Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 29(4): 1615 – 1633 (2025)
www.ejabf.journals.ekb.eg

Analysis of Cetacean Strandings Along the Moroccan Mediterranean Coast: Spatial and Temporal Patterns

Youssef Ahannach*, Abdelhamid Kaddouri, Mustapha Aksissou
LESCB URL-CNRST N° 18, FS, Abdelmalek Essaâdi University, Tetouan, Morocco

***Corresponding Author: ahannachyoussef@gmail.com**

ARTICLE INFO
Article History:
Received: May 3, 2025
Accepted: July 4, 2025
Online: July 24, 2025

Keywords:
Cetacean strandings,
Moroccan Mediterranean coast,
Anthropogenic impacts,
Distribution,
Marine conservation

ABSTRACT

Cetacean strandings provide crucial insights into population dynamics and identify threats to marine biodiversity. This study examined cetacean strandings along the Moroccan Mediterranean coast from 2016 to 2024, analyzing spatial and temporal patterns, species composition, and potential mortality causes. Data were collected through field monitoring, National Institute of Fisheries Research (INRH) reports, self-reports from fishermen and local communities, and social media. A total of 187 stranding events involving 14 species were recorded, predominantly toothed whales (95.19%). The striped dolphin (*Stenella coeruleoalba*, n = 70) was the most frequently stranded species, followed by the common dolphin (*Delphinus delphis*, n = 52). Spatial analysis revealed that 64.17% of strandings occurred in the western region (Cap Spartel to Al Hoceima). Temporal analysis showed fluctuating patterns, averaging 20.8 events annually. Although the majority of stranding causes remained undetermined, the identified cases were primarily attributed to anthropogenic activities, with fishing gear interactions (73.25%) and vessel collisions (23.25%) being the main causes. These results highlight the significant impact of anthropogenic activities on cetacean populations and offer a valuable baseline for future research and inform regional marine conservation policies.

INTRODUCTION

Cetacean species, including whales, dolphin, and porpoises, are charismatic megafauna and a key indicators of ocean health **(Byrd *et al.*, 2014; Fossi *et al.*, 2020)**. They play a vital ecological role, particularly in biogeochemical cycling and nutrient redistribution **(Roman *et al.*, 2014; Estes *et al.*, 2016)**. Moreover, cetaceans contribute to climate regulation through their role in carbon cycling and nutrient transport **(Roman *et al.*, 2014)**. While the Mediterranean Sea represents only a small part of the world oceans, it is known for its rich biodiversity, and hosts various cetacean species, with 25 species recorded in the region **(Bearzi *et al.*, 2009; ACCOBAMS, 2021b)**. The Western Mediterranean has the highest densities of these species **(Cañadas *et al.*, 2023)**. Seven cetacean species are regularly present in the Mediterranean, including *Balaenoptera physalus*, *Physeter macrocephalus*, *Ziphius cavirostris*, *Grampus griseus*, *Stenella coeruleoalba*, *Delphinus delphis*, and *Tursiops truncatus*. *Globicephala melas* is also a

regular species in the western Mediterranean, but considered a vagrant elsewhere in the region. The remaining species are considered as vagrants or occasional visitors **(Bearzi *et al.*, 2024)**. Despite their ecological importance, cetaceans in the Mediterranean Sea face numerous natural and anthropogenic threats that can lead to mortality events such as strandings **(Reynolds *et al.*, 2009; Moore *et al.*, 2018; Kanji *et al.*, 2019; Moore *et al.*, 2020)**. As cetaceans spend much of their time underwater or beyond researchers' reach, they are vulnerable to threats **(Avila *et al.*, 2018)**. Thus, researchers used strandings data as a key information source. Cetacean strandings provide essential data on species presence, abundance, diversity, and potential threats **(Leeney *et al.*, 2008; Peltier *et al.*, 2012; Crosti *et al.*, 2017; Milani *et al.*, 2017; Foord *et al.*, 2019; Yamada *et al.*, 2019; Zhao *et al.*, 2020; Wund *et al.*, 2023)**. In addition, they are crucial for the studying of elusive species like beaked whales **(MacLeod *et al.*, 2006; Thompson *et al.*, 2013)**. The main causes of cetacean strandings include plastic and chemical pollution, prey depletion, habitat degradation, and environmental perturbations, notably polychlorinated biphenyls (PCBs) and heavy metals. Anthropogenic noises like sonar can dispurt their central nervous systems, and disturbances from whale watching activities also pose threats **(Bearzi *et al.*, 2005; Notarbartolo di Sciara & Birkun, 2010; IUCN, 2012; Notarbartolo di Sciara *et al.*, 2016)**.

Cetacean strandings along the Moroccan Mediterranean coast have been the subject of limited research, despite their importance for understanding population dynamics and anthropogenic threats to marine biodiversity. Between 1980 and 2009, 205 stranding events were documented, primarily attributed to human activities, particularly fisheries bycatch, and concentrated in the Strait of Gibraltar and the adjacent areas of Atalntic Ocean and the Mediterranean Sea. These records identified 16 cetacean species, with striped dolphins (*Stenella coeruleoalba*), common dolphins (*Dephinus delphis*), and five other species being the most prevalent **(Masski & De Stéphanis, 2015)**. Recently, between 2016 and 2021, 10 cetacean species were reported stranded along the northwestern coast of Morocco, with striped dolphins, common dolphins, and bottlenose dolphins most frequently recorded. Fisheries bycatch was identified as the primary causes of mortality **(Kaddouri *et al.*, 2023; Mghili *et al.*, 2023)**.

The present study is characterized by its longer temporal (2016-2024) and geographical coverage, encompassing the entire Moroccan Mediterranean coast. This extension facilitates a deeper analysis of temporal and spatial distribution patterns, species composition, and investigation of potential causes.

MATERIALS AND METHODS

1. Study area

The study area encompasses the Moroccan Mediterranean coast, covering approximately 512km from Cap Spartel (35°48'N, 5°54'W) in the west to the Algerian border (35°05'N, 2°12'W) in the east. For analysis, this region was divided into two subregions based on geographical features and anthropogenic activity levels: from the western region (Cap Spartel to Al Hoceima) and the eastern region (Al Hoceima to Saîdia). The western region adjacent to the Strait of Gibraltar experiences strong currents and seasonal winds (easterly from April to October, westerly from November to March), influencing cetacean destribution **(Periáñez, 2007)**. This area is subject to intense anthropogenic pressures, including high vessel traffic, fishing activities (e.g., bottom trawling, seining, artisanal longlining, and gillnetting), tourism, and pollution, which pose significant threats to marine biodiversity **(UNEP/MAP-SPA/RAC, 2021; Krikech *et al.*, 2023; Khaili *et al.*, 2024; Mghili *et al.*, 2024)**. The coastline includes key urban centers (Fnideq, M'diq, Jebha, Al Hoceima, and Nador), and critical marine habitats, such as Al Hoceima National Park, a designated protected area, and the Marchica Lagoon in Nador, a Ramsar site of global ecological importance. The coast exhibits significant morphological diversity, including sandy, gravelly, and rocky beaches, which may influence cetacean stranding patterns.

