Montenegro Dolphin Research Annual Report of 2021: Turning Research to Conservation Outputs for Cetacean Protection in Montenegro

Technical Report · July 2021

DOI: 10.13140/RG.2.2.32448.05127

Aylin Akkaya
Marine Mammals Research Association, Turkey

Tim Awbery
Scottish Association for Marine Science

Selina Brouwer
DMAD - Marine Mammals Research Association in Montenegro & Turkey

Laura Rudd
University of St Andrews

MONTENEGRO DOLPHIN RESEARCH

ANNUAL REPORT OF 2021

TURNING RESEARCH INTO CONSERVATION OUTPUTS FOR CETACEAN PROTECTION IN MONTENEGRO

FIVE YEARS OF DEDICATED RESEARCH EFFORTS FOR THE CREATION OF SPECIES CONSERVATION ACTION PLAN

AYLIN AKKAYA, TIM AWBERY, SELINA BROUWER,
LAURA RUDD, CEDRIC GOOSSENS,
NATASA NIKPALJEVIC, DUSAN VARDA

MARINE MAMMALS RESEARCH ASSOCIATION
DMAD
dmad.org.tr
DENİZ MEMELİLERİ ARAŞTIRMA DERNEĞİ

MONTENEGRO DOLPHIN RESEARCH

Foreword

Radovići, July 2021

While over 60% of the world cetacean populations either have a declining population trend or deficient data to estimate the population status, the situation is worse for the Mediterranean Sea where all species have been categorised as under threat by the IUCN Red List. The species are showing patchy and scarce distributions in locations where they were once widely distributed and abundant. Common dolphins of the Adriatic Sea are virtually locally extinct, with fewer than five sightings in the last five years. Sperm whales, the giants of the deep-sea, are scattered with less than 2,500 mature individuals in the entire Mediterranean. Beaked whales, the marine mammals which hold the record as the deepest divers, are one of the least studied species, and are under heavy threat from noise pollution in a basin with no silent space left.

Cetacean species fill an important role from their pelagic to deep-sea habitats and their role for our blue planet extends beyond the boundaries of the marine realm to the terrestrial one; they store thousands of tonnes of carbon throughout their lifetime as well as trapping this in the sea after their death, thus counteracting climate change. They are also known as ecosystem engineers due to their role in the nutrient cycle with their sole presence indicating the habitats which are rich in diversity.

Nevertheless, these marine top predators are under a wide range of threats, such as habitat destruction, overfishing, bycatch, marine traffic, pollution, loud and impulsive noise from seismic and sonar operations and climate change. Despite being aware of the present threats, we do not know the range of impacts of these unregulated human activities and an assessment of their cumulative effect is a long way away. Cetaceans live between 10s and 100s of years, they reach their maturity almost half-way through their lifespan, and have long interbreeding intervals. Therefore, any short-term threat we introduce to their environment is going to have long term consequences to the species with little hope of restoration. That being the case, we have to live and learn from these magnificent creatures, assess the threats and choose our approach that will minimize our negative footprints on the blue planet at once.

Montenegro Dolphin Research (MDR) was established in 2016 and since then has run over 700 days of survey to understand the current situation regarding dolphins in Montenegro in the light of dedicated research and conservation efforts. While bottlenose dolphins showed a regular presence within the coastal waters of Montenegro, between Ulcinj and Herceg-Novi, striped dolphins were sighted in the deeper waters off the coast of Bar. Due to limitations, the current research couldn't focus its effort on the Adriatic Pit, the deepest point of the entire Adriatic Sea which is right in front of the territorial waters of Montenegro, known to hold important cetacean species from Cuvier's beaked whales to Risso's dolphins and sperm whales. Therefore, it is vital to direct the research effort to these unique but undiscovered habitats within the deep-sea.

Our research efforts revealed the critical habitats of bottlenose dolphins in Montenegro and assessed the effect of human impacts on the spatial distribution and behavioural budget of the species. Over 100 bottlenose dolphin individuals use these waters with both transient and resident populations present. It is a country that holds both feeding grounds and migration corridors, possibly connecting southern waters with its central basin. Our effort also revealed the sharp decline in the sighting rates from 49% to 24% between 2016 and 2019. As beautiful as it is in Montenegro, the threats show a steady increase in Montenegro, with limited to no mitigation measures in place. Nevertheless, the COVID19 pandemic provided the dolphins the break they need to sparkle again with an increase in sightings rate in 2021 which showed us if we can only minimize and regulate our actions, there is still hope to live together where not only nature but the economy wins as well.

This is a year to question our actions and understand how fragile we actually are if we do not work hand in hand with nature. The self-awareness is going to create all the CHANGE we need,

DMAD TEAM

Summary

Five cetacean species are known to inhabit the Adriatic Sea. While bottlenose dolphins (*Tursiops truncatus*) are the most commonly reported species of the Adriatic, they show mainly coastal distribution from its southern to the northern boundaries. On the other hand, striped dolphins (*Stenella coeruleoalba*), Risso's dolphins (*Grampus griseus*) and Cuvier's beaked whales (*Ziphius cavirostris*) show deep sea preferences to the neighbouring waters of the Adriatic Pit. Lastly, fin whales (*Balaenoptera physalus*) are occasionally reported in the coastal waters of Croatia, with a recent report in Montenegro in 2021. All the cetacean species present in the Adriatic Sea are classified as under threat by the IUCN Red List with extremely limited information on the deep-sea cetacean species.

The dedicated research effort of Slovenia and Croatia highlighted the presence of resident bottlenose dolphins and their effort for over 20 years further advanced knowledge on species baseline information with a threat assessment which eventually resulted with the implementation of MPAs and management plans within their territorial waters. Therefore, while the northern and central Adriatic Sea is relatively well-studied, the southern Adriatic Sea still holds knowledge gaps and thus mitigation strategies are far from being implemented. Despite the scarce research efforts until the late 2010s, cetaceans have been identified as a community interest with strict protection measures enforced by the Montenegrin Government.

Montenegro Dolphin Research started its dedicated cetacean research of Montenegrin waters in September 2016 and since then has been in the field for over 700 days to gather the missing knowledge on cetacean species and to understand the level of human impact on these magnificent creatures. Our results identified critical habitats of bottlenose dolphins in neighbouring waters of Ulcinj, Bar and Boka Kotorska Bay. While the estimated population size of bottlenose dolphins was 116±17 individuals in 2017, it showed a sharp decline to 79±21 individuals in 2019. However, the sighting rates of bottlenose dolphins increased from 24% in 2019 to 27% in 2020 and 47% in 2021. Since March 2020, Montenegro has had reduced human presence within the marine environment due to the COVID19 pandemic. It is interesting and also promising to see that the number of dolphin sightings immediately increased once the human pressure in the area decreased. Additionally, the inclusion of acoustic techniques in addition to the visual surveys revealed the dominant presence of foraging behaviour within the Bay of Kotor, with rare and specific vocalisation types being recorded in the area. Our previous studies in Montenegro highlighted the dominant presence of 'travelling state', proposing that Montenegro was mainly a migration corridor for the bottlenose dolphins. However, our recent acoustic results revealed that it also holds both foraging and socialising grounds. Last but not least, both the effect of tourism and fishery related boats revealed significant alterations to the behavioural budget of bottlenose dolphins in Montenegro, even when their exposure level to those specific boats are below 20% of the time.

Montenegro is a country with a growing economy and tourism related activities are one of the main income sources. Even though eco-tourism is the one and only sustainable tourism source, the tourism industry is generally directed towards coastal development of hotels with little to no investment in their environmental impact assessment. As a result, uncontrolled coastal destruction, noise and chemical pollution, and plastic debris are already showing an impact on the marine ecosystem of Montenegro. Further, oil and gas explorations have started to take place within the coastal waters of Bar as well as in the unique deep-sea ecosystem of the Adriatic Pit with no publicly available report on the activities. Even though we are fully aware of the importance of economic growth in a country, any human activities that may be carried out in an uncontrolled and unregulated nature are likely to form severe threats to marine species and their associated habitats. Therefore, our project and its research and conservation outcomes form one of the most important steps towards effective conservation strategies that promote not only the protection of nature, but also sustainable blue economic growth.

Montenegro Dolphin Research continues to be the only annual project on the field of marine mammals in Montenegro. With dedicated research efforts and engagement of the local community, knowledge about the marine mammal population in Montenegro will increase, which will give us the ability to turn our knowledge into a management plan for the conservation of cetacean populations in Montenegrin waters and its habitat. For this reason, we have created the 'Montenegro Sighting Network', through which we have involved the citizens of Montenegro and in 11 months we have received 23 reports, which shows that public awareness about cetaceans and marine ecosystems in general is increasing in Montenegro. By establishing networks and producing influential documentation within the community, the conservation implications of our actions will be more effective and longer lasting.

