CETACEANS OF THE RED SEA

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Front Cover Photograph A group of Risso's dolphins (*Grampus griseus*) headstanding against the background of the African coast, south of Abu Fandira reef, Egypt (22° 49' 44.7" N, 36° 20' 53.3" E), 12 July 2012. Photo by: A. Cesario.
Back Cover Photograph Group of 13 spinner dolphins (*Stenella longirostris*) resting under a glassy surface at Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E) on 21 June 2013. Photo by: A. Cesario.
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CHAMPION

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ISBN

Dedicated to Chris Smeek

Chris Smeenk, coauthor and coeditor of Cetaceans of the Red Sea, passed away shortly before this work went to press. He was a passionate naturalist, and eminent scholar, a kind person and a dear friend.

A true polyglot, Chris was responsible for all translations. Also a master editor, Chris was in charge of giving a uniform style to the multi-authored sections and chapters of this review, and his inspiration permeates its every page.

With deep appreciation for his commitment to our collective effort up to the last days of his life, we wish to dedicate this work to his memory.

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Foreword by Bradnee Chambers

The Red Sea marks the boundary between Africa and Southwest Asia – and includes important staging posts for a range of migratory species – both avian and aquatic – highlighting the fact that these animals are as oblivious to national frontiers as they are to continental divides. However, it remains one of the least studied regions when it comes to whales and dolphins.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) prides itself on being a Convention that bases its policy decisions on sound science, and its Scientific Council can draw on some of the best minds in the field of species conservation.

To this end, COP2 in 1988 appointed a Scientific Councillor for marine mammals, William "Bill" Perrin. On his watch, CMS developed four regional cetacean treaties and much of its marine mammal-related agenda. In 2014, Giuseppe Notarbartolo di Sciara, well known in CMS circles as a former Chair of the Scientific Committee of the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS), took over following Bill's retirement. This report, taking CMS into uncharted waters with this complete faunal record of cetaceans in the Red Sea, amply illustrates that the Convention's efforts to conserve marine mammals continue to be in safe hands.

Giuseppe, his co-editors Dan Kerem, Peter Rudolph and Chris Smeenk, and the nine other authors have produced original and ground-breaking research not previously published. The professional reputations of the authors serve as an assurance of the scientific robustness of their findings.

Sadly, one of the main collaborators on this project, Chris Smeenk, the former curator of mammals at the Naturalis Biodiversity Center in the Netherlands, passed away before the report was published. This landmark publication will stand as one of many testimonies to a life dedicated to biological research and the conservation of wildlife.

The research underlying this report brings together historic records and the latest information on a range of fascinating and enigmatic species inhabiting a region that has too long been neglected. The countries adjoining the Red Sea have a high level of participation in CMS – only Sudan is not a Party to the parent Convention but is a member of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

CMS is proud to assist Parties in the region by supplying information needed for science-based conservation measures. It will enable stakeholders to address effectively the main anthropogenic pressures affecting whales and dolphins in the Red Sea, such as climate change, chemical and noise pollution, disturbance of critical habitat and direct killings.

I am delighted that Giuseppe's team has given the cetacean species in these waters the attention they deserve. The report will, I am sure, be an invaluable addition to the CMS Technical Series.

Abstract

Based on a review of the literature, complemented by original observations at sea made by the authors during the past 34 years, the cetacean fauna in the Red Sea appears to be composed of a total of **16** species: **three** Mysticetes (Bryde's whale, *Balaenoptera edeni*; Omura's whale, *B. omurai*; and humpback whale, *Megaptera novaeangliae*) and **13** Odontocetes (dwarf sperm whale, *Kogia sima*; killer whale, *Orcinus orca*; false killer whale, *Pseudorca crassidens*; short-finned pilot whale, *Globicephala macrorhynchus*; Risso's dolphin, *Grampus griseus*; Indian Ocean humpback dolphin, *Sousa plumbea*; rough-toothed dolphin, *Steno bredanensis*; Indo-Pacific bottlenose dolphin, *Tursiops aduncus*; common bottlenose dolphin, *T. truncatus*; pantropical spotted dolphin, *Stenella attenuata*; spinner dolphin, *S. longirostris*; striped dolphin, *S. coeruleoalba*; Indo-Pacific common dolphin, *Delphinus delphis tropicalis*).

This review presents the very first documented and confirmed sightings of *B. omurai*, *K. sima* and *S. bredanensis* in the Red Sea. Of all the above species, however, only **nine** (Bryde's whale, false killer whale, Risso's dolphin, Indian Ocean humpback dolphin, Indo-Pacific bottlenose dolphin, common bottlenose dolphin, pantropical spotted dolphin, spinner dolphin, and Indo-Pacific common dolphin) appeared to occur regularly in the Red Sea, the remaining seven only occurring sporadically as vagrants from the Indian Ocean. Even regular species appeared not to be uniformly distributed throughout the Red Sea, e.g., with Indo-Pacific common dolphins mostly limited to the southern portion of the region, and the Gulf of Suez only hosting the two bottlenose dolphin species and Indian Ocean humpback dolphins. No convincing evidence was found of the Red Sea occurrence of two whale species mentioned in the literature: the common minke whale, *Balaenoptera acutorostrata*, and the sperm whale, *Physeter macrocephalus*. The absence from the region of deep diving species (e.g., *Ziphiidae* and the sperm whale) can be explained by the geomorphology of the Straits of Bab al Mandab, with its extended shallow sill likely to discourage incursions by such species into the Red Sea. The coordinated effort and the different expertise of the authors has contributed to amending previous mistakes and inaccuracies, verifying and validating specimen identification, highlighting features of relevance for species taxonomy and, most importantly, drawing a fundamental baseline to inform conservation of cetaceans in the Red Sea.

List of Acronyms and Abbreviations

MPA	Marine Protected Area
HEPCA	Hurghada Environmental Protection and Conservation Association
IMMRAC	Israel Marine Mammal Research & Assistance Center
PERSGA	Regional Organization for the Conservation of the Red Sea and Gulf of Aden
EEAA	Egyptian Environmental Affairs Agency
KAUST	King Abdullah University of Science and Technology

Initials of authors cited in the text and tables

AC	Amina Cesario
AS	Aviad Scheinin
CS	Chris Smeenk
DK	Dan Kerem
DF	Daphna Feingold
GNS	Giuseppe Notarbartolo di Sciara
MC	Marina Costa
ME	Mia Elasar
MF	Maddalena Fumagalli
NH	Nir Hadar
OG	Oz Goffman
PR	Peter Rudolph
YTM	Yohannes T. Mebrathu

Introduction

The cetacean fauna of the Red Sea is among the world's least known and even the species composition in the region is still somewhat shrouded in uncertainty. This review updates and expands preliminary work presented to the European Cetacean Society (Notarbartolo di Sciara et al. 2007) and the Scientific Committee of the International Whaling Commission (Notarbartolo di Sciara et al. 2014), and it is a first exhaustive effort to produce a comprehensive and up to date account of the species occurring in the region.

The effort was hampered by the paucity and patchiness in the data available. Unlike in many other regions of the world's oceans, such as the seas around Europe, North and South America, Eastern Asia and Oceania, until recently cetaceans in the Red Sea have never been the subject of direct, targeted ecological investigations. The uneven distribution of cetacean records available from the region can be explained by the main sources of data, i.e., reports from the diving centres mostly along the coasts of Egypt and Israel, and reports from observers aboard vessels crossing the Red Sea longitudinally along its midline. With few exceptions (e.g., Gladstone and Fisher 2000, Feingold 2007, Notarbartolo di Sciara et al. 2009), all the remaining published accounts were based on anecdotal occurrences of animals stranded, accidentally captured in fishing gear, or sighted from passing vessels. There is much need for a critical reassessment of the cetacean species occurring in the Red Sea, and even the review presented here suffers from wide spatial gaps in the available knowledge, considering that there are still large portions of the Red Sea where ecological investigations by cetacean experts have never been made.

The Red Sea is a long, narrow body of water separating Northeast Africa from the Arabian Peninsula, extending from north to south over a distance of approximately 1,900 km, with a mean width of 280 km, and a total marine surface of 440,000 km^2. The connection with the Gulf of Aden by the Straits of Bab al Mandab is 29 km wide and 137 m deep at its shallowest point, the Hanish Sill. Continental shelves are predominant in the southern portion; however, their extent is significant throughout (about 25% of the basin is <50m deep), causing the region's mean depth to be only 524 m in spite of maximum depths nearing 3,000 m (Barale 2007). The northern gulfs of Suez and Aqaba present a great contrast in bathymetry. The Gulf of Suez is a shallow and flat-bottomed basin, with a depth of <80 m, deepening at the entrance to the Red Sea proper, whereas the Gulf of Aqaba is very steep-sided and deep, reaching maximum depths of over 1,800 m. The Gulf of Aqaba is separated from the rest of the Red Sea by the Straits of Tiran, with a sill about 250-300m deep. In these respects, the Gulf of Aqaba is a very small-scale model of the Red Sea itself (Head 1987).

The Red Sea is geologically young, created and shaped by a continuing process of rifting, subsidence and pull-apart basin formation, starting roughly 24 million years ago (Bosworth et al. 2005). During most of its lifetime it formed a marine bridge between the Indian Ocean and the Mediterranean. The oceanic connections were at times restricted, as is evident from evaporitic sediments, though the deeper parts never dried up. Following the Messinian crisis which dried the Mediterranean about six million years ago, the connection to the latter through the Gulf of Suez was cut off, not to be renewed until the digging of the Suez Canal, opened in 1869 (Bosworth et al. 2005). The digging of the canal, which lies at sea level, in principle allows two-way movement of small cetaceans between the two water bodies, in a process called "Lessepsian migration" (Por 1978).

At the other end of the Red Sea, the connection with the Indian Ocean opened up c. 5 million years ago. Being an enclosed sea, connected to the ocean through a very narrow strait and a shallow sill, the Red Sea has been particularly sensitive and responsive to global sea level reductions during glacial periods. Although connections to the Indian Ocean were maintained at least during the last 500,000 years (Rohling et al. 1998), being situated in an arid zone and experiencing one of the highest global net evaporation rates, even a restricted exchange flow with the ocean would rather rapidly result in hyper-salination. Indeed, during the last glacial maximum of 26,000-19,000 years ago, associated with an estimated global sea level reduction of ca 120 m (Clark et al. 2009) and a best-estimated regional reduction of 104 m (roughly 33 m above the sill) (Biton et al. 2008), the Gulf of Suez dried up and the salinity of the Red Sea rose dramatically. According to both sea circulation models (Biton et al. 2008 and references therein) and reconstructions based on isotopic records from sedimentary cores (Siddall et al. 2003), salinity rose from 40.6 to a maximum of 57 practical salinity units. These values exceeded the tolerance of all planktonic shell-forming species that leave a fossil record (e.g. pteropods, foraminifers, calcareous nanoplankton), resulting in 'aplanktonic zones' as recorded in sediment cores taken from the central and northern parts of the Red Sea (Fenton et al. 2000, Almogi-Labin et al. 2008).

It is very probable that such conditions were incompatible with cetacean residence in all but the southernmost reaches of the Red Sea and that the cetacean fauna retreated into the Indian Ocean well before the peak of the event. In fact, conditions in the Red Sea were below optimal also following de-glaciation, sea level rise and the stepwise drop of salinity levels. Between 13,000 – 10,000 years ago, pluvial conditions caused extreme stratification and a reduced aeration of mid and deep waters, thereby hindering recolonisation by both planktonic and benthonic species and accentuating oligotrophicity (Almogi-Labin et al. 1998). Reoccupation by Indian Sea cetaceans may have been delayed even longer.

Hence, the cetacean fauna of the Red Sea is very young, probably 10,000 years or less, and differs from that of the Mediterranean. Besides species with a global distribution, it presents a selection of truly Indo-Pacific species, most of which have expanded their range into the relatively cool waters in the northern part of the Basin. The distribution of species between the Indian Ocean and Red Sea seems contiguous, and there seem to be no signs of incipient endemism in Red Sea cetaceans.

The hostile climatic conditions of the land surrounding the Red Sea and its low human population have no doubt contributed to the fact that our knowledge of its cetacean fauna is still fragmentary. The Basin is largely surrounded by harsh deserts. There are only two seasons, influenced by monsoonal circulation, northeastern in winter and southwestern in summer. Rainfall is minimal (about 60 mm/year on average), and in the absence of major rivers, the inflow of fresh water is extremely low and intermittent, limited to occasional runoff from wadis (torrent beds) scattered along the coast. Air temperatures are among the world's highest, particularly during summer and in the south, with water-surface temperatures ranging from 28°C to 31°C in June-September (Sheppard et al. 1992). Overall, the combination of these geographic and climatic variates determines the Red Sea's oceanographic conditions, making it one of the world's hottest and saltiest bodies of seawater (Barale 2007); such conditions strongly affect, in turn, the ecology of its inhabitants – cetaceans included. These unique features all contribute to making the Red Sea vulnerable to human impact, and therefore an important research area. In terms of marine productivity, the dearth of continental inflow combined with the presence of a permanent thermocline at a depth of about 50 m (Raitsos et al. 2013) makes of the Red Sea an oligotrophic basin, a condition that is most noticeable in the northern part of the region, whereas in the south this is mitigated by nutrient input from the Indian Ocean through the Gulf of Aden, and by the predominance of shelf waters (Sheppard et al. 1992). The extensive coral reefs are also an important source of nutrients, which through anti-cyclonic eddies might also reach the open waters of the central Red Sea (Raitsos et al. 2013).

The very low human population density in the Red Sea coastal zone, with a total of approximately 5 million inhabitants (Barale 2007), has until recently contributed to maintaining the region in relatively unspoilt conditions. However, the marine environment in the Red Sea has come under increasing human pressures in the past 30 years, due to the natural vulnerability of this semi-enclosed sea, with delicate habitats (coral reef, seagrass and mangroves) being progressively degraded, fish stocks becoming depleted, vulnerable species becoming threatened, and marine areas becoming polluted through oil production and transportation, or locally degraded by human waste off the major urban centres (Gladstone et al. 1999). The main human pressures on the Red Sea marine environment include maritime traffic, oil-based industrial development, fishing, and tourism. The Red Sea has been an important trade route throughout recorded human history, linking the goods from India and the Far East with the historical markets of Egypt, the classical Mediterranean world, and Europe. With the digging of the Suez Canal in 1869, the connection with the Mediterranean became direct. Today, the Red Sea is crossed by one of the world's most important shipping routes, with 25,000-30,000 ship transits annually, transporting, amongst other things, over 10^7 t of crude oil (Gladstone et al. 1999). The Red Sea continental shelf also contains its own hydrocarbon deposits, which are being exploited through platforms, e.g., in the Gulf of Suez by Egypt (Alsharhan 2003); elsewhere, these are being prospected. Fishing in the Red Sea, mainly consisting of artisanal, local commercial and foreign industrial fisheries (Tesfamichael and Pitcher 2006), have during the last decade experienced an uncontrolled boom causing severe overfishing and an increase in illegal fishing practices, resulting in a major decline in fish production throughout the region (Marshall et al. 2010).

Increasing temperatures due to climate change are also affecting the Red Sea ecosystems, particularly coral reef systems which are threatened worldwide by global warming and ocean acidification, with projected temperature and CO_2 levels foreseeing dire scenarios for coral-based reefs in the decades to come (Hoegh-Guldberg et al. 2007, Hoegh-Guldberg 2011). Long-range studies in the Red Sea have already revealed early effects of climate change in the form of decline in diversity and compromised growth (Riegl et al. 2012).

The Red Sea, with its unique and beautiful marine and coastal environments, its extensive coral reefs and clear, warm waters, and the diversity of species inhabiting them, has enormous potential for coastal tourism. Tourism, both regional and international, is an important source of foreign currency for underdeveloped countries that have no exportable natural resources. Although most of the coast of the Red Sea is too hot or remote to attract ordinary tourists, its coral reefs have an international reputation which attracts divers from all over the world. Tourist arrivals in the region approximately tripled between 1995 and 2010, reaching 33 million presences (Gladstone et al. 2013). Such development has created evident negative impacts on the marine environment, both direct (anchor damage to corals by tourist boats, coral breakage by divers, souvenir collecting) and indirect (coastal zone runaway development). Impacts are particularly relevant considering the extreme environmental conditions, so that in many assemblages, species occur at the limits of their distribution and tolerance, thereby increasing the danger of declines in abundance of marine wildlife in the vicinity of tourist areas (Gladstone et al. 2013). Cetacean watching in the Red Sea has recently acquired

increased relevance, particularly in the northern portion of the region. During the 1990s, activities to observe and approach a solitary Indo-Pacific bottlenose dolphin *Tursiops aduncus* named "Holly", were organized by the Bedouins living in Nuweiba M'zeina (Gulf of Aqaba), who considered the solitary dolphin a gift from Allah; this activity ended in 2000, when Holly left the area and was found dead on the shores of North Sinai in 2004 (Goffman 2006a). More recently swimming with wild dolphins (e.g., targeting spinner dolphins *Stenella longirostris* and Indo-Pacific bottlenose dolphins *Tursiops aduncus* in Egypt) has become an important industry, largely devoid of control and with a high potential for disruption and extirpation of the populations concerned (Fumagalli 2016), though local examples of management exist (Notarbartolo di Sciara et al. 2009).

A regional convention on the "Conservation of the Red Sea and Gulf of Aden Environment", also known as the Jeddah Convention, was signed in 1982 by all coastal nations concerned, to provide a legal framework for co-operation on marine issues in the region, to address pollution problems and conserve marine biodiversity. The Convention's implementation was mandated in 1995 to an intergovernmental organization, the Regional Organization for the Conservation of the Red Sea and Gulf of Aden (PERSGA), which in 1998 adopted a Strategic Action Plan (SAP) for the area (PERSGA 1998). Part of the conservation effort is dedicated to the establishment of Marine Protected Areas (MPAs), to conserve representative and significant biodiversity while supporting sustainable resource usage and economic development (Chiffings 1995). However, although 75 MPAs have been established or recommended in the region, according to Gladstone et al. (2003) few are being managed appropriately, and wide gaps still exist within these MPAs in the representation of regionally significant natural habitats.

The goal of this paper is to summarize and update the existing knowledge of the occurrence and distribution of cetaceans in the Red Sea, by framing within a wider regional perspective the many recent observations that have become available recently, and combining them with records published in the past, which are here critically reviewed. It is our hope that creating a more robust foundation for what knowledge exists of cetaceans in the Red Sea will support national, regional and international conservation efforts and help secure a future for this important component of Red Sea marine biodiversity.

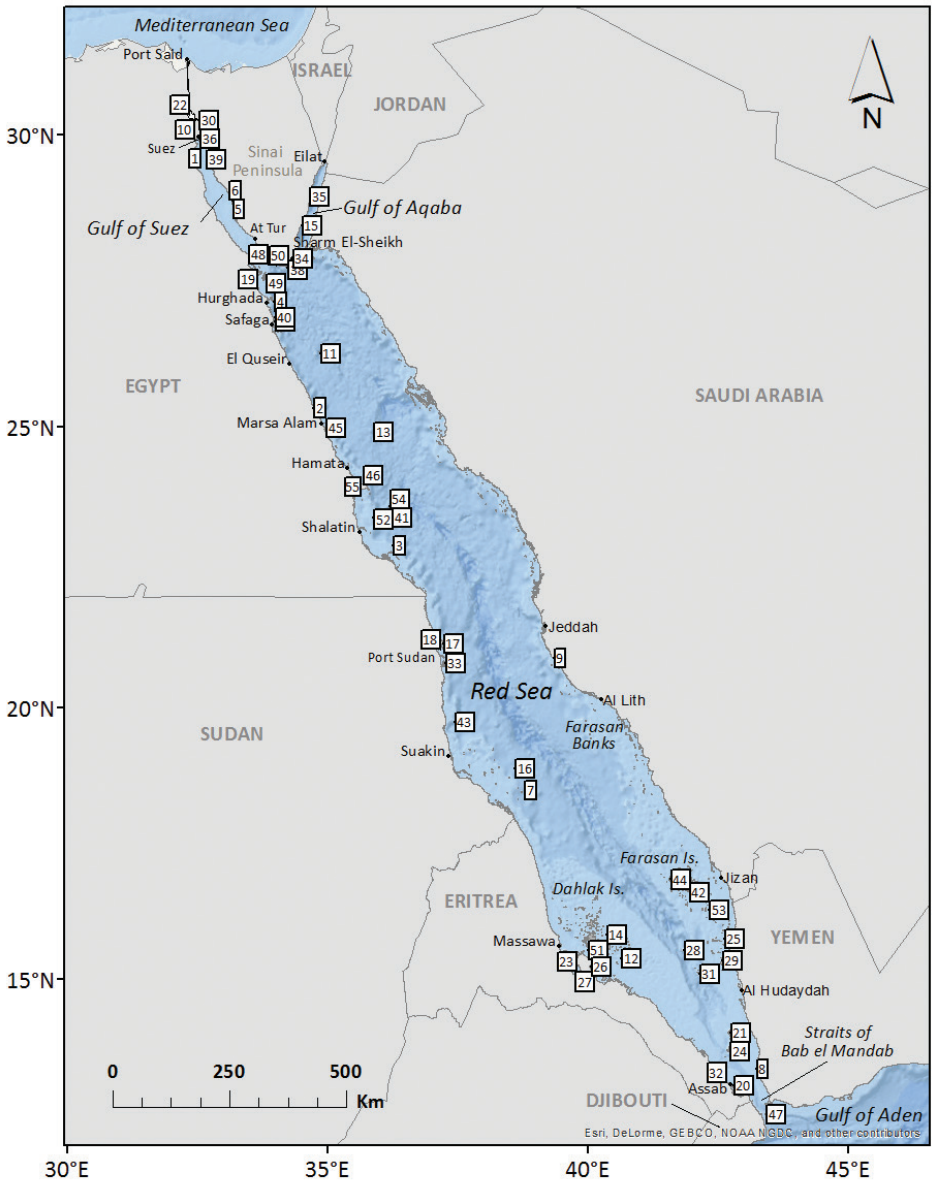
Materials and methods

The area considered in this review includes the waters of the Red Sea (Fig. 1).

The information provided in this document is based on two main source categories: a) a review of the literature, published and unpublished, and of relevant museum collections, mostly referring to older data; and b) new, largely recent information provided by the authors, either through their own observations at sea or collected from verifiable second party reports.

The literature was searched and critically reviewed for data on cetaceans in the Red Sea. For old records

Figure 1. The Red Sea region with the names of the locations mentioned in the text. 1: Ain Sokhna. 2: Abu Dabab. 3: Abu Fandira. 4: Abu Ramada/Magawish/Fanus/Giftun island. 5: Abu Rudeis. 6: Abu Zenima. 7: Adam Reef, Suakin Archipelago. 8: Al Mucha. 9: Al-Shu'aibah. 10: Ataqa beach. 11: Brothers Islands. 12: Belhosse (Bulissar) Island. 13: Daedalus Reef (Abu Kizan). 14: Dhu-n-Nafarik. 15: Dahab. 16: Dibsel Island, Suakin Archipelago. 17: Dungonab Peninsula. 18: Dungonab Bay. 19: El Gouna. 20: Umm-al-Sciora Island. 21: Zuqur Islands. 22: Great Bitter Lake. 23: Gulf of Zula. 24: Hanish Islands. 25: Hamar Island. 26: Harena. Bay of Hawakil. 27: Irafaile. 28: Jebel Tair Island. 29: Kamaran Island. 30: Little Bitter Lake. 31: Zubayr Islands. 32: Maka'aka, Assab. 33: Mukawwar Island. 34: Na'ama Bay/Tiran Island. 35: Nuweiba M'Zeina. 36: Port Tewfik (Bur Taufiq). 37: Ras Abu Soma. 38: Ras Muhammad. 39: Ras Sedr. 40: Ras Umm Hesewa. 41: Rocky Island. 42: Rumayn Island. 43: Sanganeb Atoll. 44: Sasu as-Saghir (Sarad Sarso) Island. 45: Sha'ab Samadai. 46: Sha'ab Satayah. 47: Seven Brothers Islands. 48: Sha'ab Ali. 49: Sha'ab El Erg. 50: Sha'ab Surur. 51: Shumma Island. 52: St. Johns Island. 53: Sumair Island. 54: Zabargat Island. 55: Ras Banas.



dating back to the 18th century, the libraries of the *National Museum of Natural History* in Leiden (now *Naturalis Biodiversity Center*) and the museum of the *Senckenberg Naturforschende Gesellschaft* in Frankfurt/Main, and archives of various institutes were consulted for additional information. Local, largely unpublished reports as well as news items accompanied by photographs or video clips that allowed species identification were also taken into account.

Museum specimens (mainly skeletons and/or skulls) were traced and where possible, their identification and other data were verified by directly studying the specimens or, if not readily accessible, by relying on photographs or publications or personal communications by museum workers or other researchers.

New, original observations were provided in large part through sighting cruises with the participation of the authors. These included:

- Five lengthwise crossings through the Red Sea on board Dutch research vessels on passage to and from the Indian Ocean: 10-13 June 1984 (north-south), 6-11 July 1985, 10-14 March 1993, 30 April-4 May 2000, and 2-7 May 2001 (all south-north) reported by CS and co-observers. During daylight hours, there were constantly one to four observers stationed on various vantage points of the ship; many crew members too, looked out for cetaceans. Bow-riding dolphins were often photographed or video-recorded. Naturally, many dolphins stayed away from the vessel and had to remain unidentified: there was no opportunity to change the ship's course when cetaceans were sighted.

- Twelve surveys in the month of November, between 2003 to 2014, reported by PR. Surveys were made aboard a diving Safari vessel used as platform of opportunity, departing from Sharm El Sheikh and lasting between 11-12 days at sea. Observations were conducted during daylight hours by naked eye combined with scans with 7x50 binoculars. Sighting data included the time, GPS position, species identification, group-size and the presence of calves and/or subadults. Environmental observations were also recorded (Beaufort sea state, visibility, swell height). Photographs were obtained where possible using Canon SLR cameras with 70–300mm lenses. Surveys were limited to dictated diving routes and locations and data was mainly collected within a core study area situated in the coastal waters of the northern Red Sea, where the Gulf of Suez separates from the Gulf of Aqaba. The area includes the Straits of Tiran, Sharm El Sheikh, Ras Muhammad National Park, Straits of Gubal and Sha'ab Ali.

- Data by IMMRAC contain personal observations by the authors as well as second party reports from various sea-going parties (yachtsmen, fishers, Navy, maritime police, dive boats, research vessels, etc.), mostly off Eilat, Israel, compiled by OG, DF and NH, from 1993 and ongoing. When dead stranded animals were reported to IMMRAC's stranding network, a comprehensive *post mortem* examination of the carcass was carried out. Personal observations by the authors were mostly made from platforms of opportunity, sailing on fixed courses. Those included diving safari boats, mainly operating from Sharm El Sheikh, south Sinai, Egypt and sailing between the Straits of Tiran (28° 00.33' N, 34° 28.28' E) to Sha'ab Ali (27° 47.35' N, 33° 52.44' E) and the Straits of Gubal (27°15' N, 33°48' E) (OG during 1993-1996, ME on May-August, 1996, DK on August 2000 and October 2003 and DF between August 2004 - July 2006, including effort data (Feingold 2007)) and yachts participating in the Med-Red Rally, (AS on March 2005, from Tel Aviv to Eilat and back and April 2006, from Tel Aviv to Hurghada, Egypt and back). Some sightings were also made while diving from the Safari boats.

- Data contributed by MC, AC, MF and GNS were collected during two dedicated research projects carried out in Egyptian waters and supported by the Italian Cooperation within the framework of the Italian-Egyptian Debt Swap programme. The first focussed on the spinner dolphin population in Samadai Reef (Marsa Alam, Egypt) and took place in 2005-2006. The research team carried out day-long surveys throughout the year to collect behaviour, movements, and photo-identification data on the dolphin schools encountered within the lagoon of the reef. Occasional boat-based surveys to investigate occurrence and behaviour of marine mammals in other bays and reefs in the region were also carried out. The second project (2010-2014) involved four components: a) boat-based line-transect surveys over a 55 km-wide strip along the Egyptian coast from Marsa Alam to the border with Sudan (about 15,000 km^2, for details on methods see Costa 2015); b) regular monthly surveys in Samadai Reef, intended as a continuation of the previous efforts in Samadai Reef (Fumagalli 2016, Cesario 2017); c) a community-based participatory programme involving the diving community and the tourism sector to gather information on distribution and occurrence of charismatic marine megafauna species in the Egyptian Red Sea Governorate; and d) the HEPCA Stranding Response programme, with the aim to respond to marine mammal stranding reported by members of the public. In case of dead stranded animals, an external and, when possible, an internal examination of the carcass were carried out.