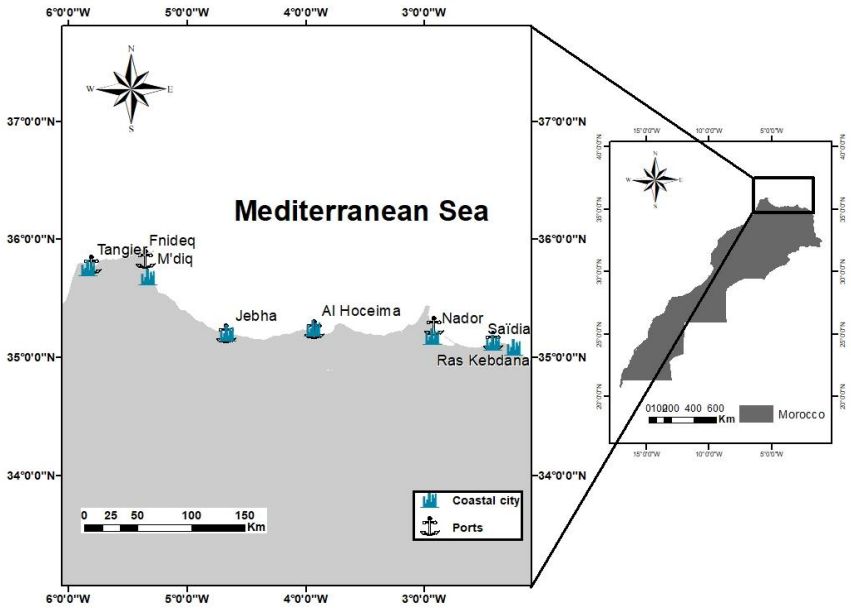

Fig. 1. Map of the study area along the Moroccan Mediterranean coast

2. Data collection

Cetacean stranding data were systematically collected in our region from 2016 to 2024. Four approaches were used to ensure comprehensive coverage and accurate data collection: i. field monitoring by local observation without official affiliation, ii. Reports from the National Institute of Fisheries Research (INRH), iii. Self-declaration by the local population and fishermen of Jebha maritime district who were trained through workshops, iv. Reports from social media platforms.

For each stranding event recorded, stranding details were documented in a standardized datasheet that included the date of the event, geographic location, species identification, the stage of decomposition of the animal, size, and sex. Any missing information was noted as undetermined. The cause of the mortality remains unknown due to the logistical constraints of a necropsy. Consequently, the causes of death were determined based on external observations of the carcass. Evidence of fishery-related mortality included fishing gear, such as lines, net marks, or other fishing-related debris, were used to identify fishery interactions. Similarly, evidence of boat collisions was indicated by fractures on the body or deep wounds caused by the boat's propellers, while predation was identified through bite marks or missing body parts. For animals lacking evidence of interaction with fisheries, boat collisions, predation or for those in an advanced state of decomposition, these cases were categorized as undetermined causes.

3. Data analysis

The stranding events and the number of stranded individuals were summarized for various species, including both toothed whales (Odontoceti) and baleen whales (Mysticeti). Location data for these stranding records were analyzed using ArcMap 10.8. Descriptive statistics were calculated for all stranding data. To illustrate the spatial distribution of the stranded species, the Mann-Whitney U test was used to explore the differences in the number of stranding events between the west and east coast. The Kruskal-Wallis test was used to explore the differences in the number of stranded individuals across different years and seasons. All the statistical comparisons were conducted using SPSS version 26.0, with a significance level set at 0.05.

RESULTS

A total of 187 events were recorded along the Moroccan Mediterranean coast from 2016 to 2024. All of them were single individuals. Toothed whales accounted for the majority of strandings, with 178 events (95.19%) documented across 11 species (Table 1). Photographs of some of the stranded species are presented as examples in Fig. (2A-J). The striped dolphin (*Stenella coeruleoalba*) was the most frequently recorded species (n = 70), followed by the common dolphin (*Delphinus delphis*) (n = 52) and the bottlenose dolphin (*Tursiops truncatus*) (n = 19). Additionally, 18 strandings involved

unidentified toothed whale species. Baleen whales were recorded with significantly lower frequency, totaling 9 strandings of which 4 involved unidentified baleen whale species (Table 1).

Fig. 2. Photographic examples of some stranded species: (**A**) Unidentified dolphin stranded in Al Hoceima on August 11, 2021; (**B**) Striped dolphin stranded in Jebha on June 6, 2021; (**C**) Common dolphin stranded in Fnideq on September, 2017; (**D**) Short-finned pilot whale stranded in Nador on January 25, 2021; (**E**) Killer whale stranded in Nador on March 24, 2021; (**F**) Long-finned pilot whale stranded between Nador and Al Hoceima on July 24, 2020; (**G**) Cuvier's beaked whale stranded in Ouedlaou between Jebha and M'diq on February 21, 2022; (**H**) Sperm whale stranded in Ouedlaou between Jebha and M'diq on April 21, 2024 ; (**I**) Pygmy sperm whale stranded in Fnideq on November 21, 2021; (**J**) Dwarf sperm whale stranded in Nador on February 25, 2021

Table 1: Frequency of stranded species along the Moroccan Mediterranean coast (2016-2024)

Order	Species	Latin name	Frequency
Odontociti			
	Striped dolphin	*Stenella coeruleoalba*	70
	Common dolphin	*Delphinus delphis*	52
	Bottlenose dolphin/ Atlantic bottlenose dolphin	*Tursiops truncatus*	19
	Short-finned pilot whale	*Globicephala macrorhynchus*	1
	Long-finned pilot whale/ pothead whale	*Globicephala melas*	6
	Dwarf sperm whale	*Kogia sima*	1
	Pygmy sperm whale	*Kogia breviceps*	1
	Risso's dolphin	*Grampus griseus*	1
	Killer whale	*Orcinus orca*	2
	Sperm whale/ cachalot	*Physeter macrocephalus*	1
	Cuvier's beaked whale/ goose-beaked whale/ Ziphius	*Ziphius cavirostris*	6
	Unidentified Odontoceti		18
Mycticeti			
	Blue whale	*Balaenoptera musculus*	1
	Common minke whale	*Balaenoptera acutorostrata*	2
	Fin whale	*Balaenoptera physalus*	2
	Unidentified Mysticeti		4
	Total		**187**

