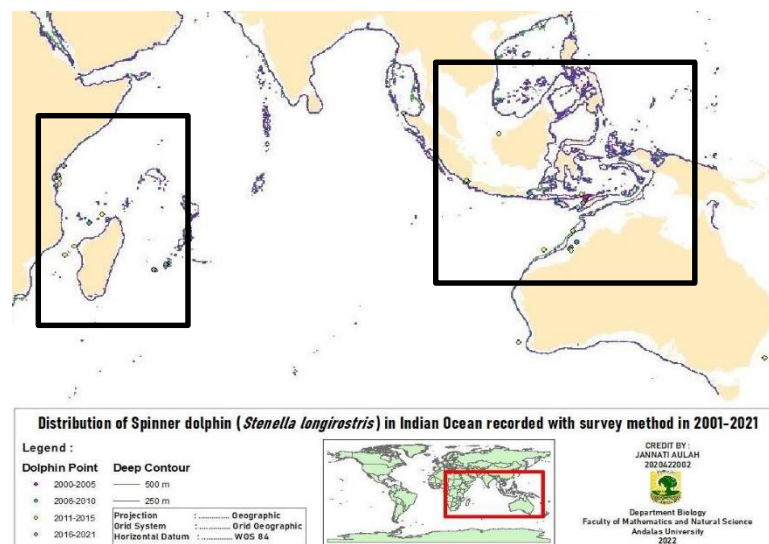


Figure 1. Recorded distribution of *S.longirostris* was found in the waters of the Indian Ocean

Several important factors are believed to be the reason of *S.longirostris* existed from before 2001 until now, one of them is the ability to adapt tolerance to high environmental changes. Figure 1, shows the distribution data of *S.longirostris* recorded by researchers from 2000-2022. Map of Figure 1, shows that the highest distribution data obtained in the range of 2011-2015 is 13 distribution locations (yellow points). Then, continued the range of 2006-2010 is 9 distribution points (blue points), and the lowest distribution data is the range of 2000-2005 (pink points). This situation shows that the scientist began to be interested and keep conducting the latest research to examine *S.longirostris* both in terms of biological aspects and others. 2011- 2015 are 13 distribution locations (yellow points), then continued the range of 2006-2010 are 9 distribution points (blue points), and the lowest distribution data is the range of 2000-2005 (pink points). It shows that the scientist began to be interested and keep conducting the latest research to examine *S.longirostris* both in terms of biological aspects or others.

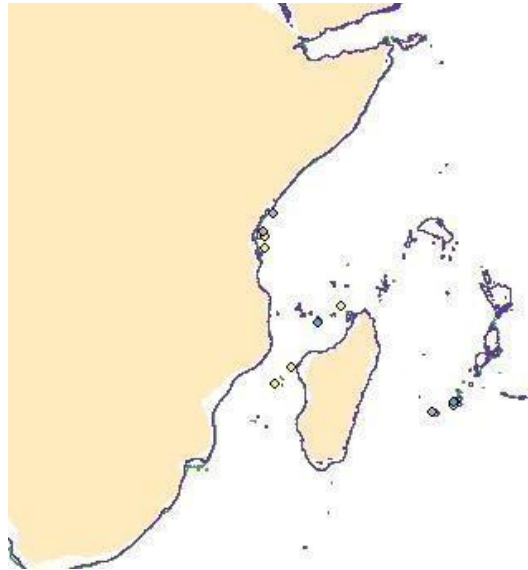


Figure 2. Recorded distribution of *S.longirostris* was found in the eastern part of the Indian Ocean waters.

