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Occurrence of Whale Shark in Nigerian Deep Water: Need for Further Survey

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Abstract

Whale shark (*Rhincodon typus*) records were reported incidentally from offshore vessels in Nigerian deep waters in 2013 and 2016. The two records were observed directly by the authors and were identified from photographs. Visual observation showed that the size of the species sighted could be approximately 10 -15 m long. This present work, however, highlighted and confirmed the possible abundance of the whale shark in Nigerian deep water. Reports from the areas of sighting showed the presence and abundance of phytoplankton, zooplankton, and benthic organisms. These could have contributed to the presence and occurrence of this species within the areas where they are sighted. This report, however, confirms the occurrence of the whale shark in Nigerian deep water and the need for a concerted and dedicated survey to properly document the presence of this species in Nigeria and the adjoining countries.

Keywords: Nigeria, Phytoplankton, *Rhincodon typus*, Whale shark, Zooplankton

Nijerya'nın Derin Sularında Balina Köpekbalığı Varlığı: İleri Çalışmalar Yapılması İçin Öncü Bir Araştırma

Özet.

Balina köpekbalığı (Rhincodon typus) kayıtları tesadüfen 2013 ve 2016 yıllarında Nijerya'nın derin sularındaki açık deniz gemilerinden rapor edildi. İki kayıt doğrudan yazarlar tarafından gözlemlendi ve fotoğraflardan teşhis edildi. Görsel gözlem, görülen türlerin boyutunun yaklaşık 10-15 m uzunluğunda olabileceğini gösterdi. Bununla birlikte, bu mevcut çalışma, balina köpekbalığının Nijerya'nın derin sularındaki olası bolluğunu doğruladı. Görülme alanlarından gelen raporlar, fitoplankton, zooplankton ve bentik organizmaların varlığını ve bolluğunu gösterdi. Bu veriler, türün görüldükleri alanlarda bulunmasına ve ortaya çıkmasına katkıda bulunmuş olabilir.

Bununla birlikte bu rapor, Nijerya'nın derin sularında balina köpekbalığının varlığını ve bu türün Nijerya ve komşu ülkelerdeki varlığını doğru bir şekilde belgelemek için uyumlu ve özel bir araştırmaya duyulan ihtiyacı doğrulamaktadır.

Anahtar Kelimeler: Nijerya, Fitoplankton, *Rhincodon* typus, Balina köpekbalığı, Zooplankton

INTRODUCTION

Whale shark (*Rhincodon typus*) is one of the known Shark species which belongs to the family Rhincodontidae. It is characterized by large size, slow growth, late maturation and extended longevity, which probably limit recruitment and make it particularly susceptible to exploitation (Weir, 2010; Colman, 1997a). It is the world's largest fish, and a filter-feeding shark along with the basking shark (*Cetorhinus maximus*), and the Megamouth Shark (*Megachasma pelagios*). The whale shark is easily recognized based on its broad, flattened head, its largemouth, and its pattern of light spots and stripes on a dark background (Last & Stevens 1994). The ventral surface is typically whitish (Norman, 2000). The available records showed that the largest Whale Shark found to date measured 20 meters and weighed 34 tones (Chen *et al*., 1997, in Chen & Phipps, 2002). Despite its immense size, the whale shark is harmless to humans. It has few defenses, although its ability to reach a very large size combined with a tough (thick) skin present on the dorsal surface can be used for protection (Norman, 1999).