1. Spatial patterns

The western region exhibited both a higher frequency and a greater diversity of cetacean strandings (64.17%) compared to the eastern region (35.83%). The western region accounted for 62.36% of the total toothed whale strandings, particularly around Fnideq, M'diq, and Tangier, while the eastern region accounted for 37.64%, with significant clusters around Nador. Among the toothed whales, striped dolphins (*Stenella coeruleoalba*) and common dolphins (*Delphinus delphis*) were the most frequently stranded species in both regions (Fig. 3). The western region demonstrated a notably higher occurrence of these species, with striped dolphins constituting a significant portion of the strandings. In contrast, baleen whales were reported only in the western region (Fig. 4). Overall, the west coast was characterized by a significantly higher number of stranding events compared to the east coast (Mann-Whitney U test, $Z = -3.581$, $P < 0.001$).

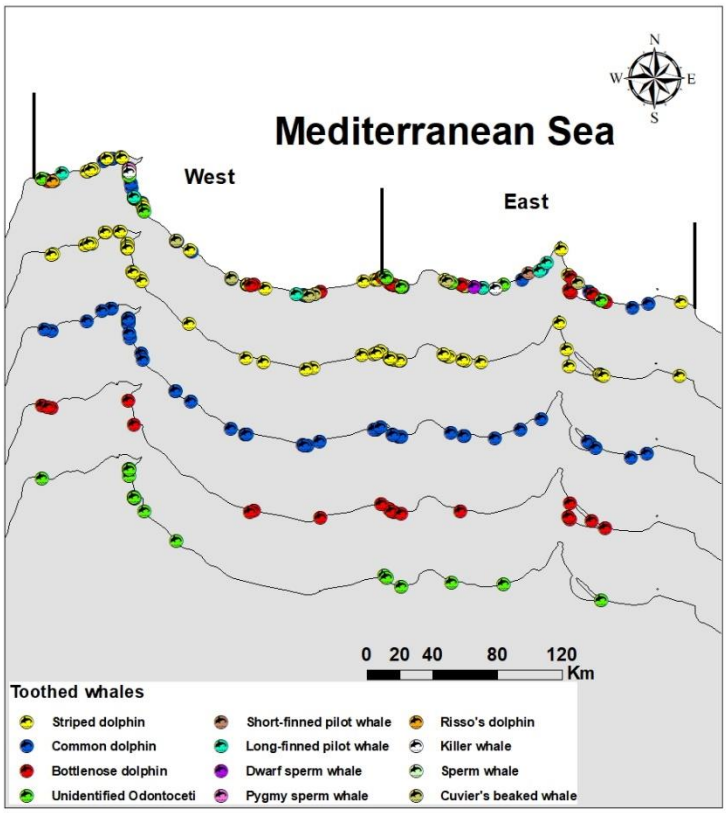

Fig. 3. Spatial distribution of toothed whale strandings in the study area

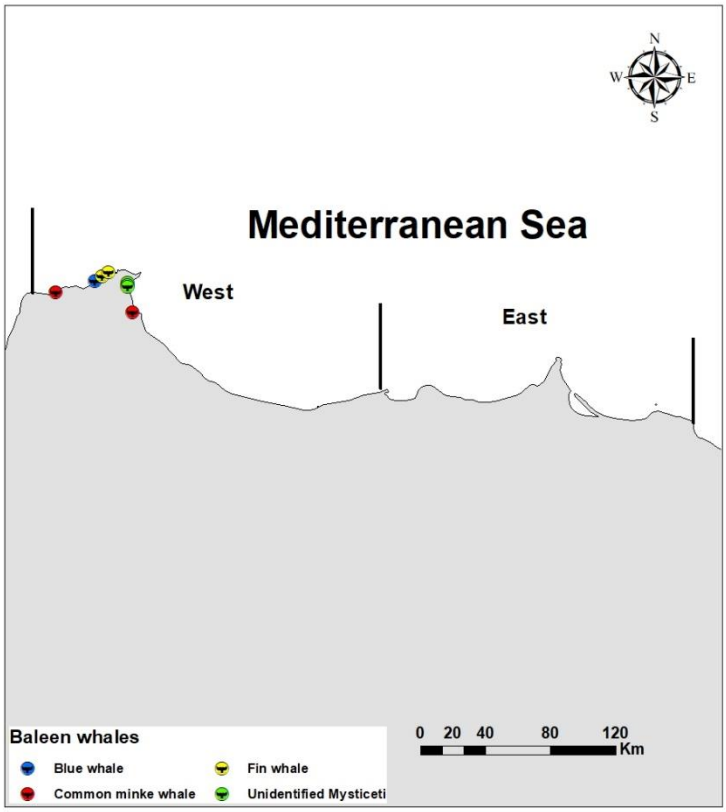

Fig. 4. Spatial distribution of baleen whale strandings in the study area

2. Temporal patterns

No statistically significant differences in stranding events were observed across years (Kruskal-Wallis test, H = 14.066, df = 8, *P* = 0.080), with an average of 20.8 events recorded annually (n = 187, 2016-2024). Interannual patterns for toothed whales (odontoceti) which comprised 95.19% of strandings, showed fluctuations, with the highest number of events in 2021 and the lowest in 2024 (Fig. 5). Baleen whale strandings were recorded only in 2017, 2019, 2022, and 2023, representing 4.81% of total events (Fig. 5). Striped dolphins (Stenella coeruleoalba, n = 70) were consistently the most frequently stranded species during this period, followed by common dolphins (Delphinus delphis, n = 52).

Similarly, no significant seasonal differences in stranding events were observed (Kruskal-Wallis test, H = 0.339, df = 3, p = 0.953). Strandings were distributed relatively evenly across seasons, with the highest number in summer (n = 50, 26.7%) and the lowest in autumn (n = 40, 21.4%) (Fig. 6). No baleen whale strandings occurred in autumn. Among the toothed whales, striped dolphins (*Stenella coeruleoalba*) consistently dominated across all seasons, followed by common dolphins (*Delphinus delphis*), which

showed higher occurrences in winter and summer. Bottlenose dolphin (*Tursiops truncatus*) strandings remained consistently low throughout the year (Fig. 6).

