Caribbean Journal of Science, Vol. 47, No. 2-3, 344-349, 2013

Observations on the whale shark (*Rhincodon typus*) in the Dutch Caribbean

A. O. Debrot[1*], R. de Leon[2], N. Esteban[3] and H. W. G. Meesters[1]

[1]*IMARES, Wageningen University Research Center, P.O. Box 57, 1780 AB, Den Helder, The Netherlands.*
[2]*Bonaire Marine Park, Barcadera z/n, Kralendijk, Bonaire,*
[3]*Dept. Bioscience, Swansea University, Singleton Park, Swansea, UK,*
**Corresponding author email: Dolfi.Debrot@wur.nl*

Abstract.-Records of whale sharks in the Caribbean are relatively sparse. Here we document 24 records of whale sharks (*Rhincodon typus* Smith 1882) for the Dutch Caribbean, four for the windward islands of Saba, St. Eustatius and St. Maarten, and twenty for the southern Caribbean leeward islands of Aruba, Curaçao and Bonaire. The results suggest a higher abundance of whale sharks in the southern, leeward part of the Dutch Caribbean, likely associated with seasonal upwelling-driven productivity known for the southeastern Caribbean area. A bimodal seasonal pattern as documented for Venezuela was not as pronounced in our findings for the Leeward Dutch Caribbean and whale sharks were recorded in 9 months of the year. In the Windward Dutch Caribbean all (4) records so far were for the winter months of December-February. Most records involved large and solitary animals in contrast to areas elsewhere suspected of being nursery habitat. According to local sources, whale sharks were most often associated with feeding tunas and sea surface swarms of crab megalopae.

Keywords: Whale shark, *Rhincodon typus*, crab megalopae swarms, tuna schools, Dutch Caribbean.

The whale shark *Rhincodon typus* is the largest shark and fish species of the world and widespread throughout tropical-temperate seas. It feeds on aggregations of small marine organisms, ranging from coral spawn (Heyman *et al.,* 2001) to crab larvae, baitfish and even small tunas (Martin, 2007; Taylor, 2003). It is a highly migratory species and shows little genetic differentiation world-wide (Castro *et al,.* 2007; Schmidt *et al.*, 2009). Due to its population dynamic characteristics it, like also many other large sharks, is very vulnerable to overfishing (Bonfil, 1997; Pauly, 2002). Most fishing on the species takes place in the Indian and Pacific Oceans (Alava, 2002; DEH, 2003). In the Caribbean, the whale shark is reportedly occasionally fished in Venezuela (Gines, 1972, as cited in Sturm, 1991) but more so in Mexico (Bonfil, 1997). It is declining world-wide and has been listed as vulnerable on the IUCN Red List of Endangered Species. It is further afforded international legal protection by enlistment in Appendix II of the Convention on Trade in Endangered Species of Flora and Fauna (CITES), Appendix II of the Convention on Migratory Species (CMS), and Annex I (Highly Migratory Species) of the United Nations Convention on the Law of the Sea (UNCLOS). The species enjoys local legal protection in various countries worldwide, among which Australia, Belize, Honduras, India, Maldives and the U.S.A. In the Dutch Caribbean, legal protection is only the case for the territory of Bonaire where, as of September 1, 2010, all sharks of the superorder Selachimorpha (which include the whale shark and related nurse shark) were declared legally protected when the new Island Nature Ordinance (AB. 2010, 15, Annex I) went into effect.

Notwithstanding its wide distribution and the fact that it is fished in several parts of its range, very little is known about its distribution and ecology. The species is best known in the Dutch Caribbean as "tribon bayena" (literally "whale shark"), analogous to the more regional Spanish usage (Zaneveld, 1983). However, in Curaçao and Aruba it is also often confusingly named "tintorero", as based on the spotting (O. Frans, and R. Croes, pers. comm.), a local name most consistently applied to the tiger shark, *Galeocerdo cuvieri* (Lesueur). Up to now, the only mention of the whale shark in the published literature for the Dutch Caribbean seas is a single observation dating from early 1960 for

(an unspecified location of) the south coast of Curaçao (Hoetink, 1969). A preliminary map by Frias-Torres (2005) showing (amongst others) whale shark distribution in the wider Caribbean shows no data for the Dutch Caribbean.