Contents

Introduction

South Adriatic Sea and Montenegro

The South Adriatic Sea holds a wide range of benthic, neritic and pelagic species and thus has been identified as a marine biodiversity hotspot as well as being an Ecologically and Biologically Significant Area (Coll et al., 2010; UN Environment-CBD, 2016; UNEP/MAP, 2012). The South Adriatic Sea shows variation in its oceanographic parameters compared to the north and central Adriatic, with differences in its depth range, current systems, salinity and sea surface temperatures (Artegiani et al., 1997; Cushman-Rosin et al., 2001; Zavatarelli et al., 1998). The deepest region of the entire Adriatic Sea, the Adriatic Pit, is found off the pelagic waters of Montenegro, with a maximum depth of 1233 m (Artegiani et al., 1997; Cushman-Rosin et al., 2001; Grbec et al., 1998). Montenegro's maritime zone extends over an area of about 2,500 km^2 and ranges approximately 12 nautical miles out to the sea (UNDP, 2008). The country has a coastline of 293 km and is characterised by rocky cliffs and beaches (Šćepanović et al., 2013; UNEP-MAP-RAC/SPA, 2014). Two-thirds of the country's coastline faces open sea and one-third of it forms the Boka Kotorska Bay (Pesic, 2011; UNEP-MAP-RAC/SPA, 2014). There are nine small islands in the country's territorial waters, overall comprising 26km of coastline (Pesic, 2011; UNEP-MAP-RAC/SPA, 2014). The extent of the continental shelf varies from 9 nautical miles off the Boka Kotorska in the North to 34 nautical miles at the estuary of the Bojana River in the South (UNEP-MAP-RAC/SPA 2014). The continental shelf has a maximum depth of about 200 m (CAU et al., 2015; UNEP-MAP-RAC/SPA, 2014).

Montenegrin coastal and deep-sea environments hold diverse habitats with high levels of species diversity to which a number of rare and endemic species belong (Markovic, 2008). It has been documented that planktonic algae and seaweeds pose the prominent vegetation of the Montenegrin coast which form nursery shelters for the numerous species of marine fauna (Buskovic, Kapa, 2010). The unique deep-sea habitats of Adriatic Pit are home to multiple benthic and pelagic species, including marine top predators (UNEP-MAP-RAC/SPA, 2015). Yet, the deep-sea ecosystems of Montenegro are largely unexplored with relatively higher research effort present within its coastal waters (Ministry for Spatial Planning and Environment, 2015). The research efforts on marine ecosystems are generally focused on marine pollution and its bioaccumulation in fish and mollusc species. Additional research lines were benthic fauna and flora distribution, invasive species, aquaculture and most recently beach litter (Peraš et al., 2017; Šilc et al., 2018). Despite marine mammals not being considered a research priority, the presence of Mediterranean Monk Seals in the Adriatic including Montenegrin waters have been assessed relatively well since the late 1980s (Antica et al, 1994; Draganovic, 1991; Gomercic, Humber, 1989; Gonzales, 2004) but it wasn't until 2013 that a systematic cetacean survey effort was conducted in Montenegrin waters (Đurovic et al., 2016, Miočić-Stošić et al., 2020).

Cetaceans of the South Adriatic Sea

Cetaceans are marine top predators and are used as an indicator species of marine ecosystem health. Despite their key importance to the ecosystem they belong to, the lack of baseline knowledge was persisting in several Mediterranean countries, including Montenegro thus preventing any basin-wide assessments and in-situ conservation and mitigation strategies. Cetacean surveys started in the late 1980s within the Adriatic Sea, mainly targeting the northern and central waters (Notarbartolo di Sciara, et al., 1993). Occasional survey efforts began in Montenegro with the first aerial survey and first boat surveys in 2010 and 2013 respectively (Đurovic et al., 2016; Fortuna et al., 2011) but it wasn't until 2016, that the first long term surveys on cetaceans were conducted, covering the entire coastline of Montenegro (Affinito et al., 2019; Awbery et al., 2019a; Bas et al., 2018).

Bottlenose dolphins are known to be the most regular species of the Adriatic Sea (Fortuna et al., 2011; Gaspari et al., 2015; Impetuoso et al., 2003; Pleslic et al., 2015; Ribarič, 2018; UNEP-MAP-

RAC/SPA, 2014), including in Montenegro (Pilleri, Gihr, 1977), whereas striped dolphin (*Stenella coeruleoalba*), Risso's dolphin (*Grampus griseus*), sperm whale (*Physeter macrocephalus*), and the Cuvier's beaked whale (*Ziphius cavirostris*) can be sighted within the offshore waters of Montenegro, specifically in the close proximity of the Adriatic Pit (Holcer, et al., 2003, 2014). Additionally, fin whales (*Balaenoptera physalus*) are occasionally reported in the coastal waters of the Adriatic Sea (Holcer, Mackelworth, 2002).

All the aforementioned species are either classified as threatened, vulnerable or data deficient at a Mediterranean level by the IUCN Red List criteria (Aguilar, Gaspari, 2012; Bearzi et al., 2012; Cañadas, 2012: Gaspari, Natoli, 2012; Notarbartolo di Sciara et al., 2012; Panigada, Notarbartolo di Sciara, 2012). The established threats to populations are identified as the killing campaigns that were legally active until 1960s, unregulated fishery practices that results with overfishing and entanglements, habitat destruction, marine traffic, chemical and noise pollution thus disease outbreaks, marine debris and climate change (Arcangeli et al., 2009; Bas et al., 2017; Bearzi et al., 2002, 2008; Christiansen et al., 2010; Gonzalvo et al., 2014; Lusseau, 2003; Lusseau, Higham, 2004; Pennino et al., 2016; Ribaric, 2018). The historical killing campaigns alongside the current ongoing threats have decreased the current population status by over 50% for multiple species (Bearzi et al., 2008; Gonzalvo et al., 2014). Bottlenose dolphins are estimated to consist of numbers in the 10,000's (Bearzi et al., 2012) with most recent estimates of bottlenose and striped dolphins being 75,885 (95% CI: 50,116-114,903) and 423,669 (95% CI: 323,666-554,568) respectively in the Mediterranean Sea (ACCOBAMS, 2021). Their Adriatic estimations are 5,772 (95% CI:3,467-9,444) for bottlenose dolphins and 15,343 (95% CI: 8,545-27,550) for striped dolphins (Fortuna et al., 2011) with striped dolphins having an encounter rate of 0.013 in the Southern Adriatic (Azzolin et al., 2020). Risso's dolphins and Cuvier's beaked whales are one of the least known species of the entire Mediterranean Sea with estimated population size of 26,659 (95% CI: 15,129-46,975) and 3,204 (95% CI: 1,503-6,830), respectively (ACCOBAMS, 2021). Due to the lack of research effort in the deeper waters of the Adriatic Sea, there is extremely limited information for both of the species where Cuvier's beaked whales were reported five times with their calves during 2010 and 2013 aerial surveys over the Southern Adriatic basin (UNEP-MAP-RAC/SPA, 2014; UNEP-MAP-RAC/SPA, 2015). Adriatic estimation for Risso's dolphins is 510 individuals (95% CI: 124-2,089) (Fortuna et al., 2011). Although regular sightings of fin whales in Mediterranean deep waters occur with a population estimate of 1,684 (95% CI: 977-2,904) (ACCOBAMS, 2021), their permanent presence in the Adriatic is uncertain (Panigada, Notarbartolo di Sciara, 2012), with recent sightings taking place in 2016, 2018 and 2020 in Croatia and Montenegro. Lastly, short-beaked common dolphins, with a Mediterranean population of 65,925 (95% CI: 30,703-141,552), were once considered the most abundant species of the Adriatic Sea, have experienced a steep decline in their population (Bearzi et al., 2004; UNEP-MAP-RAC/SPA, 2014). The Adriatic population is thought to have been locally extinct since the aerial surveys between 2001 and 2013 did not reveal any (Fortuna et al., 2011; UNEP-MAP-RAC/SPA, 2014). However, a group of 50 common dolphins were sighted off the coast of Kornati, Croatia in 2018, providing a slight hope that the habitat alteration might not be permanent for the species (Blue World Institute, 2018).

Previous Studies on Cetaceans in Montenegro

The dedicated research effort on cetaceans started in the early 1980s within the Adriatic Sea, even though the effort was concentrated in the northern and central basins (Notarbartolo di Sciara et al., 1993). The main targeted species was the bottlenose dolphin, yet common dolphins, striped dolphins and Risso's dolphins were also studied, although low in numbers, in the Adriatic (Notarbartolo di Sciara, 2010, 2016). While the early studies were mainly structured around photo-identification, site fidelities, group cohesion and identification of key habitats, later heavy metal concentration, noise monitoring, habitat suitability and bycatch was also added to the list of research topics with continuous effort on photo-identification, population structure and home range analysis (Bilandžić et al., 2012; Fortuna et al., 2010; Pleslic et al., 2019; Rako et al., 2013; Velike, 2009).