R. typus is always sighted as a single individual or as an aggregation of about hundreds where food is abundant (Compagno, 1984; Colman, 1997; Norman, 1999; Compagno, 2001). Other environmental

factors such as sea surface temperature, current and primary productivity can influence the occurrence of whale shark (Colman, 1997; Wilson *et al*., 2001; Sleeman *et al*., 2007). This species of shark is found in varying warm temperate and tropical waters worldwide including coastal, neritic, and pelagic habitat such as 28-32°C (Eckert and Stewart, 2001), 18-30°C (Fowler, 2000), an average of 27°C (Norman, 1999) or cooler temperatures (Wolfson, 1986). However, Compagno (1984) suggested that this species prefers waters with temperatures between 21-25°C. Whale sharks are scarce, their geographical distribution and biology are poorly known and they are susceptible to worldwide exploitation ranging from incidental by-catch in fisheries to directed capture in some regions (Alava *et al*., 1997; Colman, 1997; Compagno, 2001; Hanfee, 2001). Consequently, the whale shark is listed as 'Vulnerable' by the International Union for Conservation of Nature and Natural Resources and is on IUCN red list (IUCN, 2003 and 2007) and they are rapidly depleting in population (David, 2007). The decline in the population could be attributed to their being the target for fishermen due to the market for whale shark fins in some parts of the world (Alava, 2002; David, 2007; Weir, 2010).

The whale shark is a filter feeder (Compagno, 1984) and feeds on a wide variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes such as sardines, anchovies, and mackerel, and occasionally on small tuna and squid (Compagno, 1984; Last and Stevens, 1994), swarms of the tropical krill *Pseudeuphausia latifrons* (Taylor, 1994; Norman, 1999), a surface slick of coral spawn (Norman, 1999), localized concentrations of mysids (*Anisomysis spinata*) and crab megalopa (*G. natalis*), calanoid and harpacticoid copepods, larval decapods and the scales of small fishes (Norman, 1999) and crustacean namely *P. latifrons* (Wilson and Newbound, 2001; McKinney *et al*., 2012).

Off-shore Nigeria studies have shown that crustaceans are one of the most abundant and frequently occurring plankton in the area (SNEPCO, 2014; OML 118 (SNEPCO, 2008, 2011 and 2014), OML 132 (CNL, 2013), and OML 140 (CNL, 2012). These findings are supported by Omori and Ikeda (1984) reported the abundance of crustaceans in tropical marine waters of the Gulf of Guinea. Compagno (1984); Norman (1999), Wilson and Newbound (2001) and McKinney *et al*., (2012) have reported that whale shark feeds on crustaceans.

In some parts of the world, the occurrence of whale shark is well-documented especially in Western Australia, the Indian Ocean, and the Sea of Cortez, where research has focused primarily on coastal areas where whale sharks aggregate seasonally in response to fish or invertebrate spawning events (Colman, 1997). However, their occurrence in oceanic waters worldwide remains poorly documented (Eckert and Stewart, 2001). Little is known about the occurrence of this species of shark in West African waters and Nigeria in particular (Weir, 2010). Though there is a report of 10 sightings of whale sharks in Angolan and Nigerian waters (with only one in Nigeria), Weir (2010) further stated that there was no photograph to authenticate the Nigerian report. The first sighting or record of a whale shark in Nigerian ocean waters was in January 2006 (Weir, 2010) thereafter, there is no other record of this species in Nigeria. Therefore this report brings to fore the two new sightings of whale sharks including preliminary physical-chemical, plankton, and benthos characteristics of the sea waters off Nigeria coast where this species is sighted.

MATERIALS and METHODS

Whale shark records were reported incidentally from offshore vessels in Nigerian waters in 2013 and 2016. The two records were observed directly by the authors and were identified from photographs and descriptions in Weir (2010). The records of the depth, physical-chemical, plankton, and benthic characteristics of the sea waters within the areas where the whale sharks were sighted were drawn from reports of some of the Environmental Impact Assessment (EIA) studies conducted within the area between 2007 and 2014.