- Information contributed by YTM was collected during his involvement in the Marine Resources Research Division of the Eritrean Ministry of Marine

Resources (2006-2016), during which he coordinated biodiversity surveys in more than 350 islands in Eritrean waters, as well as field surveys aboard foreign industrial shrimp and fish trawlers operating in Eritrean territorial waters, which included recording of incidental catches of megafauna species. Sighting data collected included abundance (number), size (young and adult), distribution (coordinates), and behaviour of cetaceans. In addition, activities included the collection and analysis of marine mammal stranding records along the Eritrean coasts.

Reports by second parties and non-experts were confirmed and included in the review only if verified by photographic material or after interviewing the reporter to the satisfaction of the authors. This validation process was particularly strict for reports of rare species and observations of regular species at unanticipated locations.

Online sharing platforms (e.g. youtube.com, flickr.com) and diving magazines and resources (e.g. taucher.net) were regularly searched for records of cetaceans in the Red Sea. Calls for photographs of cetaceans were sent to amateur divers through personal contacts.

During encounters at sea, species identification by expert observers was in most cases unambiguous, with the exception of some sightings of *Tursiops* and *Stenella* in which the species could not be determined due to unfavourable sighting conditions (distance, poor light, dolphin evasive behaviour).

The different cetacean species were treated in the following pages on the basis of their different levels of abundance in the region, by separating, when possible, information contained in the literature from new data contributed through the authors' personal observations at sea or obtained through second-hand reports. For the species for which abundant data exist (*Grampus griseus, Tursiops aduncus, T. truncatus, Stenella attenuata, S. longirostris, Sousa plumbea*), occurrence details were too long and the new data were stored in the OBIS SEAMAP spatially referenced online database (http://seamap.env.duke.edu). Species for which an intermediate amount of information exists (*Balaenoptera edeni, Megaptera novaeangliae, Pseudorca crassidens*) a table was provided only for the new observations. Finally, in the case of species with very little data (*Balaenoptera omurai, Kogia sima, Orcinus orca, Globicephala macrorhynchus, Steno bredanensis, Stenella coeruleoalba, Delphinus delphis tropicalis*), the available information was presented without a table.

Species accounts

To the best of our understanding, the cetacean fauna of the Red Sea consists of 16 species, nine of which are regular and seven rare, being occasional or vagrants from the near Indian Ocean (Table 1). Their taxonomy, occurrence, distribution and, where available, additional information are described in the following section, "Species known to occur in the Red Sea".

In the section "Species unlikely to occur in the Red Sea" we report on two cetacean species - common minke whale and sperm whale - that are mentioned in the literature as occurring in the Red Sea, but which we believe were based on erroneous identifications.

As mentioned in the introduction to this review, future surveys in areas currently poorly explored may provide further information to confirm, or even increase, the species list and their occurrence habits. In particular, we cannot exclude that more of the Indian Ocean species may visit the southern part of the Red Sea, a data poor area.

Table 1. Cetacean species known to occur in the Red Sea.

Scientific name	Common name	Occurrence
Balaenoptera edeni	Bryde's whale	Regular, infrequent
Balaenoptera omurai	Omura's whale	Rare
Megaptera novaeangliae	Humpback whale	Rare
Kogia sima	Dwarf sperm whale	Rare
Orcinus orca	Killer whale	Rare
Globicephala macrorhynchus	Short-finned pilot whale	Rare
Pseudorca crassidens	False killer whale	Regular, infrequent
Sousa plumbea	Indian Ocean humpback dolphin	Regular in coastal waters
Steno bredanensis	Rough-toothed dolphin	Rare
Grampus griseus	Risso's dolphin	Regular, infrequent
Tursiops truncatus	Common bottlenose dolphin	Regular
Tursiops aduncus	Indian Ocean bottlenose dolphin	Regular in coastal waters
Stenella attenuata	Pantropical spotted dolphin	Regular
Stenella longirostris	Spinner dolphin	Regular
Stenella coeruleoalba	Striped dolphin	Rare
Delphinus delphis tropicalis	Indo-Pacific common dolphin	Regular in southern waters

Species known to occur in the Red Sea

Bryde's whale - *Balaenoptera edeni* Anderson, 1879

Taxonomy and distribution

The taxonomy of the *Balaenoptera edeni* complex is still unresolved, with two taxa provisionally recognized: a larger, mainly pelagic form *B. brydei* Olsen, 1913 with a circumtropical distribution, and a smaller, nearshore form *B. edeni* Anderson, 1879 in the northeastern Indian Ocean and Southwest Pacific. Following Kato and Perrin (2009) and Kershaw et al. (2013), the Committee on Taxonomy (2017) provisionally assigned the two taxa a subspecific status, i.e.: *B. e. brydei* Olsen, 1913 - offshore Bryde's whale and *B. e. edeni* Anderson, 1879 - Eden's whale, respectively. Kershaw et al. (2013) identified only the larger *B. e. brydei* in the waters off Oman, which makes it likely that this is the form occurring in the Red Sea as well. However, pending a genetic study of specimens from the Red Sea, we will just refer to Bryde's whale as *B. edeni* here, leaving open the question of the (sub) specific identity of this population.

Occurrence in the Red Sea

There are several records of baleen whales from the Red Sea. In many cases, the animals could be specifically identified as *B. edeni* (most notably by the diagnostic three longitudinal ridges on the rostrum), testifying that this is the species most commonly found here (Fig. 2). In only one case was a *Balaenoptera* found to belong to another species, Omura's whale *B. omurai* (see under that species).

In the following, records for which a certain specific identification could not be made are included as well; in all cases, the characters observed (size, shape of dorsum and dorsal fin, colouration, behaviour, shape and size of jawbones) were consistent with *B. edeni*. However, it is impossible to determine in retrospect whether whales shorter than c. 12 m were indeed *B. edeni* or may have been *B. omurai*. Future sightings with greater detail will hopefully reveal whether the latter species occurs more often in the area. In the light of our present knowledge, even confusion with a humpback whale *Megaptera novaeangliae* may not altogether be excluded (see under that species).

In the older literature, the smaller baleen whales from the Red Sea and adjacent waters were often recorded as sei whale *B. borealis*, which is reflected in some published global distribution maps. However, a careful review of strandings in the northern Indian Ocean has only revealed the occurrence of Bryde's whale (R.L. Brownell, Jr. in litt.), apart from two recent records of Omura's whale (see below). The maps in Shirihai and Jarrett (2006), Kato and Perrin (2009) and Deméré (2014) leave the Red Sea blank for Bryde's whale.

The first data on the presence of large whales in the

Figure 2. Bryde's whale *(Balaenoptera edeni)* feeding off Jeddah, Saudi Arabia, photographed on 30 September 2011. Photo by: T. Zurita.

Red Sea were published by Forskål (1775), who made an expedition to the region in 1761-1769. He mentions a few specimens of "Balæna" from the northern Red Sea: one measuring "40 uln. long." (40 ells long) [c. 18m!] , washed up "Ante tres annos" (three years ago), no locality given. In the Greek monastery of Tor (At Tur) on the Sinai Peninsula, he was shown a large "*Costam e pisce residuam grandi, ad littora Suensia non ita pridem ejecto*" (a rib from a large fish washed ashore onto the coast of Suez not so long ago), and finally relates that people "*Confirmant exemplo Balænæ in littore ad* Hateban *mortuat, cujus nares insederat Scarus*" (They assured that a specimen of *Balæna* had died on the shore at Hateban, in whose nostrils a Scarus [parrot fish] had settled). Probably, Hateban is Ra's Hatibah north of Jeddah; according to Forskål, people believed that parrot fish often killed whales by penetrating into their nasal tract.

Ehrenberg (1833) too, in a footnote to the second part ("decas") of his work on the mammals of the Red Sea expedition by Hemprich and Ehrenberg in 1819-1823, writes: "Balænæ *Bitān (australis?)* maximæ mandibulas tantum a Mari proiectas in Arabia vidimus" (We have only seen the mandibles of a very large whale *Bitān (australis?)* washed up by the Sea in Arabia). Possibly, Ehrenberg thought that it might have been a right whale.

(Von) Heuglin (1851) describes and illustrates two mandibles of *Balaenoptera* measuring "13 Pariser Fuss" (13 Paris feet) from the coast of Eritrea. He quotes the information reported to him by Mr de Goutin, the French consul at Massawa, who reported the species from the southern part of the Red Sea, particularly in deep water off the Dahlak Archipelago, Eritrea, and who gave some interesting accounts of its feeding behaviour. (Von) Heuglin and Fitzinger (1866) applied the name "*Balaenoptera (Lacep.) Forskåli* Heugl." to these whales; apart from their occurrence in the southern Red Sea, they mention an animal said to have stranded "Vor einigen Jahren" (A few years ago) near Suez. (Von) Heuglin (1877) gives a more extensive account, now using the name "*Balaenoptera Bitan* (H. and Ehr.)". He states that the species is at most 40 feet (c. 12 m) long, is not common and becomes stranded here and there on the coasts of the Red Sea; he often saw its bones as relics on graves and in places of worship. (Von) Heuglin himself encountered the whales only in the southern part of the Red Sea, "gewöhnlich zwischen inselreichen Buchten" (usually in island-strewn bays), as single animals or in groups of 3-6. Finally, Klunzinger (1878) observed a "riesiger Walfisch" (giant whale) swimming about for nearly a week off Kuseir (Qusair), Egypt, but was not even sure whether this was a baleen or a sperm whale.

As has been emphasized above, the specific identity of all these animals remains unconfirmed, but the measurements and illustration given by (Von) Heuglin (1851, 1877) agree with those of Bryde's whale.

The first well-documented record of a rorqual in the Red Sea is of an animal washed ashore near Tor (At Tur), on the Gulf of Suez side of the Sinai Peninsula, in April 1893 (de Winton in Anderson 1902). The lower jaws and postcranial skeleton were collected by Anderson and donated by his widow to the British Museum (Natural History) in London (BM 1905.12.12.7: R.C. Sabin, pers. comm.). De Winton identified it as "probably a specimen of *B. edeni*, Anderson, the Lesser Indian Fin-Whale, …" estimating that the animal had been "somewhat over forty feet in length" (c. 12 m). Strangely, Flower (1932) does not mention de Winton's identification and only refers to a "Fin-Whale". It was included with *B. edeni* again by de Silva (1987).

On 5 January 1950, a c. 12 m long baleen whale became washed up on Ataqa beach near Suez, Egypt. The animal was in an advanced state of decomposition, with the mandibles sticking out sideways from the carcass like huge tusks, greatly puzzling the local inhabitants. Photographs and press reports of this "sea monster of Suez" were published worldwide. The animal was first identified as "probably a sei whale" (Anon. 1950), but the photographs clearly show the three longitudinal ridges on the head, characteristic of *B. edeni.* Possibly, the animal or the carcass had been hit by a tanker (Laist et al. 2001), but this is not substantiated.

Roghi and Baschieri (1956) report on what they thought were four large sperm whales, observed in the shallows of the Red Sea off southern Eritrea, "… wildly chasing legions of bonitos, tunny and mackerel which were in turn following swarms of sardines". Such behaviour is more consistent with that of balaenopterid whales, which unlike sperm whales are known to prey on fish schools and occasionally venture into very shallow waters.

Slijper et al. (1964) mapped several sightings of "rorquals" for the southern Red Sea, but without any documentation and without speculating about the identity of the animals; in his more detailed maps showing the records by month (p. 67-71), however, the Red Sea is left blank.

Leatherwood (1986) mentions a stranding of a minke whale *B. acutorostrata* c. 20 km south of Jizan, Saudi Arabia, in May 1969 (see under that species); in the absence of further documentation, we regard this as a misidentification of Bryde's whale.

Neve (1973) reports on a whale carcass found by the end of 1972 in a shallow bay "about a mile south of the Petromin refinery", in the southern outskirts of Jeddah, which he identified as a young female Bryde's whale; we speculate that this may have been a stillborn individual, given that the reported length (3 m) is smaller than the known length at birth (4 m: Kato and Perrin 2009) for this species. This author also refers to a number of Bryde's

whale strandings and sightings along the Saudi Arabian Red Sea coastline in previous years (no dates specified), reported by the Saudi naturalist Hamad Aiidi. These include the possible stranding of an animal near Al-Wajh harbour, Rayyis anchorage (some 250 km north of Jeddah) and another in Al-Shu'aibah anchorage (100 km south of Jeddah); the stranding of a "15-foot" specimen in the Qishran area north of Al-Lith, and another carcass floating near the marine research station north of Jeddah. On 28 October 1979, a 14 m long animal, again decomposed, was found near Al Hudaydah in Yemen. The skeleton was collected for the University of San'a', where Robineau (1981) identified it as *B. edeni*. Charles Sheppard observed two of a group of 3-4 baleen whales which had stranded in the Farasan Archipelago and on the adjacent Saudi Arabian mainland, in the winter of 1989/90. The animals were in an advanced state of decay, and not readily identified. However, their length (8-12 m) and visible characteristics and remaining colour pattern suggest that they were Bryde's whales (Sheppard et al. 1992), though this cannot be confirmed.

Gladstone and Fisher (2000) were the first to report three sightings of live animals around the Farasan Islands, between October 1993 and March 1996, in water >50 m deep. They also mention two strandings: one on the mainland coast, c. 45 km south of Jizan, in September 1993 (length 15 m) and one on Rumayn Island in January 1996 (length >10 m). Sightings of isolated whales west off Sirray Island, Farasan Bank, Saudi Arabia in April 2009 were reported by Al-Mansi (2009). The presence of the species off the southern Saudi (Farasan Islands) and Yemeni coasts is also mentioned in Scott's (1995) Directory of wetlands in the Middle East.

Bryde's whales are apparently occurring with a higher frequency in Eritrean waters than in most other Red Sea locations, based on a list of occurrences (strandings and sightings) from Eritrea reported by Abraha et al. (2008), to which we add new observations reported by YTM.

New observations

In Table 2 we include 14 new occurrences (11 confirmed as *B. edeni* and 3 for which species identification is tentative) that have been reported from various localities in Egypt, Israel, Saudi Arabia and Eritrea, testifying to the wide, albeit sparse distribution of these whales in the region (Fig. 3). One individual observed twice on 10 July 2012 off Shalatin was spotted six days later near Abu Fandira, about 80 km south. Identification was based on recognisable marks on the dorsal fin.

Remarks

Information on the presence, abundance, seasonality, distribution, habitat use, behaviour and biology of *B. edeni* in the Red Sea is still fragmentary and anecdotal.

Most of the reported sightings have been made in coastal and reef areas; however, this may be due to observer bias rather than to ecological characteristics of the species. It is possible that there are specific areas within the Red Sea where Bryde's whales occur regularly, as can be inferred from Gladstone and Fisher's (2000) observations in the Farasan Islands and from records in Eritrean waters. Fishermen off the southern Egyptian town Shalatin report that whales, most probably Bryde's whales, are seasonally observed in their area during summer (I. El Sadek, pers. comm.), and it seems likely that in the future, similar information will be obtained for other areas, as local knowledge increases.

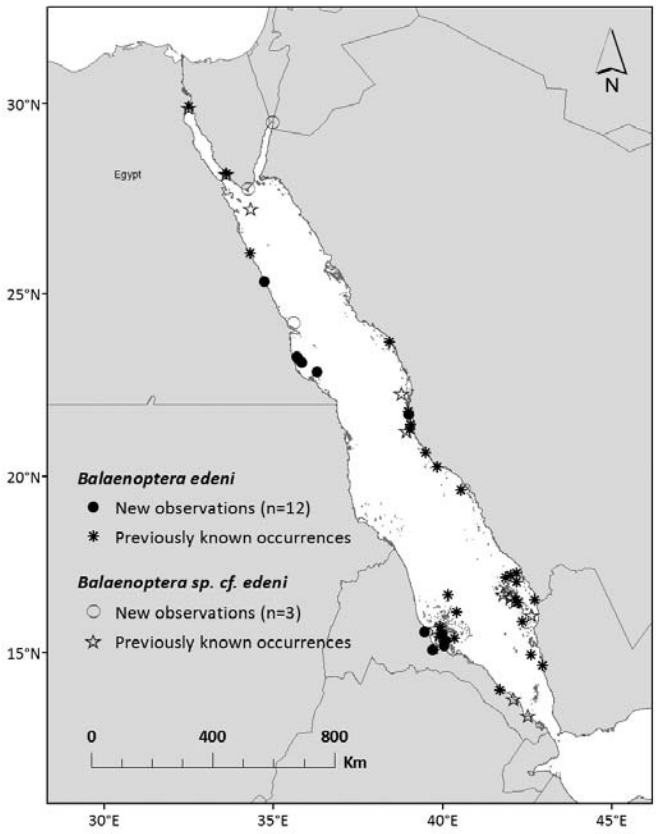
Several observations are of animals likely that appeared feeding on small schooling fish, a type of behaviour that is consistent with observations elsewhere (e.g., Kato and Perrin 2009) and, more specifically, for Bryde's whales caught in the Arabian Sea by the Soviet whaling fleet (Mikhalev 2000). As expected (Kato and Perrin 2009), Bryde's whale in the Red Sea has mostly been sighted singly or in groups of two. With the exception of the report by Neve (1973) of a very small specimen found dead in Saudi Arabia, there is no evidence yet of the species' breeding in the Red Sea, though it seems likely that it occurs. Bryde's whales are (or at least were) commonly seen in the Arabian Sea, such as off Oman (Baldwin et al. 1999). More significantly, during illegal Soviet whaling operations between 1963 and 1967, they were caught in large numbers in the Gulf of Aden, along the coasts of both Somalia and Yemen (Mikhalev 2000). In view of the above and in the absence of information to the contrary, we suppose that the occurrence of the species in the Red Sea and Indian Ocean is contiguous, though nothing is known about movements between the two areas. At present, we have no data on possible negative factors that may affect the status of Bryde's whale in the Red Sea.

Table 2. New records of *Balaenoptera edeni* (including tentative identifications) from the Red Sea since 1999.

Date	Locality	Details	Reported by	Notes
1999	Shumma Island, **Eritrea** 15° 32' 33.7" N, 39° 59' 15.4" E	14 m long, museum-mounted skeleton of stranded whale	Northern Red Sea Regional Museum of Massawa	
2006	Bay of Eilat, near **Israeli/Jordan** border	Sighting of 1, 6-7 m long	Reported by E. Mitzpe to IMMRAC	Tentative species identification
13 March 2007	Marsa Mubarek, **Eritrea** 16 °43'42" N 39 °07'38" E	Adult approached at 6 m from vessel	YTM and S. Zeremariam	Tentative species identification
11 Dec. 2007	Irafaile, Gulf of Zula, **Eritrea** 15° 5' 16.9" N, 39° 43' 17.48" E	Stranded, 12.5 m long	Goitom et al. 2007, unpublished	Authors report on similar cases having occurred at Irafaile and Shumma in 1995 and 1998.
Aug. 2008	Off Shalatin, **Egypt**	Sighting of 2	M. Fouda, EEAA	Video documentation
Apr. 2009	Off Abu Dabab, **Egypt**	Sighting of 1	Diving Ocean, Hurghada	Photographic documentation
8 Jan. 2009	Harena, Bay of Hawakil, **Eritrea** 15° 13' 24.7" N, 40° 3' 27.34" E	Stranded, 10 m long	YTM and S. Zeremariam	Photographic documentation
10 Aug. 2009	South Sinai, **Egypt**	Stranded, >10 m long	M. Fouda, pers. comm.	Tentative species identification based on photographic documentation
30 Sep. 2011	Off Jeddah, **Saudi Arabia**	Sighting of 1, clearly engaged in surface feeding	Reported by T. Zurita to M. Khalil and M. Costa	Photographic documentation (see Fig. 2)
10 July 2012	Off Shalatin, **Egypt**, in the following locations: 23° 15' 04" N, 35° 44' 25" E; 23° 18' 08" N, 35° 42' 51" E; and 23° 18' 47" N, 35° 42' 50" E	3 separate sightings made within a 1.5h period: first 2 individuals, then one, and finally another, the latter likely to have been amongst the first two	I. El Sadek, HEPCA	Photographic documentation
16 July 2012	Off Abu Fandira reef, **Egypt** 22° 54' N, 36° 17' E	Sighting of 1, swimming southward	HEPCA	Re-sighting of one of the 2 whales seen twice on 10 July 2012 (identified by pictures of the dorsal fin)
25 Sep. 2012	Fury Shoals, **Egypt** 24° 12' 58" N, 35° 31' 35" E	Sighting of 1, presumed feeding	E. Ibrahim	Tentative species identification based on video posted on youtube.com

Date	Locality	Details	Reported by	Notes
14 Oct. 2014	Degebta (5 km North of Harena), Bay of Hawakil, **Eritrea** 15° 16' 41.62" N, 40° 3' 13.00" E	Stranded, 12 m long	YTM and H. Hailemichael	Photographic documentation
26 Dec. 2016	Massawa Salt Work, Massawa, **Eritrea** 15° 37' 0.25" N, 39° 28' 24.44" E	Stranded, 14 m long	T. Mengstu and H. Hailemichael	Photographic documentation

Figure 3. Observations of confirmed and presumed Bryde's whales (*Balaenoptera edeni*) in the Red Sea.



Omura's whale - *Balaenoptera omurai* Wada, Oishi and Yamada, 2003

Taxonomy and distribution

Omura's whale has recently been recognized and described as a valid species, based on solid morphological and genetic evidence. Previously, the animals were regarded as a small form of Bryde's whale *Balaenoptera edeni* (Rice 1998, Jefferson et al. 2015).

Omura's whale is found in tropical to warm-temperate waters in the western Pacific Ocean and Indo-Pacific region. It probably occurs throughout the (sub)tropical Indian Ocean, as the species has been discovered and studied off Madagascar (Cerchio et al. 2015), and there is one well-documented record of an animal stranded in September 2007 on Qeshm Island, Iran, in the Strait of Hormuz (Ranjbar et al. 2016). However, many details of the species' distribution and ecology are still unknown. Recent strandings in the Atlantic Ocean, in Mauritania (Jung et al. 2016) and Brazil (Cypriano-Souza et al. 2016), suggest that Omura's whale might have a much wider tropical distribution.

We here report on the first observation of *B. omurai* in the Red Sea.

Occurrence in the Red Sea (new observation)

On 20 April 2009, a single individual was sighted between Ras Abu Soma and Ras Umm Hesewa, Safaga, Egypt (26° 53' N, 34° 00' E; Fig. 4). It was originally reported as Bryde's whale, but videos taken by Daniel Balke (http://bit.ly/2jdeuPc) and photographs taken by Martin Marienhagen allowed species identification on the basis of the following characters: a) overall small size; b) rostrum bowed at mid-point rather showing a nearly straight profile as in *B. edeni*, and with only one well-defined medial ridge (Fig. 5a); c) whitish colouration of the right mandible (Fig. 5b); d) lightly pigmented chevron on right side between flipper insertion and posterior edge of lower jaw, present on both sides but asymmetrical and most prominent on the right side (Fig. 5a); and e) dorsal fin strongly falcate, but proportionally smaller than in *B. edeni* (Fig. 5c). See Jefferson et al. (2015) and particularly Cerchio et al. (2015) for descriptions and photographic documentation of the differences between *B. omurai* and *B. edeni*.

Although going by the present data, Omura's whale seems a vagrant in the Red Sea and adjacent waters, it cannot be altogether excluded that one or more baleen whales listed above under *B. edeni* have in fact been *B. omurai*.

Figure 4. Observation of Omura's whale (*Balaenoptera omurai)* in the Red Sea.

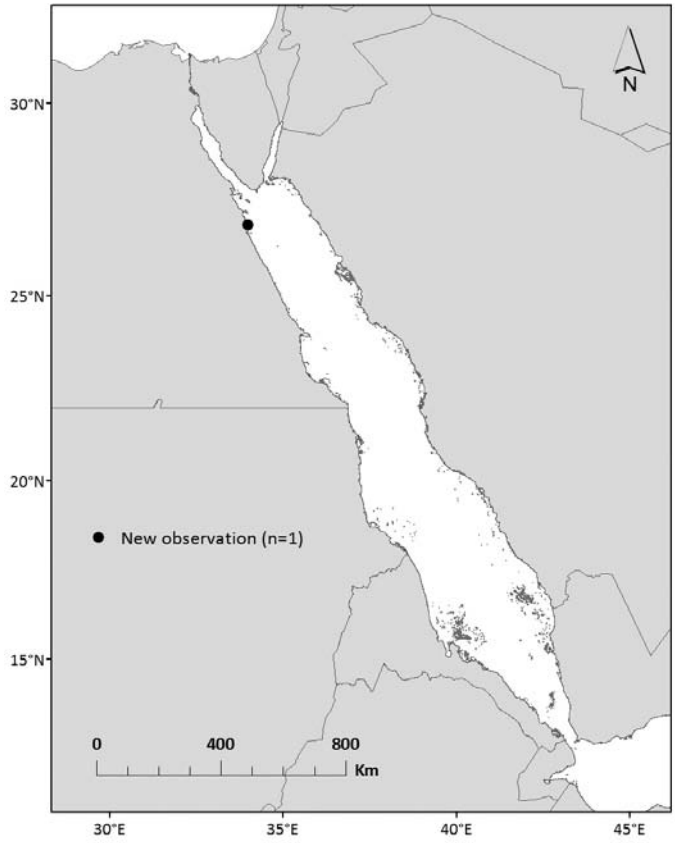
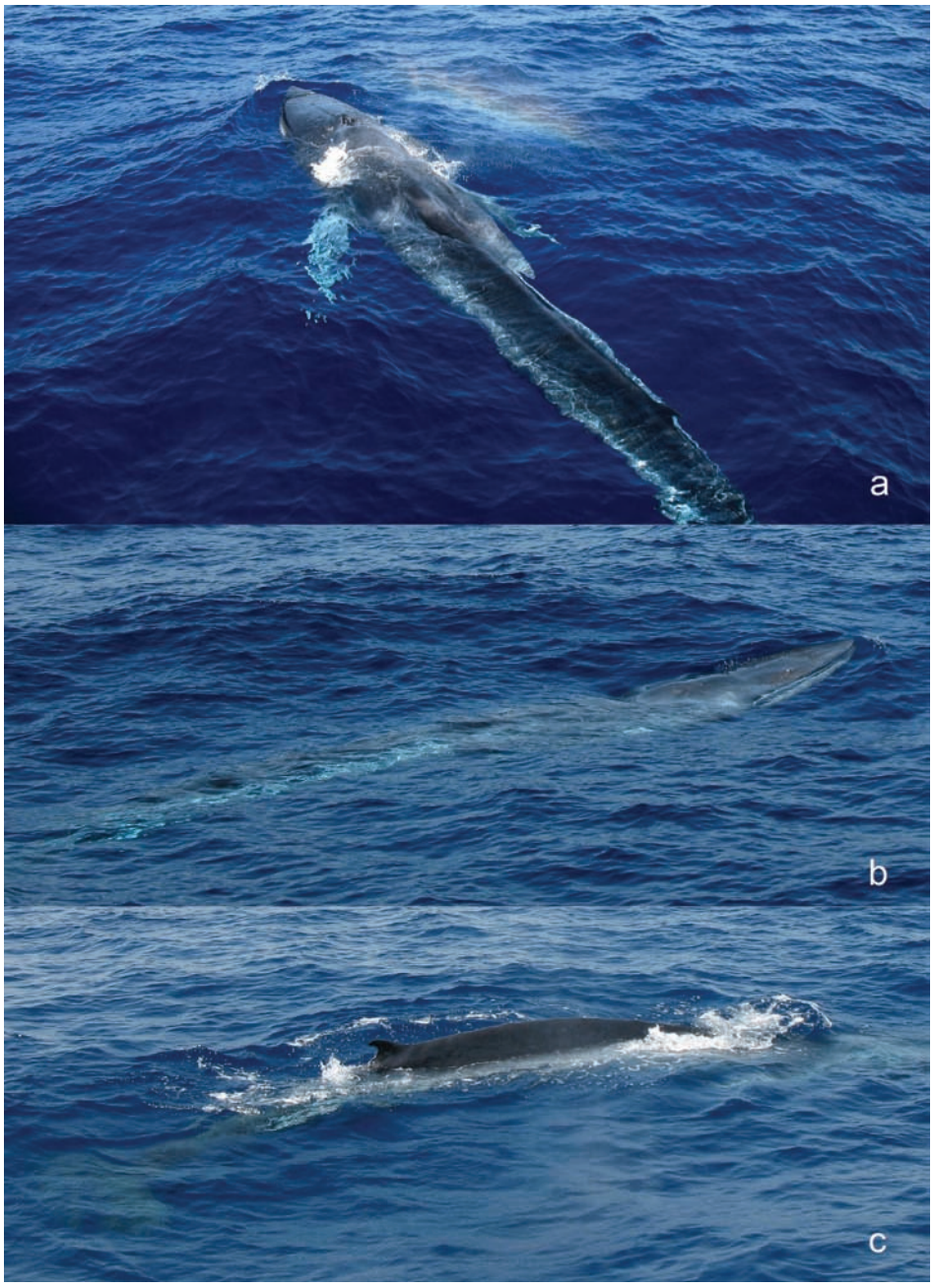


Figure 5. A single individual of Omura's whale (*Balaenoptera omurai*) sighted on 20 April 2009 between Ras Abu Soma and Ras Umm Hesewa, Safaga, Egypt (26° 53' N, 34° 00' E). Photographs by: M. Marienhagen.