Despite its geographically important position with large variation in water depth and undersea habitats, Montenegro had extremely limited research effort targeting cetaceans. The first scientific report of bottlenose dolphins was from a water bird survey in the Bojana River that was conducted between 2003 and 2004 (Sackl et al., 2007). Unfortunately, it was not until 2013 where the first systematic cetacean research was conducted in Boka Kotorska. The photo-identification study revealed the presence of eight individuals of bottlenose dolphins using the Boka Kotorska (Đurovic et al., 2016). A wider study covering the entire Adriatic Basin, including Montenegro, identified the 72 individuals through a photo-identification study in the Montenegrin waters (Fortuna et al., 2015). A recent article published in 2016, confirms the presence of bottlenose, striped dolphins and other cetaceans such as the Cuvier's beaked whale and the Risso's dolphin and occasional sightings of fin whales in the Boka Kotorska Bay (UNEP-MAP-RAC/SPA, 2014). However, only bottlenose dolphins were pinpointed as regular visitors of Montenegro (Đurovic et al., 2016).

Montenegro Dolphin Research was established in 2016 and since then has run dedicated research effort within the coastal waters of Montenegro (Affinito et al., 2019; Awbery et al., 2019a; Bas et al., 2018). The research scope ranged from spatial-temporal distribution of bottlenose dolphins to residency and site fidelity patterns, key habitat identification and threat assessment (Affinito et al., 2019; Awbery et al., 2019a; Bas et al., 2018; Clarkson et al., 2020).

Existing Human Pressure in Montenegro

Tourism activities

Tourism in Montenegro has one of the fastest growth rates in the world (Government of Montenegro, 2008). According to the Montenegro Tourism Development Strategy 2020, travel and tourism has played a central role in Montenegro's dramatic growth and transformation. It accounted for over 25% of countries' GDP, with an expectation to increase in upcoming years. The Central Bank estimated that tourism income increased by 460% between 2001 and 2007, or from €86 million to €480 million. Additionally, the number of cruise ships increased by 23.5% between 2012 and 2017 (Cimbaljevic, Muratovic, 2018).

Rather than being steady and balanced between seasons, mass tourism activities occur in the summer season, resulting in the overuse of resources (Bigović, 2011; Cimbaljevic, 2013; Cimbaljevic, Muratovic, 2018). The negative consequences of mass tourism on the marine environment can range from habitat destruction to noise and chemical pollution, marine debris and increased marine traffic. The uncontrolled coastal development can destroy coastal ecosystems both in the terrestrial and the marine realm (Maragos, 1993; Weaver, 2021). It eliminates important habitats such as seagrass meadows, the nursing grounds of many economically important fishes, distorts coastal structures, including caves, and alters the current system that is responsible for nutrient flows and oceanographic parameters (Walker, Kendrick, 1998). Its negative consequences have already been documented in Montenegro, through the decrease of seagrass meadows (Macic et al., 2010). Regarding tourist vessels, it is estimated that cetaceans in the Mediterranean Sea are five times more vulnerable to collision risk than the worldwide average (Štrbenac, 2015). Further, its direct and indirect effects have also been reported worldwide (Christiansen, Lusseau 2015; Constantine, 2004; Gales et al., 2003; Heiler et al., 2016; Lusseau 2003; Lusseau, Higham, 2004; Stockin et al., 2008) as well as in Montenegro (Clarkson et al., 2020). Pollution is another important threat of unregulated tourism activity which can accumulate in the seafloor or also enter into the food chain (Wilson, Verlis, 2017).

Marine traffic

The Mediterranean Sea is an area of high marine traffic intensity (Pennino et al., 2017) with approximately 220,000 vessels travelling its waters daily (Panigada et al., 2006; Pennino et al., 2017). As a result of high marine traffic both in the coastal and offshore waters, the Mediterranean Sea is assumed to lack silent spots throughout the entire basin (Maglio et al., 2016). Regarding Montenegro, cruise ships, leisure boats, and jet-skis show a steep increase of usage in the summer months while artisanal fishing boats are present year-round with coastal distribution. In 2019 460 cruise ships arrived in the port of Kotor, Montenegro, with a total of 649 038 passengers on board. When compared to 2018, this is an increase of 15.6% on the number of cruise ships and the number of passengers increased by 28% (Cimbaljevic, 2020).

Regarding the waterway transportation, four international ports are in operation (ports of Bar, Kotor, Zelenika and Risan) of which three of them are located in the Boka Kotorska Bay. Kotor ports account for 100% of cruising vessels turnover and 84% of nautical tourism turnover in Montenegro. Despite hosting a high level of tourism related vessels within its waters, maritime transportation, including the domestic shipping industry, is very low in Montenegro, with around 2.5 million tons of goods and 66,000 passengers annually arriving (Coastal Area Management Programme Montenegro, 2008).

Marine traffic can have direct and indirect threats on the marine environment from continuous noise presence, chemical pollution, collision risks, behavioural alterations and habitat avoidance (Campana et al., 2015; Pennino et al., 2017). Rapid development of the shipping industry and marine vessel traffic has already resulted with an increase in cetacean ship strikes (Carrillo, Meissner et al., 2015; Ritter, 2010) with large whales and small cetaceans, such as dolphins and beaked whales, being particularly vulnerable (Waereebeek et al., 2007). Ship strikes are a common occurrence in the Mediterranean, however there have been no known reports of collisions between cetaceans and marine traffic in the Adriatic (Carić and Mackelworth, 2014; Panigada et al., 2006). Disturbance to small cetaceans from shipping and boating activity has been documented however, particularly during the summer, resulting in seasonal displacement of cetacean populations (Awbery et al., 2019a; Rako et al., 2013;). Further negative consequences of marine traffic can be classified either under short or long term. While long term consequences can be identified as ship strikes and permanent area avoidance (Meissner et al., 2015), short term consequences of marine traffic presence can be identified as behavioural alterations (Clarkson et al., 2020; Lusseau, 2003) and temporary area avoidance (Awbery et al., 2019a; Rako et al., 2013) which if persistent for a continued period of time can result in population level effect (Clarkson et al., 2020).

Fishing Practises

Within the Mediterranean, the Adriatic Sea is one of the largest areas of occurrence of demersal and small pelagic shared stocks, of great value to the fisheries (UNEP-MAP-RAC/SPA, 2014). The Adriatic Sea is responsible for 15.2% of fishery catch in the entire Mediterranean Basin (Bernal et al., 2020). Montenegro had an average annual catch of 922 tons between 2016- 2018, forming only 0.5% of the annual catch of the Adriatic (Bernal et al., 2020). The country had an insignificant fishing effort up until the early 1990s, with the sector blooming between 1992 and 1998 (Pesic et al., 2011). In 1997-1998, 196 vessels were licensed, of which 31 vessels belonged to demersal fishery activities (Pesic et al., 2011). In 2002, the number of trawlers dropped to 17 vessels and since then has shown a steady number of vessels within its territorial waters. There are only two purse seiners active in the territorial waters of Montenegro (Pesic et al., 2011). Montenegro has no fishery cooperatives or organised landing sites and fish auction markets. The main fishing ports are Herceg Novi, Budva, Bar and Ulcinj. In all ports bottom trawlers, small purse seiners, trammel netters, gillnets and long-liners are present, while the commercial vessels are mainly present in Herceg Novi (trawlers) and Bar (Purse seiners) (Awbery et al., 2021). Even though the majority of the fishing effort originates from artisanal fishery in

Montenegro, data on the catch numbers are unknown (Pesic et al., 2011). A rough estimation, based on fishery interviews, was approximately 1,200 tonnes (Regner et al., 2003). Additionally, 20 mussel farms and two fish farms are present in the Boka Kotorska Bay (Pesic et al., 2011).

Despite the relatively low fishing pressures in Montenegro, the presence of illegal nets and explosive fishing dropped the catch per unit effort from 60 to 20kg/h between 1990 and 2000. A sharp decline in elasmobranchs was also documented in the country. It accounted for 36-42% of the total catch in the early 1970s when the fishery pressures were insignificant and dropped quickly to 17-30% in the 2000s. Yet, Montenegrin waters are still characterised by the occurrence of quite a high proportion of demersal sharks and different species of ray. These species showed drastic declines in the Mediterranean, indicating that the Montenegrin fish community may still contain high biodiversity despite the destructive methods. Beyond the frame of common species, a few more sharks can be observed and are found to be present. A special focus should be put on Angular roughshark (*Oxynotus centrina*) and Sandbar shark (*Carcharhinus plumbeus*) as a rare and endangered species in the Adriatic Sea. Moreover, occasional records of Common thresher shark (*Alopias vulpinus*) and Bluntnose sixgill shark (*Hexanchus griseus*) should be taken into consideration. These species should be subjected to long-term monitoring in order to collect better dataset on all of these highly threatened species (Cetkovic, 2018).