RESULTS and DISCUSSION

Between April 14th 2013, and March 20th 2016, we observed the whale shark in Nigerian deep-water twice (Table 1). The photographs and visual observation showed that the size of the species sighted could be approximately 10 -15 m long (Figures 1 and 2). These species were sighted on either side of the old one (Figure 1). The only published record on the presence and occurrence of this species in Nigerian deep-water is that of Weir (2010). In the author's report, she noted that the record from Nigeria was not backed-up with the picture. This present work, however, highlighted and

confirmed the possible abundance of whale sharks in Nigerian deep-waters based on the fact that between April 14th 2013, and March 20th 2016, we have seen this species twice during our surveys. It is worthy to note that these species are rarely seen within the area under review. In our two sightings, we saw a single individual that corroborates with the previous report that stated that the whale shark mainly occurs as a single individual (Colman, 1997; Compagno, 2001; Weir, 2010). In New Zealand, sighting of whale sharks mainly occurred between November and April and mostly (89.6%) from January to March with 55% reported in February (Duffy, 2002). Also, those whale sharks are the world's largest living fish and can grow to 18 meters, a weight of 34 tons, and may live for 100 years (Pierce and Norman, 2016).

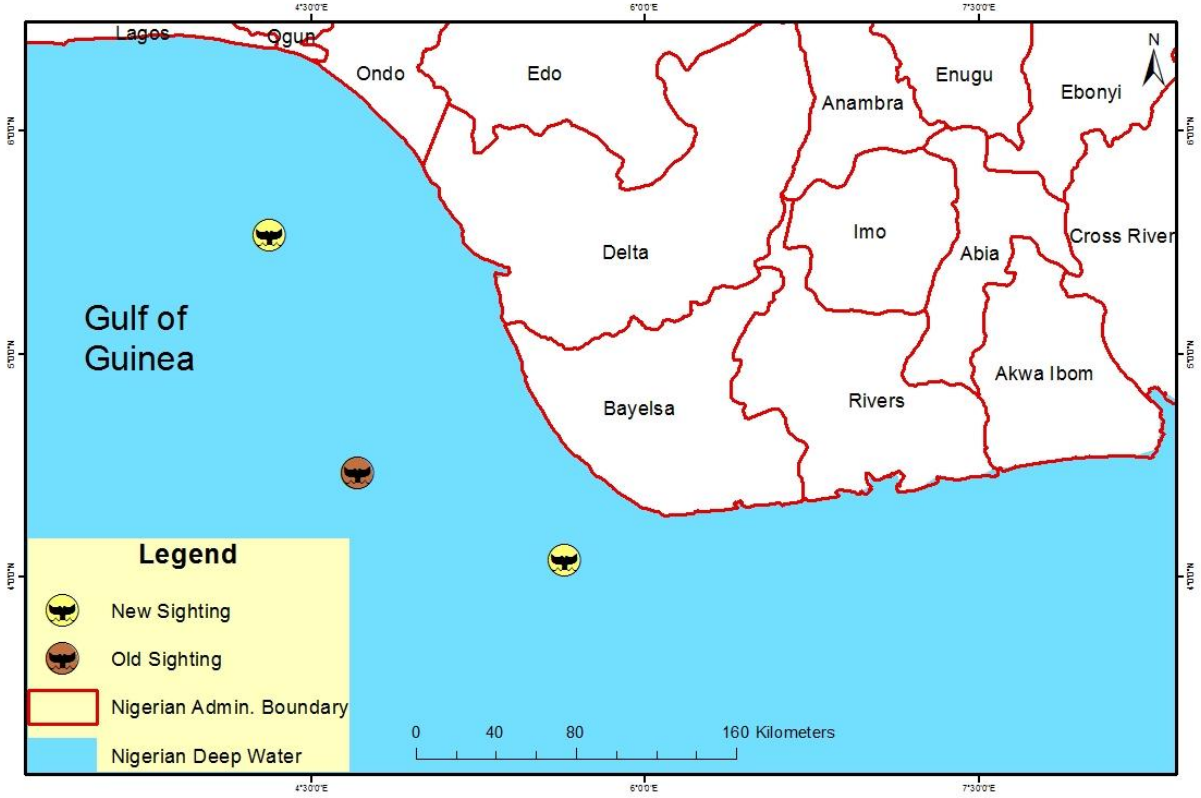

Figure 1. Location of old and new sightings of whale shark (*Rhincodon typus*) in Nigerian deep water

Published EIA reports from the areas of sighting showed the presence and abundance of phytoplankton, zooplankton, and benthic organisms (Tables 2). These could have contributed to the presence and occurrence of this species within the areas where they were sighted. This is evident in the fact that the whale shark feeds and breeds in areas with an abundance of plankton organisms (Compagno, 1984; Last and Stevens, 1994; Taylor, 1994; Norman, 1999; Wilson and Newbound, 2001; McKinney *et al*., 2012).