Humpback whale - *Megaptera novaeangliae* (Borowski, 1781)

Taxonomy and distribution

The humpback whale has a cosmopolitan distribution and is found in all ocean basins (Deméré 2014, Jefferson et al. 2015). Until recently, the species has been regarded as monotypic. Based on genetic evidence, however, Jackson et al. (2014) identified three potential subspecies: *Megaptera n. novaeangliae* (Borowski, 1781) in the North Atlantic, *M. n. kuzira* Gray, 1850 in the North Pacific, and *M. n. australis* (Lesson, 1828) in the Southern Hemisphere.

In the Arabian Sea, between Arabia and Sri Lanka, there is an isolated, distinct population of non-migratory humpback whales, which may well merit subspecific status; in that case, the name *M. n. indica* (Gervais, 1883) would apply. Its existence was already suspected by Winn and Winn (1985) and Whitehead (1985) and has been further documented by Reeves et al. (1991), who argue that these animals are resident, not migrants from the Southern Hemisphere population. Data from illegal Soviet whaling in 1965 and 1966 off Oman, Pakistan and NW India revealed by Mikhalev (1997, 2000) have made clear that these humpbacks differ from the SH population in external characters, breeding season (adhering to a Northern Hemisphere breeding cycle) and pathological details. A research project off the coast of Oman (Minton et al. 2011, 2015) confirmed the special status of this population, which is now recognized by the International Whaling Commission (2011) as the Arabian Sea humpback whale population and with the status of 'endangered' in IUCN's Red List (Minton et al. 2008). Pomilla et al. (2014) conducted a genetic study of animals sampled off Oman and concluded that the Arabian Sea (AS) population is highly distinct and has been isolated for approximately 70,000 years. Based on an effective population size off Oman of ~100 animals (as derived from microsatellite data), the authors recommend that its status be revised to 'critically endangered'.

Occurrence in the Red Sea

The occurrence of humpback whales in the Red Sea has only recently been confirmed and records are still scarce. Baldwin et al. (1999) mention only one sighting in the Red Sea by P. Vine, without documentation and hence regarded here as unconfirmed. The first well-documented sighting was made by B. Vogel, who encountered an animal of c. 7 m in length on 2 September 1992, in water 15 m deep, while diving at 'The Canyon' diving site near Dahab, western (Sinai) coast of the Gulf of Aqaba (Lat. 28°33'29"N, Long. 34°31'26"E; B. Vogel, pers. comm.; Fig. 6). Photographs of this animal have been published by Debelius (1998); it is also mentioned by Hoath (2003). Judging by its size, this whale would have been a yearling at most (R. Baldwin and T. Collins, pers. comm.).

Al-Mansi and Sambas (2006), Hagan (2006) and Bruckner (2011) report on a humpback whale observed

Figure 6. Humpback whale (*Megaptera novaeangliae*), 7m in length, sighted on 2 September 1992, in water 15 m deep, while diving at 'The Canyon' diving site near Dahab, western (Sinai) coast of the Gulf of Aqaba (28° 33' 29" N, 34° 31' 26" E). Photo by: B. Vogel.

in May 2006 in waters approximately 100 m deep, west of Sasu as-Saghir (Sarad Sarso) Island, at 16°52' N 41°36' E, in the Farasan Archipelago, Saudi Arabia. However, no description, photographs or video recording of this sighting exists and we regard this record as unconfirmed.

New observations

Since the 1992 event, nine more sightings have been reported between 2006 and 2016, including a mother and calf pair, all of them having occurred between April and October. All sightings are from the northern section of the Red Sea: six off southern Egypt, two near the tip of the Sinai Peninsula and one in the northernmost reach of the Gulf of Aqaba, off Eilat (Table 3 and Fig. 7).

Remarks

The origin of the Red Sea animals is enigmatic. With most sightings occurring during or close to the austral winter, the Arabian Sea as well as Southern Hemisphere populations, or indeed both, are potential sources. Photographic and video material of the humpback whales encountered in the northern Red Sea, especially since not showing details of the flukes, does not allow to determine whether these animals match catalogued individuals belonging to either population. The size of the smaller of the two animals documented in September 2011, however, would fit a calf born in the main calving period (February-March) of the Arabian Sea population (R. Baldwin and T. Collins, pers. comm.). Animals of that population are geographically closer to the Red Sea entrance. At least up to the 1960s, humpback whales resided in the Gulf of Aden during the northern winter and were the first to fall victim to the illegal Soviet whale factory ships, which steamed out of the Red Sea during the night (Mikhalev 1997). More recently, the westernmost record of the Arabian Sea population is an animal satellite-tagged off Oman in March 2015, which moved west into Yemeni waters at the entrance to the Gulf of Aden in July and was still there when the tag stopped transmitting in August (Willson et al. 2016).

The other possibility holds that (some) animals in the northern Red Sea may be vagrants belonging to a Southern Hemisphere population (most likely stock C as identified by the International Whaling Commission). Such animals would have to travel much further, as apparently, the northern limit of the winter migration of this stock does not normally extend beyond East African

Table 3. New records of *Megaptera novaeangliae* from the Red Sea.

Date	Locality	Details	Reported by	Notes
20 Jan. 2006	Sharm El Sheikh, **Egypt**	Sighting of 2 adults	Hatem Sanyeldin	Photographic documentation
Summer 2006	Abu Ramada, Hurghada, **Egypt** 27° 21' N, 33° 58' E	Sighting of 1	B. Kledt	Photographic documentation
13 Oct. 2006	Marsa Bareika, Sharm el Sheikh, **Egypt** 27° 53' N, 34° 21' E	Sighting of 1	Anonymous	Identification based on video posted on youtube.com
16 Apr. 2009	Hurghada, **Egypt**	Sighting of 1	S. Kazan	Photographic documentation
25 Apr. 2009	Sha'ab Saiman, Hurghada, **Egypt**	Sighting of 1	Anonymous	Identification based on video posted on youtube.com
12 Sep. 2011	Magawish Island, Hurghada, **Egypt** 27° 09' N, 33° 52' E	Sighting of 2, one adult and one juvenile	S. Caramelle	Photographic and video documentation (see Fig. 8)
12 Apr. 2012	Off Eilat, **Israel**	Sighting of 1	Anonymous	Video documentation
25 Sep. 2016	South of Qusair, **Egypt** 26° 01' N, 34° 19' E	Sighting of 1	A. Ghallab	Underwater video documentation (see Fig. 9)
2 Oct. 2016	Wadi El Gemal area, **Egypt** 24° 41' 19" N, 35° 05' 15.5" E 35°05'15.52"E	Presumably same individual as above, estimated size 12 m	K. Ehlart	Underwater photographic and video documentation

waters (sub-stock C1-N: Amir et al. 2012, International Whaling Commission 2011), though there may be some overlap with the Arabian Sea population. The sightings of humpback whales published by Brown (1957) off the Somali coast of the Gulf of Aden and all records (except one of calves) reported by Slijper et al. (1964) for the months November-January are within or near the borders of the assumed range limits of the Arabian Sea population. It should be noted, however, that recent (albeit limited) tagging studies show Southern Hemisphere members in wintering grounds (Cerchio et al. 2016) to be much more active and far-reaching travellers than Arabian Sea counterparts (Willson et al. 2016). The northernmost confirmed record of an animal of the C1-N sub-stock is of a male tagged off Ile Sainte-Marie, NE Madagascar, on 24 July 2012 and followed for over 2,800 km to southern Somalia as far as 2°59.9' N. The whale was still travelling at a steady speed of 150 km/day when the tag stopped transmitting on 24 August 2012 (Cerchio et al. 2016). One other point may speak in favour of Southern Hemisphere vagrancy into the Red Sea. The most recent Red Sea sighting, in September-October 2016, showed a whale with a bright white underside and flanks, a white dorsal surface on the pectoral fins and a lot of barnacle scars on flippers and flanks (Fig. 9), all being typical of Southern Hemisphere populations, and rather unusual of the Arabian Sea population (Gianna Minton, pers. comm.).

In conclusion, based on the limited available information, humpback whales seem rare in the Red Sea and may represent animals that occasionally enter the Straits of Bab al Mandab and proceed all the way to the northern end of the Basin. Pending genetic studies, the origin of the Red Sea animals remains uncertain.

Figure 7 (left). Observations of humpback whales (*Megaptera novaeangliae*) in the Red Sea.
Figure 8 (right). Sighting of two humpback whales (*Megaptera novaeangliae*), adult (top) and juvenile, on 12 September 2011 in Magawish Island, Hurghada, Egypt (27° 09' N, 33° 52' E). Photo by: S. Caramelle.

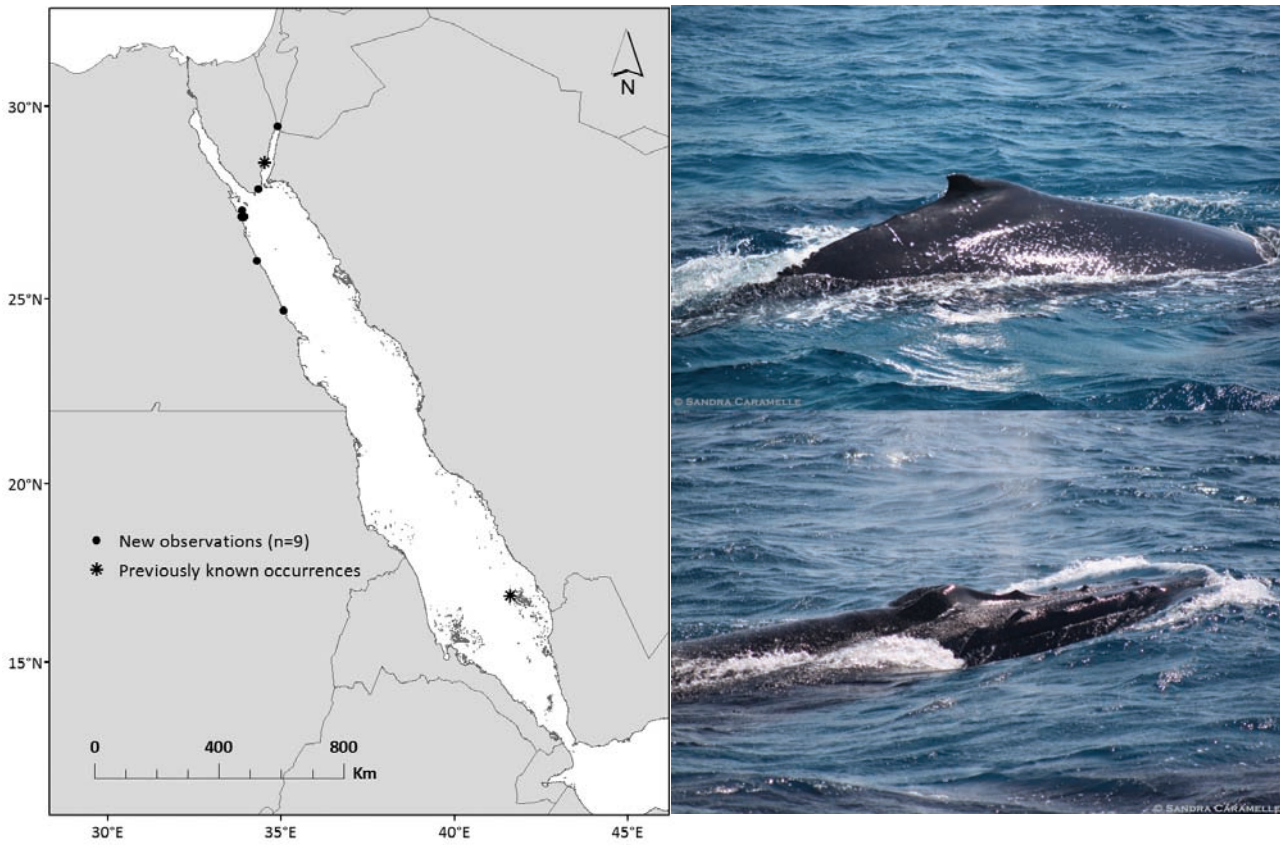


Figure 9. Humpback whale (*Megaptera novaeangliae*), app. 12m long, sighted in September 2016 at al-Zerib al-Kabir area, 10 kilometers south of the town of Qusair, Egypt. Photo by: A.G. Nabil

Dwarf sperm whale – *Kogia sima* (Owen, 1866)

Taxonomy and distribution

At present, two species of Kogia are recognized: pygmy sperm whale *Kogia breviceps* (Blainville, 1838) and dwarf sperm whale *K. sima* (Owen, 1866). Originally described as *Physeter simus* and later transferred to the genus *Kogia Gray,* 1846, the species has long been known as *K. simus*, but the specific name has correctly been changed into *sima*, to make it agree in gender with the generic name *Kogia*, which is to be treated as feminine (Rice 1998). Both pygmy and dwarf sperm whales have a worldwide distribution in tropical to warm-temperate waters and occur largely sympatrically, with the dwarf sperm whale penetrating less far into colder waters than the pygmy sperm whale (McAlpine 2014, Jefferson et al. 2015).

The dwarf sperm whale differs from the pygmy sperm whale in several morphological characters, such as total length (smaller in *K. sima*), the size and position of the dorsal fin (higher and more centrally placed in *K. sima*), and the number of teeth in the lower jaw (8-10 in *K. sima*, generally 12-16 in *K. breviceps*). A recent analysis of mitochondrial DNA in both *Kogia* species has revealed the existence of two clades of *K. sima*: one in the Atlantic Ocean and one in the Indo-Pacific, which could differ specifically (Chivers et al. 2005). Pending further research, *K. sima* is still treated as monospecific.

Dwarf sperm whales are widely distributed, particularly over continental shelf and slope waters of all oceans. In the western Indian Ocean, the species occurs from South Africa to the Arabian Sea and Gulf of Oman (Ballance and Pitman 1998, Baldwin et al. 1999, McAlpine 2014, Jefferson et al. 2015). It is generally considered uncommon throughout its range, probably due to the fact that the animals are difficult to observe at sea; they are mainly known from strandings.

Occurrence in the Red Sea (new observation)

So far, the presence of the dwarf sperm whale in the Red Sea has been documented by a single adult specimen (sex unknown) stranded on Maka'aka beach north of Assab, Eritrea (13°03'16" N 42°40'23" E), on 30 October 2010 (Fig. 10). Identification at the species level was based on size and shape of the dorsal fin and on the number of teeth in the mandible (Fig. 11, 12). The existence of a single record and the proximity of the stranding site to the Straits of Bab al Mandab could be an indication that *K. sima* may only be a vagrant in the Red Sea. Future research should reveal whether the dearth of information on the species in the region is due to ecological reasons or to the difficulty of sighting the animals at sea, combined with a lack of expert monitoring in the area.

Figure 10. Observation of dwarf sperm whale (*Kogia sima*) in the Red Sea.

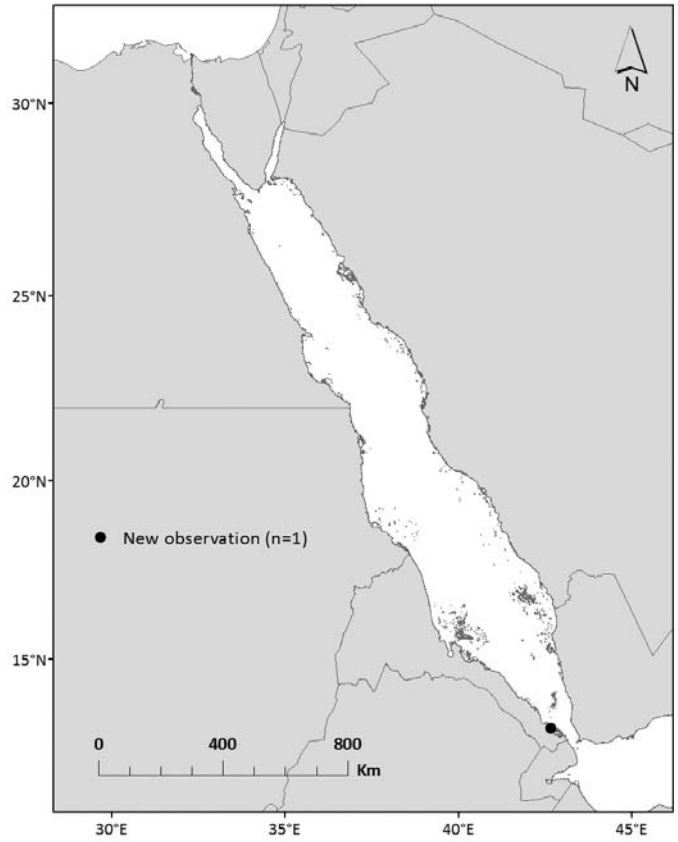


Figure 11. Dwarf sperm whale (*Kogia sima*). Adult (sex unknown) stranded on Maka'aka beach north of Assab, Eritrea (13° 03' 16" N, 42° 40' 23" E), on 30 October 2010. Identification based on size and shape of dorsal fin and number of teeth in the mandible (see fig 12). Photo by: K. Uombuda.

Figure 12. Dwarf sperm whale (*Kogia sima*). Adult (sex unknown) stranded on Maka'aka beach north of Assab, Eritrea (13° 03' 16" N, 42° 40' 23" E), on 30 October 2010. Identification based on size and shape of dorsal fin and number of teeth in the mandible (see fig 11). Photo by: K. Uombuda.

Killer whale - *Orcinus orca* (Linnaeus, 1758)

Taxonomy and distribution

The genus *Orcinus* is generally treated as monotypic, with one cosmopolitan species. However, intensive studies in the Northeast Pacific, North Atlantic and in New Zealand and Antarctic waters have revealed the existence of several distinct populations or "ecotypes" which occur sympatrically without being in contact. These forms differ in external characters, sound ('dialects'), behaviour, ecology and genetic characters, and may be regarded as incipient species or perhaps deserve full specific status (Pitman et al. 2011, Wang et al. 2014, Jefferson et al. 2015). The populations in the (sub) tropical oceans have not been studied in this respect, and the taxonomic status of killer whales in the northern Indian Ocean is as yet unknown.

Killer whales (also known as "orcas"), all types taken together, have the widest distribution of all marine mammals, ranging from the tropics to the Arctic and Antarctic Oceans and occurring in many semi-enclosed seas. They are most common in waters of high productivity, in coastal areas or over continental shelves (Ford 2009, Wang et al. 2014). The species is known to occur in the northwestern Indian Ocean including the Gulf of Aden (Robineau and Rose 1984, Leatherwood et al. 1991, Small and Small 1991, Ballance and Pitman 1998, Baldwin et al. 1999, CS and co-observers, unpublished record). A 'NIO killer whale ID catalogue' is being maintained by the Northern Indian Ocean Killer Whale Alliance (NIOKWA): http://niokillerwhales.wix.com/niokwa).

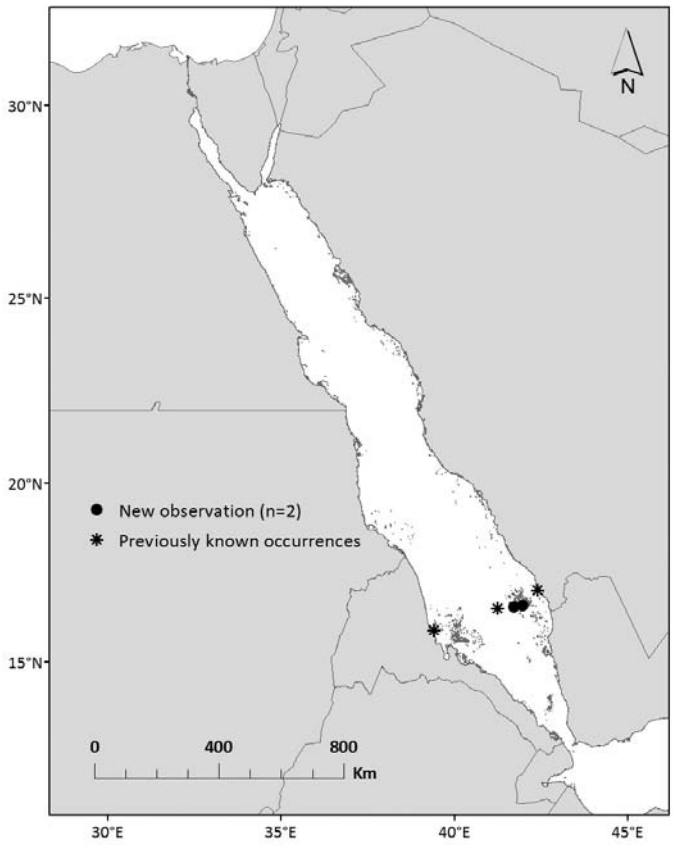
Occurrence in the Red Sea

Evans in Frazier et al. (1987) writes that the killer whale has been recorded occasionally in the Red Sea, "mainly in summer", a statement repeated by Baldwin et al. (1999) who plotted an undocumented, possibly haphazard, locality on their map on p. 167. No details or sources were given, but nonetheless Evans supposed that the species is "probably more regular than the records suggest." Gladstone and Fisher (2000) report that local fishermen had seen killer whales, recognized from illustrations, on two occasions in the Farasan Marine Protected Area, Saudi Arabia: in 1992 off Sumair Island, in 1994 off the Abalat Islands.

We hereby report on three more-recent sightings in the southern Red Sea. The first concerns a pod of six killer whales (including a large adult male and a mother with calf), seen and photographed on 6 May 2004 by the crew of the 'Odyssey', 10 km off the Eritrean coast, in water of c. 30 m deep (Johnson 2004a) (Fig. 13, 14). Four individuals from this pod have been included in the NIO killer whale ID catalogue (http://bit.ly/2p8qKn6); so far, no matches could be made with individuals from 14

Figure 13. Mother and calf killer whales (*Orcinus orca*), part of a pod of six seen and photographed on 6 May 2004 by the crew of the 'Odyssey', 10 km off the Eritrean coast, in water of c. 30 m deep. Photo by C. Johnson.

Figure 14. Observations of killer whales (*Orcinus orca*) in the Red Sea.



other catalogued pods outside the Red Sea (Georgina Gemmell, pers. comm.).

New observations

The two other sightings, both from the Farasan Islands, were retrieved from video clips uploaded on the net and from related posted news items (Fig. 14). The first was made in February 2015 by two border guards, Wahib Abu Rasin and Khaled al-Amiri, while on a regular mission about 5 km west of the Islands. They sighted and photographed a group of killer whales travelling at high speed, but details on group size and composition are lacking as the original video is no longer available on the net. A short clip of a single male (http://bit.ly/2p93THR), however, confirms species identification. The second sighting was made by fishermen on January 2017, off the island of Salubha (16° 35′ 38.13″ N, 41° 58′ 55.82″ E). The video (http://bit.ly/2jKMvXd) shows a group of 3-4 milling animals, including a male and a small individual, either a calf or a young juvenile. A reasonably clear view of the male's fin did not appear to match any from the current NIO catalogue (Georgina Gemmell, pers. comm.).

Remarks

Given the fact that killer whales are impressive and conspicuous animals which are easily spotted, the apparent absence of the species from the northern Red Sea and its rarity in its southern reaches supports the view that it is a rare visitor from the Indian Ocean.

False killer whale - *Pseudorca crassidens* (Owen, 1846)

Taxonomy and distribution

The genus *Pseudorca* is monotypic and cosmopolitan. Although Kitchener et al. (1990) describe some cranial differences between various populations, none of those appears sufficient to distinguish different (sub)species, and the form *P. meridionalis* (Flower, 1864) described from Tasmania and applied by Deraniyagala (1945) to animals from Ceylon, is no longer recognized (Stacey et al. 1994, Rice 1998).

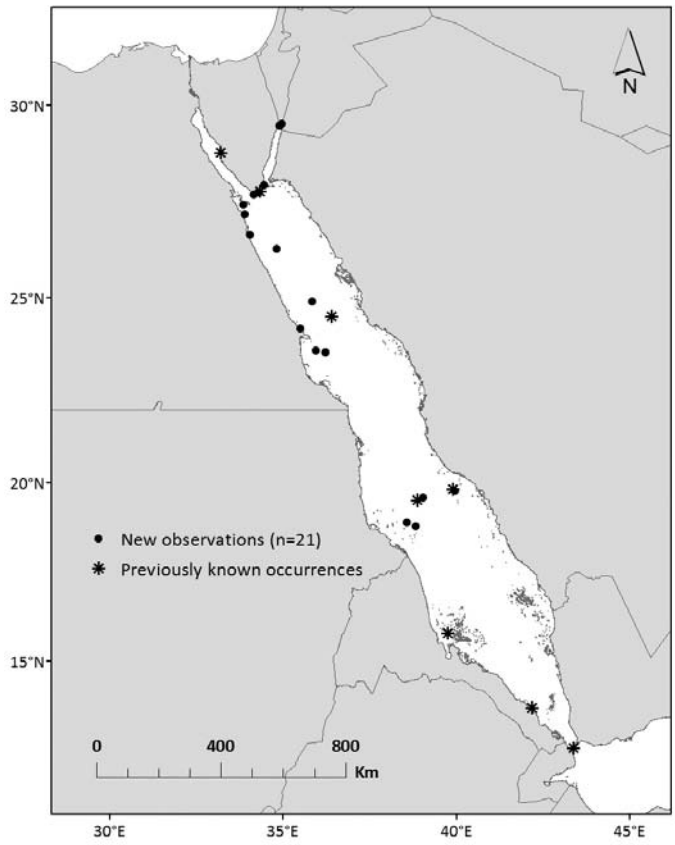
False killer whales occur worldwide in tropical to warm-temperate oceans and several adjacent seas. The species is most common in deep oceanic waters, but often occurs over continental shelves or even penetrates into coastal waters (Wang et al. 2014, Jefferson et al. 2015).

Occurrence in the Red Sea

An Italian expedition to the Dahlak Archipelago, Eritrea, reported a sighting of 16 "pilot whales" off Dur Gaam Island in 1952 (Roghi and Baschieri 1956). The photographs (Fig. 16 in the cited book), however, clearly show on the basis of the shape of the dorsal fin and rostral profile that the animals were false killer whales. This is the earliest documented record of this species within the Red Sea.