Fishing practices, if employed in an unsustainable manner, can both directly and indirectly change marine ecosystem dynamics (Coll et al., 2007), altering complex structures within whole ecosystems (Tudela, 2004). Interactions between cetaceans and fisheries have been documented for centuries and have been reported to be increasing in frequency and intensity (Read et al., 2006). This results in lower prey availability, habitat loss or degradation, injury or mortality through collusions and by-catch (Bearzi, 2002). Additionally, fishery practices can result behavioural modifications, such as changes in direction, an increase in swimming speed, changes on habitat preferences and behavioural budgets with opportunistic feeding behaviour (Bearzi et al., 1997; Fortuna et al., 1996; Holcer, 2012; Nowacek et al., 2007;).

Seismic surveys and drilling

The Adriatic Sea has been highlighted as a potential source of undiscovered hydrocarbons (oil and gas) which was stressed as economic opportunities for countries in the Adriatic. This has been highlighted by previous prospecting attempts that took place from the late 1970s to the early 2000s and involved the cumulative mapping of 3500 km^2 of geophysical reflective profiles (CAU et al., 2015). Seismic surveys are used to delineate structures below the seafloor which suggest the potential for future hydrocarbon exploitation. The surveys use an array of airguns, which are arranged along streamers towed behind the vessels. The air guns emit high-intensity, low frequency pulses directly towards the sea floor. The ensuing data is picked up by acoustic listening devices known as hydrophones. Based on the delay in receipt of sound, an image of the seabed is produced and the potential for hydrocarbons is exploited (Przeslawski et al., 2018).

Seismic surveys were most recently conducted off the coast of Montenegro in November 2018 with the presence of three supportive vessels (Širović, Holcer, 2020). These seismic surveys lasted for 34 days. A basic Environmental Impact Study was made, however this was done without any previous detailed studies of environmental assessment for designated areas.

Sounds emitted by airguns are likely to be heard from survey vessels at distances up to 4,000km away (Nieukirk et al., 2012). As it has in the past in other locations worldwide, unregulated seismic activities can have catastrophic impacts on the marine ecosystem as a whole (Gordon et al., 2003; Nowacek et al., 2007, 2015). For marine mammals specifically, there are a wide range of impacts in response to seismic that have been reported including temporary and permanent hearing loss (Gordon et al., 2003; Simmonds, Lopez-Jurado, 1991; Weilgart, 2013), masking vocalisations (Weilgart, 2007), changes in behavioural states (Abgrall et al., 2009; Barry et al., 2012), and displacement and avoidance (Monaco et al., 2016).

Drilling operations began in March 2021 utilising the Topaz Driller vessel off the coast of Bar, 28 km from the shore with an expected four-to-six-month operation planned. The hydrocarbon companies Novatek and Eni will drill an oil exploration well 14 miles off the coast of Montenegro with a well depth of 6,525 metres planned (Kulovic, 2021).

Similar to the seismic exploration phase, the construction of oil wells produces noise with broad frequency ranges between 10Hz -10kHz (Gales, 1982; Turl, 1982). With oil well drilling and a drill vessel generating SPLs between 119-127dB re 1 μPa and 174-185 dB re 1 μPa respectively (Kuşku et al., 2018; Richardson et al, 1995). Turl (1982) reported that noise generated from oil and gas drilling may be detectable from 174km from the source at 1kHz although it may be challenging to ascertain accurate source level noises in shallow water due to propagation and background noise (Turl, 1982). However, it is an additional source of anthropogenic noise pollution that is further altering the natural soundscape (Farina, 2013) with drilling increasing the ambient noise level by 80-100dB compared to if they were not operating (Gales, 1982). Audiograms show that cetaceans are capable of hearing drilling noises and therefore may suffer short- or long-term impacts such as masking, behavioural alterations, and displacement (Farina, 2013; Turl, 1982).

Additionally, drilling causes direct damage to the habitat which may impact prey availability for marine mammals. Further, with drilling there is always the risk of a blowout or accidental spill (Stirling, Calvert, 1983). Although currently in Montenegro there is only drilling for one exploratory well, the potential impact of this smaller project should not be underestimated.

2. Methodology

Survey Area

The territorial waters of Montenegro were surveyed using a combination of fixed land stations and boat-based surveys since 2016 (Figure 1). The land survey coverage was calculated using wedges for each land station. The extent of a wedge was determined using the outermost data point collected on either side of a station. The radius of the wedge was determined using the furthest data point collected. The total land survey coverage was 509 km^2. The boat survey coverage was calculated by drawing an area around the boat survey track lines in Montenegrin waters. The total boat survey coverage was 5,069 km^2 with the furthest distance of 83.5 km from the nearest coast. The surveys were mainly conducted in shallow waters (<100m depth), the maximum depth that was surveyed reached to 1000 m depth (Figure 1).

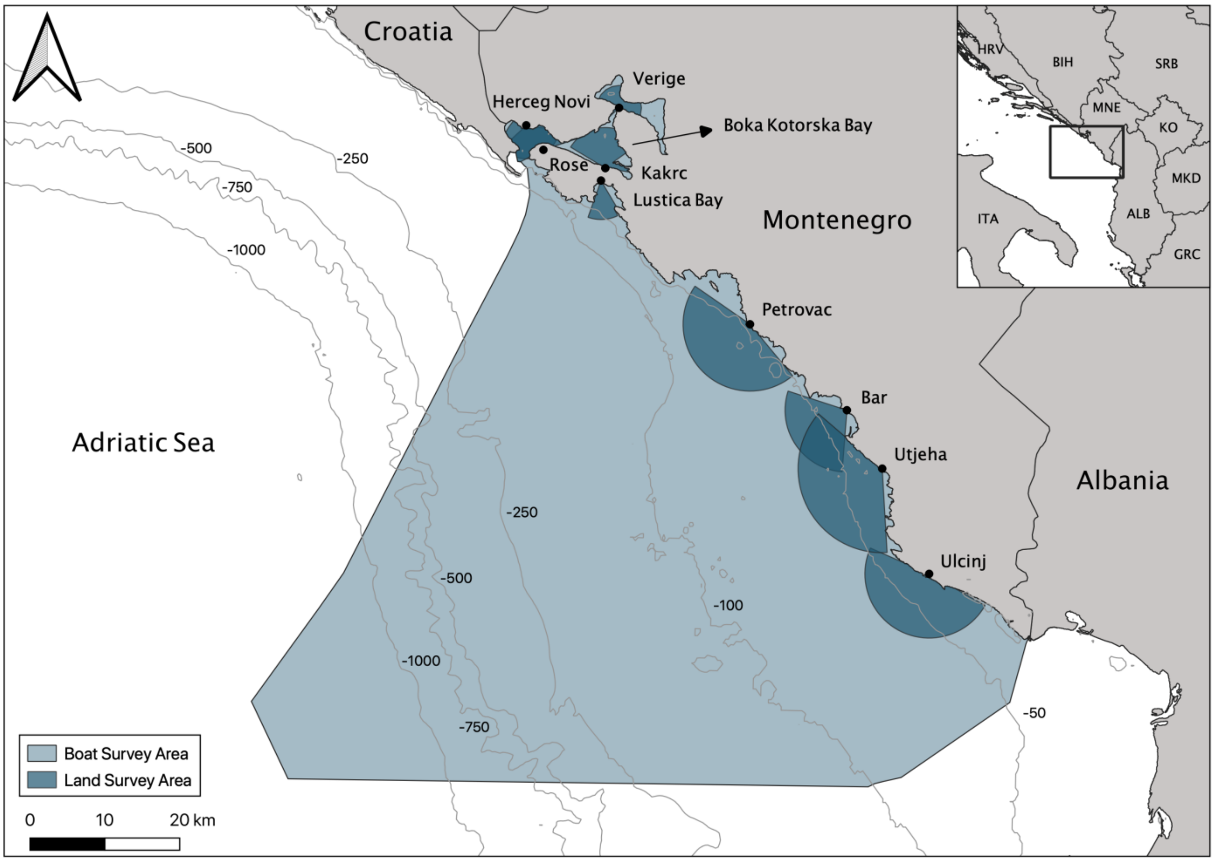


Figure 1. Survey Area of Montenegro with land station and boat survey coverages.

Survey platforms

Land surveys

To cover all of the coastal waters of Montenegro, the project has nine predetermined locations along the Montenegrin coastline and in the Boka Kotorska Bay (Figure 1; Table 1). Every land survey location was carefully selected at least 10 metres above sea level with no obstructions such as trees or buildings blocking the line of sight. This maximised the range of view and thus the likelihood of cetacean sightings. The observations were conducted during the morning (beginning with sunrise) and the afternoon (ending with sunset) for a minimum of 3 hours. By completing land-based surveys, researchers observe cetaceans in their natural behavioural state without being disturbed by the research vessel.

Table 1. The coordinates and altitudes of land stations.