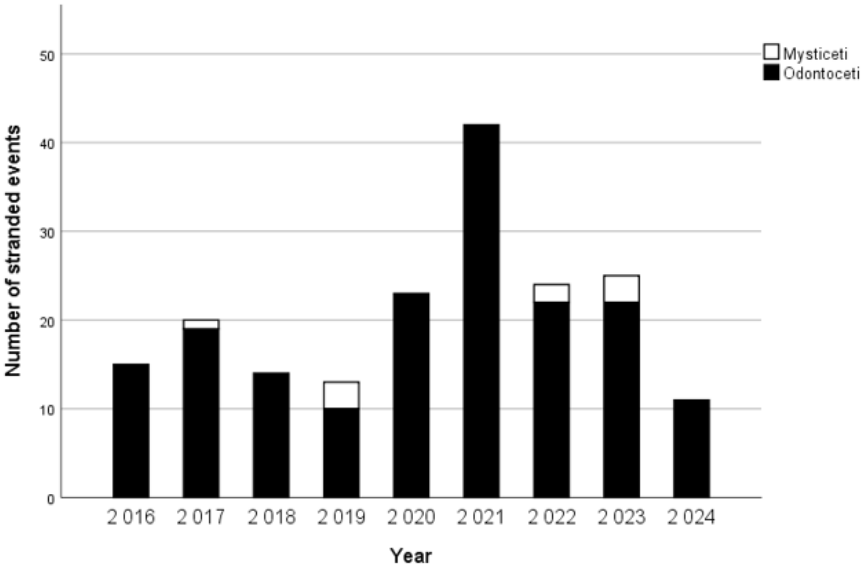

Fig. 5. Annual cetacean stranding events from 2016 to 2024

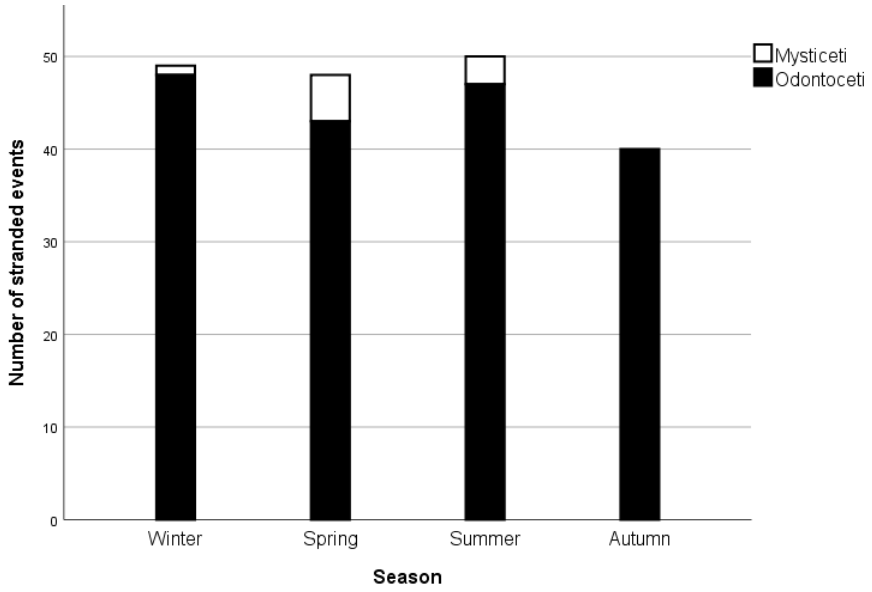

Fig. 6. Seasonal cetacean stranding events from 2016 to 2024

3. Condition of carcass and cause of mortality

The condition of stranded cetaceans (n = 187) was assessed, with 45.46% (n = 85) found in a fresh state, 28.34% (n = 53) in advanced decomposition, 25.13% (n = 47) in early decomposition stage, and 1.07% (n = 2) found alive (one pygmy sperm whale, *Kogia breviceps*, and one striped dolphin, *Stenella coeruleoalba*) (Fig. 7).

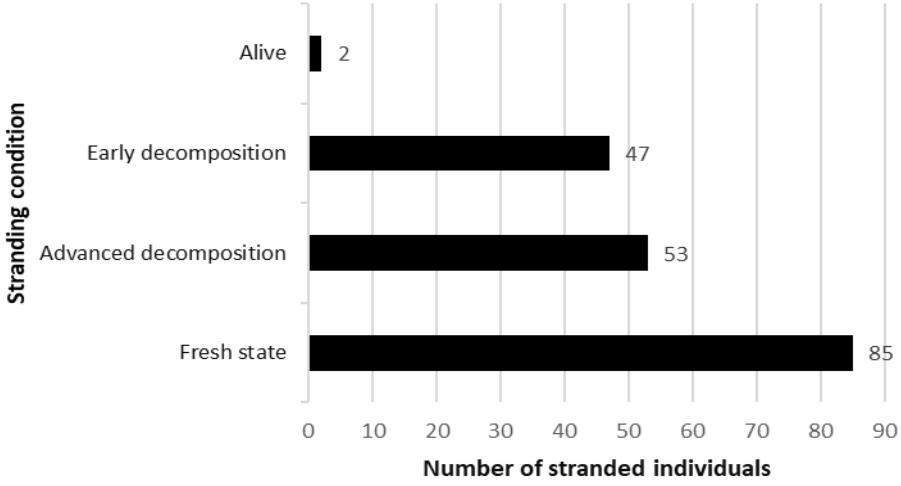

Fig. 7. Condition of stranded individuals from 2016 to 2024

The cause of death was determined in 45.99% of cases (n = 86) (Fig. 8), with 54.01% (n = 101) remaining undetermined (Fig.8). Among identified causes, interactions with fishing gear were primary driver, accounting for 73.25% (n = 63) of the identified cases (33.69% of the total), followed by vessel collisions at 23.25% (n = 20; 10.70% of the total), and predation 3.50% (n = 3; 1.60% of the total).