The Dutch Caribbean maritime Exclusive Economic Zone (EEZ) as established on June 10, 2010, falls principally in the pelagic zone of the Venezuela Basin, and concerns two discontinuous areas, separated by a minimum of some 550 km. One is based around the southeastern Caribbean island group of Aruba, Bonaire and Curaçao, and amounts to some 72 thousand square kilometers of sea surface. The other is based around the northeastern Caribbean islands of Saba, St. Eustatius and St. Maarten, and amounts to a total sea surface of some 22 thousand square kilometers (Fig. 1). Based on a review of published and unpublished sources, our own encounters with whale sharks, and information from experienced local divers and fishermen, we here compiled 24 records of sightings for the Dutch Caribbean for this species and summarize the findings.

Our compiled records span a period of more than 50 years (1960<). However, sixty-seven percent (67%) of the records, date from the last 5 years (2007 and onwards). This probably does not reflect any real trends in abundance of the species but is more likely due to increasing public interest in and awareness about these large and charismatic animals. All six Dutch Caribbean islands are represented with at least one or more records for the species (Fig. 1). The majority of these (20) were for the leeward Dutch maritime sector of the southeastern Caribbean (the ABC-islands). Only four records were documented for the Windward Dutch Caribbean EEZ centered around the northeastern Caribbean islands of Saba, St. Eustatius and St. Maarten. The two islands with the most records were Curaçao (9 records) and Bonaire (8). All except four records, regarded adult-sized animals (≥10 m), and all records concerned solitary individuals. The four smaller immature sharks (4-7 m) were observed (one each) off Bonaire and Curaçao, Saba and St. Maarten. Spatially-clustered records on successive days for Curaçao and Bonaire in 2010 and 2011 likely regard multiple observations of the same animal. In the Leeward Dutch Caribbean, whale sharks are present throughout much of the year but appear to be least numerous towards the end of the year (November, December) and possibly mid-year (June) (Fig. 2). In the windward Dutch islands, all four records occurred in the winter months of December-January.

The southeastern Caribbean Sea, off Margarita Island, Venezuela, at about 63° W, is the most important upwelling area of the Caribbean (Monente, 1997) and supports the largest commercial (clupeid) fisheries in the region (Sturm, 1991). The leeward Dutch islands lie downstream from this area and also experience elevated marine productivity compared to most other areas of the Caribbean, including the Windward Dutch Caribbean. This may partially account for the difference in documented records for this large filter feeding species between the windward and leeward Dutch Caribbean maritime sectors, as has also been suggested to underlie inter-regional differences in marine mammals (Debrot *et al.,* 2011; Romero *et al.,* 2001).

Based on a study documenting twenty records for this species, Romero *et al.* (2000) found a pronounced uneven bimodal annual pattern for whale shark records in Venezuela. The highest concentration of whale shark records were for the Gulf of Cariaco area and occurred principally during the months of August-October while a lesser peak in whale shark records was found in January-February (Romero *et al.,* 2000). The principal peak in occurrence coincided with the period of greatest marine productivity in the area, as governed by wind-driven seasonal upwelling and inflow of freshwater from the Orinoco (Romero *et al.,* 2000). Others have found that whale sharks may time their seasonal movements to benefit from localized productivity (e.g. Wilson *et al.*, 2001). Based on our results, the same may be the case in the leeward Dutch islands but seasonality appears to be much less pronounced than in the center of marine productivity near the Gulf of Cariaco, Venezuela. Zaneveld (1961) suggests