Station	Latitude	Longitude	Altitude (m)
Ulcinj	41°55'28.7"	19°12'37.8"	33
Utjeha	42°03'01"	19°07'52"	78
Bar	42°07'11"	19°04'19"	23
Petrovac	42°13'14.09"	18°54'42.77"	165
Verige	42°28'38.20"	18°41'25.19"	14
Lustica Bay	42°23'20.54"	18°39'51.012"	103.6
Kakrc	42°24'14.942"	18°40'14.37"	30.2
Rose	42°25'26.85"	18°34'9.25"	255
Herceg Novi	42°27'11"	18°32'25"	84

To get the geographical position of the cetaceans and the marine vessels in the area, a theodolite (SOKKIA DT5A) was used to record the horizontal and vertical angles. The tracking software Pythagoras (version 1.2) was used to convert these angles into geographical coordinates, using the predetermined geographical position of the station (Table 1) as well as the height of the observation location, the reference point and the azimuth. The software stores the predetermined type and behaviour of the cetaceans and marine traffic. Additionally, it stores other important information about the cetaceans such as group size, calf presence and which group type and swim style they are swimming in.

During all the land- and boat-based surveys the environmental conditions were recorded every 60 minutes or when the conditions changed as environmental conditions can influence the visibility of the cetaceans. The conditions that were recorded consist of the tide height, sea state, glare, cloud cover, sea surface temperature, swell, air temperature, wind speed and direction. The sea state was recorded using the 0-12 integers of the Beaufort scale. Glare and cloud cover were estimated as a percentage in steps of 10 (0, 10, 20, 30, 40 etc.). The tide, sea surface temperature, swell, weather temperature, wind speed and direction were ascertained from online sources before the survey started. Environmental conditions were noted on a datasheet as well as in the software Pythagoras.

When the team of at least 4 researchers arrived at the survey station, the team leader divided the tasks. One researcher was responsible for theodolite operation, one for entering the horizontal and vertical data from theodolite onto the laptop using the program Pythagoras. The other researchers were constantly scanning the sea with binoculars. In case of a cetacean sighting, the researcher on the theodolite would give the behavioural information of the cetaceans. One of the researchers on the binoculars was responsible for writing down all the information on the datasheet. Tasks were rotated periodically to avoid observer fatigue.

Boat surveys

An attempt was made to conduct boat surveys at least every 10 days, dependent on the weather conditions and logistics. Additional logistical issues were introduced due to restrictions resulting from the COVID-19 pandemic in 2020 and 2021. Boat surveys took place throughout the year in calm seas, where the visibility was more than 1 nautical mile and there was a Beaufort Sea State between 0-3. These surveys took place between sunrise and sunset times (06:00 and 21:00). Depending on the sea state, the surveys lasted between 3-7 hours. Surveys were generally conducted at a speed of 4 knots, and 3 different kinds of boats used:

1. Motorboat with an outboard engine, with a length of 6 metres
2. Rigid inflatable Boat with an inboard engine, with a length of 12 metres

3. Sailing boat with an inboard engine, with a length of 17 metres

To create the track line of the survey, the geographical coordinates of the boat were recorded every 1-2 minutes in the software Logger 2010 (Marine Conservation Research, 2019). For this, a GlobalSat G-Star IV (SIRF Star IV) GNSS (Global Navigation Satellite System) was used. The software Logger 2010 also recorded data on the date and time of the survey, the number of researchers and their responsibilities, behavioural data of cetaceans, marine traffic and environmental data which was collected as with land surveys. To calculate the true coordinates of the cetacean group, the distance and bearing of the focal group were recorded during the sighting.

In the case of a cetacean sighting, the research boat/vessel would approach and follow the focal group maintaining a low and consistent speed from the side or rear and in the case that the cetaceans approached the research boat/vessel, the speed was reduced gradually to idle. The distance between the cetacean and the boat ranged from a minimum of 50 metres to a maximum of 400 metres. Any sudden changes in the speed and direction were avoided and in order to measure the impact of the presence of the research vessel, any changes in the cetacean's behaviour were recorded.

During both the land and boat-based surveys, researchers used a focal group scan sampling to collect time and date of the observation, species, group size, behaviour, reaction to marine traffic, presence of juveniles and surrounding marine traffic. All data was collated to a database at the end of each week and photo-identification pictures and acoustic recordings were saved on a hard drive and regularly backed up.

Visual data collection

Behaviour Sampling

To collect the behavioural data of the group of cetaceans, it was chosen for the method of instantaneous focal group scan sampling with an interval of 5 minutes. For the sampling method a gathering of cetaceans (when the cetaceans were less than 100 metres apart from the next closest cetacean in the group with the chain rule) was defined as the focal group. At the beginning of every sampling unit, the time, minimum and maximum individuals in a group and the number of calves were noted. The focal group was scanned for the first minute to determine the most frequent group type, swim cohesion and behavioural state. But also during this scan sampling all the individual behaviours states and behavioural events were recorded. Behavioural states endure for an appreciable time, whereas behavioural events are instantaneous (Shane, 1990; Bearzi et al., 1999).

The behavioural states and events are explained in more detail in Table 2 and Table 3. During these 5 minutes all the information about the marine traffic such as number, type and distance to the focal group was recorded.

Table 2. The predetermined behavioural states and their abbreviations used in the study.

Behavioural states	Description
Travelling (TR)	Movement of the group with constant speed and direction and the group has to travel at least 200metres in 1 minute (approx. speed of 4 knots).
Travel-Diving (TR-DV)	Dolphins swim underwater for 5 to 10 minutes and move in a consistent direction, often appearing 200 to 400metres from where they were last seen.
Diving (DV)	Characterised by steep dives, dolphins stay within a ~ 100metres radius, moving in varied directions. This behaviour often relates to

	foraging and can also be linked to vertical avoidance from the human presence.
Surface-feeding (SU-FE)	Movement is extremely varied with lots of splashes in the same area. High activity on the surface. There are likely to be birds and fish present.
Socialising (SOC)	Dolphins are highly active on the surface with observed physical contact between the individuals.
Resting (RE)	Dolphins travel very slowly in a coordinated manner, staying close to one another. Dive intervals are short and group activity is very low. The group travels less than 100metres in 1minute.
Milling (MI)	Non-directional movements. Even though the group moves, the group cohesion doesn't considerably change. It looks like a meeting to coordinate their next move.
Bow-riding (BOW)	Dolphins 'surf' alongside the bow of a boat, using the upwelling caused by the boat to allow them to travel using very little energy.
Interacting (IN)	Any other interaction with the nearest vessel including inspecting the vessel.
Undetermined (UND)	Dolphins do not show any of the behaviours listed above.

Table 3. The predetermined behavioural events and their abbreviations used in the study.

Behavioural Events	Definition
Tail slap (TS)	Individual slaps its tail on the water surface
Spy hop (SH)	Individual raises its head shortly above the surface
Breaching (BR)	Individual leaps out of the water and lets its body slap the surface
Belly up (BU)	Individual turns upside down
Full leap (FL)	Individual leaps its complete body above the water surface
Fluke up (FU)	Individual protrudes its fluke above water surface

Acoustic Data Collection

Acoustic data was collected if the cetaceans were present in the area during the boat-based surveys. The acoustic recorder that was used was a TASCAM (DR-40x linear PCM Recorder) with a custom-built Vanishing Point hydrophone (recording to ~170kHz with a gentle (3dB down at 2k) low cut filter) on a 20 metre 'drop-down' cable. Researchers would deploy the hydrophone, the moment that the research boat was idle either on the side or on the back of the boat, depending on the position of the propeller. One researcher was responsible for tracking the location of the hydrophone in the water and was in constant communication with the captain whilst another would check proper functioning of the device and listen to the acoustics during the recordings, to listen for clicks and/or whistles. To avoid damage to the hydrophone, the hydrophone would be retracted if the boat moved more than 2 knots.

Marine Vessel Sampling

To study the effects of the marine traffic on cetacean behaviour, the type and number of marine vessels and their distance to the focal group was collected. During the boat-based surveys the distance of the research boat/vessel was recorded.

Marine traffic was categorised into thirteen groups:

- Research boat (RB)

- Jet ski (JS)
- Motor boat (MB)
- Luxury boat (LB)
- Peddler / Kayak (PED)
- Passenger boat (PB)
- Research vessel (RV)
- Cargo ship (CS)
- Ferry (FE)
- Fishing vessel (FV)
- Sailing boat (SB)
- Cruise ship (CR)
- Undetermined (UND)

Marine activity was defined as:

- Fishing (FI)
- Speeding (SP)
- Tourism (TO)
- Trawling (TR)
- Cruising (CR)
- Idle (IDL)
- Not applicable (NA)
- Undetermined (UND)

To record the density of the marine traffic the number and activity of vessels within the radius of 100 metres, 400 metres, 1000 metres and more than 1000 metres of the cetaceans were noted.

In the case that cetaceans changed their behaviour and/or swimming direction due to the presence of marine traffic (including the research boat/vessel) it was classified as positive (cetaceans swim towards the marine vessel), negative (cetacean swims away from the marine vessel) or neutral (cetaceans didn't change behaviour or direction of swimming).