The next sighting is of 15 December 1981, when Alling (1986) recorded a group bow-riding in the central Red Sea at 19°31' N 38°53' E. Group size was not reported, but this must have been the same record of 11 animals given by Alling et al. (1982), see also Leatherwood et al. (1991). The team of the dolphinarium in Tel Aviv encountered a scattered group of false killer whales off the southern tip of the Sinai Peninsula in February 1981. At first, a single animal was seen in the shallow waters of the Gulf of Suez, over an approximately 5 m deep sandflat in an offshore reef. It joined a second animal off the shelf edge and, after swimming east to the southern end of the Gulf of Aqaba, the two joined a larger group of 10 animals, which moved northward. One 3.9 m long male was captured for the dolphinarium (Beadon 1991). Robineau and Rose (1984) also refer to this expedition and further mention an observation by naval captain Barré, who encountered false killer whales on 20 September 1981 in the Straits of Bab al Mandab, at the entrance of the Red Sea. This paper was erroneously quoted by Weitkowitz (1992) where he mentions an inaccurate number of sightings in the Red Sea ("half a dozen") published by Robineau and

Figure 15. Observations of false killer whales (*Pseudorca crassidens*) in the Red Sea.



Rose. Weitkowitz, however, also mentions the find of a lower jaw by R. Kinzelbach in April 1990, 13 km south of Abu Rudeis, on the Sinai coast of the Gulf of Suez; it was deposited in the Senckenberg Museum in Frankfurt (SMS 76880). We have verified the identification of the mandible, which up to now is the only evidence of the species' occurrence in the shallow Gulf of Suez. Evans in Frazier et al. (1987) mention a group of 25 animals seen by V. Papastavrou on 2 July 1984 in the central Red Sea; this encounter occurred at approximately 24°05' N, 36°04' E (H. Whitehead, pers. comm.). False killer whales in the Red Sea apparently can be found in non-aggressive association with sharks. Röthig et al. (2016) report on sightings of false killer whales in association with silky sharks (*Carcharhinus falciformis*) at different reef sites of the Farasan Banks, Red Sea, Saudi Arabia in 2014.

New observations

In Table 4 we summarize 20 new sightings in the Red Sea, mainly in the northern section, three off Israel and Jordan at the end of the Gulf of Aqaba, and 13 off Egypt around the Straits of Tiran, Ras Muhammad National Park, Hurghada, Brother Islands, and Daedalus Reef. Other sightings were made near the border between Egypt and Sudan, off Saudi Arabia and in the centre of the basin (at 19° N) (see Fig. 15, 16).

Remarks

The few published records and the overall low number of opportunistic sightings in the area (compared to most other delphinids) suggest that the abundance of the false killer whale in the Red Sea is relatively low. However, based on our own research and other sightings since the mid-1980s, we conclude that the species occurs regularly in the area, at least in the northern part of the Basin and in the Gulf of Aqaba, where observer effort is highest. Probably, the species is also more common elsewhere in the Red Sea from where reports are scarce, but occurs in low densities. Sightings are spread throughout the Red Sea, mostly in deep water but occasionally close to the shore.

False killer whales are extremely social, usually travelling in groups of 10 to about 100, with occasional associations of several hundred animals (Baird 2009, Culik 2011, Wang et al. 2014); in the Red Sea, maximum group size has been recorded as >30, with a mean of 12 (SD ± 9.1). Worldwide, the species is known to associate with other delphinids occasionally (Odell and Miller McClune 1999). We report two encounters of mixed groups: a pod of >20 was spotted in company with bottlenose dolphins *Tursiops truncatus*, another group with c. 20 Risso's dolphins *Grampus griseus* (Table 4).

The false killer whale has been reported from the

Figure 16. Part of a group of 20+ false killer whales (*Pseudorca crassidens*) sighted at Little Brother Island, Egypt (26° 18' 38.34" N 34° 50' 30.84" E) on 16 February 2010. Photo by: E. Bojanowski.

Table 4. Records of *Pseudorca crassidens* from the Red Sea.

Date	Locality	Reported by	Group size
8 July 1985	19°36'N, 39°03'E, **Saudi Arabia**	C. Smeenk and co-observers	8
8 Aug. 1995	Sharm El Sheikh, **Egypt**	IMMRAC	7
3 July 2005	Rocky Island, **Egypt-Sudan** border	E. Bojanowsky	~9
5 Apr. 2006	Bay of Eilat, **Israel**	IMMRAC	8
26 Feb. 2008	Ras Muhammad, **Egypt**	E. Bojanowsky	~3
9 Apr. 2008	Bay of Eilat, **Israel**	IMMRAC	7
16 Feb. 2010	Brother Islands, **Egypt**	E. Bojanowsky, see Fig. 16	20+
5 July 2010	Safaga, **Egypt**	S. Rolandhe	4
1 Oct. 2010	Hurghada, **Egypt**	T. Neeser (and Bluewaterdive)	7
12 Apr. 2011	Fury Shoal, Lahami Bay, **Egypt**	U. Wystrach	10
19 May 2011	Jeddah, **Saudi Arabia**	M. Khalil	1
28 Apr. 2012	Hurghada, **Egypt**	R. Bargoud	4
23 June 2012	West of Zabargat, Shalatin, **Egypt-Sudan border**	HEPCA	25
22 May 2013	Daedalus Reef (Abu Kizan), **between Egypt and Saudi Arabia**	J. Pettiward	20-30 (+ 3-4 *Tursiops truncatus*)
8 Aug. 2013	Ras Muhammad, **Egypt**	E. van Doesburg	>30
8 Aug. 2013	Rocky Island / El Gabal, St. Johns Island, **Egypt-Sudan border**	L. Ouillet	~25
26 Mar. 2014	Bay of Eilat, **Israel**	IMMRAC	12
9 Apr. 2014	Straits of Tiran, **Egypt**	J. Smith	Unknown (+ >20 *Grampus griseus*)
26 Apr. 2014	Adam Reef, Suakin Archipelago, **Sudan** 18°29'N 38°47'E	B. Cozzi	2 (video recording)
25 June 2014	Dibsel Island, **Sudan** 18°53'N 38°36'E	B. Cozzi	5-6

Straits of Bab al Mandab and just outside the straits, around the Seven Brothers Islands and in the Gulf of Aden (Mörzer Bruyns 1969, Robineau and Rose 1984, Leatherwood et al. 1991), which taken together with sightings in the southern Red Sea suggests a contiguous distribution between the Red Sea and adjacent waters. No observations have been made of movements between the Red Sea and Gulf of Aden or within the Red Sea as, e.g., between the southern tip of the Sinai Peninsula (Ras Muhammad and the Straits of Tiran) and the Bay of Eilat, an area where the species is quite often seen.

Short-finned pilot whale - *Globicephala macrorhynchus* Gray, 1846

Taxonomy and distribution

At present, two species are recognized within the genus *Globicephala*: the long-finned pilot whale *Globicephala melas* (Traill, 1809) and the short-finned pilot whale *G. macrorhynchus* Gray, 1846. The former has a disjunct distribution, with the subspecies *G. m. melas* occurring in the North Atlantic and *G. m. edwardii* (Smith, 1834) with a circumpolar distribution in the Southern Hemisphere, ranging from Antarctic to subtropical waters. *G. macrorhynchus* has a worldwide distribution in tropical to warm-temperate waters. In the western Indian Ocean, long-finned pilot whales have not been found north of South Africa, where the ranges of both species overlap. Although the taxonomic position of some populations of pilot whales in the Pacific is still unresolved, the pilot whales of the tropical Indian Ocean are all considered to belong in *G. macrorhynchus* (Rice 1998, Wang et al. 2014, Jefferson et al. 2015).

There are several records of short-finned pilot whales from the Arabian Sea including the area off the Horn of Africa, but only few from the easternmost Gulf of Aden (Small and Small 1991, Eyre and Frizell 2012, CS and co-observers, unpublished records).

Occurrence in the Red Sea

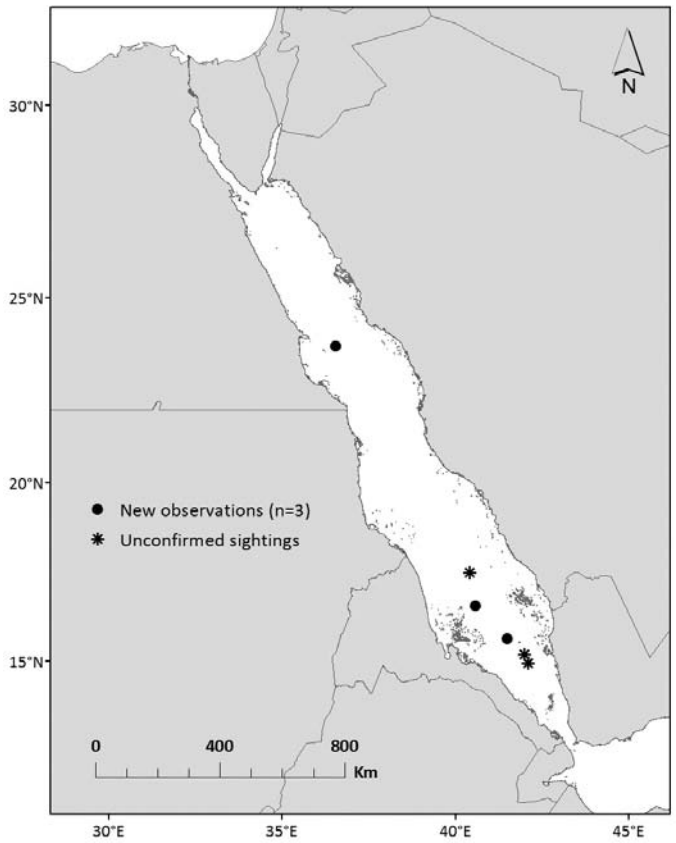
A problem regarding documentation of sightings of pilot whales may be confusion with false killer whales *Pseudorca crassidens* (and perhaps also the smaller melon-headed whales *Peponocephala electra* and the pygmy killer whales *Feresa attenuata*, neither of which having yet been observed in the Red Sea). This is demonstrated by the photographs of supposed pilot whales published by Roghi and Baschieri (1956: their Fig. 16) in the Dahlak Archipelago, Eritrea, which in fact are *Pseudorca* (also cited by Abraha et al. 2008; see under that species).

Leatherwood et al. (1991), in their review of pilot whale observations in the Indian Ocean and adjacent waters, give only three records for the southern Red Sea (nrs 62, 76 and 96 in their table 5): 2 June 1981 at 14° 57' N, 42° 06' E: five animals seen by D. Carpenter; 29 August 1983 at 17° 30' N, 40° 25' E: two animals seen by J.N. Balkwil, and 1 April 1986 at 15° 12' N, 42° 00' E: two animals seen by T.S. Mosley. These sightings, however, are not further documented and regarded here as unconfirmed.

New observations

On 1 April 2000, in the southern Red Sea at 15° 39' N, 41° 30' E (Fig. 17), CS and co-observers sighted a scattered group of large dolphin-like animals, with

Figure 17. Observations of short-finned pilot whales (*Globicephala macrorhynchus*) in the Red Sea.



rounded head and with one animal looking larger than the others. They were a long distance away and their number was difficult to estimate (10-20 or perhaps more). They were tentatively identified as pilot whales. Later that same day, at 16° 34' N, 40° 35' E, another small group was seen, again not close enough to allow an absolutely certain identification. A similar observation was made by CS and co-observers on 5 May 2001, in the central Red Sea at 23° 43' N, 36° 33' E, where a group of five large animals was seen far off, again to all intents and purposes looking like pilot whales.

Remarks

The paucity of records, nearly all from the southern Red Sea, suggests that pilot whales are uncommon in the area, and may be occasional visitors from the Indian Ocean. However, the lack of documentation of the earlier records and the slight air of uncertainty about identification of the later ones make any conclusions preliminary, pending firm and final confirmation of the species' presence in the Red Sea.

Risso's dolphin – *Grampus griseus* (G. Cuvier, 1812)

Taxonomy and distribution

Grampus is monotypic. The species has a worldwide distribution in tropical and temperate seas. Greatest densities occur in deeper waters, and particularly near the edges of continental slopes and around oceanic islands with steep bottom topography (Kruse et al. 1999, Jefferson et al. 2015).

Risso's dolphins occur throughout the tropical and temperate western Indian Ocean, including the Gulf of Aden and the Red Sea (Alling 1986, Kruse et al. 1991, Weitkowitz 1992, Eyre 1995, Jefferson et al. 2014) (Fig. 18).

Occurrence in the Red Sea

The oldest record from the Red Sea of what appears to be *G. griseus* is reported by Rüppell (1842), who mentions the occurrence of a very large dolphin nearly 15 feet long (c. 5 m), with a short, round head and of a light grey colouration, which he supposed belonged to the genus *Phocoena* (*"die andere Art wird sehr gross, bei 15 Fuss lang, hat einen kurzen runden Kopf, ist von hellgrauer Farbe, und gehört vermuthlich zur Gattung* Phocaena*"*). No locality was given and no specimen was obtained, but Rüppell found it fairly common (*"ziemlich häufig"*) in the Red Sea. Although the size of this animal seems somewhat over-estimated, the description otherwise fits Risso's dolphin. Klunzinger (1878) also confirms the occurrence of such large dolphins off Egypt.

Robineau and Rose (1984), Leatherwood (1986) and de Silva (1987) refer to a skull in the Natural History Museum in London catalogued in 1924 (BM 1924.9.20.1). The partial skull (*calvaria*) was collected by G.W. Grabham at app. 20° N, about 60 nautical miles north of Port Sudan (date of collection not known; Richard Sabin, NHM London, pers. comm.). Beadon (1991) led a live-capture team for the Tel Aviv Dolphinarium during the period of September 1980 - September 1981 and found Risso's dolphin the second most abundant species (after the pantropical spotted dolphin *Stenella attenuata*) in the deep waters of the Straits of Tiran, at the entrance of the Gulf of Aqaba. Robineau and Rose (1984) and Evans in Frazier et al. (1987) also refer to this expedition. Weitkowitz (1992) recounts two observations from the Red Sea, off Egypt and Saudi Arabia. One group of two individuals was reported on 7 January 1984, a few nautical miles south of Daedalus Reef, also known as Abu Kizan (24° 55' N, 35° 51' E). This is the most offshore of all the reefs in the Egyptian Red Sea, almost halfway to Saudi Arabia. Another small group was reported by him along the Saudi Arabian coast, south of Jeddah (at 20° 12' N, 39° 22' E), on 30 August 1984.

Two cetacean surveys aboard platforms of opportunity, following a similar route from Australia to Israel and crossing the Red Sea along its midline, took place in 1993 and 1995 (Eyre 1995, Eyre and Frizell 2012). During these surveys, 11 groups of Risso's dolphins were encountered throughout the Red Sea Basin (five in 1993, six in 1995), except in the Gulf of Suez (the journeys did not include the

Figure 18. Two Risso's dolphins (*Grampus griseus*) from a group of 10 sighted in the Straits of Tiran, Egypt (28° 00.33' N, 34°28.28' E), 29 April 2005. Photo by: D. Feingold.

Gulf of Aqaba).

Feingold (2007) found Risso's dolphin the most frequently encountered species in Egyptian waters of Ras Muhammad National Park, Sharm El Sheikh and the Straits of Tiran, during monthly surveys aboard platforms of opportunity conducted between 2004 and 2006.

New observations

Based on the authors' own research and collation of opportunistic sightings, we here report on 110 new sightings, with a group size range of 1-50. Risso's dolphins appear to be widespread across the Red Sea, but occur sparsely throughout the region (Fig. 20). There were areas, however, where Risso's dolphins seemed to occur more frequently, i.e., a) the Gulf of Aqaba from its northernmost part to the Straits of Tiran in the south, and off the Egyptian coast below 23° N (equal effort carried out north of that latitude until Marsa Alam resulted in few or no sightings; Costa 2015).

Records from the central and southern parts of the Red Sea are few, probably due to observations having occurred more sparsely there. Five groups of Risso's dolphins were spotted during length-wise crossings along the southern Red Sea midline. On 11 March 2009 a sighting of at least 3-4 individuals was made over the Farasan Banks off Saudi Arabia, at 19° 44' N, 39° 54' E (B. Cozzi, personal communication to GNS).

Remarks

Habitat and distribution

Risso's dolphins are mostly found in deep waters, but have been observed also at depths of around 20 m off southern Egypt (Costa 2015). They do not seem to occur in the shallow Gulf of Suez.

Group size and abundance

Group size estimated by Beadon (1991) in the Straits of Tiran averaged 30-40, sometimes up to 100 animals, which is much higher than reported by other observers; the mean (± SD) group size in the northern Red Sea as derived from the new observations for which it was available (n=64) was 11.6 ± 11.8 (median=8). The group size of the few observations in the south did not exceed 5. This may be compared to another closed sea, the Mediterranean, where mean group size derived from several studies in the western and central regions (N=402) was 17.8 (computed from Table 2 in Bearzi et al. 2011).

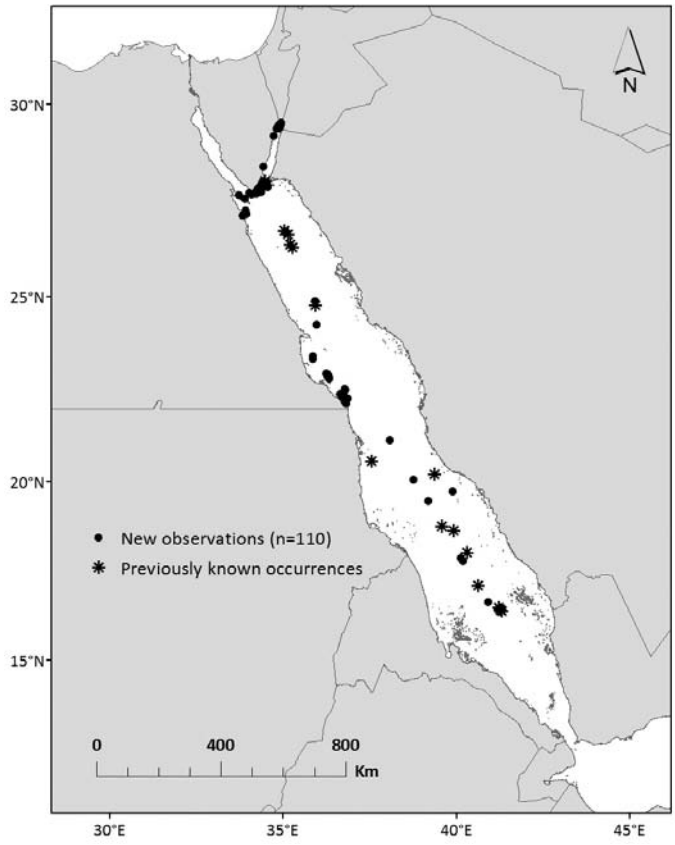
A density of 0.024 ind/km^2 (CV=0.37) for the species has recently been estimated for a near-coastal strip of roughly 15,000 km^2 in southern Egypt (Costa 2015).

Behaviour, reproduction

Observed behaviours of the species included breaching, bow-riding, the characteristic head-standing (Fig. 19), which in calm waters allowed its identification from a long distance, and in one case even spinning. A very young calf,

Figure 19. "Headstanding" behaviour displayed by Risso's dolphins (*Grampus griseus*) south of Abu Fandira reef, Egypt (22°49' 44.7" N, 36° 20' 53.3" E). Two of a group of 9 individuals seen on 12 July 2012. Photo by: M. Costa.

Figure 20. Observations of Risso's dolphins (*Grampus griseus)* in the Red Sea.



1.5 m long with unerrupted teeth, stranded on July 2015 on the northern shore of Eilat.

Contiguity with other seas

Risso's dolphin is quite common in the northwestern Indian Ocean (Balance and Pitman 1998) and has been sighted off both shores of the Gulf of Aden, all the way to the western end (Kruse et al. 1991). Contiguity with the Indian Ocean is therefore suggested, but awaits genetic and/or tagging studies for firm evidence of inter-basin exchange. It also occurs in south Levantine waters (Kerem et al. 2012), but the shallow Gulf of Suez seems to serves as a barrier for movement between the two seas.

Indian Ocean humpback dolphin - *Sousa plumbea* (G. Cuvier, 1829)

Taxonomy and distribution

The recognition by Rice (1998) of *Sousa plumbea* (G. Cuvier, 1829) as a species distinct from *S. chinensis* (Osbeck, 1765) has recently received genetic (Frère et al. 2008) and combined genetic and morphological (Mendez et al. 2011, 2013) support. These studies suggest the existence of at least four species within the genus *Sousa* Gray, 1866: *S. teuszii* (Kükenthal, 1892) in the Atlantic Ocean off West Africa, *S. plumbea* in the tropical and subtropical central and western Indian Ocean including the Red Sea and Persian Gulf (Fig. 21), *S. chinensis* in the eastern Indian and West Pacific Oceans, and the recently described *S. sahulensis* Jefferson and Rosenbaum, 2014 off northern and eastern Australia (see also Jefferson and Curry 2015). As yet, no subspecies have been distinguished (see below).

Genetic samples from the Red Sea are notably absent from all databases on which this taxonomic revision is based and the osteological material of 100 specimens referred to by Jefferson and Rosenbaum (2014) only includes seven skulls from the Red Sea, which in their analysis were included with *S. plumbea*, pending a further study of the Red Sea population.

Occurrence in the Red Sea

The humpback dolphin is thought to occur off the entire African and Arabian coasts of the Red Sea, wherever suitable shallow habitat exists (Jefferson and Karczmarski 2001; Mendez et al. 2013). The lack of records from certain areas (Sudan) probably reflects the lack of observers in the area. Being a distinctive coastal species, surveys conducted aboard platforms of opportunity traversing the central Red Sea are unlikely to yield sightings of humpback dolphins. Exceptions are the narrow Suez Canal and Gulf of Suez, a section of the track that has indeed yielded quite a few sightings. The species, however, does not seem very abundant in the Basin as a whole (Evans in Frazier et al. 1987), though a long-term study in any part of its distribution area would greatly increase the chances of encounters. The complete lack of sightings from the steep-shored Sinai coast of the Gulf of Aqaba, despite a reasonable observer effort and reporting system, is likely to reflect the real situation.

The first known record from the Red Sea was located serendipitously, while following up on a note by Flower (1932), on a sighting by J. Burton of a bottlenose dolphin in the Gulf of Suez in 1823. The record is mentioned in an unpublished manuscript held in the British Museum Library (Brit. Mus. Add. MSS. 25623, pp. 45-46), part of a diary by James Burton covering the years 1823-1831. Inspecting a copy of these pages, the handwritten text offers little clue as to species identity, but the pencil drawing leaves no doubt that the animal was *Sousa* (Fig. 22).

The next record is of a skull collected by Captain Giovanni Caramagna, commander of the Italian frigate “Ettore Fieramosca”, near Assab, Eritrea, in 1882 and

Figure 21. Indian Ocean humpback dolphin (*Sousa plumbea*) observed interacting with the rope of a mooring buoy within the waters of the Hamata harbour, Egypt (24° 17' 31.7" N, 35° 22' 52.6” E). Photo by: A. Cesario.

preserved in the Natural History Museum of Genoa (MSNG 3781).

There are four skulls from the Red Sea area in the London Natural History Museum. Two of these were collected by W.A. MacFadyen: an incomplete specimen found in 1924 on the eastern shore of the Great Bitter Lake in the Suez Canal (BM 1929.9.11.1: Pilleri and Gihr 1972b, Baldwin et al. 2004), the other in 1925 at Hurghada, Egypt (BM 1948.3.13.1: Ross et al. 1995, Baldwin et al. 2004). BM 1948.3.13.2, collected on Kamaran Island, Yemen, was deposited in the museum in March 1948 by Major D. Thompson (Robineau and Rose 1984, Baldwin et al. 2004); BM 1962.2.19.1 (Red Sea, no further data: Baldwin et al. 2004) in 1962 by Colonel E.T. Peel.

One other skull from the Red Sea, first in the Amsterdam, now in the Leiden Museum Naturalis (ZMA 19.781), was collected in August 1977 on Hamar Island, Yemen. The inclusion by Baldwin et al. (2004) and Jefferson and Van Waerebeek (2004) of skull ZMA 19.782 is erroneous: that specimen is a *Sotalia* from South America. The Hurghada Marine Museum and Aquarium has a mounted skin on display.

In the northern Red Sea, the Gulf of Suez and the Suez Canal seem to be favoured by the humpback dolphin. Mörzer Bruyns (1960) reports a sighting of an animal at Newport Rock in Suez Bay near the southern entrance of the canal on 14 June 1952, and three sightings in the Little Bitter Lake: one on 23 March 1958, three on 10 February 1959 and one on 17 May 1960. Burton (1964) recounts an observation of a single animal in the canal in August 1963. The species was also observed in the canal by the French navy officer Y. Alix in July, August and September 1977 (Robineau and Rose 1984). Beadon (1991), reporting on cetacean live-capture operations for the Tel Aviv dolphinarium between 15 September 1980 and 1 September 1981, remarks that humpback dolphins "… were seen not infrequently in the Gulf of Suez, including Port Said and Port Suez, usually as singles or as groups of up to 12. They were the fourth most frequently encountered species [after *Stenella attenuata*, *Tursiops aduncus* and *Grampus griseus*], but it was our impression we were seeing the same few animals repeatedly, either in groups or as scattered individuals". In January 1981, an animal was captured in a purse seine at En Nigh (Sha'ab Surur, 27°47' N, 34°01' E, c. 10 nm west of Ras Muhammad) but later released, as humpback dolphins were not a target species for the dolphinarium. A more recent published record from the northern Red Sea is of a group photographed by R. Nielsen in November 2009 off Giftun Island, Hurghada, Egypt (Culik 2010).

Humpback dolphins may very well travel the entire length of the canal into the Mediterranean. In a personal communication to Marchessaux (1980), Mörzer Bruyns (1960) confirmed sightings of humpback dolphins at the entrance of Port Said harbour. A single animal was even

Figure 22. Pencil drawing of Indian Ocean humpback dolphin (*Sousa plumbea*) from an unpublished manuscript: Burton (1822-1832) Voyages and travels in Egypt and the Eastern Desert: Diaries by J. Burton of his journeys to the Eastern Desert, 16 May-14 Sept. 1823, and 22 Jan.-l Aug. 1831, with notes upon the Natron lakes and their vicinity. British Museum Library, Add MS 25623. Source: British Library.