Table 1. Record of whale shark (*Rhincodon typus*) sighting off the Nigerian coast

S/N	Platform	Coordinate	Date	Group size	Estimated size (m)	Source	The estimated distance from the previous sighting
1	Bonga FPSO	04^0 33.75'N; 4^0 37.47'E	13/01/2006	1	15	Weir (2010)	-
2	MV Orient	5^0 33' 10.27''N 4^0 18' 26.59''E	14/04/2013	1	12-14	New sighting	112 km
3	RV Brone Explorer	5^0 37' 47.11''N 4^0 5' 8.35''E	20/03/2016	1	15	New sighting	102 km

Figure 2. Whale shark (*Rhincodon typus*) observed off Nigerian coast onboard MV Orient on April 14th 2013 (Photograph: Dr. Ekeke, Chimezie)

Some physicochemical characteristics of the seawater (Table 1) such as pH, temperature, and dissolved oxygen (DO) varied from 7.04 – 8.75, 27.00 – 32.80°C, and 3.06 – 10.00 mg/l respectively within the area (Table 1). Also, the characteristics of the water body in the area are typical of that which supports the breeding of this species (Eckert and Stewart, 2001; Onyema and Bako, 2015). This temperature range reported in this survey corresponds to those in which the survival and striving of whale shark 28-32°C (Eckert and Stewart, 2001), 18-30°C (Fowler, 2000), an average of 27°C (Norman, 1999) 21-25°C (Compagno, 1984) and 15.1-35°C (Hector *et al*., 2018). This, however, suggests that there is a high possibility that Nigerian deep water may harbor this species and the need for a further and comprehensive study to establish this fact since their distribution is also believed to be linked to specific environmental conditions, such as narrow temperature ranges and areas of upwelling (Colman 1997, Sequeira *et al*. 2014, Hoffmayer *et al*. 2005). This species is thought to prefer surface sea-water temperatures between 21 - 25°C. Sightings at Ningaloo Marine Park, however, are most common in water temperatures around 27°C (McKinney *et al*., 2012). Bacillariophyta (diatoms) with a relative abundance of 44-87% were the dominant phytoplankton division that also includes cyanophyta, chlorophyta, euglenophyta and dinophyta. Copepods contributed 32-6% of the zooplanktonic fauna. The characteristics of ocean waters concerning biological and physicochemical) across deep offshore Nigeria are in accordance with literature reports (Puyate and Rim-Rukeh 2008, Oketoki 2015, Onyema and Bako 2015).

The whale sharks were sighted within Nigerian deep water in dry seasons (January and March) and the beginning of the wet season (April). Also, the sighting at Bonga in January 2016 i.e. dry season (Weir, 2010) corresponds to when the abundance of planktons and pelagic species are high and could account for the presence of this species (Compagno, 1984; Colman, 1997; Norman, 1999; Compagno, 2001). The presence of this species in Nigerian waters is also supported by the earlier stated physicochemical characteristics and the fact that the study area is a comfortable feeding and foraging grounds for this species of fish (Compagno, (1984); Omori and Ikeda, 1984; Norman, 1999; Wilson and Newbound, 2001; and McKinney *et al*., 2012).