Photo Identification

Focal group and individual photographs were taken during the boat surveys using various models of DSLR cameras, with 70-300m, 150-600m and 70-200mm f/2.8 APO lenses. To maximise the number of high-quality images, the photographer took multiple photographs of each individual dolphin, from both sides of the individual wherever possible.

Photo-identification was carried out using Discovery Software, whereby the photographs were stored, cropped, matched, and added to the catalogue and subsequently graded 1 to 3 for image quality following criteria published by Ingram (2000):

• Photo Grade 1 – Well-lit and focused shots taken perpendicular to the dorsal fin at close range
• Photo Grade 2 – More distant, less well-lit, or slightly angled shots of dorsal fins
• Photo Grade 3 – Poorly lit or out of focus shots taken at acute angles to the dorsal fin.

Where multiple photos of dolphins were available, photos from both the left and right side of the dolphin, that best represented each individual, were used in the matching stage. Pre-determined categories and descriptors were used upon adding the photos to the catalogue in order to filter individuals. Photos added to the catalogue were either matched to an existing individual or, if there was no match, a new individual was created and assigned a unique identification number. The most obvious feature of the dorsal fin was determined and the appropriate category was subsequently assigned upon matching. Two to three additional features were also identified using the descriptors.

Further, whilst adding the photos to the catalogue each photo was graded 1-3 for distinctiveness of the fin following criteria published by Ingram (2000):

- Distinctiveness Grade 1 – Marks consisting of significant fin damage or deep scarring considered permanent
- Distinctiveness Grade 2 – Marks consisting of deep tooth rakes and lesions with only minor cuts present
- Distinctiveness Grade 3 – Marks consisting of superficial rakes and lesions.

In addition to image quality and fin distinctiveness, each fin added to the catalogue was documented as either 'left', 'right' or 'fluke'. Information about the individual, if known, was also noted such as the sex, maturity and calf presence. Sighting data was also added, such as the date and time of the sighting, along with the geographical coordinates. Once all individuals identified from a survey were added to the catalogue, additional information for the entire focal group was added to the Discovery database, including survey effort and sightings data such as; environmental conditions, geographical coordinates and behaviour. Finally, each match was independently verified by a second judge to reduce error.

Data Analysis

Montenegro Dolphin Research Team has had an ongoing survey effort in Montenegro. The current report approaches data that was collected between 2016 and 2020, with additional information from 2021 to investigate changes in dolphin sightings when human impact reduced even slightly during the COVID-19 pandemic.

The report firstly presents the variation in survey effort per year and its associated sighted species within Montenegrin waters. Later, the annual variation in sighting rates of bottlenose dolphins is described with an assessment of behavioural preferences and group cohesion for southern, central and northern Montenegrin waters.

Photo-identification results are also presented with their sighting history in Montenegro. Further, re-sighting maps have been produced to investigate the movement patterns of individual bottlenose dolphins.

Preliminary results on the vocalisation behaviour of bottlenose dolphins in the Boka Kotorska Bay also analysed by RavenPro software and summarised in this report.

Species distribution was mapped to visualise bottlenose dolphin range and habitat preferences. Bottlenose dolphin data points, collected from land and boat surveys, were clustered according to survey date and group number. Paths were then created to show dolphin movement along the Montenegrin coast and in Boka Kotorska Bay. Based on these paths, kernel density maps were produced. Finally, contour polygons were drawn to indicate bottlenose dolphin core zones (50% inclusion for seasonal and annual variation, 70% inclusion for general variation). Initially, seasonal variation was assessed. Core zones, depth and distance to shore of dolphin observations for each season were compared. Following their seasonal spatial distribution, core zones were calculated for each year to allow for a comparison between years. Then, general spatial distribution was mapped for the entire period between 2016 and 2021. Finally human pressure maps, including marine traffic and seismic operation were mapped to overlap the general core zones of bottlenose dolphins and human pressure in the area to assess the impact range. Marine traffic maps were created using boat data points from land surveys. Kernel density maps were then produced in the same way as for the bottlenose dolphins. Following the total spatial distribution, specific density maps were created according to the aforementioned boat types (and activities):

- Tourism: JS, MB (TO), LB, PED, SB
- Small fishing: MB (FI)
- Big fishing: FV
- Transport: FE, PB
- Large ships: CS, CR

The seismic operation map was produced using GPS coordinates from three ships performing seismic activities in 2019: the Sanco Sea, the Ramform Titan and the Thor Freyja. Kernel density maps were produced in the same way as for the other maps.

All spatial analyses were conducted in QGIS software, Version 3.14.

3. Results

Survey Effort

In total, 699 surveys (2339:20 hours) were carried out between the 15th of September 2016 and 26th of April 2021 (Table 4). The majority of the survey effort consisted of land surveys which formed 84% of the total effort. While three years (2017, 2018, 2019) had full yearly survey effort, 2016 had only five months, covering autumn and winter, and 2020 and 2021 had eight and four months of survey effort, respectively, due to restrictions that took place during the COVID-19 pandemic. While the highest survey effort was in 2017 with 192 days spent in the field, the lowest efforts were in 2016 with 51 days and 2021 with 53 days of surveys. It is important to note, however, that the survey effort for 2016 and 2021 represents only five and four months of survey, respectively.

Table 4. Number of survey days of each survey type. The number in brackets represents days where a dolphin sighting took place.

Year	Boat Survey (Sighting)	Land Survey (Sighting)	Total
2016	8 (5)	43 (20)	51 (25)
2017	31 (20)	161 (51)	192 (71)
2018	36 (23)	118 (35)	154 (58)
2019	23 (11)	132 (26)	155 (37)
2020	18 (8)	76 (17)	94 (25)
2021	6 (3)	47 (22)	53 (25)
Total	122 (70)	577 (171)	699 (241)

Regarding variation in survey effort per season, each season was surveyed almost equally with a slightly higher survey effort in autumn with 200 days. The lowest survey effort was recorded in winter with 146 days of survey effort (Figure 2).

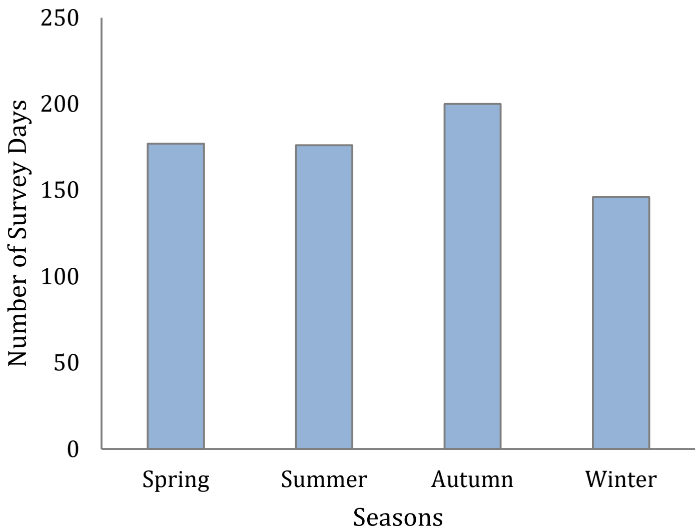


Figure 2. Number of survey days per season.

Sighting History

Overall, 403 focal groups were encountered in 241 days of survey effort, during which two species were recorded; Bottlenose dolphins (*Tursiops truncatus*) and striped dolphins (*Stenella coeruleoalba*). While bottlenose dolphins formed the highest sighted species being responsible for 95% of the sightings, striped dolphins were only encountered on 20 occasions (Figure 3).

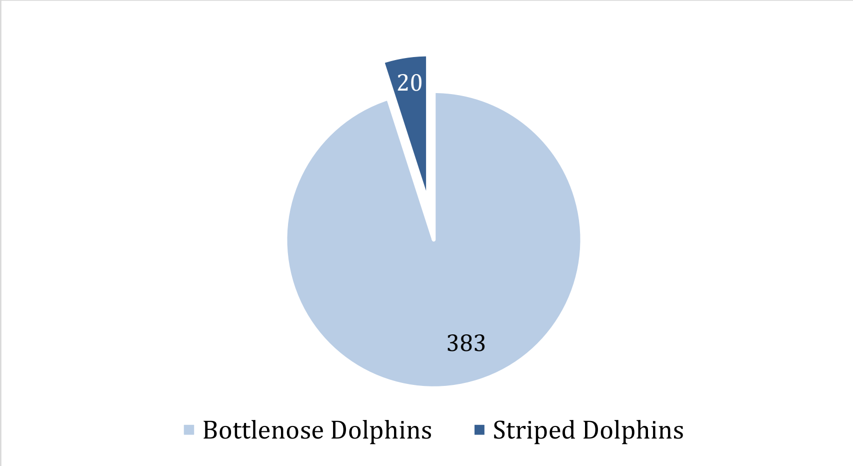


Figure 3. Species sighting numbers during the surveys.