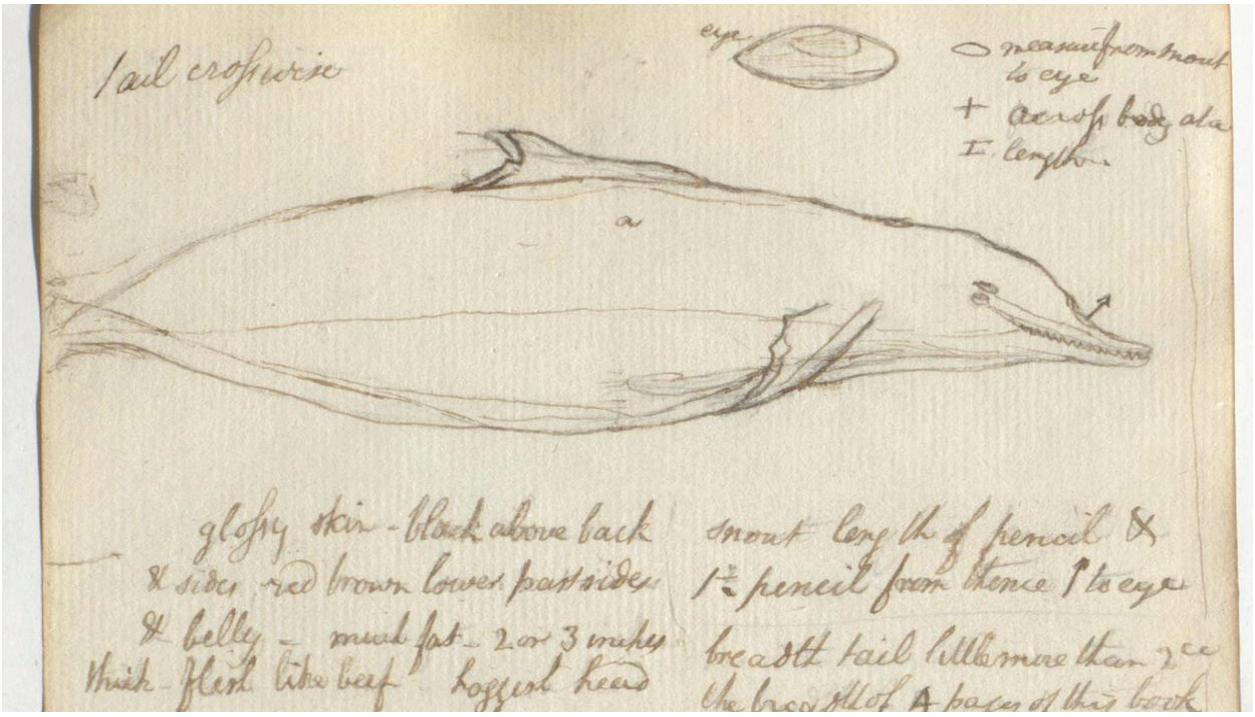
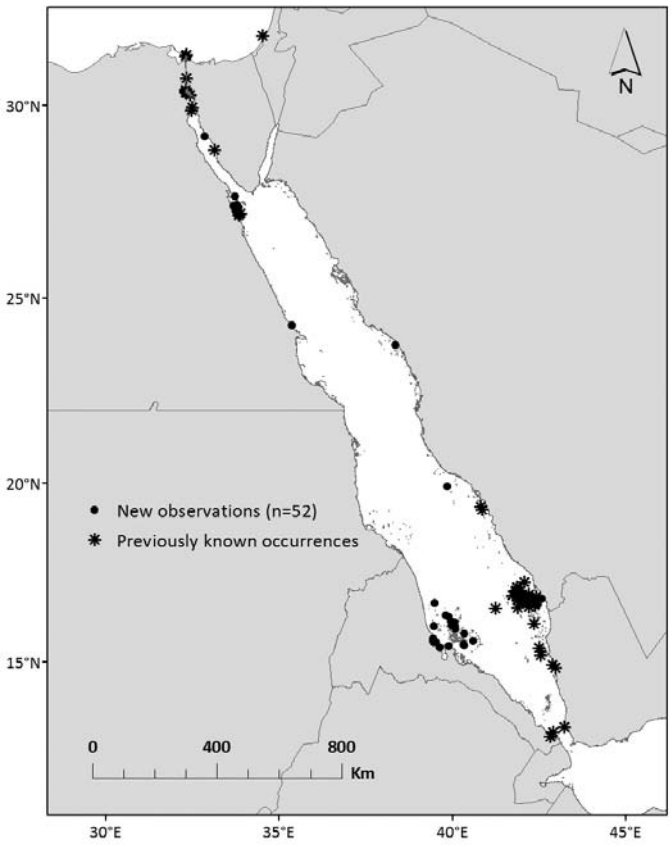


Figure 23. Observations of Indian Ocean humpback dolphins (*Sousa plumbea*) in the Red Sea.



repeatedly sighted along the Israeli Mediterranean coast in January 2000 (Kerem et al. 2001). More recently (February and April 2016), the presence of humpback dolphins interacting with bottom-trawling operations was video-documented in the bay of Mersin, southern Turkey, suggesting the possibility of an increasing presence of the species in the Mediterranean (Notarbartolo di Sciara 2016). So far, these are the only documented cases of 'Lessepsian migration' by a marine mammal.

In the southern Red Sea, during the Acropora 1976 Expedition in early November 1979, G. Schulze and others of the Meeresmuseum, Stralsund, saw groups of up to 20 animals near the island of Umm-al-Sciora, Assab, Eritrea (Schröder and Schulze 1981, G. Schulze, pers. comm.); a photograph has been published by Schröder (1981: 54) and Pilleri (1985: 30). Weitkowitz (1992) saw 5-6 animals on the outer roadstead of Al Hudaydah, Yemen, on 24 October 1980, where the species was also observed by S. Rouleau (Robineau and Rose 1984). Alling (1986) reported a sighting south of Mocha (Al Mucha), Yemen, at 13° 09' N, 43° 14' E, on 22 December 1981. The species has been reported again from the Kamaran and other shelf islands off the northwestern coast of Yemen (Al-Safadi et al. 1995) and from the Farasan Archipelago, Saudi Arabia, by Newton (1995), Gladstone and Fisher (2000) and Hagan (2006). Gladstone and Fisher recorded a total of c. 69 individuals in 21 observations between 15 September 1993 and April 1996. The animals, single or in groups of up to eight, were always observed close to islands in shallow (3.5-8 m deep), often turbid water with a sandy substrate. Al-Mansi (2009) reported two humpback dolphins on the Farasan Banks at app. 19°24' N 40° 47' E, in April 2009. Two recent sightings were made by Dutch land-based observers along the Saudi Arabian coast: one animal on 20 January 2014 in Mecca Province and two animals (an adult and an immature) on 21 January 2014 at Jazan (P. Ruiters and G.O. Keijl, pers. comm.).

New observations

For the northernmost section of the Basin, in Egyptian waters, we here report 23 new records made between July 1985 and December 2016 (Fig. 23). Two records are from dead animals found in the Hurghada area, one stranded and the other floating at sea. Group size from sightings ranged from one to four. One sighting was made about. 15 nm off the southern entrance of the Suez Canal. Angela Ziltener (Dolphin Watch Alliance) reported 9 sightings made from 2014 to 2016 in the Hurghada - El Gouna area (Egypt), eight of which in association with *T. aduncus*. Group size ranged from one to five.

In the central part of the basin, two sightings of the same individual were made in the Hamata lagoon nine days apart in 2010, and two other sightings were reported off the coast of Saudi Arabia, near Jeddah and Al-Lith. The latter was of a single animal in a mixed species group with 15 spinner dolphins.

In the southern section of the Basin, we here report 26 new observations made between January 1993 and April 2014. One sighting was made off Jazan, in Saudi Arabia while the others were reported from Eritrean waters. Records include one entanglement victim, one floating carcass and 15 stranded individuals collected from and off beaches of mainland northern Eritrea, and seven sightings made around Islands in the Dahlak Archipelago, Eritrea, with a group size ranging from 1 to 15 (one sighting of a group numbering 13 animals included mother and calf pairs, resting in waters not deeper than 3 m: GNS, personal observation.

Remarks

Habitat

The humpback dolphin is restricted to coastal habitats. As elsewhere throughout its range, in the Red Sea the species occurs in shallow, nearshore waters, most often within the 25-m isobath (Jefferson and Karczmarski 2001): near sandy beaches, in enclosed bays and coastal lagoons, mangrove areas (particularly mangrove channels), sea grass meadows, around rocky and coral reefs, and in turbid estuarine waters, depending on the locality.

Group size

Mean (±SD) group size in the northern Red Sea Basin is 2.2 ± 1.3 (n=27, median=2, range 1-5) while in the southern part it is 4.1 ± 3.2 (n=33, median=3, range 1-15), significantly higher (Mann Whitney U test; p=0.004). Both values are lower than elsewhere as, e.g., 6.6 in Plettenberg Bay and c. 7 in Algoa Bay, South Africa, and nearly 15 in Maputo Bay, Mozambique (Jefferson and Karczmarski 2001). Off Oman, the majority of sightings are of single animals or groups of up to 20, though large aggregations of up to c. 100 have been reported; mean group size for Oman is 11.7 (SD=14.6, n=110: Baldwin et al. 2004).

Reproduction

The calving season is unknown. Calves were reported a few times: a single calf by K. Wohlrab in July, and several ones by GNS and one by P. Ruiter and G.O. Keijl in January. Off Oman, calves have been seen nearly throughout the year (Baldwin et al. 2004).

Occurrence in mixed groups

Occurrence in mixed groups with *Tursiops sp.* has been twice described by Gladstone and Fisher (2000) in the Farasan Islands (three *Sousa* with seven *Tursiops* and four *Sousa* with six *Tursiops*) and once by K. Wohlrab in Hurghada (one *Sousa* with unspecified number of *Tursiops*). Since all sightings of *Sousa* were made near-shore in very shallow water, the association in both locales was most probably with *T. aduncus*, as is often the case at the southwest coast of Zanzibar (Stensland 2004). Indeed, this association in the Hurghada area has recently been confirmed by the sightings reported by A. Ziltener, where eight out of nine encounters with the species occurred in association with groups of up to 30+ *T. aduncus.*

Contiguity with adjacent waters

The population in the southern Red Sea may be contiguous with that off the southern coast of the Gulf of Aden, as the species also occurs in Djibouti (Alling 1986, Mörzer Bruyns 1960, Burton 1964, Robineau and Rose 1984) and Somalia (Small and Small 1991). Along the northern coast of the Gulf of Aden, the westernmost known population is off Oman, near the border with Yemen (Baldwin et al. 2004). Although individual home ranges in South Africa can span several hundred kilometres (Karczmarski et al. 1999), population ranges usually appear restricted. In many areas, ecological or anthropogenic conditions may prevent exchange between stocks and may have resulted into or increased the species' fragmented distribution. Mendez et al. (2011) provided evidence of significant genetic differences between animals in different parts of the western Indian Ocean, suggesting the existence of separate populations in South Africa/Mozambique, Tanzania and Oman. The suggestion by Jefferson and Rosenbaum (2014) that "there is some evidence for the existence of several geographic forms… which could receive subspecies consideration after additional data are collected" could be applicable to the Red Sea and should be tested by comparing genetic as well as osteological samples from the Red Sea to material from other areas.

Notes on population status and threats

All potential threats affecting an obligate coastal cetacean confined within waters less than 3 km from the shore and/or shallower than 25 m, apply to this species. They include habitat degradation or loss (through alteration or destruction of inshore environments by coastal development), accidental mortality in fishing gear, deliberate killing for human consumption or bait, disturbance by oil and gas exploration including the threat of a major oil spill, and pollution. The latest assessment in the IUCN Red List of Threatened Species still treats the Indo-Pacific humpback dolphin as a single species *Sousa chinensis,* which is assigned

a 'near threatened' status, though it is acknowledged that *S. plumbea*, if separately assessed, would become 'vulnerable' (Reeves et al. 2008). Indeed, just recently, Braulik et al. (2015) advocated the status of 'endangered' for this species, mainly on account of a "suspected or inferred population reduction ≥50 per cent over three *S. plumbea* generations (75 years), from approximately 1960 in the past to 2035 in the future". The authors claim that the decline in habitat quality and the actual or potential levels of exploitation, i.e. fisheries bycatch and hunting, are expected to increase, given the lack of adequate conservation measures throughout most of the species' range. While basing their conclusions on the few available long-term studies, mainly in South Africa and Oman, they project them onto the species' entire range, the Red Sea included. In the latter Basin, potentially adverse behavioural responses to boat tourism as this may occur off Egypt and perhaps Sudan, as has been recorded off Zanzibar (Stensland and Berggren 2007; Christiansen et al. 2010).

Rough-toothed dolphin – *Steno bredanensis* (Lesson, 1828)

Taxonomy and distribution

The name *Delphinus bredanensis* is by many authors attributed to G. Cuvier in Lesson (1828). Miyazaki and Perrin (1994) correctly give René Lesson as the author of this name. The genus is monotypic.

Rough-toothed dolphins occur worldwide in all oceans, mainly in tropical, subtropical and warm-temperate waters (Miyazaki and Perrin 1994, West et al. 2011). They are most often found in deep oceanic waters and over steep slopes surrounding oceanic islands, but also occur in shallow, coastal waters (Jefferson 2009, West et al. 2011). In the western Indian Ocean, the species has been reported off Somalia, in the Gulf of Aden, the Gulf of Oman and the wider Arabian Sea (Ballance and Pitman 1998, Baldwin et al. 1998, 1999, Van Waerebeek et al. 1999, Johnson 2004c, Minton et al. 2010).

Occurrence in the Red Sea

There are very few records of the rough-toothed dolphin from the Red Sea (Fig. 24). Blyth (1846, 1863) mentions a skull of *Delphinorhynchus rostratus* F. Cuv. (= *Steno bredanensis*) in the Museum of the Asiatic Society, Calcutta, reported to be from the Red Sea and presented by J. Owen in 1844 (also mentioned by Sclater 1891). We have been unable to trace this specimen.

A more recent possible record from the southern Red Sea is given by Evans in Frazier et al. (1987), without further documentation. His source was sighting reports contained in the diaries of the late Captain P. Chilman, which he considered reliable (P.G.H. Evans, pers. comm.).

New observations

Final confirmation of the species' presence in the Red Sea comes from stranding records in Eritrea. Based on photographs clearly showing the distinctive head profile and the number of teeth, the strandings of two rough-toothed dolphin specimens were recorded, one on the beach of Hamassien (north of the city of Massawa) on 19 October 2004 (Fig. 25), and the second on Dhu-n-Nafarik Island (eastern Dahlak Archipelago), on 23 September 2005 (Fig. 26).

Considering that the rough-toothed dolphin also occurs in the Gulf of Aden and that the Red Sea contains suitable habitat for this species, it is likely that the current dearth of observations is partly due the scarcity of expert identification (both at sea and of stranded carcasses), though the species does not seem common in the Basin.

Figure 24 (left). Observations of rough-toothed dolphins (*Steno bredanensis*) in the Red Sea.
Figure 25 (right). Rough-toothed dolphin (*Steno bredanensis*) found on 19 October 2004 on the beach of Hamassien (north of the city of Massawa), Eritrea (15° 40' 23.1" N, 39° 27' 9.09",E), Photo by: Y. T. Mebrahtu.

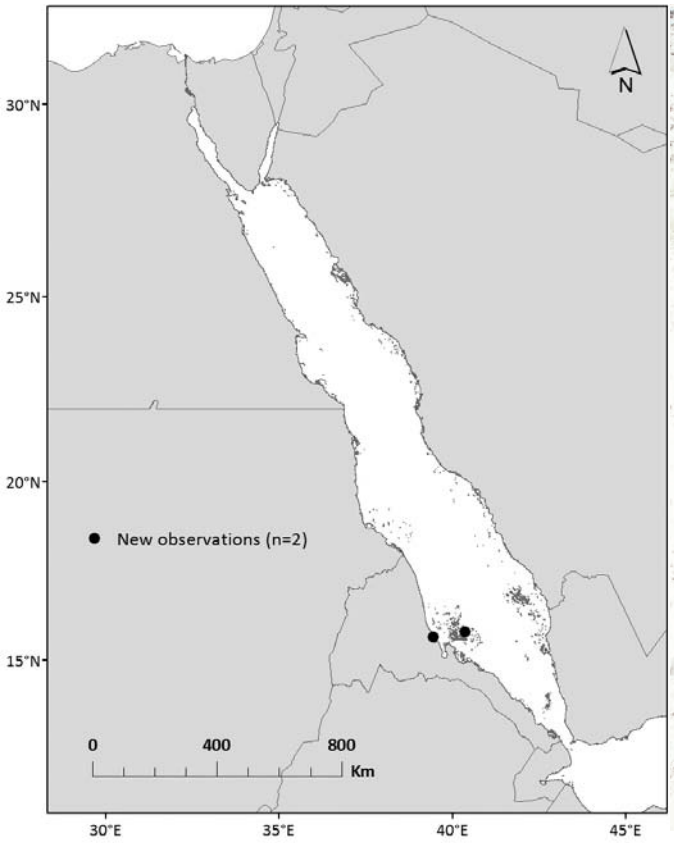


Figure 26. Rough-toothed dolphin (*Steno bredanensis*) found on 23 September 2005 on Dhu-n-Nafarik Island (eastern Dahlak Archipelago), Eritrea (15° 48' 54.9" N, 40° 21' 18.5" E). Photo by: Y. T. Mebrahtu.

Indo-Pacific bottlenose dolphin – *Tursiops aduncus* (Ehrenberg, 1833)

Taxonomy and distribution

The taxonomy of the genus *Tursiops* is still far from settled. Despite a plethora of available names for various populations around the world, until recently many authors treated all bottlenose dolphins as one species, *Tursiops truncatus* (Montagu, 1821); see, e.g., Wells and Scott (1999). Today, two species are generally recognized: the cosmopolitan *T. truncatus* (see next species) and the Indo-West Pacific *Tursiops aduncus* (Ehrenberg, 1833): see Rice (1998), Perrin et al. (2007a), Wang and Shih Chu Yang (2009), Wang et al. (2014) and Jefferson et al. (2015).

The Indo-Pacific bottlenose dolphin occurs in tropical to warm-temperate waters of the Indian and West Pacific Oceans, from South Africa to the Gulf of Aden and the Red Sea (Fig. 27), and to Australia and Japan; it is virtually restricted to coastal waters. The type-locality of *T. aduncus* is in the Red Sea (see below). Various subspecies or distinctive populations have been recognized; the animals off southeastern Australia have recently been described as a separate species, *T. australis* Charlton-Robb et al., 2011, though this does not (yet) seem generally accepted. The population off South Africa too, appears genetically distinct (Natoli et al. 2004).

The main morphological features allowing discrimination between *T. aduncus* and *T. truncatus* (mostly at close quarters) are in the head. The former has a relatively longer and more slender beak, a less convex melon, a dark ring around the eye, extending forwards into the crease between melon and beak, and often a white beak tip (Fig. 28). In addition, adult *T. aduncus* develop dark abdominal spots/flecks, although not all individuals necessarily display those (Jefferson et al. 2015). In the Red Sea, there is a large size difference in favour of *T. truncatus* (see under that species).

Occurrence in the Red Sea

Due to the taxonomic confusion and the fairly recent general recognition of *T. aduncus* as a valid species as distinct from *T. truncatus* (see Rice 1998 and later authors), many published records of bottlenose dolphins cannot be attributed with certainty to one of the two species.

The oldest record of what almost certainly is *T. aduncus* is given by Forskål (1775), who made an expedition to the Red Sea in 1761-1769. In his enumeration of species, he reports: “19 DELPHIS. Djiddæ vocatur Mas *Darfil* vel *Gobâr*; Foemina *Arra*; alibi vero *Abu salâme*. Gregatim 10. vel 15.mares foemellam persequuntur. Victiat Muricibus tribulis.” (In Djedda the Male is called *Darfil* or *Gobâr*; the Female *Arra*; elsewhere rightly *Abu salâme*. Groups of 10. or 15. males pursue a female. Lives on Murex tribulus [a snail]). The Arabic name “Abu salâme” or “Abu salam

Figure 27. Four of a group of 11 Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) resting in a mixed group with 100+ spinner dolphins (*Stenella longirostris*) on 21 July 2013 at Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E). Note ventral spotting of the individual in the center. Photo by A. Cesario.

("Father of peace") is also used for this species on the Sinai coast (Rüppell 1842, Beadon 1991, see also below), which attests that this dolphin is highly respected by coastal inhabitants of Arab nations bordering the Basin.

About 60 years after Forskål's journey, members of the expedition by Hemprich and Ehrenberg to the Red Sea found a decaying carcass of a dolphin on Belhosse (Bulissar) Island in the Dahlak Archipelago, Eritrea (15° 20' N, 40° 40' E), on 13 April 1825 (Stresemann 1954). Ehrenberg collected the skull and briefly described this animal under the name "*Delphinus aduncus* H. and E." in a footnote dated September 1832, in the second part ("decas") of his work on the mammals observed or collected during this expedition; this was published in 1833 (Woodward 1904). However, this description gives insufficient details to distinguish the animal from *T. truncatus*. The skull was long thought to be lost, but in 1978 was rediscovered in the Berlin Museum (ZMB 66400) and recognized as the holotype of *Delphinus aduncus* Ehrenberg, 1833. Thirty years later, Perrin et al. (2007a) carried out a morphological and genetic analysis of the skull, which confirmed that the specimen does indeed belong in the species that had become known as *T. aduncus*.

In 1826, a further two specimens were collected by Rüppell in the northern part of the Red Sea and deposited in the Senckenberg Museum, Frankfurt/Main: a mounted skin of an adult female with skull included (SMF 4337) and a skull and partial skeleton of an adult individual (SMF 1522). The collection localities were not given, but in a letter in the Senckenberg archives dated 1 September 1826, Rüppell announced that while he was at At-Tor (At Tur) on the Gulf of Suez side of the Sinai Peninsula, he dispatched a skin and skeleton of a dolphin that had previously been collected in the area (Mertens 1949). Rüppell (1842) published a detailed description of this animal and its skeleton and skull, accompanied by an excellent plate clearly showing its distinctive characters such as the slender body, fairly long beak and light-coloured abdomen with dark spots (Fig. 29). He considered it an independent species which he called "*Delphinus Abusalam* (Rüppell)"; he did not mention that the skin and the skeleton and skull were of different specimens. Mertens (1925) designated the mounted skin with skull in situ the lectotype of the species. Measurements of the skull were published by True (1889), who treated *T. aduncus* and *T. abusalam* as separate species (see True 1914). Rüppell remarked that these dolphins occurred in small family parties in the entire Red Sea.

Klunzinger (1878) recorded two dolphins found near Kuseir (Qusair), Egypt (no dates given), which he identified as "*Tursio abu salām* Rüppell"; he noted that the smaller animal (1.85 m long), found in a fresh state, essentially agreed with Rüppell's plate, though his description rather fits Stenella attenuata; indeed, its skull was later identified with that species (see there). The larger specimen (2.63 m long) is not further described and so cannot be identified.

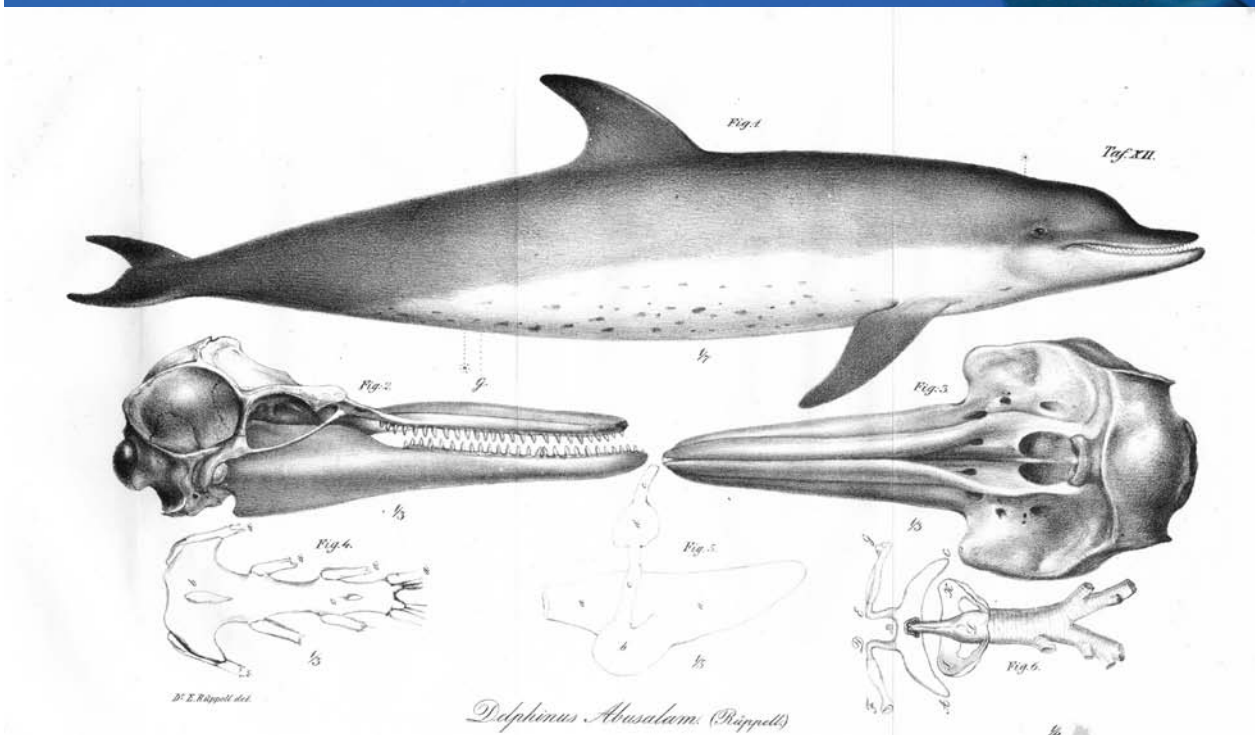
Among the first observations of live bottlenose dolphins in the Red Sea are those reported by Flower (1932) in 1904 and 1911 off Port Tewfik (Bur Taufiq) near Suez, and in the Gulf of Suez (one sighting reported by J. Burton in 1823). For want of a description, these animals cannot be identified to species level. Moreover, the drawing in Burton's diary of the dolphin observed is not included in Flower's manuscript (preserved in the London Natural History Museum), and clearly applies to Sousa plumbea (see under that species). Mörzer Bruyns (1971) called *T. aduncus* the "Red Sea dolphin", stating that it mainly lives in deep water ("rarely inside the 100 fathom line") and is more abundant in the southern part of the Red Sea than in the north, though it occurs throughout the deep Gulf of Aqaba; according to him, it had not been seen in the Gulf of Suez. His records, however, are not specified and not substantiated.

The first well-documented observations of *T. aduncus* in the Red Sea are from the early 1980s, when a team of the Tel Aviv Dolphinarium conducted live-capture operations in the Gulf of Suez and around the southern Sinai Peninsula between 15 September 1980 and 1 September 1981. Beadon (1991) reports that the team observed and caught two "types" of bottlenose dolphins, specifying that "One was small (to no more than about 2.2m) and relatively slender, with a gentle slope from the melon onto a relatively elongated snout. They were pale grey on the back and sides, lighter on the venter, and frequently had spotting, particularly on the throat". This figure is not very clear, but appears indeed *T. aduncus*. Beadon stated that this small form had at times been assigned to *Tursiops abusalam*. Groups of about 20 individuals were commonly encountered by the team in the Gulf of Suez, in close association with coastal and offshore coral reefs and inside inner lagoons. Beadon suggested that these animals were "resident", each associated with a given reef system, because some recognizable individuals were repeatedly observed. Larger groups (up to 200 animals) were also seen further offshore, supposedly forming "short-term feeding aggregations of many local groups". Evans in Frazier et al. (1987) quoted a letter by Beadon saying that he had seen "herds of up to sixty at Shaab Ali in the Gulf of Suez". Beadon did not observe this form in the Gulf of Aqaba, but elsewhere found it the third most abundant species; it was also seen "in the Narrows of the Suez Canal, itself". For the larger type in his report, see under *T. truncatus* below.

Alling et al. (1982) traversed the Red Sea lengthwise from 12 to 23 December 1981 and reported four sightings of bow-riding *T. aduncus* (and one of *T. truncatus*). However, in a later paper covering the same trip, Alling (1986) listed nine sightings of bottlenose dolphins in the Red Sea, without further identification. Weitkowitz (1992) reported specified sightings of *T. aduncus* between 1980

Figure 28. **Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) showing white beak tip. Seen while diving at the "Thistlegorm" wreck near Sha'ab Ali lagoon, Ras Muhammad, Egypt (27° 48′ 51″ N, 33° 55′ 12″ E). Photo by: Y. Nir.**

Figure 29. **Drawing of "*Delphinus Abusalam* (Rüppel)" (=Indo-Pacific bottlenose dolphin *Tursiops aduncus*), Plate XII from Rüppell (1842).**



and 1987 in the southern part of the Red Sea, around the Zubayr Islands and near Jebel Tair Island, Yemen, and off the Farasan Islands, Saudi Arabia. He also gave one record from the central Red Sea, between 21° and 24° N. Unfortunately, descriptions of the animals are not given. Eyre (1995) listed several records of bottlenose dolphins in the Red Sea, but did not distinguish the two species. During a later voyage, Eyre and Frizell (2012) specified one record in the central Red Sea (no co-ordinates given) on 29 April 1995, of "lighter and smaller animals [than *T. truncatus*] identified as Indo-Pacific bottlenose dolphins, *Tursiops aduncus*".