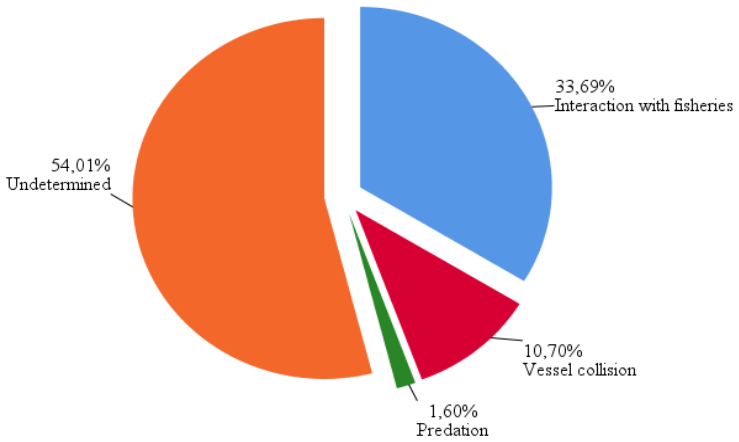

Fig. 8. Mortality causes in stranded cetaceans

DISCUSSION

This study offers a comprehensive analysis of cetacean strandings along the Moroccan Mediterranean coast from 2016 to 2024, revealing critical insights into species composition, spatial patterns, temporal trends, and causes of mortality. The findings highlight the significant impact of anthropogenic activities, particularly interactions with fishing gear and vessel collisions, on cetacean mortality in the region.

The dominance of toothed whales (Odontoceti), which account for 95.19% of recorded stranding events, reflect their higher abundance and greater presence in nearshore environments compared to baleen whales (Mysticeti). Among odontocetes, the striped dolphin (*Stenella coeruleoalba*) was the most frequently stranded species (n = 70), consistent with its status as the most abundant cetacean in the in the Mediterranean **(ACCOBAMS, 2021a; Cañadas *et al.*, 2023; Panigada *et al.*, 2024)**. This pattern aligns with previous studies conducted in other Mediterranean regions **(Rojo-Nieto *et al.*, 2011)** and along the Moroccan coast **(Masski & De Stéphanis, 2015)**. In contrast, baleen whales were rarely stranded, accounting for only 4.81% (n = 9), which include three identified species and four undetermined cases. This rarity reflects their typically pelagic nature and limited occurrence in coastal waters. The fin whale (*Balenoptera physalus*), the only baleen whale regularly present in the Mediterranean **(Notarbartolo di Sciara *et al.*, 2016; ACCOBAMS, 2021a)**, was recorded in two strandings, similar to findings from the Algerian coast **(Henda-Benrekaa & Moulaï, 2021)**. The presence of unidentified strandings, particularly among odontocetes (n = 18) and mysticetes (n = 4), underscores the challenges of species identification, which are often exacerbated by advanced decomposition.

Stranding events were primarily observed along the western segment of Moroccan Mediterranean coastline, specifically from Cap Spartel to Al Hoceima, which accounted for 64.17% of all documented occurrences. This observation corroborates recent findings by **Kaddouri *et al.* (2023)**. The spatial observation of these stranding events is likely influenced by a combination of ecological and anthropogenic factors. The western region, located near the Strait of Gibraltar, is characterized by strong currents, seasonal winds, and significant biodiversity, making it a crucial habitat for cetaceans **(Periáñez, 2007; UNEP/MAP-SPA/RAC, 2021)**. Due to its ecological richness, the Al Hoceima Marine Protected Area may serve as an attractive habitat for cetaceans, simultaneously increasing their exposure to anthropogenic threats **(El Hadri *et al.*, 2019)**. However, the primary factors contributing to strandings in this area are anthropogenic, particularly the intense fishing activities and elevated vessel traffic associated with Tangier-Med port **(Khaili *et al.*, 2024; Mghili *et al.*, 2024)**. These findings align with previous research indicating that the Strait of Gibraltar is a significant stranding hotspot, accounting for 22% of Moroccan

strandings from 1980 to 2009 **(Masski & De Stéphanis, 2015)**. In contrast, the eastern region, extending from Al Hoceima to Saîdia and encompassing the ecologically significant Marchica Lagoon (a RAMSAR site), reported a lower incidence of strandings (35.83%), likely due to reduced fishing intensity and maritime traffic **(Demiathi *et al.*, 2022)**. Notably, strandings of baleen whales were exclusively recorded in the western region, further underscoring its ecological anthropogenic complexities.

Temporal analysis revealed no statistically significant interannual or seasonal variation in stranding events, as determined by Kruskal-Wallis tests ($P > 0.05$). The average number of stranding events recorded annually was 20.8, with a relatively stable seasonal distribution, peaking in summer (n = 50) and reaching a low point in autumn (n = 40). The notable increase in stranding events observed in 2021, followed by a subsequent decline, may indicate fluctuations in environment factors, such as prey availability or oceanographic conditions. However, the precise causal mechanism remains unidentified. These findings are consistent with **Kaddouri *et al.* (2023)** and suggest that stranding events are primarily influenced by ongoing human activities rather than seasonal or annual environment changes. The consistent prevalence of striped and common dolphins across both years and seasons likely reflects their year-round abundance and increased vulnerability to threats such as bycatch **(Bearzi, 2002; Braulik *et al.*, 2021)**.

The condition of stranded cetaceans provides valuable insights into the causes of mortality. A significant proportion of strandings was observed in a fresh state (45.46%, n = 85), indicating effective monitoring in key coastal areas, particularly in the western region. However, 28.34% (n = 53) were found in advanced state of decomposition, which limits the ability to determine the causes of mortality, especially in less monitored. This challenge is consistent with previous studies **(Masski & De Stéphanis, 2015; Kaddouri *et al.*, 2023)**. Among the identified causes (45.99%, n = 86), interactions with fishing gear were the leading driver for mortality (73.25%, n = 63), followed by vessel collisions (23.25%, n = 20) and predation (3.50%, n = 3). These findings align with global and Mediterranean trends, where bycatch and vessel strikes represent the primary anthropogenic threats to cetaceans **(Taylor *et al.*, 2017; Brownell *et al.*, 2019; Bedriñana-Romano *et al.*, 2021)**. Predation, likely by sharks or orcas, was a minor cause, consistent with the predominance of human-induced mortality in the Mediterranean **(Bearzi, 2002)**. The high rate of undetermined causes (54.01%, n = 101) highlights the urgent need to implement standardized necropsy protocols for more accurate mortality assessments **(Bouslah *et al.*, 2022)**.