When the encounters were assessed by season, even though bottlenose dolphins were slightly more regularly encountered in spring months with 29% of their entire sightings, their sighting rates were similar between seasons with a minimum rate recorded in summer of 22% (Figure 4). Therefore, bottlenose dolphins do not appear to use Montenegrin waters preferentially in a season, instead showing a similar abundance between seasons. On the other hand, striped dolphins were rarely sighted, with the highest encounters in the summer and autumn months with 8 encounters in each season, followed by three encounters in winter and only one in spring (Figure 4).

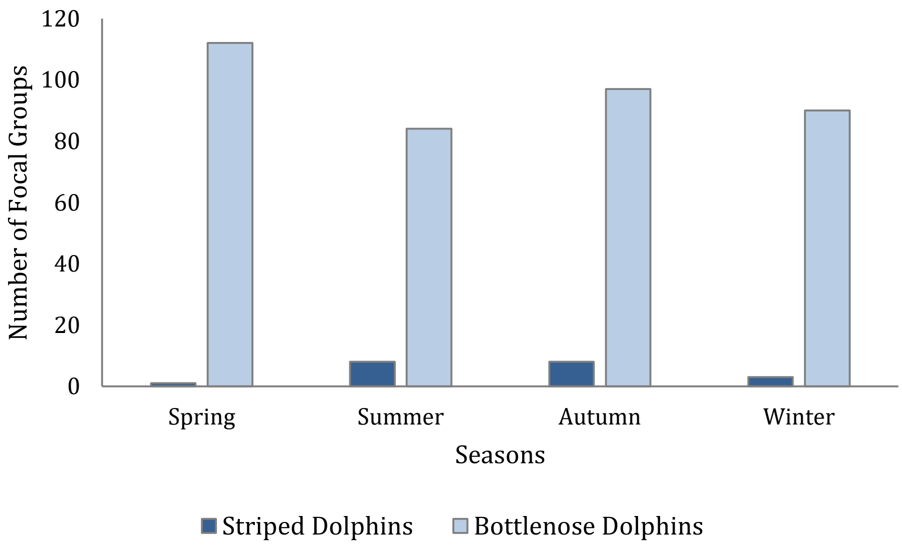


Figure 4. Seasonal variation in the sightings of dolphins in Montenegro.

When the yearly variation on the bottlenose dolphins' sighting rate was assessed, the species were sighted in 49% of surveys in 2016 with a steady decline in their sighting rate up until 2019, with 37%, 38% and later 24% in 2017, 2018 and 2019 respectively. Later in 2020, the sighting rate slightly increased to 27%. However, the sighting rate reached up to 47% in 2021 (Figure 5). The variation in the sighting rate of striped dolphins was not examined due to the small sample size.

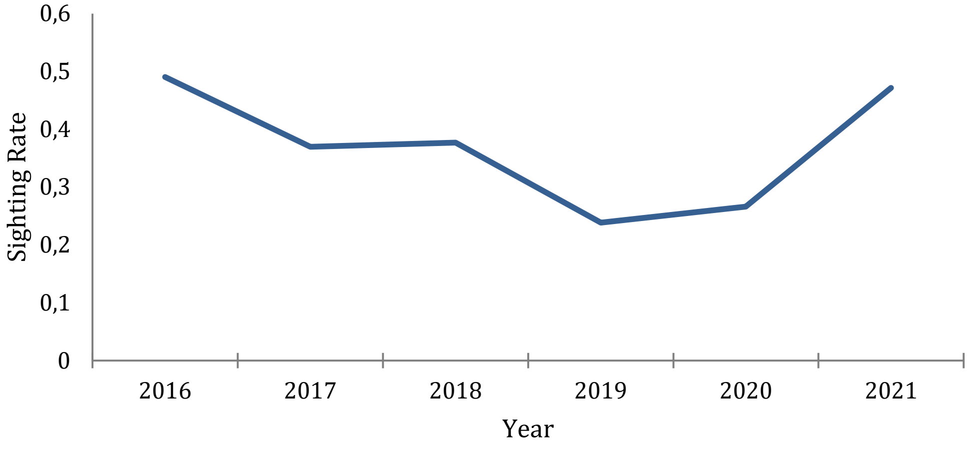


Figure 5. The yearly variation in sighting rate of bottlenose dolphins in Montenegro.

Behavioural Variations and Group Cohesion

Dolphins were followed for an overall of 181.6 hours of the 2339 hours of survey effort (7.8%), comprising 2179 behavioural sampling intervals. While group sizes of bottlenose dolphins ranged from 1 to 20 individuals with a mean of 3 ± 2 individuals and mode of 2 individuals, it was between 1 and 30 individuals with a mean of 7 ± 2 individuals for striped dolphins. Approximately 50% of the bottlenose dolphins' groups had at least one sub adult, yet sub adult groups were also recorded with a maximum group size of six. Striped dolphins were also recorded with sub adults in 20% of the recordings, with the number of sub adults ranging from 1 to 10 in a group.

Focal group scan sampling of bottlenose dolphins revealed that the dominant behaviour recorded in Montenegro was diving, forming 35% of the total recordings, followed by travelling behaviour, making up 26% of recordings. Bow-riding was the least reported behaviour when combined with interaction with marine vessels formed 3% of the total recordings, which is equal to the reported resting behaviour (Figure 6).

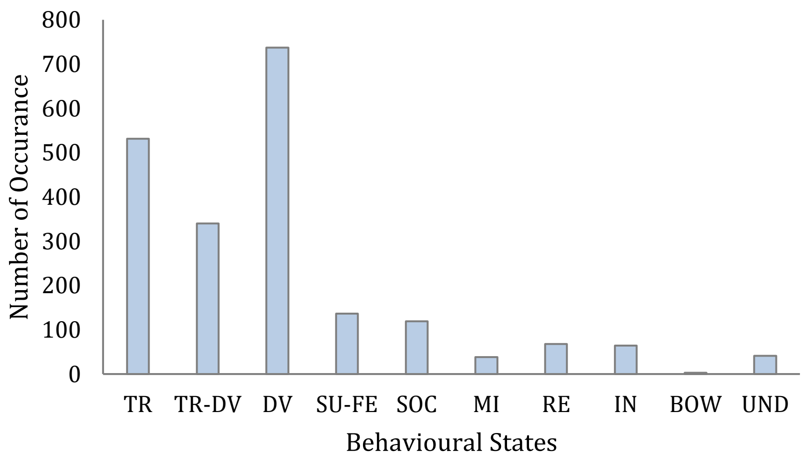


Figure 6. The behavioural variation of bottlenose dolphins in Montenegro.

Striped dolphins also showed similar behavioural patterns with diving forming 22% of the reported behaviours followed by traveling (19%), travel-diving (18%) and surface feeding (16%). Bow-riding was once again the least recorded behaviour (Figure 7).

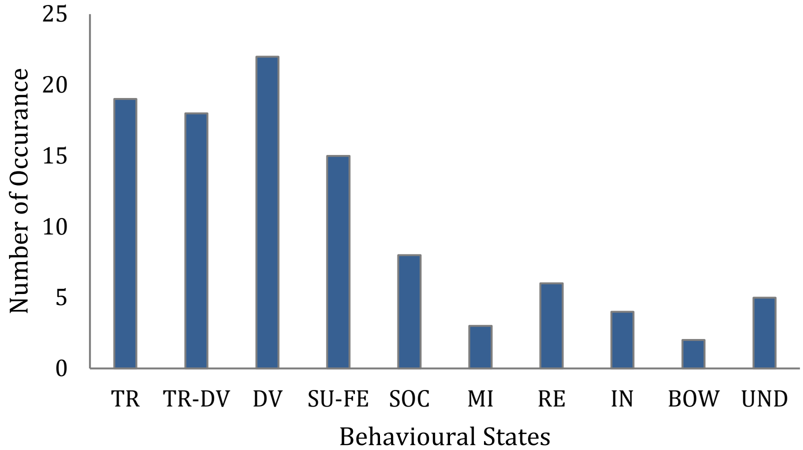


Figure 7. The behavioural variation of striped dolphins in Montenegro.

When the effect of year and season on behaviours was considered, bottlenose dolphins showed similar patterns between years. Each year, either diving or traveling was the most dominant behaviour. Similarly, either resting or milling was one of the least recorded behaviour, except in 2017 where dolphins engaged in relatively more resting. Further, interaction with boats was highest in 2018 (Table 5).

Table 5. Behavioural variation of bottlenose dolphins per year in Montenegro.

Years	**Behavioural States**									
	TR	TR-DV	DV	SU-FE	SOC	RE	MI	IN	BOW	UND
2016	42	23	51	23	18	4	5	0	0	0
2017	197	128	164	26	18	52	13	14	1	7
2018	130	57	228	34	28	8	4	50	2	10
2019	103	25	90	44	25	1	3	0	0	17
2020	32	35	102	6	29	1	3	0	0	6
2021	17	82	102	3	1	2	10	0	0	1
Total	521	350	737	136	119	68	38	64	3	41

Season also showed a similar pattern on behavioural variations in bottlenose dolphins in Montenegro, with diving and travelling being the most dominant behaviour recorded. However, travel-diving, diving and interaction with boats showed a considerable increase in Spring, whereas socialising behaviour was highest in autumn (Table 6).