The possible presence of *T. aduncus* around the

Farasan Islands was discussed by Gladstone and Fisher (2000), based on observations carried out during several periods between 1993 and 1996. The authors reported 16 sightings of *T. truncatus*, but in the discussion added: "The size and form of *T. truncatus* observed inshore in Farasan waters appeared to be more synonymous with *Tursiops t. aduncus*; however, no light [!] spotting on the ventral surface was observed and their general colour was a dark slate grey (Plate 1)". The animals figured in that plate are only silhouetted, so no colour pattern is visible; however, they do look like *T. aduncus*, which would also agree with their coastal habitat. Al-Mansi and Sambas (2006) also reported on bottlenose dolphins in the Farasan Islands protected area between 16°48' and 16°54' N, but without further specification; their description of *Tursiops* is a general one taken from the literature, so cannot be used for identification.

Off Sudan, Salam (2006) reported the presence of "a pod of 8-10 Bottlenose Dolphins (*Turciops [sic] truncatus*)" around the mouth of the lagoon" of Sanganeb atoll. He noted that "This pod is probably resident and females from it have been observed to give birth inside the lagoon. Individuals of this pod tend to approach small boats and bow-ride…". This too, is strongly suggestive of *T. aduncus*. He also reported the presence of *T. truncatus* in the areas of Dungonab Bay and off nearby Mukawwar Island, but again without further comments on their identity.

In the northern part of the Red Sea, *T. aduncus* is frequently encountered near reefs and islands in the area off the Egyptian city of Hurghada, where these dolphins have been extensively studied since 2009, using underwater photo-identification techniques. Preliminary results suggest that at least 119 individuals may occur in the area year-round (Kleinertz et al. 2014, Ziltener and Kreicker 2013).

Whereas the presence of *T. aduncus* in the Gulf of Suez has been affirmed since the 18th century, for the Gulf of Aqaba there was only the unspecified statement on its occurrence by Mörzer Bruyns (1971). The first well-documented record was reported only in 1994, when a solitary adult female, identified by the Bedouins as "darfeel (dolphin) Abu Salam", made her first appearance off the fishing village of Nuweiba M'zeina on the Sinai coast. The dolphin (named "Holly") showed interactive behaviour with humans and was followed intensively for 5.5 years (Mizrahi et al. 2009, Spanier et al. 2000) and more loosely later, when she terminated her association with humans and moved north to Eilat with her only surviving female calf, to form a group with three photo-identified males. Holly gave birth four times during the period from her arrival until her death in December 2004, at the age of 18 (as determined from tooth sections by C. Lockyer); at Nuweiba, up to five *T. aduncus* were occasionally seen around Holly's daily home-range, without making close contact (Goffman 2006a,b; Mizrahi et al. 2009).

New observations

The difficulty in telling apart the two *Tursiops species* is also evident from the unpublished records hereby reported. Out of a total of 421 records involving the genus since 1984, 119 were designated '*Tursiops sp.*', as species identification was not possible (Fig. 30). Nevertheless, 217 new records of *T. aduncus* were made by the authors, the vast majority being sightings at sea (Fig. 31).

The new observations are mainly concentrated along the Egyptian coast where tourist infrastructure has been developed in many places and people reports wildlife observations (Gouda 2012, Rouphael et al. 2013). *T. aduncus* appears common along the entire Egyptian coast, from the Strait of Gubal to the Sudan border and around the southern part of the Sinai Peninsula (Fig. 31). In the Gulf of Aqaba, *T. aduncus* occurs all the way to its northern end, off Eilat, with several encounters along the Sinai coast. The tendency of some individuals to form long-term associations with humans has been reported on two other occasions in the Gulf, where the dolphins 'Crispy' (Goffman 2003) and 'Marko' (IMMRAC, unpublished records) befriended swimmers and divers off the northern beaches of Eilat, during the periods 1992/93 and 2007/08, respectively. 'Crispy', at the time regarded as *T. truncatus* due to the lack of ventral spotting, has lately been identified as *T. aduncus* by close inspection of photographs. In the Gulf of Suez, there is one sighting off Abu Zenima. Several observations supported by underwater video and photographs off Ain Sokhna and Ras Sudrin in the northernmost part, suggest that the species is common throughout the Gulf.

In the Suez Canal, bottlenose dolphins have been encountered a few times, but the species was not identified. The same holds true for videos showing bow-riding dolphins taken from vessels navigating the canal. However, some characteristics such as a relatively small body size and a long and slender rostrum, often with whitish tip, suggest that at least the majority of these are *T. aduncus*. Species identification in the canal, especially the northern section, could be even more problematic, since individuals may also belong to the Mediterranean population of *T. truncatus* (see Remarks), the adult size of which matches that of *T. aduncus* (Sharir et al. 2011).

Authenticated observations of the species in the southern section of the Basin are scant. In Saudi Arabia, international tourism is restricted (in particular after 2009) and sighting reports are limited. However, PhD students at the Red Sea Research Center of King Abdullah University of Science and Technology (KAUST) reported two sightings of *T. aduncus* around the Farasan Bank during their field-trips in 2011; another sighting was reported from the Farasan Islands in September 2013 (J.

Figure 30. Observations of unidentified bottlenose dolphins (*Tursiops sp.*) in the Red Sea.

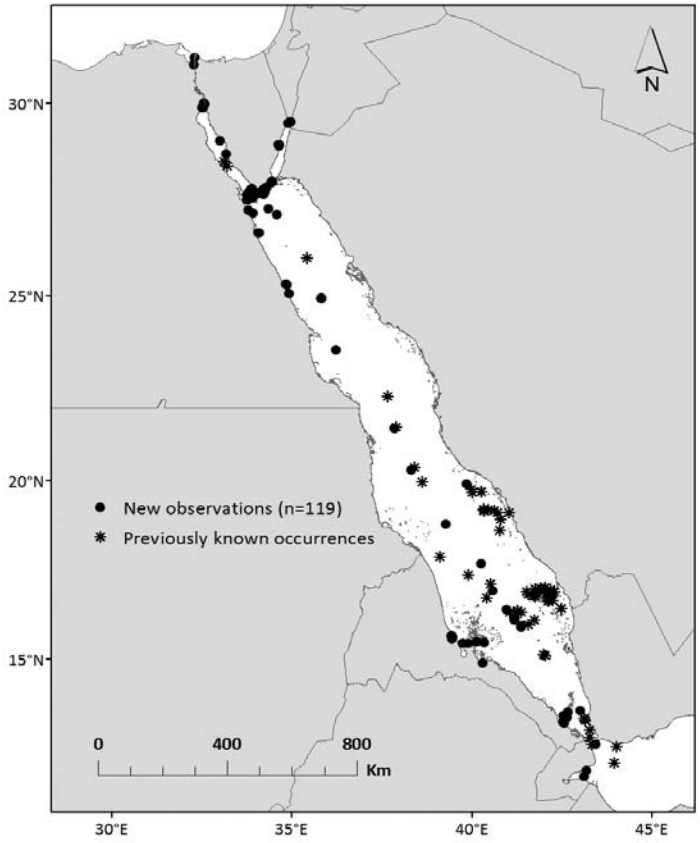
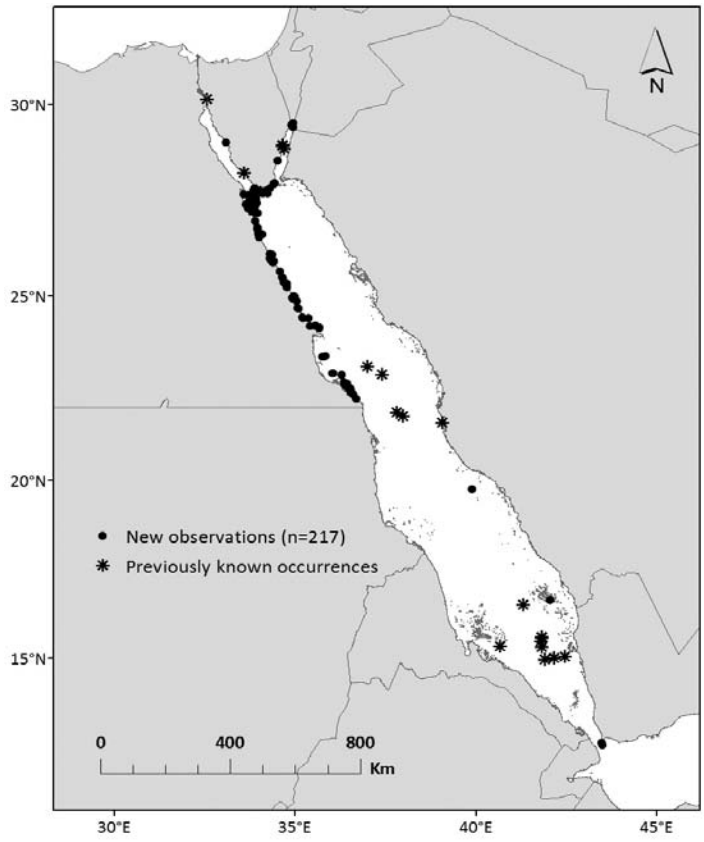


Figure 31. Observations of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in the Red Sea.



Babbington, pers. comm. to PR). Off the Eritrean coast, two beached specimens and one sighting of the species were verified through photographs/video clip. Further south, two groups of bow-riding dolphins, one including a calf, were photographed in the Straits of Bab al Mandab.

Remarks

Habitat

From the above, it appears that *T. aduncus* is common in coastal waters throughout the Red Sea. Its preference for shallow waters may, however, be less strict than in the humpback dolphin *Sousa plumbea*, especially where deep waters are close to the shore, such as in the Gulf of Aqaba. As may be expected, most observations are from the northern section off the Egyptian coast, where tourist facilities and research activities are concentrated. Elsewhere, data are fragmentary. In Egyptian waters, the species is found near the shoreline and around coral reefs on both the seaward and coastal side of the coral barrier. Several sightings are from lagoons inside offshore reefs, including those that are also used by spinner dolphins *Stenella longirostris* during daylight hours (e.g., Satayah Reef, 24°09' N, 35°41' E); see under that species. Beadon (1991) suggested that some groups might be regularly associated with a particular reef system, as some recognizable individuals were repeatedly sighted. The presence of such resident animals was confirmed by the observations off Hurghada by Ziltener and Kreicker (2013). Contrary to the statement by Mörzer Bruyns (1971), there is little evidence that *T. aduncus* moves far from the coast; the two sightings reported offshore in the central part of the Red Sea by Eyre and Frizell (2012) and Weitkowitz (1992) are unusual in this respect.

Group size and abundance

Although aggregations of up to 300 animals have been reported (Beadon 1991, Weitkowitz 1992), group size generally ranges from 2 to 50; the mean (± SD) group size of the new observations for which has been recorded (n=134), heavily biased towards the northern section, is 7.9 ± 8.8. The median group size of 5 is smaller than the median range of 8-21 found by Stensland et al. (2006) during four yearly surveys (1999-2002) off Zanzibar (n=186). The estimated density of the species off the Egyptian coast (Costa 2015) was 0.044 individuals/km^2 (CV=0.69).

Reproduction

The close long-time monitoring of Holly, the solitary and human-friendly female off Sinai, provided the only data on calving and inter-birth periods in the region. Her four calves were born in December 1996, December 1998, October 2000 and April 2004. The last inter-birth period (3.5 years) possibly is the only representative one, as the first two calves (both males) survived for only six months, whereas the third (female) calf was 4.5 years old when observations ended (Goffman 2006b). Sighting data from IMMRAC suggest that young calves are present year-round. This was confirmed by Ziltener and Kreicker (2013) for the animals repeatedly spotted off Hurghada.

Diet

Lack of scientific facilities renders the systematic study of the feeding habits of any resident species in the Basin very difficult. Only 'Holly', the solitary sociable dolphin, allowed a glimpse of diet composition through the systematic collection of regurgitated items over the 5-year period of her sociability (Mizrahi et al. 2009). As a rule that may apply to the population as a whole, Holly rested/slept and socialized during daytime and foraged during the night. The most important prey items in the fish-dominated diet were *Fistularia commersonii (Fistulariidae)*, *Lithognatus mormyrus* (*Sparidae*) and *Lethrinus sp.* (*Lethrinidae*). The combined assembly of collected items, when compared to results of stomach content analysis of stranded animals in Natal (Cockroft and Ross 1990) and Zanzibar (Amir et al. 2005), supported the notion that the diverse diet expressed by the species is not solely due to a variety of individual preferences and specializations but also (and probably largely) to individual versatility in feeding habits.

Occurrence in mixed groups

During several occasions, *T. aduncus* has been observed in association with spinner dolphins *Stenella longirostris* while swimming in internal lagoons of offshore reefs such as Satayah (PR and co-observers, HEPCA), and eight times the species was seen in association with humpback dolphins *Sousa plumbea* off Hurghada (A. Ziltener, pers. comm. to MC, see Sousa plumbea species account). *T. aduncus* and *T. truncatus* were never encountered together, although they have been witnessed to occur in the same area.

Contiguity with adjacent seas

Reports of bottlenose dolphins from the southern coast of the Gulf of Aden are mostly given as *Tursiops sp.* (Robineau and Rose 1984, Small and Small 1991), yet the coastal distribution is suggestive of *T. aduncus*. One freshly stranded specimen described by Robineau and Rose (1984) in Djibouti (see their Fig. 3) and at least one sighting at sea were definitely of this species. Records from the northern coast are lacking, but in all probability the populations in the Red and Arabian Seas are contiguous.

Conservation issues

The estimated abundance of the species in the 15,000 km^2 near-coastal area in southern Egypt studied by Costa (2015), was 659 (CV = 0.69), roughly 1/10 that

of *Stenella longirostris*. The resident dolphins known to occur off Hurghada (Ziltener and Kreicker 2013) have been reported to be heavily harassed by tourist boats (A. Ziltener pers. comm., HEPCA data). According to this information, the use of rigid inflatable boats chasing dolphins at full speed has increased lately. These activities are known to have caused distress to other populations (Christiansen et al. 2010). The Hurghada Environmental Protection and Conservation Association (HEPCA), an Egyptian non-governmental organization, has implemented a code of conduct and regulation for whale-watching activities (including a decree by the Red Sea Governor protecting two high-concentration spots in Sha'ab El Erg (27° 20' N, 22° 49' E) and Fanus (27° 16' N, 33° 52' E)); however, enforcement of these rules by the authorities has proved difficult.

Common bottlenose dolphin - *Tursiops truncatus* (Montagu, 1821)

Taxonomy and distribution

For the taxonomic problems regarding the genus *Tursiops*, see under the previous species. Most authors now treat the common bottlenose dolphin as a single species *Tursiops truncatus* (Montagu, 1821), without recognizing subspecies except in the Black Sea, from where *T. truncatus ponticus* Barabash-Nikiforov, 1940 has been described. There are, however, considerable external, morphological and genetic differences between various populations. The bottlenose dolphins from the (sub)tropical southwestern Atlantic Ocean have now been distinguished as a separate species *Tursiops gephyreus* Lahille, 1908 (Wickert et al. 2016) and further studies will almost certainly reveal the existence of more (sub)species. Also, in several areas there are differences between inshore and offshore populations ("ecotypes"), the nature of which is not clarified (Rice 1998, Natoli et al. 2014, Wells and Scott 2009, Wang et al. 2014, Jefferson et al. 2015).

Occurrence in the Red Sea

Bottlenose dolphins have been recorded throughout the Indian Ocean including the Red Sea (Fig. 32). However, as has been remarked for *T. aduncus*, many records and general distributional reviews do not distinguish the two *Tursiops* species (as, e.g., Baldwin et al. 1999). Whereas *T. aduncus* has been documented for the Red Sea since the second half of the 18th century, the presence of *T. truncatus* remained uncertain until the 1980s, with no specifically identified records in the literature and with no specimens in museum collections.

The presence of *T. truncatus* was confirmed for the first time by Beadon (1991), who during capturing operations for the dolphinarium in Tel Aviv between 15 September 1980 and 1 September 1981, noted the occurrence of a smaller and a larger form of bottlenose dolphins near the tip of the Sinai Peninsula. Beadon clearly described the differences between the two forms (see above under *T. aduncus*), stating: "The second type of bottlenose dolphin was large (up to 4m or more) and robust with a comparatively steeper melon, shorter, broader snout, and apparent lack of ventral spotting". This form was seen only three times (one, six and ten animals, respectively) against numerous records of the smaller species (see above), and in October 1980 a 3.9 m long male from the group of six was captured, "the smallest member in its group". Beadon speculated that these animals were not resident in the area, but "travellers". Somewhat strangely, Evans in Frazier et al. (1987) cited a letter by Beadon saying that he had recorded this form, by Evans called *Tursiops truncatus/gilli*, "… from the Gulf of Suez (Ras Muhammad up to Marsa Bareca) in herds of thirty to forty individuals during the months of August and September (J. Beadon in litt.)". Clearly, Beadon (1991) later must have included these with the smaller form (see above).

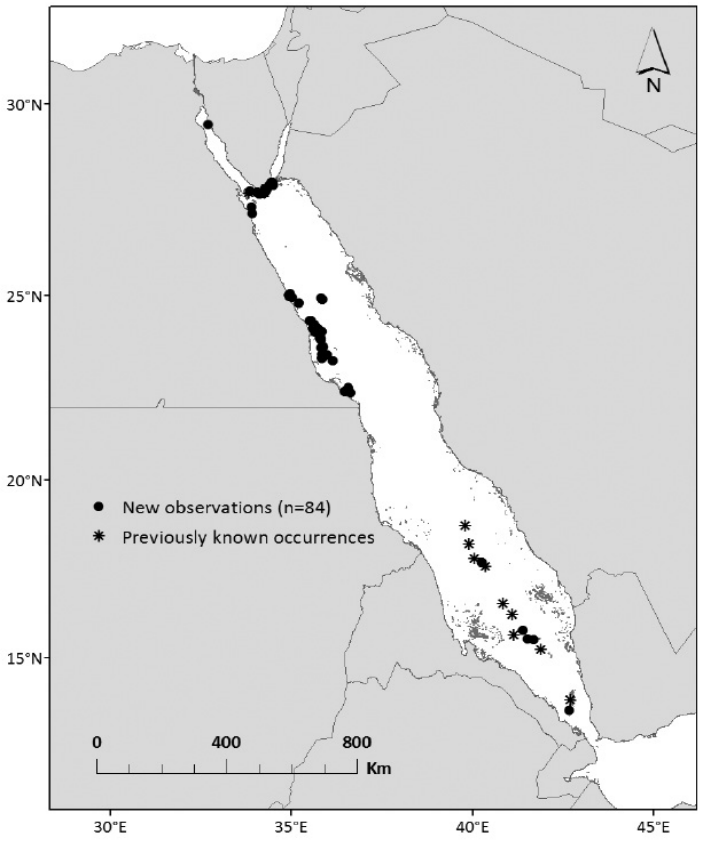
Figure 32. Common bottlenose dolphin (*Tursiops truncatus*) feeding on a blue spine unicornfish (*Naso hexacanthus*). One of a group of 3 individuals seen on 19 June 2010 at Abili Ali, off Shalateen, Egypt (23° 25' 10.2" N, 35° 59' 42.6" E). Photo by: M. Costa.

One year later, Alling et al. (1982) who traversed the Red Sea lengthwise, reported one sighting of *T. truncatus* (without specifying the position), but in the following paper (Alling 1986) mentioned nine records of *Tursiops sp*. in the Red Sea, without further specification (see above). These observations were also cited by Leatherwood (1986) as *T. truncatus*. One record was reported by Weitkowitz (1992) for 20 September 1983 in the Straits of Gubal, noting: "Four specimens, from their size probably *T. truncatus*".

Robineau and Rose (1984) could only confirm the presence of *T. aduncus* off Djibouti and mentioned two observations of bottlenose dolphins (not further identified) in the southern Red Sea by naval captain Barré; one sighting was of a group of ten animals bow-riding on 17 October 1981 at 90 nautical miles northwest of the Hanish Islands, Yemen. They were greyish beige in colour and measuring more than 2.5 metres long ("de couleur gris-beige, mesuraient plus de 2,5 m de long"), and thus may have been *T. truncatus*.

Miyazaki and Amano (1991) traversed the Red Sea along its main axis in January 1990 and noted seven observations of "*Tursiops truncatus*" between 15°31' and 18°46' N. The large school size of some observations (e.g. 30, 50. 250) casts doubt on their indeed being common bottlenose dolphins. Eyre (1995), who also traversed the Red Sea lengthwise in July 1993, reported several sightings of bottlenose dolphins, stating: "The two types of bottlenose dolphin mentioned by Beadon (1991) were not evident". On a similar traverse, between 27 April and 1 May 1995, Eyre and Frizell (2012) made several observations of "*Tursiops spp.*" and noted: "Most of the animals encountered were quite large, robust and with short, blunt rostrums. Colour varied from dark grey (except for the ventral surface), to grey gradation along the flanks", which is strongly suggestive of *T. truncatus*. Only once did they encounter "lighter and smaller animals identified as Indo-Pacific bottlenose dolphins, *Tursiops aduncus*" (see under that species). Gladstone and Fisher (2000) published 16 records of *T. truncatus* (single animals or groups of up to 12) around the Farasan Islands, Saudi Arabia. They almost certainly were *T. aduncus* (see above). On the voyage of the Odyssey up the Red Sea from the Indian Ocean in May 2004, it must be common bottlenose dolphins that are noted in the log (Johnson, 2004b): "However, the species that is most intriguing to the crew is the bottlenose dolphin (*Tursiops*). These are the largest bottlenose dolphins sighted on the voyage to date, dwarfing the spinner and spotted dolphins when riding together ahead of our bow. While the latter two species form schools numbering in the hundreds, we scarcely see more than ten bottlenose dolphins together at one time.". Al-Mansi and Sambas (2006) also reported four groups of bottlenose dolphins (consisting of 2-15

Figure 33. Observations of common bottlenose dolphins (*Tursiops truncatus*) in the Red Sea.



animals) in the Farasan Islands protected area, between 16°48' and 16°54' N, in May 2006; their description, however, is taken from the literature so cannot be used for identification (see above).

Al-Mansi (2009), during a diving trip on the Farasan Bank, reported 13 sightings of "Bottlenose dolphin *Tursiops truncatus*" with a total of 88 individuals, in both sheltered and offshore waters. Again, the specific identity remains unclear.

New observations

In this review, 84 sightings of *T. truncatus* made by or reported to the authors have been incorporated (Fig. 33). Sightings date back to 1985. Group size ranges from 1 to 27 individuals. The majority of the sightings were made in Egyptian waters, mainly off the southern Sinai Peninsula, around Ras Banas and the offshore reefs of Daedalus and Brothers. An unusual encounter with what seemed to be a scattered aggregation of over 50 animals including juveniles, occurred in the windless early morning hours, off Na'ama Bay (Sinai, Egypt). Animals were slowly travelling (some bow-riding) in an easterly direction. Species identity was verified from photographs. In the Gulf of Suez, *T. truncatus* was identified and photographed by A. Ziltener (pers. comm. to MC) off Ras Sedr. A bottlenose dolphin was observed in the northern section of the Suez Canal, 30 km south of El Tina, on 9 June 1984. It looked like *T. truncatus*, but identification cannot be confirmed. So far, we have no documented records of the species in the Gulf of Aqaba.

In the southern part of the Red Sea, along the midline transect, from off the Hanish Islands at 13°30' N and up to 17°41' N , 5 groups with a size range of 1-20 were encountered.

Remarks

Distribution and habitat

Whereas in many areas of the world *T. truncatus* is one of the best known dolphins, there is little sound information on the distribution of this species in the Red Sea and on the differences in ecology between *T. truncatus* and *T. aduncus* in the Basin.

Although sightings are distributed unevenly, all data combined suggest that the species is present throughout the Red Sea. In agreement with the findings of Beadon (1991), we too, typically encounter the species in deep waters (of "oceanic depths" in Beadon's words). In Egyptian waters (tip of Sinai and southern coast), it is observed in deep coastal waters and around islands and reefs, in which habitat it partly overlaps *T. aduncus*; however, it has never been observed inside the lagoons of coastal reefs, in contrast with the latter species. It also occurs in deep offshore waters (including remote offshore reefs and islands such as Brothers Islands, Daedalus Reef, Zabargat and Rocky Island). Based on only three encounters (versus many more of *T. aduncus*) near the tip of the Sinai Peninsula, Beadon (1991) suggested that these dolphins were transient visitors ("travellers") in the area; however, recent experience shows the ratio of *T. truncatus* to *T. aduncus* sightings in that area to be roughly 1:4 and in the northern section of the Basin, to be roughly 1:3. In the southern section of the Basin, the species is encountered far from the shore, along its midline.

When considering the sighting distribution of *Tursiops* unidentified to species level (Fig. 30) in the light of the sighting distributions of the two species (Figures 31 and 33), it would seem that all *Tursiops sp.* sightings in the Gulf are most probably *T. aduncus*. Apart from those, species identification is uncertain and the new observations offer little if any additional geographic insight.

Group size and abundance

Based on the data reported above, the mean (± SD) group size for common bottlenose dolphins in the region, excluding the aggregation of c. 50 animals described above, was 4.9 ± 4.0 (n = 71). Group sizes of *T. truncatus* and *T. aduncus* are not significantly different (independent sample Mann-Whitney U test; p = 0.093). Costa (2015) estimated the abundance of the species in the 15,000 km^2 coastal strip in southern Egypt to be 0.034 individuals/km^2 (CV=0.33), roughly the same as that of *T. aduncus*.

Occurrence in mixed groups

In offshore waters, *T. truncatus* has been encountered in mixed groups with *Stenella longirostris, S. attenuata*, and both species together (data from HEPCA, IMMRAC, PR, and CS and co-observers). A mixed group of 3-4 *T. truncatus* with 20-30 *Pseudorca crassidens* was documented by underwater video by J. Pettiward at Daedalus Reef, on 22 May 2013 (PR and co-observers). Bottlenose dolphins were seen in association with false killer whales on another occasion by MC; though pictures could only be taken from above, preventing definite identification, the size of the animals suggested that they were *T. truncatus*. The two *Tursiops* species were never encountered together in Egyptian waters, not even in areas where they both occur, such as Satayah Reef (HEPCA data).

Contiguity with adjacent seas

From the Gulf of Aden and the Arabian Sea, there are very few data of bottlenose dolphins where *T. truncatus* and *T. aduncus* have been clearly identified. Minton et al. (2010) mention the occurrence of "at least two readily distinguishable forms, likely representing the two

recognized species, *T. truncatus* and *T. aduncus*, …" off Oman. Thus, it seems likely that the range of the animals in the Red Sea and adjacent waters is contiguous.

The potential for anthropogenic interbreeding of *Tursiops* species

A. Through Lessepsian migration

Many delphinid species are known to interbreed, both in captivity and in the wild (Bérubé 2009). *T. truncatus* is one of the species known to be common in the eastern Mediterranean Sea (Kerem et al. 2012). The opening of the Suez Canal created the opportunity for Mediterranean and Red Sea bottlenose dolphins (of both species) to enter the canal and even beyond. Bottlenose dolphins have been observed inside the Suez Canal (Beadon 1991 and observations by the present authors). As yet, it is not clear which species is/are frequenting the canal (although the available pictures suggest that it is *T. aduncus* that enters the southern section) and whether animals from the Red and Mediterranean Seas ever meet, with a potential to mate.

B. Through introduction of imported animals

Since 1992, a 'swimming-with-a-dolphin' facility has been operating in Eilat, Israel. The original inhabitants were from the Sea of Japan, later to be replaced by a breeding group of Black Sea bottlenose dolphins, *Tursiops truncatus ponticus* (see Brensing et al. 2005). For a while, the facility followed an 'open gates' policy, which allowed the residents free access to the open sea, where native bottlenose dolphins reside. In May 2002, one of the inbred offspring went missing and 11 days later was spotted more than 100 km to the south, in Dahab Bay (28°28' N 34°30' E), where the indigenous *T. aduncus* has been observed. In 2003, this practice was discontinued by order of the Israeli Nature and Parks Authority, on the grounds of potential genetic contamination as well as disease transmission in the area. More recently, accidental tearing of the enclosures' meshed barrier again resulted in the escape of the inhabitants. Although there is no evidence of interbreeding to have occurred, the possibility cannot be ruled out. Imported *T. truncatus* escaping to the wild may also thwart science by leading to misidentification of observed animals and thus to wrong conclusions about the presence/distribution of native *T. truncatus* within the dolphins' travelling range from the enclosure.