This study highlights the urgent need for targeted conservation measures to mitigate anthropogenic impacts on cetacean in the Moroccan Mediterranean. To reduce bycatch, we recommend implementing gear modifications, such as acoustic deterrents (e.g., pingers) and time-area closures in stranding hotspots like the western region

(IUCN, 2012; Goetz *et al.*, 2015). Vessel speed limits and traffic management in high-risk areas, particularly near the Strait of Gibraltar, could minimize collisions **(Bedriñana-Romano *et al.*, 2021)**. Additionally, establishing standardized necropsy protocols is critical for improving mortality cause identification, especially for decomposed carcasses **(Ortiz-Wolford *et al.*, 2021)**. Future research should investigate the role of pollution (e.g., plastics, chemicals) and noise, which were not assessed in this study due to the absence of necropsies. These findings provide a baseline for cetacean conservation in the region and emphasize the importance of integrating stranding data into marine spatial planning and policy development.

CONCLUSION

In conclusion, the present study provides a comprehensive analysis of cetacean strandings along the Moroccan Mediterranean coast based on 187 stranding records collected from 2016 to 2024. The study involved the identification of species, an assessment of their distribution, an analysis of mortality causes, and an exploration of temporal trends. Our findings indicate that the toothed whales, particularly striped dolphins (*Stenella coeruleoalba*) and common dolphins (*Delphinus delphis*), are the most frequently stranded species, underscoring their prevalence and susceptibility through the region. The observed higher incidence of strandings in the western area suggests significant influences from anthropogenic activities, including fishing and maritime traffic. Conversely, the limited occurrences of baleen whale strandings may be attributed to their specific habitat preferences and migratory patterns, which differ from those of toothed whales. Anthropogenic factors, especially interactions with fishing gear and vessel collisions remain the main threats that highlight the urgent need for coordinated efforts to effectively reduce their influences. Raising awareness among fishermen and local communities reduces cetacean mortality while establishing effective surveillance systems and setting regional stranding response teams in identified hotspots. Future research should emphasize toxicological and genetic analyses to improve our understanding of cetacean health and population dynamics, thus enhancing conservation strategies in the Moroccan Mediterranean waters.

REFERENCES

ACCOBAMS. (2021a). *Conserving whales, dolphins and porpoises in the Mediterranean Sea, Black Sea and adjacent areas: an ACCOBAMS status report*.

ACCOBAMS. (2021b). *Estimates of abundance and distribution of cetaceans, marine mega-fauna and marine litter in the Mediterranean Sea from 2018-2019 surveys (eds. S. Panigada, O. Boisseau, A. Cañadas, C. Lambert, S. Laran, R. McLanaghan, A. Moscrop).*

Avila, I. C.; Kaschner, K. and Dormann, C. F. (2018). Current global risks to marine mammals: Taking stock of the threats. *Biological Conservation*, *221*: 44–58. https://doi.org/10.1016/J.BIOCON.2018.02.021

Bearzi, G. (2002). *Interactions between cetacean and fisheries in the Mediterranean Sea. In: G. Notarbartolo di Sciara (Ed.), Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies, Section 9*.

Bearzi, G.; Bonizzoni, S.; Genov, T. and Notarbartolo di Sciara, G. N. (2024). Whales and dolphins of the Adriatic Sea: present knowledge, threats and conservation. *Acta Adriatica*, *65*(1): 75–121. https://doi.org/10.32582/aa.65.1.1

Bearzi, G.; Fortuna, C. M. and Reeves, R. R. (2009). Ecology and conservation of common bottlenose dolphins Tursiops truncatus in the Mediterranean Sea. *Mammal Review*, *39*(2): 92–123. https://doi.org/10.1111/j.1365-2907.2008.00133.x

Bearzi, G.; Politi, E.; Agazzi, S.; Bruno, S.; Costa, M. and Bonizzoni, S. (2005). Occurrence and present status of coastal dolphins (Delphinus delphis and Tursiops truncatus) in the eastern Ionian Sea. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *15*(3): 243–257. https://doi.org/10.1002/aqc.667

Bedriñana-Romano, L.; Hucke-Gaete, R.; Viddi, F. A.; Johnson, D.; Zerbini, A. N.; Morales, J.; Mate, B. and Palacios, D. M. (2021). Defining priority areas for blue whale conservation and investigating overlap with vessel traffic in Chilean Patagonia, using a fast-fitting movement model. *Scientific Reports*, *11*(1). https://doi.org/10.1038/s41598-021-82220-5

Bouslah, Y.; Zaidi, R.; Mesaoudi, M.; Maamar, K.; Belmahi, A.-E. and Bouderbala, M. (2022). New occurrence of cetacean stranded on the Algerian West Coast and Associated Threats: (2016-2020). *South Asian Journal of Experimental Biology*, *12*(3): 357–365. https://doi.org/10.38150/sajeb.12(3).p357-365

Braulik, G.; Jefferson, T. A. and Bearzi, G. (2021). *Delphinus delphis. The IUCN Red List of Threatened Species 2021: e.T134817215A50352620*. https://doi.org/10.2305/IUCN.UK.2021

Brownell, R. L.; Reeves, R. R.; Read, A. J.; Smith, B. D.; Thomas, P. O.; Ralls, K.; Amano, M.; Berggren, P.; Chit, A. M.; Collins, T.; Currey, R.; Dolar, M. L. L.; Genov, T.; Hobbs, R. C.; Kreb, D.; Marsh, H.; Zhigang, M.; Perrin, W. F.; Phay, S.; … Wang, J. Y. (2019). Bycatch ingillnet fisheries threatens critically endangeredsmall cetaceansand other aquatic megafauna. *Endangered Species Research*, *40*: 285–296. https://doi.org/10.3354/ESR00994

Byrd, B. L.; Hohn, A. A.; Lovewell, G. N.; Altman, K. M.; Barco, S. G.; Friedlaender, A.; Harms, C. A.; McLellan, W. A.; Moore, K. T.; Rosel, P. E. and Thayer, V. G. (2014). Strandings as indicators of marine mammal biodiversity and human interactions off the coast of North Carolina. *Fishery Bulletin*, *112*(1): 1–23. https://doi.org/10.7755/FB.112.1.1

Cañadas, A.; Pierantonio, N.; Araújo, H.; David, L.; Di Meglio, N.; Dorémus, G.; Gonzalvo, J.; Holcer, D.; Laran, S.; Lauriano, G.; Perri, M.; Ridoux, V.; Vázquez, J. A. and Panigada, S. (2023). Distribution patterns of marine megafauna density in the Mediterranean Sea assessed through the ACCOBAMS Survey Initiative (ASI). *Frontiers in Marine Science*, *10*. https://doi.org/10.3389/fmars.2023.1270917