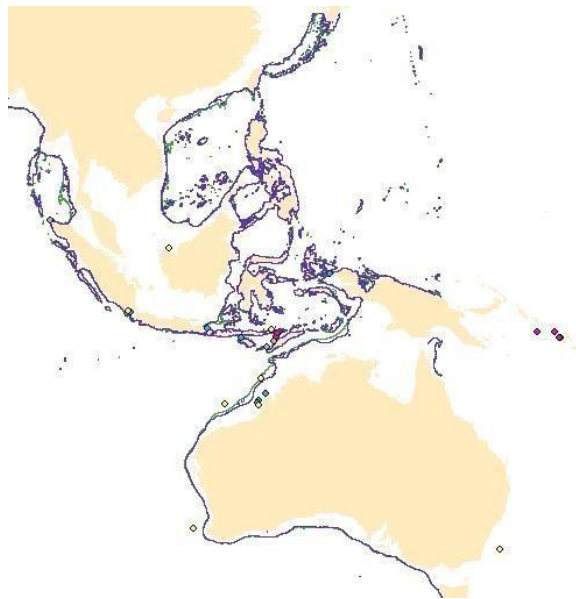


Figure 3. Recorded distribution of *S.longirostris* was found in the western part of the Indian Ocean waters.

The existence of *S.longirostris* is spread around the escarpment with an average depth range of 0-250 m in Figure 2 & Figure 3. Perrin (1998), states that *S.longirostris* eats fish, squid, and mesopelagic shrimp more than 250m a depth. The young *S.longirostris* prefer to dive in depths <50m around the reef and feed on benthic coral organisms (Perrin et al., 2007). Figure 1, shows that the *S.longirostris* distribution from 2000-2021 (differentiated by color). As detailed in Figure 2 and Figure 3., the average distribution of *S.longirostris* is found in almost adjacent locations even in the same location. This indicates that the location of *S.longirostris* in the waters only in the region continuously. Several important factors are believed to be the reason of *S.longirostris* existed from before 2001 until now,

one of them is the ability to adapt tolerance to high environmental changes. Figure 1, shows the distribution data of *S.longirostris* recorded by researchers from 2000-2022.

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*S.longirostris* is mostly found in deep offshore waters (Figure 2. and Figure 3.). Although they can be observed around oceanic islands or other coastlines where there is deep water near the coast (Perrin, 1998). Another reason why *S.longirostris* always stay in migratory areas is due to oceanographic conditions (Mujjiano et al., 2017). *S.longirostris* is affected by its environmental conditions (Astuti, 2012), including its oceanographic parameters, such as ocean salinity (Selzer and Payne, 1988; Forney, 2002 in Hastie et al., 2005 in Ali, 2006); depths of the sea (Ross et al., 1987 in Ali 2006 in Astuti 2012); temperature at sea level (Selzer and Payne 1998 in Ali 2006 in Astuti 2012) and tides (Jong Huat 2003 in www.o-fish.com 2010 in Wahyudi 2010).

Dharmadi et al., (2017) states that if the availability of food resources and oceanographic parameters; salinity, temperature, current velocity (Andersen 1696 in wahyudi 2010), and ocean tides are favorable in an area, dolphin migration will be affected and they will most likely move and stay in that area. *S.longirostris* Australian waters does not make migrations, but warm temperatures affect daily movements. In 1998, Carwardine et al. stated that the season also affects the cetaceans spreading. A latitudinal region will have a longer summer than another. In addition, when the ice sheet melts, it will bring a bunch of phytoplankton. After that, phytoplankton will be eaten by krill, copepods, zooplankton, and finally also eaten by fish, squid, and cetaceans (Mashar et al., 2019; Solihin, 2015).

#### 4. CONCLUSION

Numerous scientific studies have pointed out that *S.longirostris* spread almost all over the waters of the Indian Ocean at a depth of 1-250 m in the escarpment area. The survey method is a method that is still efficiently used to see the *S.longirostris* distribution from the high seas. Besides, it should also be noted that there are shortcomings in research using survey methods, such as the duration of time in the field and the length of the study. Research conducted periodically will provide an overview of the location coordinates of the *S.longirostris* existence and is able to know the homerange *S.longirostris* in the Indian Ocean waters.

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