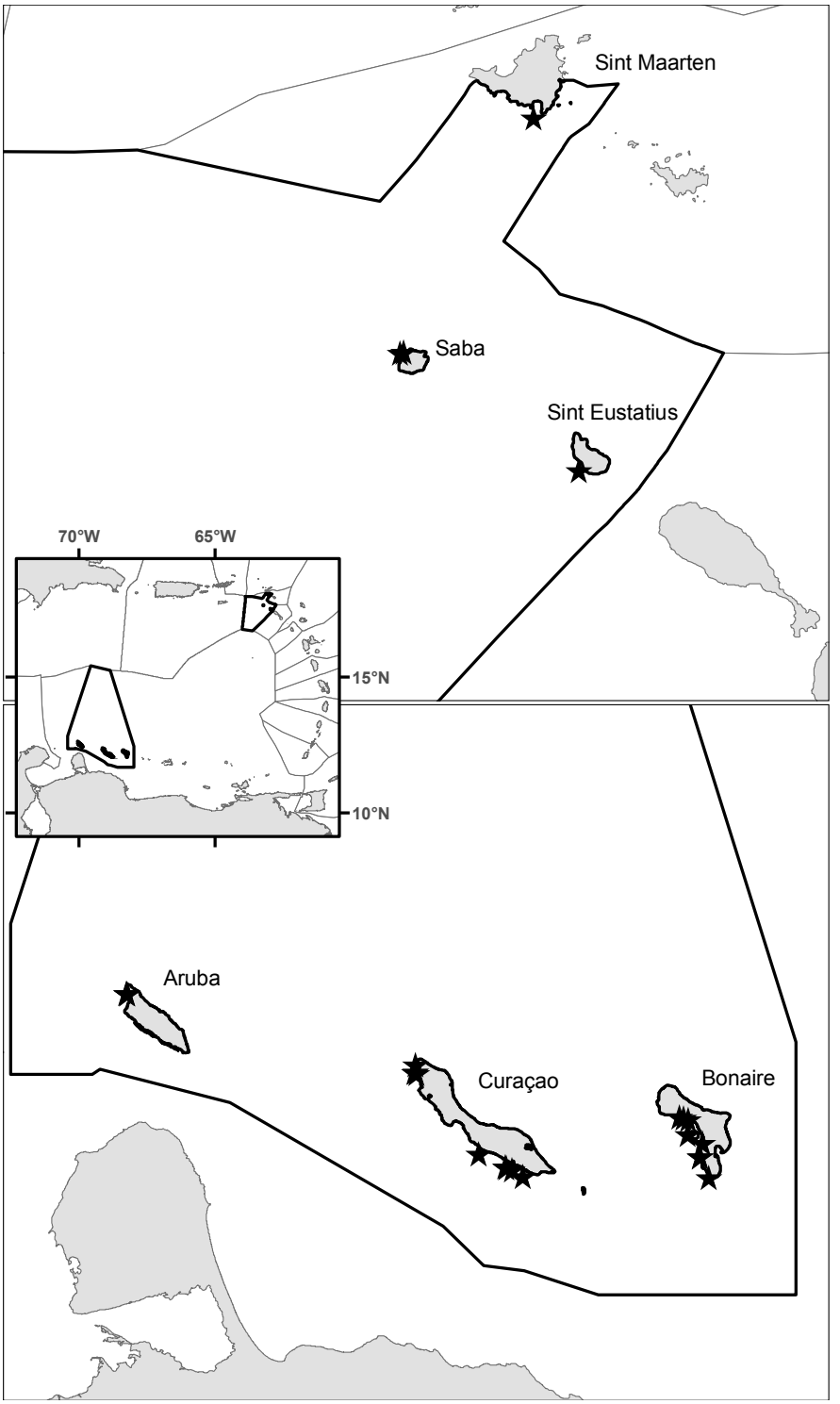

Fig 1. Spatial distribution of twenty-three whale shark records documented for the Dutch Caribbean (top: Windward Dutch Caribbean; bottom: Leeward Dutch Caribbean).