Demiathi, M.; Aknaf, A.; Settih, J.; Awadh, H.; Aksissou, M. and Analla, M. (2022). Socioeconomic Aspects and Characteristics of Artisanal Fishing in the Marchica Lagoon (Mediterranean, Morocco). *International Journal of Social Ecology and Sustainable Development (IJSESD)*, *13*(1): 1–14. https://doi.org/10.4018/IJSESD.295969

El Hadri, S.; Jaoui, A. and Bouziane, H. (2019). Le Parc National D'al Hoceima: Panorama Entre Terre Et Mer. *European Scientific Journal ESJ*, *15*(27). https://doi.org/10.19044/esj.2019.v15n27p311

Estes, J. A.; Heithaus, M.; McCauley, D. J.; Rasher, D. B. and Worm, B. (2016). Megafaunal Impacts on Structure and Function of Ocean Ecosystems. *Annual Review of Environment and Resources*, *41*: 83–116. https://doi.org/10.1146/annurev-environ-110615-085622

Fioravanti, T.; Maio, N.; Latini, L.; Splendiani, A.; Guarino, F. M.; Mezzasalma, M.; Petraccioli, A.; Cozzi, B.; Mazzariol, S.; Centelleghe, C.; Sciancalepore, G.; Pietroluongo, G.; Podestà, M. and Caputo Barucchi, V. (2022). Nothing is as it seems: genetic analyses on stranded fin whales unveil the presence of a fin-blue whale hybrid in the Mediterranean Sea (Balaenopteridae). *European Zoological Journal*, *89*(1): 590–600. https://doi.org/10.1080/24750263.2022.2063426

Fossi, M. C.; Baini, M. and Simmonds, M. P. (2020). Cetaceans as Ocean Health Indicators of Marine Litter Impact at Global Scale. *Frontiers in Environmental Science*, *8*. https://doi.org/10.3389/fenvs.2020.586627

Goetz, S.; Read, F. L.; Ferreira, M.; Portela, J. M.; Santos, M. B.; Vingada, J.; Siebert, U.; Marçalo, A.; Santos, J.; Araújo, H.; Monteiro, S.; Caldas, M.; Riera, M. and Pierce, G. J. (2015). Cetacean occurrence, habitat preferences and

potential for cetacean–fishery interactions in Iberian Atlantic waters: results from cooperative research involving local stakeholders. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *25*(1): 138–154. https://doi.org/10.1002/AQC.2481

Henda-Benrekaa, A. and Moulaï, R. (2021). First data on cetacean strandings and in situ observations along the algerian coast. *Zoology and Ecology*, *31*(1): 37–44. https://doi.org/10.35513/21658005.2021.1.7

IUCN. (2012). *Marine mammals and sea turtles of the Mediterranean and Black Seas. Gland, Switzerland and Malaga, Spain: IUCN. 32 pages*.

Kaddouri, A.; Analla, M.; Tamsouri, N.; Aksissou, M.; Awadh, H. and Benchoucha, S. (2023). Evaluation of cetacean strandings on the north-western coast of Morocco from 2016 to 2021. *Mammalian Biology*, *103*(3): 317–328. https://doi.org/10.1007/s42991-023-00359-2

Kanji, S. N.; Rajesh, M. and Rajesh, K. M. (2019). Stranding of Whales: its causes and measures to protect stranded animals. *AQUA. INTERNATIONAL*, *27 (3)*: 64–68.

Kemper, C.; Flaherty, A.; Gibbs, S.; Hill, M.; Long, M. and Byard, R. (2005). Cetacean captures, strandings and mortalities in South Australia 1881-2000, with special reference to human interactions. *Australian Mammalogy*, *27*: 37–47.

Khaili, A.; Touiss, I.; El Azhari, H.; El Maadoudi, M.; Rharrass, A.; Chairi, H.; Barrijal, S. and Essalmani, H. (2024). Bacteriological study of the sea urchin Paracentrotus lividus (Lamarck, 1816) gonads associated with seawater physico-chemistry and environmental factors in the Mediterranean Sea of Morocco. *Egyptian Journal of Aquatic Research*, *50*(1): 78–87. https://doi.org/10.1016/j.ejar.2024.02.005

Krikech, I.; Oliveri Conti, G.; Pulvirenti, E.; Rapisarda, P.; Castrogiovanni, M.; Maisano, M.; Le Pennec, G.; Leermakers, M.; Ferrante, M.; Cappello, T. and Ezziyyani, M. (2023). Microplastics (≤ 10 μm) bioaccumulation in marine sponges along the Moroccan Mediterranean coast: Insights into species-specific distribution and potential bioindication. *Environmental Research*, *235*. https://doi.org/10.1016/j.envres.2023.116608

MacLeod, C. D.; Perrin, W. F.; Pitman, R.; Barlow, J.; Ballance, L.; D'Amico, A.; Gerrodette, T.; Joyce, G.; Mullin, K. D.; Palka, D. L. and Waring, G. T. (2005). Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). *Journal of Cetacean Research and Management*, *7*(3): 271–286.

Masski, H. and De Stéphanis, R. (2015). Cetaceans of the Moroccan coast: Information from a reconstructed strandings database. *Journal of the Marine Biological*

Association of the United Kingdom, *98*(5): 1029–1037. https://doi.org/10.1017/S0025315415001563

Mghili, B.; Hasni, S.; Ben-Haddad, M.; Rangel-Buitrago, N.; Keznine, M.; Lamine, I.; Hamiche, F. Z.; Haddaoui, H.; Abelouah, M. R.; Demiathi, M.; Oubahaouali, B.; Jellal, N.; Touaf, M.; Ahannach, Y.; Hassou, N.; Cherradi, S. and Aksissou, M. (2024). Plastic pollution on Moroccan beaches: Toward baselines for large-scale assessment. *Marine Pollution Bulletin*, *201*. https://doi.org/10.1016/j.marpolbul.2024.116288

Mghili, B.; Keznine, M.; Analla, M. and Aksissou, M. (2023). The impacts of abandoned, discarded and lost fishing gear on marine biodiversity in Morocco. *Ocean and Coastal Management*, *239*. https://doi.org/10.1016/j.ocecoaman.2023.106593

Milani, C. B.; Vella, A.; Vidoris, P.; Christidis, A.; Koutrakis, E.; Frantzis, A.; Miliou, A. and Kallianiotis, A. (2018). Cetacean stranding and diet analyses in the North Aegean Sea (Greece). *Journal of the Marine Biological Association of the United Kingdom*, *98*(5): 1011–1028. https://doi.org/10.1017/S0025315417000339

Moore, K. M.; Simeone, C. A. and Brownell, R. L. (2018). Strandings. *Encyclopedia of Marine Mammals, Third Edition*, 945–951. https://doi.org/10.1016/B978-0-12-804327-1.00249-1

Moore, M. J.; Mitchell, G. H.; Rowles, T. K. and Early, G. (2020). Dead Cetacean? Beach, Bloat, Float, Sink. *Frontiers in Marine Science*, *7*. https://doi.org/10.3389/fmars.2020.00333

Notarbartolo di Sciara, G. (2002). *Summary. In: G. Notarbartolo di Sciara (Ed.), Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies* (G. Notarbartolo di Sciara, Ed.).