Pantropical spotted dolphin – *Stenella attenuata* (Gray, 1846)

Taxonomy and distribution

Two subspecies of pantropical spotted dolphins are currently recognized (Perrin et al. 1987, 2009; Jefferson et al. 2015): an offshore subspecies *S. attenuata attenuata* (Gray, 1846), having a pantropical distribution (including the Red Sea), and a coastal subspecies *S. attenuata graffmani* (Lönnberg, 1934) found along the coast of Latin America from southern Mexico to Peru (Perrin 2001; Escorza-Treviño et al. 2005).

Occurrence in the Red Sea

The oldest record from the Red Sea was provided by Klunzinger (1878), who reported on two specimens which he collected during his stay in Koseir (Qusair), Egypt, and which he identified with "*Tursio abu salām* Rüppell" (=*Tursiops aduncus*). However, his description of the colouration of one of the animals, found in a fresh state, makes very clear that this was *Stenella attenuata* (page 69): "*Die Haut ist glatt und glänzend, der Rücken tief glänzend schwarz, untere Körperhälfte blaugrau, Bauch bis zum After dicht schwärzlich gefleckt. Dazu fand ich aber nach meinen Notizen noch am Rücken eine, unten scharf bogig begrenzte, besonders dunkle schabrakenartige Färbung, welche den mittleren Theil des Körpers einnahm, von der Stirne bis hinter die Rückenflosse sich erstreckend……(p.70): Ein scharf begrenzter schwarzer Streif zieht sich ferner vom vorderen Ende des Stirnhöckers, welcher stark gegen den Schnabel und die Kopfseiten abgesetzt ist, zum Auge. Die Kopfseiten darunter und besonders darüber sind weiss. Die Flossen sind schwarz…..Vorderer Rand der Rückenflosse fast gerade, hinterer sehr concav, Brustflosse sichelförmig spitzig… Masse: Ein Exemplar hatte 1,85 Meter Gesammtlänge. Kopf bis zur Basis der Rückenflosse 39 Ctm,… Ein anderes Exemplar war 2,63 Meter lang.*" (The skin is smooth and shiny, the back deep shiny black, lower half of the body bluish grey,

Figure 34 (left). The oldest Red Sea record of pantropical spotted dolphin (*Stenella attenuata*). Dorsal (a), ventral (b) and lateral (c) view of the skull (ZMB 31975), collected by Carl Benjamin Klunzinger in 1874 in Qusair, Egypt (26° 04' N, 34° 15' E). Photos by: C. Radke, Museum für Naturkunde, Berlin.

Figure 35 (right). Skull of a pantropical spotted dolphin (*Stenella attenuata*), dorsal (a), ventral (b) and lateral (c) view. Field Museum of Natural History Chicago (FM105019), collected on a beach a few kilometres north of Marsa Alam on the southern Egyptian coast by D.J. Osborn, on 8 April 1966. Photos by: R. Benasiak, Field Museum.

Figure 36. Bowriding pantropical spotted dolphins (*Stenella attenuata*), sighted in a mixed group with spinner dolphins (*Stenella longirostris*) off Ras Ghamila, Sharm El-Sheikh, Egypt (27° 58' N, 34° 25' E) on 7 May 2006. Photo by: M. Ebert (MY Independence-Tauchsafari).

abdomen as far the anus densely spotted with blackish. According to my notes, I also found a very dark-coloured saddle-like field on the back, ventrally curved and sharply demarcated, which covered the central part of the body, extending from the forehead to behind the dorsal fin... In addition, a sharply demarcated stripe runs from the front of the melon, which is clearly demarcated from the beak and sides of the head, towards the eye. The sides of the head below and particularly above it are white. The flippers are black... Leading edge of the dorsal fin nearly straight, trailing edge very concave, flipper falcate, pointed… Measurements: One specimen had a total length of 1.85 meter. Head to the basis of the flipper 39 cm,… Another specimen was 2.63 m long."). Most probably, the smaller animal is the one that he described; the larger specimen may indeed have been *Tursiops aduncus* (see under that species). Many years later, Klunzinger (1915) mentions that he sold zoological material to various university collections, among which those in St. Petersburg and Berlin. Among these were "Skelette [plural!] vom [singular!] Delphin (abu sallam)", but he does not specify how many specimens he sent, and to which museums. Two have been traced. There is a partial skeleton in the Zoological Museum of Berlin (ZMB 31975), collected at Qusair in 1874, and consisting of a cranium with a nearly complete vertebral column and ribcage; C. Funk and C. Radke provided photographs of the skull, which leave no doubt that it is *S. attenuata* (Fig. 34). It seems likely that this is the animal extensively described in 1878, though this cannot be established. The condylobasal length of the skull is about 39 cm, which agrees with the measurements of the head given in his description. There is another skull (without skeleton) in the Zoological Institute of the Russian Academy of Sciences in St. Petersburg (ZMAN 6886), also collected at Qusair, dated 1877; this must be the year of its acquisition by the museum, as Klunzinger left Egypt in 1875. Its condylobasal length is 39.2 cm; it was identified with *S. attenuata* by W.F. Perrin. The length of the two skulls being equal, this can hardly be the larger animal of 2.63 m mentioned by Klunzinger in 1878, particularly since Perrin et al. (2004) listed this skull as immature. Nowhere, however, does Klunzinger (1878, 1915) refer to other dolphins collected at Qusair, so this problem cannot be solved. Both specimens are mentioned by Leatherwood (1986), Gilpatrick et al. (1987) and Perrin et al. (1987, 2004).

A further skull was collected on a beach a few kilometres north of Marsa Alam on the southern Egyptian coast by D.J. Osborn, on 8 April 1966. The specimen has a field label HH 16036 (as reported in Harry Hoogstraal's field notes); it was deposited in the Field Museum of Natural History in Chicago (FM 105019). The specimen, a cranium with missing teeth and a damaged rostrum, was initially labeled as an unidentified species of the *Delphinidae* (W. Stanley and R. Banasiak, pers. comm. and photographs) and identified by us from photographs provided by R. Banasiak as a juvenile (CBL c. 32 cm) *S. attenuata* (confirmed by W.F. Perrin) (Fig. 35). In Leatherwood (1986) and Gilpatrick et al. (1987) it is erroneously listed as *S. longirostris*.

Many sightings of *S. attenuata* have been reported from the Red Sea in following years (Fig. 36). Evans in Frazier et al. (1987) writes: "It is probably the most common dolphin in the Red Sea, and although most records are from the northern end and the Gulf of Aqaba, it is likely to be as abundant in the less well known parts of the Red Sea further south". Beadon (1991) reports that "Spotted dolphins, *Stenella attenuata*, were by far the most abundant and frequently encountered cetaceans" observed during live-capture operations for the Tel Aviv Dolphinarium between 15 September 1980 and 1 September 1981. They were seen almost daily in the pelagic reaches of the Gulf of Aqaba, in herds of up to 300 or more, whereas they seemed rare or absent from the shallower Gulf of Suez. Eight animals were captured between September and November 1980, but later released (Beadon, 1991).

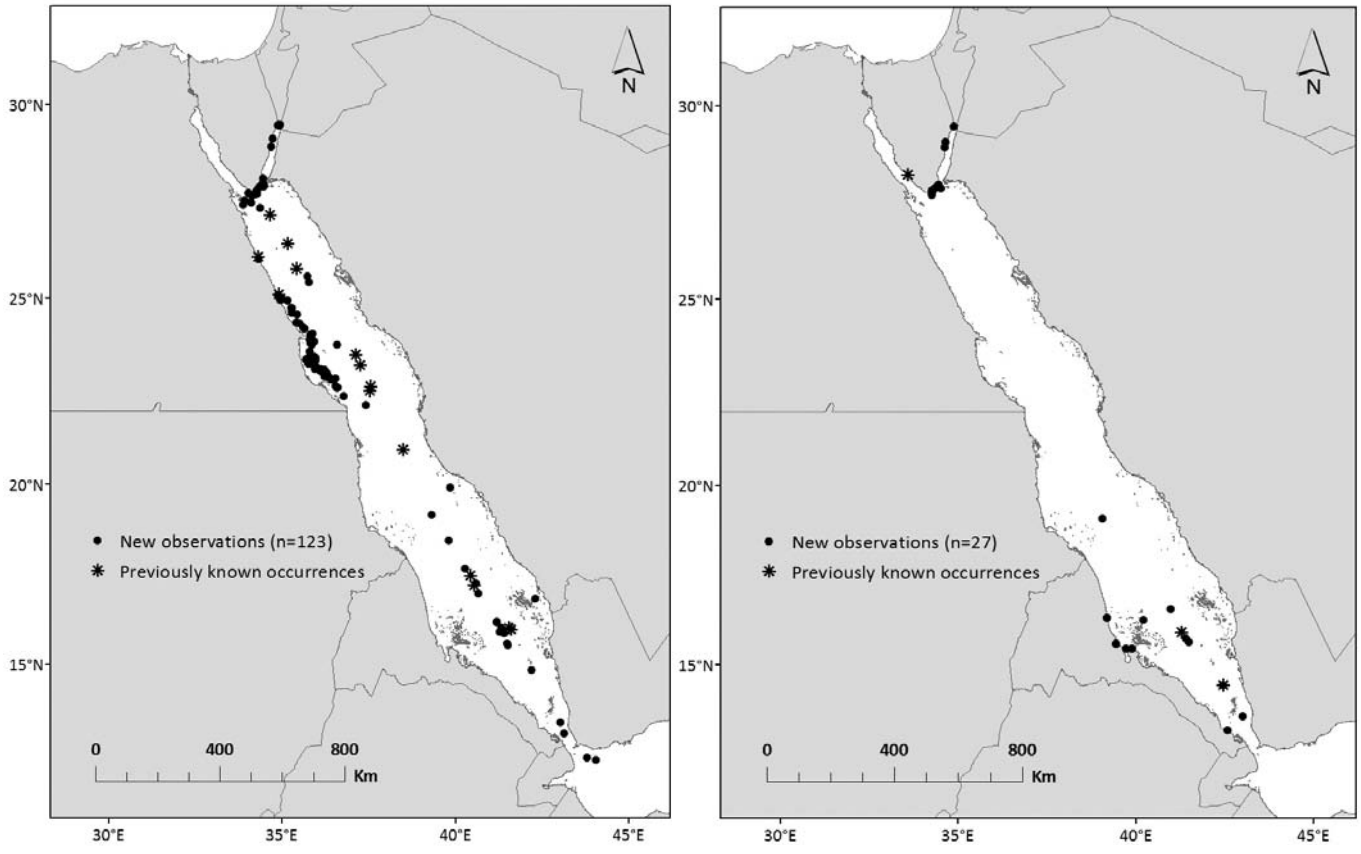
Eyre (1995) and Eyre and Frizell (2012) made several observations while traversing the Red Sea along its central axis, once in a mixed-species group with spinner dolphins *S. longirostris*. The Hurghada Marine Museum and Aquarium has two stuffed specimens (an adult and a calf) of *S. attenuata* on display. We have no information on where and when these were collected.

New observations

About 120 new records of *S. attenuata* are reported in this paper, mainly from the northern part of the Red Sea, accrued between 1984 and 2015, including two single strandings but mostly based on sightings, with group sizes occasionally reaching 200 (Fig. 37). Sightings of *Stenella sp.* in which identification of species could not be made are indicated in Fig. 38. Twenty-two sightings of *S. attenuata* were made along the midline transect between 13° and 19° N, corroborating the notion that the species may be commonly occurring in the souther part of the Red Sea.

A total of 114 new records of *S. attenuata* are reported in this review, mainly from the northern part of the Red Sea, accrued between 1984 and 2016 (Fig. 37). Except two single strandings (near El Quseir and Marsa Alam), all were sightings at sea, with group sizes ranging from one to 200. Fifteen sightings of *S. attenuata* were made on the midline transect between 13° and 19° N, confirming that the species commonly occurs in the southern part of the Red Sea. *S. attenuata* and *S. longirostris* (see next species account) appear to be both the most abundant of Red Sea cetaceans. During approximately 1/3 of all sightings made by Costa (2015), these two species could not be told apart, and are often spotted in mixed species groups. We suspect that many of the sightings designated *Stenella sp.*, especially in the south (Fig. 38)

Figure 37 (left). Observations of pantropical spotted dolphins *(Stenella attenuata)* in the Red Sea.
Figure 38 (right). Observations of unidentified dolphins (*Stenella sp.*) in the Red Sea.



might have been pantropical spotted dolphins.

Remarks

Habitat

As elsewhere throughout its range, the species typically occurs in deep waters although it is also observed at shallower depths, such as around offshore reefs and near the Straits of Bab al Mandab. It has not been found in the shallow Gulf of Suez, whereas it does occur in the deep Gulf of Aqaba, to its northern tip, in agreement with the observations by Beadon (1991), who found it abundant in deep water near the southern entrance of the Gulf.

Group size and abundance

Evans in Frazier et al. (1987) suggested that the pantropical spotted dolphin is probably the most common dolphin in the Red Sea, with normal group sizes of 1-50 individuals, reaching a maximum of up to 200. Beadon (1991) reported herds of up to c. 300 animals or more. In accordance of the above, the mean (±SD) group size of the newly reported sightings for which it was available (N=104) was 40.5 ± 43.5, median=22. Herds in the low thousands, as encountered in the Gulf of Aden (Small and Small, 1991), were not observed.

The quantitative study carried out in 2010-2012 between Marsa Alam and the Egyptian-Sudanese border (Costa 2015), estimated a density of 0.96 individuals/km^2 (CV=0.26).

Reproduction

There are few data on reproduction. Off southern Egypt, newborn calves were seen during the summer months. CS and co-observers saw calves in March and July, PR observed calves in November, Eyre and Frizell (2012) in April. Robineau and Rose (1984) observed epimeletic behaviour of adults towards a stillborn calf in the Gulf of Tadjoura, Djibouti, in November.

Ocurrence in mixed groups

Off southern Egypt, *S. attenuata* and *S. longirostris* were seen in mixed groups the majority of the time they were encountered and on two occasions *Tursiops truncatus* was also present. PR observed seven mixed groups of *S. attenuata* and *S. longirostris* in the waters of the southern Gulf of Suez around Sharm El Sheikh and Straits of Tiran. Mixed groups were also observed along the southern mid transect, mostly with *S. longirostris* and twice with *Tursiops truncatus*. The association between the two *Stenella* species is a well-know interspecies association in the Eastern Tropical Pacific and southwest Indian Ocean (e.g. Kizka et al. 2011) suggesting that such association may surrogate moving into protected reefs for daytime resting as a protective measure against predation by pelagic sharks.

Contiguity with other seas

S. attenuata is commonly present in the Gulf of Aden (Baldwin and Salm 1994, Baldwin et al. 1999, Baldwin 2003) and throughout the surrounding tropical Indian Ocean (Jefferson et al. 2015). Small and Small (1991) reported many observations off northern Somalia, “at bottom depths from 3-800m", where herds of c. 2000 individuals were encountered. In view of the sightings by CS and co-observers in the Straits of Bab al Mandab, it may be assumed that the species’ range in the Red Sea and Gulf of Aden is contiguous.

Spinner dolphin – *Stenella longirostris* (Gray, 1828)

Taxonomy and distribution

The taxonomy of the spinner dolphin, distributed worldwide in tropical and subtropical waters, is still insufficiently known. For the Pacific Ocean, Perrin (1990) described two subspecies besides the nominate form: *S. l. orientalis* and *S. l. centroamericana* (later confirmed by genetic data: Leslie and Morin, 2016) and in coastal waters of Southeast Asia and northern Australia, a small form has been distinguished as *S. l. roseiventris* (Wagner, 1846); see Perrin et al. (1999, 2007b), Jefferson et al. (2015). Similar small animals have been reported and photographed in inshore waters off Oman, but have not been further examined (Baldwin and Salm 1994, Van Waerebeek et al. 1999, Minton et al. 2010) and their characteristics and status remain unclear.

To date, all spinner dolphins in the Indian Ocean and Red Sea (Fig. 39) are still regarded as *S. l. longirostris* (Gray, 1846), though future research may well reveal the existence of other forms deserving of a subspecific status (Rice 1998, Perrin et al. 2009). For the colour pattern of the Red Sea population, see below.

Occurrence in the Red Sea

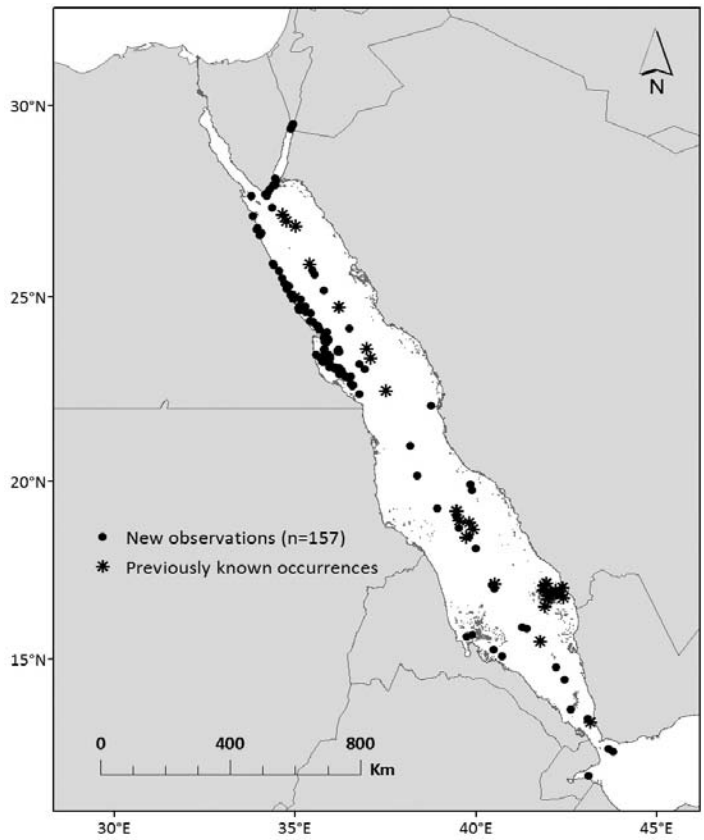
As far as we are aware, there are no museum specimens from the Red Sea. A skull in the Field Museum of Natural History, Chicago, collected in 1966 from the southern Egyptian coast (see Leatherwood 1986, Glipatrick et al. 1987), turned out to be *S. attenuata* and is discussed under that species.

The first record from the Red Sea of what may have been a spinner dolphin is given by Rüppell (1842), who, besides describing *Delphinus Abusalam* which is a synonym of *Tursiops aduncus* (Ehrenberg, 1832) – see under that species – speaks of the occurrence of two other kinds of dolphin, one of those characterized by a very long, narrow, beak-like rostrum with about 50 teeth in each jaw; he suggested that this could be "*Delphinus longirostris* Dussumier" ("die eine mit langem, schmalem, schnabelförmigem Kiefer, welche beiläufig 50 Zähne auf jeder Seite haben sollen, dürfte vielleicht *Delphinus longirostris* des Dussumier seyn; …"). Rüppell at that time was stationed at At-Tor (At Tur), southwestern Sinai, which according to our observations (Fig. 40) is outside the known range of *S. longirostris*; and given the fact that spotted dolphins *S. attenuata* are commonly sighted around the southern tip of the Sinai Peninsula (Beadon 1991), the identification must remain uncertain. The first confirmation of the species' presence in the Gulf of Aqaba was provided in 1996 by O. Barnea, who photographed a bow-riding group north of Tiran Island (Goffman et al. 1996).

Evans in Frazier et al. (1987) remarks: "Finally, the Common dolphin *Delphinus delphis* and Spinner dolphin *Stenella longinestris* [sic] are perhaps surprising absentees from the Red Sea", but in a footnote adds that after the cetacean section had gone into press, he had

Figure 39. Spinner dolphins (*Stenella longirostris*) displaying petting behaviour at Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E). Photo by A. Cesario

Figure 40. Observations of spinner dolphins (*Stenella longirostris*) in the Red Sea.



received, in 1986, personal communications by J. Gordon and C. Smeenk that spinner dolphins were commonly recorded in the southern Red Sea.

Robineau and Rose (1984) mentioned a sighting of spinner dolphins (number unknown) by M. Barré off Port Sudan. Eyre (1995) reported six sightings during a northward passage lengthwise through the Red Sea in July 1993, Eyre and Frizell (2012) made ten sightings during a second northward passage in April 1995, one of which was a mixed-species group with *S. attenuata*. Gladstone and Fisher (2000) reported eleven encounters on dedicated surveys and six more incidental observations around the Farasan Islands, Saudi Arabia, during 1993-1996, noting that *S. longirostris* was the most abundant species around the islands. They also reported a mixed-species sighting of six spinner dolphins and eight *Tursiops sp.* The UK Royal Navy Marine Mammal Observation reported two sightings in the middle of the Basin in 2000 (Maughan 2003).

The daytime frequentation by spinner dolphins of specific reefs off Southern Egypt has recently attracted specific investigations. Observations have concentrated on Samadai Reef (Shawky and Afifi 2008, Notarbartolo di Sciara et al. 2009, Shawky et al. 2015, Cesario 2017) and Satayah Reef (Fumagalli 2016). Dolphins enter the internal lagoons in the early morning, and spend daylight hours resting, showing synchronous diving and slow circular swimming until their departure at dusk. Similar resting behaviour has been observed off Sudan (Notarbartolo di Sciara et al. 2009).

New Observations

We here report on 157 new sightings of spinner dolphins, mainly concentrated along the coast of southern Egypt, observed during vessel-based line-transect surveys off Southern Egypt, and targeted observations within offshore reefs along the Egyptian coast (see also Costa 2015, Fumagalli 2016, Cesario 2017) (Fig. 40). Spinner dolphins are also commonly observed in coastal waters off Sudan (GNS, unpublished observations), and within the Dahlak Archipelago, Eritrea (GNS and YTM, unpublished observations). In conclusion, published occurrences combined with new observations suggest that spinner dolphins are widespread and abundant throughout the Red Sea, including the Gulf of Aqaba. Conversely, and similarly to *S. attenuata*, we could not find occurrences of *S. longirostris* in the Gulf of Suez.

With the distributions of the two *Stenella* species being quite similar (Figures 37 and 40), the distribution of *Stenella sp.* (i.e., not identified to species level), as reported by the same sources, would be expected to

overlap the latter, which indeed it does (Fig. 38) and therefore does not add geographical information.

Remarks

Colouration and sexual dimorphism

The Red Sea spinner dolphin displays a tripartite colouration and size comparable to *S. l. longirostris*. However, differently from the latter subspecies, Red Sea spinner dolphins exhibit a rather pronounced sexual dimorphism and some unique features of pigmentation.

Sexual dimorphism in spinner dolphins has been found to vary geographically (Perrin and Mesnick, 2003) following an approximate east-west gradient in the Pacific Ocean from highly dimorphic forms, such as *S. l. orientalis*, to ecotypes displaying a moderate to weak dimorphism, such as *S. l. longirostris*. Wherever sexual dimorphism occurs, adult males are larger than females, and develop a more forward-canted dorsal fin and a larger post-anal hump than females (Perrin, 1998). These traits were also found in Red Sea spinner dolphins (Fig. 41) (Cesario, 2017), similarly to *S. l. orientalis* and *S. l. centroamericana*, although not as exaggerated.

The tripartite colouration pattern displayed by mature Red Sea spinner dolphins is characterized by an eye-to-anus stripe that divides the lateral and ventral fields. Based on studies of photo-identified individuals over a 9-year period by AC, this stripe progressively thickens and darkens in older individuals of both sexes (Fig. 42), confirming the suggestion by Eyre and Frizell (2012) that the colour pattern is age-related for the spinner dolphins in the Red Sea.

A peculiar trait that appears to be displayed only by the spinner dolphins of the Red Sea and the adjacent Gulf of Aden (Robineau and Rose 1983, 1984) is the dark pigmentation of the lower lip that broadens in the posterior half of the lower jaw (Fig. 43). This inverted-bell-shaped black lip patch apparently characterizes Red Sea spinners of both sexes and all age classes (Cesario, 2017).

Habitat

In the Red Sea, spinner dolphins may be found around islands (e.g., the Farasan Islands and Dahlak Archipelago) and coral reefs (Shawki and Afifi 2008, Notarbartolo-di-Sciara et al. 2009, present observations) as well as offshore (Eyre and Frizell 2012, present observations). Accordingly, habitation ranges from waters of only a few metres deep in lagoons or within reefs to >1000 m in the central basin. Night feeding of day-resting groups also involves moving into deeper waters.

Resting areas

Observation of *S. longirostris* have been systematically carried out in Samadai Reef, Egypt, from 2005 to 2006 and from 2010 to 2014 (Cesario 2017) and in

Figure 41. Secondary sexual characters in a spinner dolphin (*Stenella logirostris*) adult male photographed at Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E): prominent post-anal hump, enlarged peduncle and erect dorsal fin. Photo by: A. Cesario.

Figure 42. Spinner dolphin (*Stenella longirostris*) eye-to-anus stripe thickening and darkening with age. Individual sighted on 14 Jan. 2006 when line was faint (above) and again (same individual) on 14 June 2014 with thicker and darker (bottom) (Cesario, 2017). Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E). Photos by: A. Cesario.

Satayah Reef, Egypt, from 2010 to 2014 (Fumagalli 2016) suggesting that groups of resident dolphins are present all year around and use the internal lagoon as resting area during daylight hours. Similar resting behaviour has been observed elsewhere (Würsig et al. 1994, Karczmarski et al. 2005, Silva et al. 2005, Gannier and Petiau 2006, Oremus et al. 2007, Cribb et al. 2012).

Behaviour

Aerial spinning (high jump, as many as seven spins) has only been occasionally observed in the Red Sea, and not quite as frequent and energetic as that described for spinner dolphins from the Pacific (Norris et al. 1994) and Indian Oceans (observations by PR, CS and co-observers).

Group sizes of spinner dolphins in the Red Sea vary enormously (range 2-220, average 43, SD=36.13, Costa 2015), and also depend on whether observations are made within reefs or in the open sea. In the Farasan Islands spinner dolphins were encountered in groups of two size classes: 3-15 animals and 30-50+ (Gladstone and Fisher 2000). Schools numbering in the high hundreds or even a few thousand as reported for the northwestern Indian Ocean (Mörzer Bruyns 1971, Baldwin et al. 1999, Minton et al. 2010) have not been observed in the Red Sea.

Reproduction

Calves were observed year-round, but more often in March-August. A long-term study at Samadai Reef, southern Egypt, suggested a calving peak in June-August (Notarbartolo di Sciara et al. 2009, personal observations by MC, MF and AC). In July 2010 Kai Ogasa photographically documented the birth of a calf at Sha'ab Marsa Alam, 25°04' E, 34°56' N, when snorkelling with a group of app. 40 animals with 4 small calves (PR). Off Oman, Baldwin et al. (1999) observed most calves in April-June, Minton et al. (2010) in October and February, but no numbers are given.

Occurrence in mixed groups

S. longirostris was often observed by us in association with other species, most often with S. attenuata but also occasionally with *T. aduncus*, *T. truncatus*, both *S. attenuata* and *T. truncatus, S. coeruleoalba* and *S. plumbea*. PR, CS and co-observers noted that within bow-riding associations, the different species kept apart in small subgroups, or appeared shortly after each other.

Figure 43. Lower lip dark patch of Red Sea spinner dolphin (*Stenella longirostris*). Samadai Reef, Egypt (24° 59' 20.3" N, 34° 59' 49.7" E), 20 March 2012. Photo by: M. Ismail.

Contiguity with adjacent waters

The spinner dolphin is common in both inshore and offshore waters of the Gulf of Aden including the Straits of Bab al Mandab and in the Arabian Sea (Robineau and Rose 1984, Gilpatrick et al. 1987, Small and Small 1991, Ballance and Pitman 1998, Baldwin et al. 1999, Minton et al. 2010). Therefore, it is assumed that the distribution of this species in the Red Sea and adjacent Indian Ocean is likely to be contiguous, though it is not known how far the peculiar colour pattern of the Red Sea spinner extends into the Indian Ocean.