The new sightings were on northward southern axis of the old sighting at approximately 112 km and 102 km suggesting that the whale shark may have traveled to these areas in search of food. Whale sharks travel long distances and the timing of their movements is typically associated with localized blooms of planktonic organisms and water temperature changes (Compagno, 2001; John *et al*., 2013). Works have shown that this species of whale can travel as far as 7,772 km (with an average minimum of 48.1 to 51.81 km/day) (John *et al*., 2013), 20,000 km in 841 days (Hector *et al*., 2018) and, 4,567 and 8,025 km with an overall mean travel rate of 24.7 km/day (Eckert *et al*., 2002) in search of food and that their movements may correspond to the presence of zooplankton assemblages and fish populations that are known to accumulate near these features (Balch and Byrne 1994). This is evident

to the fact that the area has a high abundance of phytoplankton 5.56×10^5 – 3.28×10^6 organisms/litre of seawater and zooplankton 7.8×10^3 – 4.34×10^4 organisms/litre of seawater (Table 2).

Figure 3. Whale shark (*Rhincodon typus*) observed off Nigerian coast onboard RV Brone Explorer on March 20, 2016 (Photograph: Dr. Ekeke, Chimezie)

It is worthy to note that this species of whale sharks are currently listed as an 'endangered/threatened species by the International Union for the Conservation of Nature and Natural Resources (Pierce and Norman, 2016) and included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; www.cites.org). These listings are based on their susceptibility to fisheries collapse and slow recovery due to their k-selected life-history characteristics (Stevens 2007).

CONCLUSION

This report, however, confirms the occurrence of whale sharks in Nigerian deep water and the need for a concerted and dedicated survey to properly document the presence of this species in Nigeria and the adjoining countries.

Table 2. Some characteristics of seawater of the Nigerian coast

Project	Coordinate	Water depth (m)	Dominant phytoplankton	Dominant zooplankton	pH range	Temperature range (^{o}C)	Dissolved oxygen (mg/l)	No. of phytoplankton per litre	No. of zooplankton per litre
SNEPCo (2015)	4°33'N; 4°36'E	1000-1300	Bacillariophyta (Diatoms)	Crustaceans/not stated	8.30 (mean)	26.50 (mean)	6.93 (mean)		
OPL 222 (2009/2007)	-	750 – 800	Bacillariophyta (Diatoms) 44%	Copepods 32-40%	7.10-7.24	20.20-27.1	3.83-4.95	5.56×10^{5} – 3.28×10^{6}	7.8×10^{3} – 4.34×10^{4}
TEPNG (2010)	-	35-42	Bacillariophyta (Diatoms) 76.21%	Arthropods 83.42%	7.45–8.23	20.02–23.86		not stated	not stated
SNEPCo (2014b)	4°26'51.739"N; 4°39'14.462"E	1160-1340	Bacillariophyta (Diatoms) 87%	Crustaceans/68.7%	7.04–8.48	27.80-32.80	3.06-5.04	not stated	not stated
CNL (2013)	4° 25' 9.263"N; 4° 35' 25.208"E	700-1500	Bacillariophyta (Diatoms) 77%	Crustaceans/62%	6.87–8.30	28.12-29.30	5.81–10.0	not stated	not stated
CNL (2012)	4.480813N; 4.594725E	1250-2300	Bacillariophyta (Diatoms) 75%	Crustaceans/50%	8.05–8.81	27.1–30.03	4.86–6.20	not stated	not stated
SNEPCo (2011)	4^{0} 38' 38.462''N; 40 34' 40.498''E	-	Bacillariophyta (Diatoms)	Crustaceans	7.40–7.80	29.00-31.80	5.60–7.40	not stated	not stated
Usan OML 138 EIA, 2009	005^{0} 54' 32.6''N; 03^{0} 53' 56.28''E	730-850 m	Bacillariophyta (Diatoms)	Copepods	7.10-8.30	8.40-29.10	1.93-8.55	not stated	not stated
SNEPCo (2014b)	--	900-1500	Bacillariophyta (Diatoms) 47.46%	Crustaceans 60.30%	8.24-8.34	25.90-28.30	9.15-10.10	not stated	not stated

CNL = Chevron Nigeria Limited, OML = Oil Mineral License, EIA = Environmental Impact Assessment, SNEPCo = Shell Nigeria Exploration and Production Company Limited, TEPNG = Total Exploration and Production Nigeria Limited, OPL = Oil Prospecting License

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