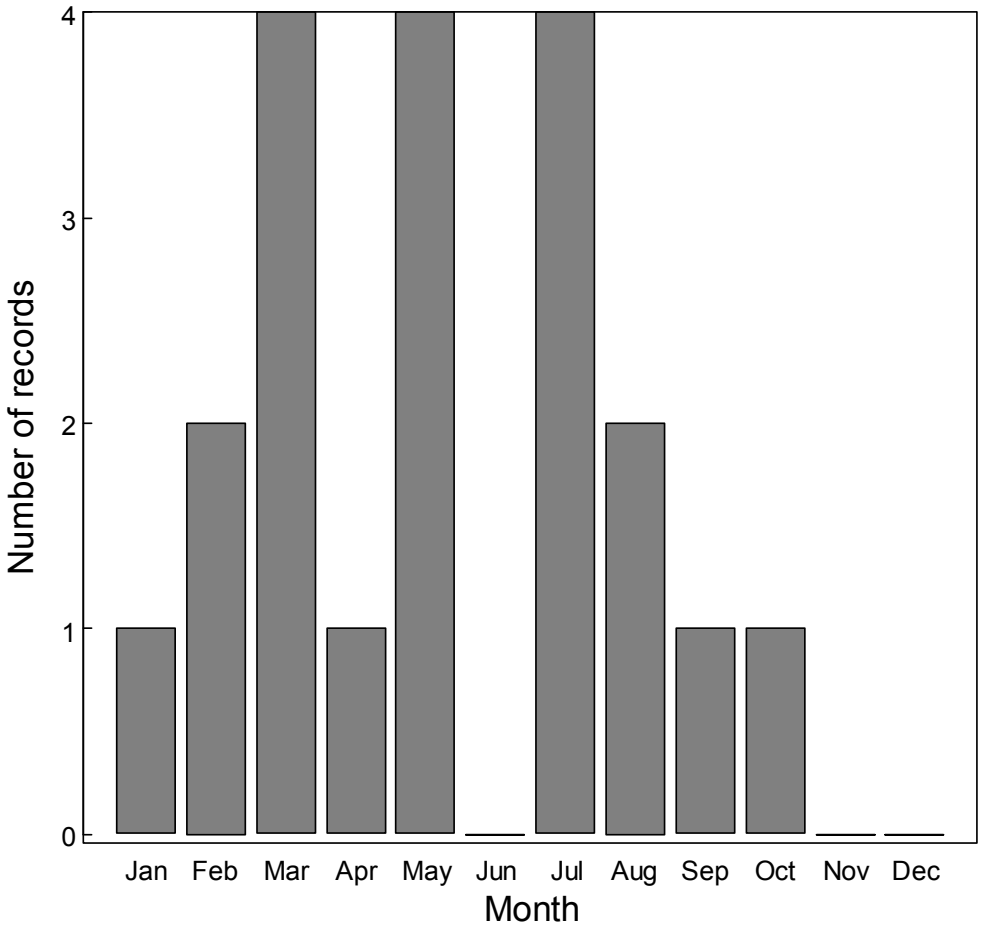

FIG 2. Temporal distribution of twenty whale sharks records in the Leeward Dutch Caribbean.

a rough bimodal annual pattern in potential food species of the whale shark for Curaçao, such as *Engraulis* (anchovies), *Harengula* (sardines) and *Decapturus* (scad), which may suggest a proximate underlying cause for bimodality in whale shark occurrence.

Grouping behavior and size distributions provide valuable insight into the way in which a species may use an area. All our twenty-four sightings regarded solitary animals. In contrast, Hoffmayer *et al.* (2005) who conducted a similar survey for the northcentral Gulf of Mexico noted that 26% of their twenty-six sightings regarded two or more animals. Also, whale sharks mature at upwards of 9 m in length (Hoffmayer *et al.,* 2005). So, while only four of our sightings regarded immature animals (16%), in the northeastern Gulf of Mexico, animals were documented down to as small as 3 m in length and 50% of the animals were below 7.5 m in length (Hoffmayer *et al*. 2005).. Based on grouping behavior and size structure Hoffmayer *et al.* (2005) concluded that their study area appeared to be used as a nursery area for the species. Obviously, our results show a totally different picture for the Leeward Dutch Caribbean and suggests that the area forms part of the (feeding) range for principally larger individuals of an as yet undefined Caribbean subpopulation of this species.

Observations of the whale shark in the Leeward Dutch Caribbean generally take place

in blue waters offshore from the coastal fringing reefs and in association with feeding tuna schools.

During one such instance off Fuikbaai in eastern Curaçao in the mid 1980s, AOD observed a whale shark feeding in tuna schools positioned in a stationary vertical stance by opening and closing its mouth at the water surface. It was surrounded by schools of 2-ft-long yellowfin tunas (*Thunnus albacares*) that were preying on smaller baitfish which in turn sought protection in compact schools around the whale shark. This implies potential feeding benefit to the whale shark derived from the predatory activities of the tunas. Hoffmeyer *et al.* (2005) has remarked that the highest diversity of pelagic fish aggregations in the Gulf of Mexico are associated with whale sharks. We propose that the causal mechanism for this may be based on pelagic schools of baitfish seeking protection from (a diversity of) predators by schooling tightly around whale sharks. Colman (1997) and Hoffmayer *et al.* (2005) have similarly described whale sharks feeding from a stationary vertical stance, also referred to as "suction-feeding" (Hoffmayer *et al.* 2005). However, the bulk of local observers indicate that most feeding behavior witnessed in the Dutch Caribbean concerned ram surface-feeding directed towards surface shoals of baitfish (Taylor, 2007).