Notes on population status and threats

The only estimate of density/abundance of the species in the Red Sea has recently been made for a near-coastal strip of roughly 15,000 km^2 in southern Egypt (Costa 2015), resulting in c. 0.46 ind/km^2 (CV=0.26). It has recently been suggested (Tyne et al. 2017) that the constrained nature of spinner dolphin behaviour, as expressed by the daily spatio-temporal partitioning of behavioural activities, renders them less resilient to human disturbance than other cetaceans. At Samadai Reef, southern Egypt, the ever increasing and unregulated snorkelling and diving tourism at a resting site of spinner dolphins appeared to be a serious threat, but firm regulations have considerably lessened this pressure (Notarbartolo di Sciara et al. 2009). The accessibility of resting areas elsewhere to this growing tourism, often including unregulated dolphin watching and "swim with dolphins" programmes, poses widely recognized threats to local populations (Courbis and Timmel 2009).

Striped dolphin – *Stenella coeruleoalba* (Meyen, 1833)

Taxonomy and distribution

The striped dolphin is found worldwide in tropical and warm-temperate waters, mainly offshore. Although there are some geographic differences between populations, no subspecies have been recognized to date (Rice 1998, Jefferson et al. 2015).

Ballance and Pitman (1998) found the species common in the northwestern Indian Ocean. Reported sightings from the Gulf of Aden, however, are rare. On 14 June 1984, a scattered group numbering some tens of animals was spotted travelling by CS and co-observers in the centre of the Gulf, at 12° 24' N, 46° 42' E, with frequent synchronous jumping in pairs. Small and Small (1991), in their survey along the Somali coast, report that the species was "identified tentatively only once in the western inshore Gulf of Aden". That sighting was of a wave-riding group (number not specified) and, reading from their map in Fig. 5j, was off Saylac (at approximately 11° 40' N, 43° 35' E).

Occurrence in the Red Sea

Wilson et al. (1987: Fig. 1, p. 3), in their review of the species' distribution, mark a sighting in the northern part of the Red Sea; however, we could find no reference to this locality in the sources given. Evans in Frazier et al. (1987) does not include the species for the Red Sea, but in a footnote at the end of the chapter notes that boat surveys conducted in the Red Sea since the cetacean section went to press yielded "…occasional sightings of False Killer, Common and Striped dolphins (*S. coeruleoalba*)". This footnote, probably based on the sighting detailed below, may have prompted the inclusion of the Red Sea within the species' range in some later accounts (e.g. Perrin et al. 1994, Archer and Perrin 1999), or its exclusion from the same, with the remark that "…a few extralimital records are known from the Persian Gulf and Red Sea" (Hammond et al. 2008). Wang et al. (2014) regard the species as a "vagrant" to the Red Sea.

The only conclusive evidence of the species' occurrence in the Basin from the literature was inadvertently provided by Hagan (2006), with a photograph of a striped dolphin (mislabelled as "common dolphin") riding the bow of M.Y. Golden Shadow, during an expedition around the Farasan Islands (Saudi Arabia), 3-24 May 2006 (Fig. 44).

New observations

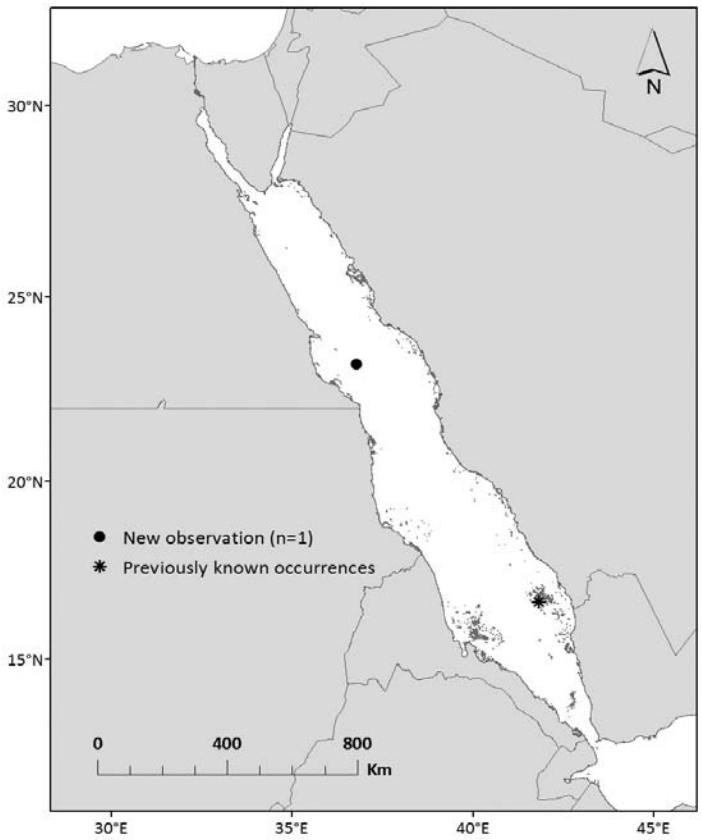
We here report one sighting of two striped dolphins, bow-riding within a group of c. 15 spinner dolphins, made by CS and co-observers in the offshore waters of southern Egypt (23°12' N, 36°47' E), on 9 July 1985 (Fig. 45).

Remarks

The rarity of the striped dolphin in the Red Sea and probably also in the Gulf of Aden is somewhat puzzling,

Figure 44. Striped dolphin (*Stenella coeruleoalba*) mislabelled as "common dolphin", riding the bow of M.Y. Golden Shadow, during an expedition around the Farasan Islands (Saudi Arabia), 3-24 May 2006. In Hagan (2006).

Figure 45. Observations of striped dolphins (*Stenella coeruleoalba*) in the Red Sea.



but may be in line with the dichotomy in habitat preference of spinner and spotted dolphins on the one hand and striped and common dolphins on the other in the eastern Pacific, with the first pair favouring more stable and stratified "tropical waters" and the latter more variable "upwelling-modified waters" (Au and Perryman 1985).

Indo-Pacific common dolphin – *Delphinus delphis tropicalis* Van Bree, 1971

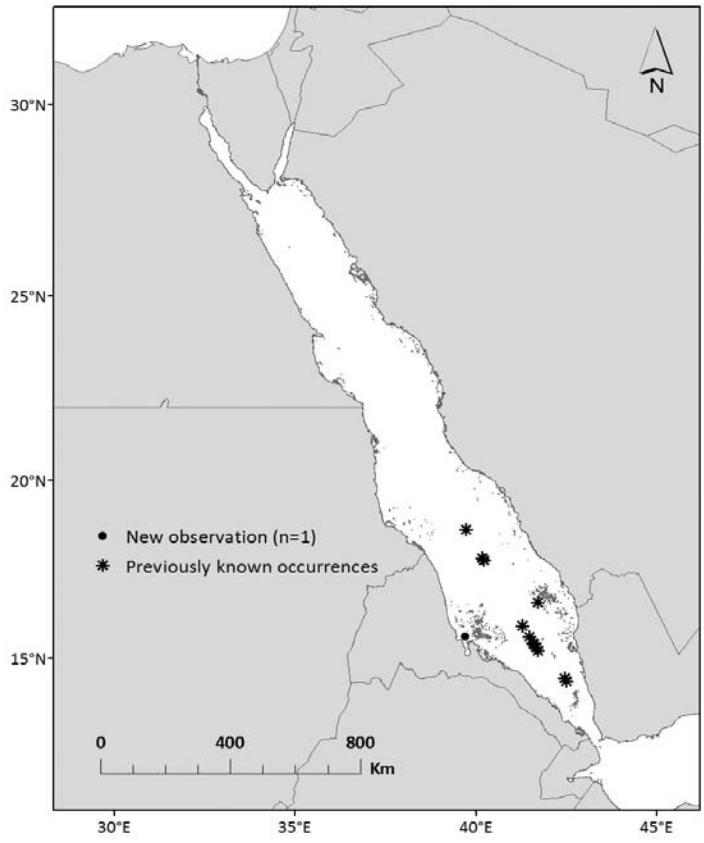
Taxonomy and distribution

The taxonomy of the genus *Delphinus* L., 1758 is complicated and largely unresolved. Apart from the short-beaked common dolphin *Delphinus delphis* L., 1758, the long-beaked populations occurring disjunctly in neritic waters of the (sub)tropical oceans were collectively distinguished as *Delphinus capensis* Gray, 1828, which was described from the Cape of Good Hope. Based on genetic evidence, however, Natoli et al. (2006) argued that this long-beaked form is not monophyletic and thus artificial, probably including different (sub)species. On the other hand, in a recent study based on both molecular and morphological characters, Cunha et al. (2015) concluded that *D. delphis* and *D. capensis* cannot really be distinguished and for that reason they consider *D. capensis* an invalid species, which would make the name a junior synonym of *D. delphis* L., 1758. This needs further study, but has provisionally been accepted by the Committee on Taxonomy (2017), and we are following their recomemndations.

The common dolphins found in coastal waters of the northern Indian Ocean and West Pacific are characterized by a very long beak and a correspondingly large number of teeth. Earlier publications have distinguished these under two names which later proved invalid: *Delphinus longirostris* G. Cuvier, 1829 which is preoccupied by *D. longirostris* Gray, 1828 (= *Stenella longirostris*), and *Delphinus dussumieri* Blanford, 1891 which is preoccupied by *D. dussumieri* Fischer, 1829 (= *D. capensis* Gray, 1828, or *D. delphis* L., 1758). Therefore, Van Bree (1971) renamed this form *Delphinus tropicalis*.

Van Bree and Gallagher (1978) studied *Delphinus* skulls from the coasts of Oman and the Persian Gulf. By establishing the ratio rostrum length/zygomatic width, they distinguished the long-beaked *D. tropicalis* as a species distinct from the shorter-beaked *D. delphis*, and concluded that these two occurred sympatrically in the area. A limited study by Smeenk et al. (1996) of skulls from the same coasts, however, concluded that the variation in this ratio is individual and that all specimens belonged in the same form which they called *Delphinus cf. tropicalis*, at the same time suggesting that this might be a very long-beaked form of *D. capensis*. Ballance and Pitman (1998) observed and photographed these dolphins off Oman and found that their colour pattern clearly differed from *D. delphis*, as well as from *D. capensis* in the eastern Pacific; they too, listed them as *Delphinus cf.* tropicalis.

Figure 46. Observations of Indo-Pacific common dolphins (*Delphinus delphis tropicalis*) in the Red Sea.



Jefferson and Van Waerebeek (2002) made an extensive study of skulls and external characters of common dolphins from the Indo-Pacific (including only one skull from the Red Sea); they considered *D. tropicalis* to constitute a subspecies of *D. capensis*, occurring from the Red Sea and Gulf of Aden to South and Southeast Asia as far north as China, perhaps intergrading with shorter-beaked populations of *D. capensis* off East Africa and NE China, though this could not be established. Whereas some authors have treated *tropicalis* as a distinct species (Pilleri and Gihr 1972a, b, Rice 1998), more recent authors, following Jefferson and Van Waerebeek (2002), regard it as a subspecies of *D. capensis* (Wang et al. 2014, Jefferson et al. 2015) or, when not recognizing the latter as a valid species, of *D. delphis* (Cunha et al. 2015, Committee on Taxonomy 2017).

Occurrence in the Red Sea

There are relatively few records of common dolphins from the Red Sea (Fig. 46). Although Alling (1986) mentions its occurrence there, her observations are from just outside the Red Sea in the Gulf of Aden. Leatherwood (1986) gives five observations of "*D. delphis*" in the Red Sea reported by Anne Collet: 26° 10' N, 35° 08' E, c. 17 nautical miles SE of the Brother Islands off Egypt, 10 November 1981: c. 100 animals; 21° 55' N, 38° 25' E, NW of Jeddah, Saudi Arabia, 20 May 1982: c. 30 animals; 21° 25' N, 38° 37' E, NW of Jeddah, 14 September 1981: 20 animals; 16° 15' N, 41° 03' E, between the Dahlak Archipelago, Eritrea, and the Farasan Islands, Saudi Arabia, 30 May 1982: c. 50 animals; 16° 10' N, 41° 04' E, between the Dahlak Archipelago and Farasan Islands, 30 May 1982: c. 100 animals. The depth at these localities ranges from 20-70 m NE of the Dahlak Archipelago to c. 1000 m near the Brother Islands. The latter would be the northernmost observation of Delphinus in the Red Sea so far. Unfortunately, these records are not followed by remarks on the animals' characteristics. Anne Collet (in litt.) wrote that these records had been reported to her by others and could no longer be verified. Therefore, they are regarded here as unconfirmed.

The first well-documented records from the Red Sea were published by Smeenk et al. (1996), who made the following observations in the southern Red Sea, mainly off Zuqur and Zubayr Islands, Yemen, supported by descriptions, photographs and video-recordings of these very long-beaked dolphins:

Between 14° 25' N, 42° 28' E and 14° 21' N, 42° 31' E, 13 June 1984: a large mixed herd of *Stenella sp*. and larger dolphins foraging in a broad formation, not closely approaching the ship; nonetheless, two of the larger animals were positively identified with *Delphinus*. Slightly later, a group of 10-15 *Delphinus* were seen foraging at a short distance from the ship and came bow-riding, including a half-sized calf swimming in synchrony with an adult; these were photographed. Water depth ranged from 80-110 m.

Between 15° 13' N, 41° 43' E and 15° 37' N, 41° 29' E, 10 March 1993: many groups of dolphins were encountered: *Delphinus, Tursiops sp*. and *Stenella attenuata*; several groups of *Delphinus* ranging from two to up to c. 25 animals were foraging close to the ship, with some bow-riding for a brief moment; these were video-recorded. The dolphins showed a fairly "faded" colouration, with whitish flanks and abdomen, though the Delphinus pattern was obvious; the long beak was striking. Water depth ranged from 80 to 500 m, with a sheer drop.

17° 48' N, 40° 12' E, 11 March 1993: some dolphins ahead, most of them not closely approaching; one animal came to the bow and was positively identified with *Delphinus*. Water depth was 800-1500 m.

Al-Mansi and Sambas (2006) report the occurrence of the "common dolphin *Delphinus delphis*" in the Farasan Islands protected area, Saudi Arabia, where they recorded 15 groups of 2-25 animals during a survey in May 2006. Their description of the species, however, is taken from the literature, so does not give details on the characteristics of the animals seen. Salam (2006) reports that "common dolphins (*Delphinus delphis*)" were frequently seen outside Dungonab Bay, Sudan, stating that "a large group of common dolphins is apparently resident at Shambaya reef". The animals are not further described.

Jefferson and Van Waerebeek (2002) studied one skull from the Red Sea in the Natural History Museum, London: BMNH (ZD) 1995.55, collected on Farasan Island, Saudi Arabia, on 14 July 1993 by David Simmons.

New Observations

We report a record of 5-6 individuals occurred between Massawa and the Dahlak Archipelago, Eritrea, on 3 December 2006, accompanied by a beautiful photograph by Henrik Stabell, showing all characters of this species (Fig. 47). Further records including three strandings and six sightings from Eritrea, reported by YTM between 1995 and 2007, were tentatively identified as *Delphinus delphis tropicalis* but could not be confirmed by documental support.

Remarks

Delphinus d. tropicalis does not seem very common in the Red Sea at large, and most observations are from the southern part not far from coastal islands, though many animals were seen in deep water. The records of 10 March 1993 by Smeenk et al. (1996) were made at and around the steep edge of the continental shelf, where the animals were foraging in close proximity to other dolphin species. So far, there are no documented records from Egyptian waters, despite the numerous

Figure 47. Indo-Pacific common dolphin (*Delphinus delphis tropicalis*) seen in a group of 5-6 between Massawa and the Dahlak Archipelago, Eritrea, on 3 December 2006. Photo by H. Stabell.

observations of dolphins that have become available from that area during the last few decades. The only record of reproduction is the calf seen in June 1984 by Smeenk et al. (1996).

Species unlikely to occur in the Red Sea

Common minke whale – *Balaenoptera acutorostrata* Lacépède, 1804

Two species of minke whales are now recognized: the common minke whale *Balaenoptera acutorostrata* Lacepède, 1804 and the Antarctic minke whale *Balaenoptera bonaerensis* Burmeister, 1867. Both species occur in the Indian Ocean, but the taxonomic position and distribution of the common minke whale in the area is not clarified. It is provisionally regarded as a still unnamed subspecies of *B. acutorostrata*, the "dwarf" minke whale (Rice 1998, Perrin et al. 2009, Jefferson et al. 2015). The Antarctic minke whale occurs in the southern part of the Indian Ocean; its winter range here probably does not extend as far north as the Equator (Jefferson et al. 2015, Deméré 2014).

Common minke whales, or small baleen whales suspected to be of this species, have been reported from the northwestern Indian Ocean including the Gulf of Aden and Gulf of Oman (Slijper et al. 1964, Frazier et al. 1987, Baldwin et al. 1999), but proper documentation is lacking. Baldwin (2003) later regarded the sightings off Oman as highly unlikely, see also Minton et al. (2010). Best (2007) only found the species south of 10° S in the southwestern Indian Ocean. A careful review of strandings in the northern Indian Ocean has not revealed any minke whale, only Bryde's whale *B. edeni* (R.L. Brownell, Jr. in litt.; see under that species above). Although the occurrence of vagrant common minke whales in the area cannot be ruled out, in all cases misidentification of Bryde's whales or Omura's whales would seem most likely. The distribution maps of *B. acutorostrata* in Shirihai and Jarrett (2006), Deméré (2014) and Jefferson et al. (2015) seem erroneous for the Indian Ocean.

Supposed occurrence in the Red Sea

Slijper et al. (1964) mapped two sightings of "little piked whales" in the southern Red Sea, without further documentation. Leatherwood (1986) mentions a stranding of *B. acutorostrata* at c. 20 km south of Jizan, Saudi Arabia, in May 1969. Photographs of this animal, reportedly taken by W. Suchanek, could not be traced. In an additional footnote to his paper, Evans in Frazier et al. (1987) mentioned reports of "small baleen whales, possibly Minke Whale". In the absence of solid evidence, we regard all these records as very unlikely, based on confusion with *B. edeni* or *B. omurai,* and conclude that common minke whales have not been proven to occur in the Red Sea.

Sperm whale – *Physeter macrocephalus* Linnaeus, 1758

The sperm whale occurs throughout the deep waters of all the oceans and some adjacent seas including the Gulf of Aden, from the Equator to the edges of the polar ice. There is a strong geographical segregation between sexes. Females with young stay in tropical to warm-temperate waters whereas in most populations the males, when becoming independent, form "bachelor groups" which migrate to higher latitudes, to return to the females when sexually and socially mature; old bulls, too, may move again into colder waters (Whitehead 2003, Taylor et al. 2008, Mesnick 2014, Jefferson et al. 2015). The species' habitat is typically one of deep-slope to open ocean waters, being found in practically all marine waters deeper than c. 500 m not covered by ice.

Supposed occurrence in the Red Sea

No documented records of sperm whales exist from within the Red Sea. The observation by Roghi and Baschieri (1956) of an encounter with four "sperm-whales (*Physeter catoden*)" [sic] near the island of Curunsas in Dankalia, Eritrea, in May, which "were in the coastal shallows, wildly chasing legions of bonitos, tunny and mackerel which were in turn following swarms of sardines", clearly does not relate to sperm whales, which forage in deep water, mainly on squid. The same authors' further, unspecified records of the occurrence of the species off southern Eritrea "following big shoals of fish" too, appear erroneous. Slijper et al. (1964) mapped a sighting of sperm whales in the southern Red Sea. However, the documentation of this record is very poor: on p. 32 it is dated December (no year given), on p. 87 it is entered for October, the map for December on that page showing a blank. This record is therefore regarded as unsubstantiated.

Some authors reported on ambergris washed ashore in the Red Sea. There are vague records by (Von) Heuglin (1861, 1877) and (Von) Heuglin and Fitzinger (1866) of what they called "ambra" (= ambergris) or something similar, regularly being washed ashore on the coasts of the Red Sea, but the nature and origin of this substance remained unclear and the authors could not confirm the presence of sperm whales in the area. Klunzinger (1878) too, mentions the common occurrence of "ambra" in the Red Sea, which led him to speculate that the large whale he had seen near Koseir (Qusair), Egypt, could have been a sperm whale.

Based on information received from inhabitants of Djibouti that traders from Assab in Eritrea collected ambergris on the northern coast of Djibouti, between Ras Bir and the Eritrean border, which would be at the

very entrance of the Red Sea, Robineau and Rose (1984) surmised that the sperm whale might enter the southern part of the Red Sea, though rarely. Gladstone and Fisher (2000) relate that fishermen of the Farasan Islands off southern Saudi Arabia sometimes find ambergris on the shore; one of the authors had been shown a large piece. They emphasize, however, that this might have drifted into the area from the Gulf of Aden, which seems a real possibility considering the strong influx of surface water constantly entering the Red Sea through the Straits of Bab al Mandab, or by prevailing winds in some seasons. Thus, the occasional presence of sperm whales in the (southern) Red Sea remains unconfirmed. The sperm whale's apparent absence from the Red Sea may seem puzzling at first sight, considering that the species is well-known from the Gulf of Aden (Slijper et al. 1964, Robineau and Rose 1984, Baldwin et al. 1999, Mikhalev 2000) and some other semi-enclosed seas such as the Mediterranean (Jefferson et al. 2015). However, the Straits of Bab al Mandab and the adjacent southern end of the Red Sea over a distance of c. 150 km consists of a long, shallow sill generally less than 100 m deep, with only a very narrow central canal that is up to 200 m deep or in some places slightly more (Werner and Lange 1975, Head 1987, Jarosz 1997). This oceanographic configuration forms a barrier that would be hard to negotiate for the oceanic, deep-water sperm whale. It is very different from the much shorter and deeper Strait of Gibraltar at the entrance of the Mediterranean, where sperm whales habitually pass.

In this context, it may be noticed that no beaked whales (*Ziphiidae*), all deep diving animals, have been found in the Red Sea to date.

Discussion

Zoogeography

Until now, 16 species of cetaceans have been demonstrated to occur in the Red Sea. Only nine of these appear to have found a suitable habitat for their regular presence in the Basin, with the remaining seven probably occurring only occasionally, as vagrants from the Indian Ocean. Given the limited chances of observing those rarer species, it is to be expected that the list of such vagrants may still increase, particularly as the quality of observations and the expertise of observers in the area will improve with time.

Jefferson et al. (2015) indicate that at least 28 cetaceans (6 baleen whales, the sperm whale, 2 Kogia, 3-4 *ziphiids*, 15 *delphinids* and 1 porpoise) occur throughout the greater part of the tropical Indian Ocean, most of which may also venture into the Gulf of Aden. There can be several explanations why only one third of these species have permanently settled in the Red Sea; these could include factors relating to habitat suitability such as temperature and salinity, dearth of primary productivity, availability of preferred prey, and constraints to migratory habits.

In particular, the absence from the Red Sea of deep-diving species such as the otherwise ubiquitous sperm whale and any of the beaked whales inhabiting the adjacent Indian Ocean waters may seem puzzling. Their absence can perhaps be explained by the longitudinal extension of the shallow sill separating the Gulf of Aden from the Red Sea deep waters north of the Straits of Bab al Mandab (the 200 m isobath extending as far as 180 km north of the straits proper), which may prevent incursions by deep divers into the Red Sea. The Red Sea cephalopod fauna is poorly known (Mastaller 1987), but the apparent paucity of deep-see squid may be a factor explaining that these deep-diving cetaceans cannot find sufficient prey in the Red Sea.

Equally, if not even more puzzling, is the rarity or in some cases even absence of several medium- and small-sized cetaceans from the Indian Ocean, such as dwarf and pygmy sperm whales, killer whales, pilot whales and striped and rough-toothed dolphins. Interestingly, though having been less intensively researched, it is the southern region where all encounters with the rare toothed whales have occurred. Taken together with Indo-Pacific common dolphin seemingly restricted to the southern region, this condition may point to a combination of environmental characteristics of the northern Red Sea as a factor impeding permanent occupation by some or all of these species.

Conversely, the land barrier to the north between the Mediterranean and Red Seas marks a clear zoogeographical boundary between the temperate North Atlantic and the Western Indo-Pacific realms (Spalding et al. 2007). Accordingly, the cetacean species composition of these two regions is markedly different, with the Mediterranean cetaceans having an Atlantic, the Red Sea cetaceans an Indian Ocean origin. The relatively recent, human-induced breach of this land barrier through the Suez Canal has facilitated considerable faunal exchanges of a variety of phyla of invertebrates and fishes called “Lessepsian migration”, mostly from the Red Sea into the Mediterranean. Moreover, recent global warming has served to further mitigate the ecological boundary between these realms, in that the eastern Mediterranean, in particular, is experiencing an unparalleled degree of invasion by Red Sea biota (Edelist et al. 2013). Until now, Lessepsian migration has resulted in a very limited passage of cetaceans, restricted to a few known incursions of Indo-Pacific humpback dolphins into the Levantine Basin (Kerem et al. 2001, Notarbartolo di Sciara 2016), readily noticeable as this species is very distinct from any Mediterranean dolphin and thus easy to recognize. Detecting any movements across the Suez Canal, northwards or southwards, of bottlenose dolphins of either species is more challenging, and until now it has not been proved or disproved that such movements do occur. As far as we know, these three Red Sea species are the only ones frequenting the Gulf of Suez, with easy access to the Suez Canal providing an opportunity for Lessepsian migration.

Conservation

Due to the lack of continuous systematic research, providing a general assessment of the conservation status of Red Sea cetaceans is very difficult. Such lack would also hamper the planning and followup of science-based conservation measures. Concerns relate to the main direct or indirect anthropogenic pressure factors known to be at work in the Red Sea such as climate change, chemical and noise pollution, disturbance of critical habitat and direct killings. Other known threats have so far spared the Basin, as e.g. bycatch, dwindling resources caused by overfishing, and ship-strikes.

Climate change has clearly begun to show its effects on Red Sea marine biota, but these are for now mainly visible in the coral reefs (Riegl et al. 2012). Possible effects on cetacean populations are still undetected.

We are unaware of studies describing contamination by xenobiotic substances in Red Sea cetaceans but presume that, with the exception perhaps of local hotspots, the levels of pollution in the region are generally low compared to most of the world’s marine areas, due to the restricted human presence and industrial activity along its coasts. However, considering the huge amount of oil being transported by ship across the Red Sea (with >187 million tonnes of oil products having passed the Suez Canal in 2016), there is always the danger of a major oil spill in a cetacean habitat.

More localized conservation problems are likely to occur in places where coastal construction (e.g., near commercial ports) provides the danger of chemical pollution of the marine environment by toxic waste, or of noise pollution, such as during pile-driving (Dawoud et al. 2016).

Disturbance by tourist activities within vulnerable resting areas of dolphins is also known to occur in the Red Sea. At Samadai Reef, southern Egypt, the ever increasing and unregulated snorkelling and diving tourism at a resting site of spinner dolphins appeared to become a serious threat, but firm regulations have considerably lessened this pressure (Notarbartolo di Sciara et al. 2009). This form of tourism capitalizing on the accessibility of dolphin resting areas, e.g. of Indo-Pacific bottlenose dolphins in the waters off Hurghada, Egypt, and of spinner dolphins in Satayah, also in Egypt, is rapidly developing and largely out of control, and with a high risk of disturbance, disruption and finally extirpation of the populations concerned (Fumagalli 2016).

Finally, cases have been observed of dolphins being deliberately killed in the Red Sea to provide bait for illegal shark fishing, as has become apparent from dolphin remains found by Egyptian authorities in seized Yemeni vessels in 2010 (GNS, personal observation). However, the limited available information does not indicate that this kind of mortality is as yet of particular concern for the viability of the affected populations.

In conclusion, although there are reasons for concern about cetacean conservation in the Red Sea, we suggest that conservation measures should in the first place be directed at the areas where such impacts are known to occur. On a wider level, we assume that the Red Sea at large may still be considered one of the world's marine regions where cetaceans are least affected by negative pressures deriving from human activities, or by the ongoing changes in global environmental conditions. However, in view of the increasing human requirements and resulting environmental exploitation, we recommend that the status of cetaceans in the Red Sea be carefully monitored. This should include efforts to establish the degree of isolation of regional cetacean populations, in order to assess the existence and status of any Red Sea "subpopulations" in IUCN's Red List.

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