Notarbartolo di Sciara, G. (2014). Sperm whales, Physeter macrocephalus, in the Mediterranean Sea: A summary of status, threats, and conservation recommendations. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *24*(SUPPL.1): 4–10. https://doi.org/10.1002/aqc.2409

Notarbartolo di Sciara, G. and Birkun, A. J. (2010). *Conservin whales, dolphins and porpoises in the Mediterranean and Black Sea: An ACCOBAMS status report, 2010. 212p*.

Notarbartolo di Sciara, G.; Castellote, M.; Druon, J. N. and Panigada, S. (2016). Fin Whales, Balaenoptera physalus: At Home in a Changing Mediterranean Sea?

Advances in Marine Biology, *75*: 75–101. https://doi.org/10.1016/BS.AMB.2016.08.002

Notarbartolo di Sciara, G.; Hoyt, E.; Reeves, R.; Ardron, J.; Marsh, H.; Vongraven, D. and Barr, B. (2016). Place-based approaches to marine mammal conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *26*: 85–100. https://doi.org/10.1002/aqc.2642

Ortiz-Wolford, J.; Corona-Figueroa, M. F.; Dávila, V. and Cabrera, A. A. (2021). Cetacean stranding records along the Pacific coastline of Guatemala, 2007–2021: Implications for management, conservation and research. *Marine Policy*, *134*. https://doi.org/10.1016/j.marpol.2021.104827

Panigada, S.; Pierantonio, N.; Araújo, H.; David, L.; Di-Méglio, N.; Dorémus, G.; Gonzalvo, J.; Holcer, D.; Laran, S.; Lauriano, G.; Paiu, R. M.; Perri, M.; Popov, D.; Ridoux, V.; Vázquez, J. A. and Cañadas, A. (2024). The ACCOBAMS survey initiative: the first synoptic assessment of cetacean abundance in the Mediterranean Sea through aerial surveys. *Frontiers in Marine Science*, *10*. https://doi.org/10.3389/fmars.2023.1270513

Periáñez, R. (2007). Chemical and oil spill rapid response modelling in the Strait of Gibraltar-Alborán Sea. *Ecological Modelling*, *207*(2–4): 210–222. https://doi.org/10.1016/j.ecolmodel.2007.04.033

Reynolds, J. E.; Marsh, H. and Ragen, T. J. (2009). Marine mammal conservation. *Endangered Species Research*, *7*(1): 23–28. https://doi.org/10.3354/esr00179

Rojo-Nieto, E.; Álvarez-Díaz, P. D.; Morote, E.; Burgos, M.; Burgos-Martín, M.; Montoto-Martínez, T.; Sáez-Jiménez, J. and Toledano, F. (2011a). Strandings of cetaceans and sea turtles in the Alboran Sea and Strait of Gibraltar: a long-term glimpse at the north coast (Spain) and the south coast (Morocco). *Animal Biodiversity and Conservation*, *34*(1): 151–163.

Rojo-Nieto, E.; Álvarez-Díaz, P. D.; Morote, E.; Burgos, M.; Burgos-Martín, M.; Montoto-Martínez, T.; Sáez-Jiménez, J. and Toledano, F. (2011b). Strandings of cetaceans and sea turtles in the Alboran Sea and Strait of Gibraltar: a long-term glimpse at the north coast (Spain) and the south coast (Morocco). *Animal Biodiversity and Conservation*, *34*(1): 151–163.

Roman, J.; Estes, J. A.; Morissette, L.; Smith, C.; Costa, D.; McCarthy, J.; Nation, J. B.; Nicol, S.; Pershing, A. and Smetacek, V. (2014). Whales as marine ecosystem engineers. In *Frontiers in Ecology and the Environment*, 12(7): 377–385. Ecological Society of America. https://doi.org/10.1890/130220

Taylor, B. L.; Rojas-Bracho, L.; Moore, J.; Jaramillo-Legorreta, A.; Ver Hoef, J. M.; Cardenas-Hinojosa, G.; Nieto-Garcia, E.; Barlow, J.; Gerrodette, T.; Tregenza, N.; Thomas, L. and Hammond, P. S. (2017). Extinction is Imminent for Mexico's Endemic Porpoise Unless Fishery Bycatch is Eliminated. In *Conservation Letters*, 10(5): 588–595. Wiley-Blackwell. https://doi.org/10.1111/conl.12331

Thompson, K. F.; Millar, C. D.; Scott Baker, C.; Dalebout, M.; Steel, D.; van Helden, A. L. and Constantine, R. (2013). A novel conservation approach provides insights into the management of rare cetaceans. *Biological Conservation*, *157*: 331–340. https://doi.org/10.1016/j.biocon.2012.07.017

UNEP/MAP-SPA/RAC. (2021). *Conservation de la biodiversité marine et côtière d'ici 2030 et au-delà au Maroc. By H. Bazairi. Ed. SPA/RAC, Tunis: 122 pp.*

Wund, S.; Méheust, E.; Dars, C.; Dabin, W.; Demaret, F.; Guichard, B.; Jauniaux, T.; Labrut, S.; Spitz, J.; Van Canneyt, O. and Caurant, F. (2023). Strengthening the health surveillance of marine mammals in the waters of metropolitan France by monitoring strandings. *Frontiers in Marine Science*, *10*: 18. https://doi.org/10.3389/fmars.2023.1116819

Yamada, T. K.; Kitamura, S.; Abe, S.; Tajima, Y.; Matsuda, A.; Mead, J. G. and Matsuishi, T. F. (2019). Description of a new species of beaked whale (*Berardius*) found in the North Pacific. *Scientific Reports*, *9*(1). https://doi.org/10.1038/s41598-019-46703-w