One of the records compiled concerned the unusual live stranding of a 10-plus m long shark, in Curaçao in 2005. The animal had come onto a hotel beach the day before but was pushed out to sea by concerned beach goers. The next day it beached itself again nearby and got lodged in a rock crevice. During stranding the animal was heard producing a whining sound, as if in distress (AOD, pers. obs.). Attempts to rescue it failed (Amigoe, 2005) and it was later pulled out to sea, where it sank in deep water.

In one of the whale shark records for the leeward islands, and in general fishermen's accounts, close association to surface swarms of crab megalopae was indicated. Such swarms have been documented for Curaçao before by Rice and Kristensen (1982) and further east in the southern Caribbean (St. Lucia) by Chase and Barnish (1976) and Kidd and Rice (1986). For the Leeward Dutch Caribbean crab megalopae swarms appear to be relatively common and are reported by Rice and Kristensen to be practically an annual occurrence from 1970 through 1982. An anonymous newspaper article from September 1993 (B&N, 1993), reports a mass stranding of larval crabs in Bonaire. According to the fishermen cited in that article, such crab swarms occur practically annually and "exceptionally large sharks, the likes of which are seldom seen around Bonaire" (i.e. whale shark) are thereby typical. The most recent larval crab swarm in Bonaire occurred mid June 2010 and lasted about two weeks during a spell of quiet weather (RdL, pers. obs.).

By way of its documented food habits, the whale shark is principally an offshore pelagic species. So even though our results show that the whale shark is certainly more common in Dutch Caribbean waters than previously realized, most of our records were largely near-shore records and must certainly under-represent the actual species occurrence in the Dutch Caribbean.

Nevertheless, our results show how simple compilation of casual observations can provide various potential insights which may be used to encourage and direct more extensive study both in the Dutch Caribbean and elsewhere in the region. We conclude that there are several opportunities for further critical research and emphasizes the value of and need for more observations by all interested parties to help further elucidate the biology and conservation of these endangered, charismatic creatures.

Acknowledgments.-We thank Marco Accattatis, Karel Boon of Trunk Divers, Irene da Cunda, Raul Croes, Mr. R. A. Damberg, Susan Davis, Gielmon Egbreghts, Oscar Frans, John de Freitas, Kelly-Mae Gibbs of Dive Safaris, Bryan Horne of Ocean Encounters, Ron Huijbers and Jair Valentijn of Private Diving, David Kaplan, Luciana de Lima of Ocean Explorer, John Magor and Lynn Costenaro of SeaSaba, Mabel Nava, Peter Nayoski, Patrick O'Neill, Sea Saba, Eric Newton, Luis Felipe Puntel, Oswaldo Serberie, Pieter van der Vlies of Miss Ann Boat Trips, David van Weeghel, Menno Walther of

Squabaqua Dive Center, Erik Noteboom and Peter Bot of Scubadoo, Larry Wyatt and Joyce Cicchelli of Carib Inn, and Peter Montanus and Frank van Slobbe of DROB, for recording the sightings and providing the supporting information on which this report is based. We thank Jenny Cremer for drafting our map and are also grateful to an anonymous reviewer for suggesting several important improvements to an earlier draft of this manuscript.

Literature Cited

Alava, M. 2002. Conservation and Management of Whale Sharks in the Philippines. In: *Shark Conference 2002*: Sustainable Utilization and Conservation of Sharks, Taipei, Taiwan, May 13-16, 2002.

B&N (Beurs en Nieuwsberichten), 1993. Miljoenen krabbetjes bezorgen stankoverlast. *Beurs en Nieuwsberichten*. Curaçao newspaper, 2 Sept, 1993, p. 2.

Bonfil, R. 1997. Status of shark resources in the Southern Gulf of Mexico and Caribbean: implications for management. *Fish. Res.* 29: 101-I 17.

Castro, A.L.F., B.S. Stewart, S.G. Wilson, R.E. Heuter, M.G. Meekan, P.J. Motta, B.W. Bowen and S.A. Karl. 2007. Population genetic structure of Earth's largest fish, the whale shark (*Rhincodon typus*). *Molecular Ecology* 16, 5183–5192.

Chace, F. A. and G. Barnish. 1976. Swarming of a raninid megalopa at St. Lucia, West Indies (Decapoda, Brachyura). *Crustaceana* 31: 105-107.

Colman, J.G. 1997. A review of the biology and ecology of the Whale Shark. *J. Fish Biol.*. 51: 1219-1234

Debrot, A. O., R. H. Witte, and M. Scheidat, 2011. The marine mammals of the Dutch Caribbean: a comparison between EEZ sectors, contrasts and concerns. Paper presented to IWC Scientific Committee SC/63/E9.

Frias-Torres, S. 2005. Large pelagic fish distribution in the tropical Western Atlantic relevant to conservation. *Proc. Gulf Caribb. Fish. Inst.* 56: 253-257.

Gines, H. 1972. *Carta pesquera de Venezuela. 1. Areas del Noriente y Guayana.* Monografia 16. Fund La Salle de Ciencias Naturales. Caracas. 328 pp.

Heyman, W. D., R. T. Graham, B. Kjerfve and R. E. Johannes. 2001.Whale sharks *Rhincodon typus* aggregate to feed on fish spawn in Belize. *Mar. Ecol Prog. Ser.* 215: 275–282.

Hoetink, H. 1969. (ed.). Encyclopedie van de Nederlandse Antillen. Elsevier, The Netherlands. 707 pp.

Hoffmayer, E. R., J. S. Franks, and J. P. Shelley. 2005. Recent Observations of the whale shark (*Rhincodon typus*) in the northcentral Gulf of Mexico. *Gulf and Caribbean Research* 17: 1-4.

DEH (Australia Department of the Environment and Heritage) 2003. Whale Shark (*Rhincodon typus*). *Recovery Plan-Issues Paper*. Threatened Species Scientific Committee, Australia. 1:26.

Kidd, R. J., and A. L. Rice. 1986. A mechanism for the transport of swarms of raninid megalopas in the Eastern Caribbean. *J. Crust. Biol.* 6(4): 679-685.

Martin, R. A. 2007. A review of behavioural ecology of whale sharks (*Rhincodon typus*). *Fish. Res.* 84: 10-16.

Monente, J. A. 1997. Phenomena contributing to the periodic enrichment of Caribbean Waters. *Interciencia* 22: 24-27.

Pauly, D. 2002. Growth and mortality of the basking shark *Cetorhinus maximus* and their implications for management of whale sharks *Rhincodon typus*. In: S.L. Fowler, T.M. Reed and F.A. Dipper (eds), Elasmobranch Biodiversity, Conservation and Management. Proceedings of the International Seminar and Workshop, Sabah, Malaysia, July 1997, pp.

Rice, A. L. and I. Kristensen. 1982. Surface swarms of swimming crab megalopae at Curaçao (Decapoda, Brachyura). *Crustaceana* 42: 233-240.

Romero, A., A. I. Agudo, S. M. Green, and G. Notarbartolo di Sciara. 2001. Cetaceans of Venezuela: Their distribution and conservation status. *NOAA Technical Reports*, NMFS 151:1-60.

Romero, A., A. I. Agudo and C. Salazar. 2000. Whale shark records and conservation status in Venezuela. *Biodeversity* 3(1):11-15.

Schmidt, J. V., C. L. Schmidt, F. Ozer, R. E. Ernst, K. A. Feldheim, M. V. Ashley and M. Levine. 2009. Low genetic differentiation across three major ocean populations of the whale shark, *Rhincodon typus*. *PLoS ONE* 4: e4988. doi:10.1371/journal.pone.0004988

Taylor, J. G. 2007. Ram filter-feeding and nocturnal feeding of whale sharks (*Rhincodon typus*) at Ningaloo Reef, Western Australia. *Fish. Res.* 84: 65-70.

Sturm, M. G. de L. 1991. The living resources of the Caribbean Sea and adjacent regions. *Caribb. Mar. Stud.* 2: 18-44.

Zaneveld, J. S. 1983. Caribbean fish life: index to the local and scientific names of the marine fishes and fishlike invertebrates of the Caribbean area (Tropical Western Central Atlantic). E.J. Brill, Leiden, 163 pp.

Zaneveld, J. S. 1962. The fishery resources and the fishery industries of the Netherlands Antilles. *Proc. Gulf Caribb. Fish. Inst.* 14 (Miami Beach, FL, 1961): 137-171.