Table 6. Seasonal behavioural variation of bottlenose dolphins in Montenegro.

Seasons	Behavioural States									
	TR	TR-DV	DV	SU-FE	SOC	RE	MI	IN	BOW	UND
AUTUMN	146	53	171	27	62	36	16	4	1	6
SPRING	130	168	274	43	8	6	14	30	0	12
SUMMER	148	64	162	20	32	23	4	16	1	17
WINTER	107	55	130	46	17	3	4	14	1	6
Total	531	340	737	136	119	68	38	64	3	41

Individual Identification of Bottlenose Dolphins

Photo-identification results were only based on the data collected between 2016 and 2019, as photographs collected in 2020 and 2021 are still being processed for the identification of individuals. Overall, 83 days of boat surveys between 2016 and 2019 were embedded in the photo-identification study, resulting in the identification of 80 well-marked bottlenose dolphin individuals catalogued in Montenegro.

Vocalisation Behaviour of Bottlenose Dolphins

Acoustic data on bottlenose dolphins were collected on 8 separate survey days between the 17th of August 2020 and the 9th of April 2021 in the Boka Kotorska Bay. A total of 7:12 hours of acoustic recordings were analysed, with an average of 56 minutes of recording in each acoustic survey. A total of 5:24 hours of dolphin vocalisations were recorded which resulted in the identification of 847 calls, of which 541 belonged to good quality recordings therefore further investigated. During the recordings, both echolocation clicks and tonal calls were recorded in similar proportions with echolocation clicks recorded slightly more, forming 55% of the entire recordings. Of the 467 echolocation clicks, 27% were formed from burst pulses, thus indicating possible foraging activities. Additionally, nine different whistle types were recorded, of which multiloop whistles were the most dominantly recorded whistles making up 39% of whistles, followed by type U which made up 29% of whistles. Less than 3% of the recordings involved flat, harmonic and a specific call we termed "grunt" (Figure 8).

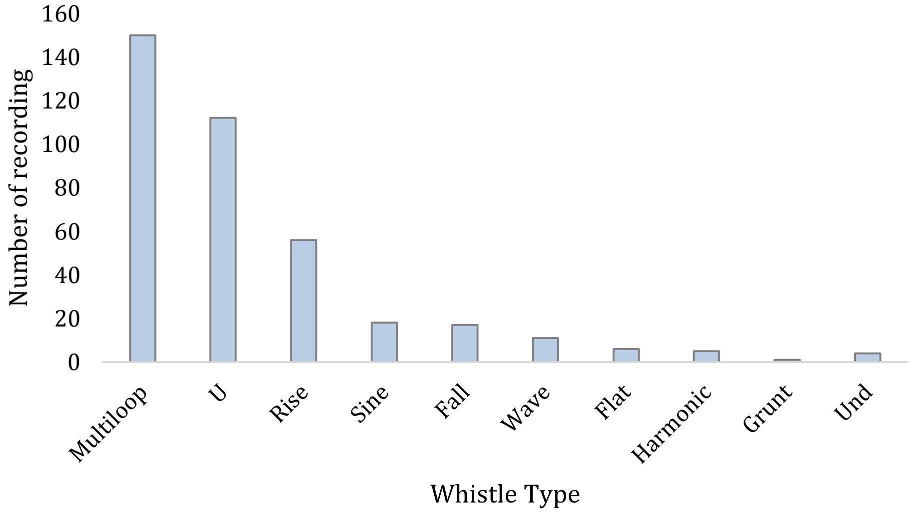


Figure 8. Whistle type of bottlenose dolphins in the Boka Kotorska Bay.

Spatial Distribution of Bottlenose Dolphins

There was no considerable variation in the depth and distance to shore preferences of bottlenose dolphins between seasons (Figure 9). The median depth range was between 36.5 meters in autumn and 40m meters in summer months, with spring and winter showing the same preference to a median of 39m depth. However, the maximum theodolite range covers waters ofa maximum depth of 88m. Therefore, it is important to consider the highly concentrated survey effort in shallow waters and deeper water preference of dolphins might be unnoticed due to the survey methodology. A similar pattern was also recorded when the distance from the nearest coast was considered with the median distance from the nearest coast ranging between 899m (spring) and 1138m (winter).

The core zones of bottlenose dolphins were present within the Boka Kotorska Bay for each season, however the core zone in Petrovac was only present in winter months and they were present for spring and autumn for Bar. Utjeha had core zones only in colder months (autumn and winter) while Ulcinj had it for summer and autumn.

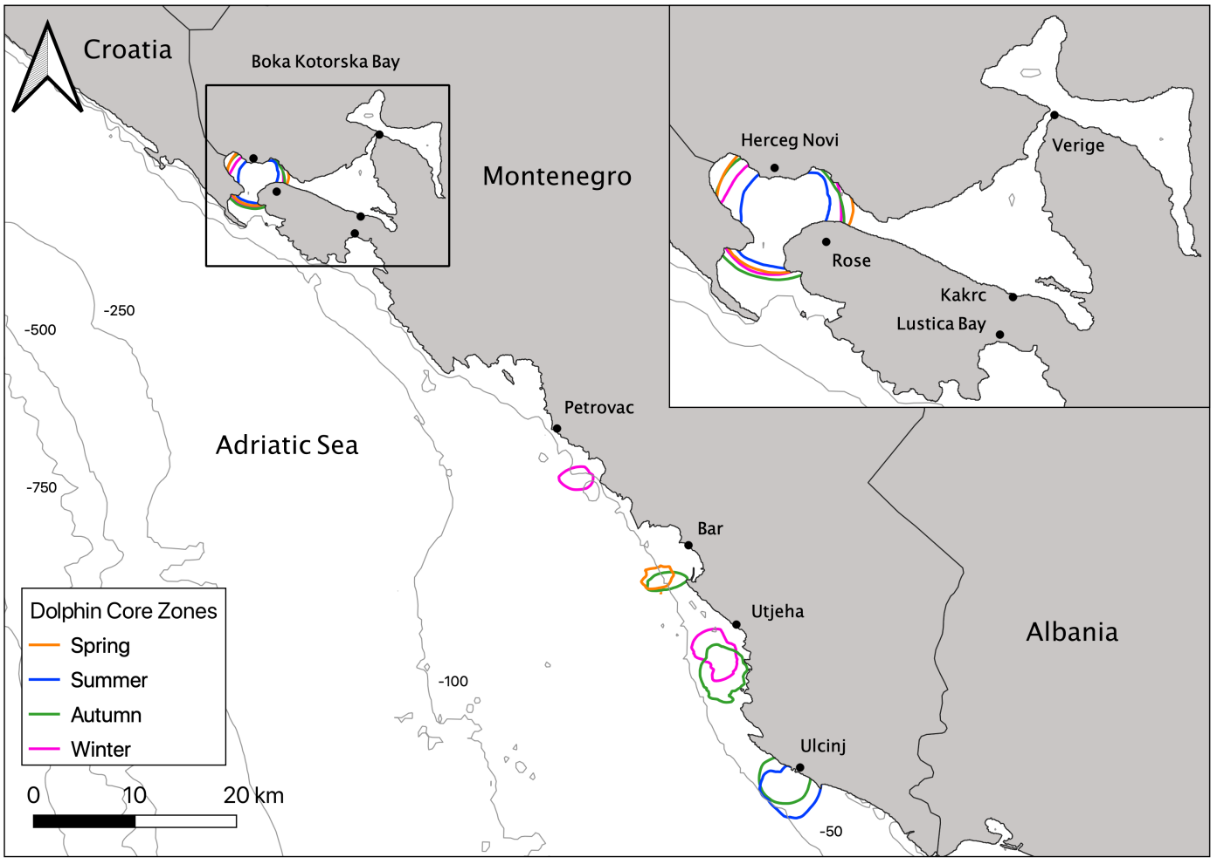


Figure 9. Bottlenose dolphin core zones in Montenegrin waters per season.

Next, variation between years was compared. The coastal waters of Bar, Utjeha and Ulcinj contained core zones in 2016, 2017, 2018 and 2020. The entrance of Boka Kotorska Bay contained core zones in 2018, 2019 and 2020. A single core zone was identified further into Boka Kotorska Bay in 2021 (Figure 10). In 2016 and 2017, survey efforts were skewed to the southern section of Montenegro (43 of the 51 surveys in 2016 and 123 of the 192 surveys in 2017), due to DMAD being based in Ulcinj and in Bar in 2016 and 2017 respectively. This explains the absence of core zones in the other sections of Montenegro. The presence of a single core zone in Boka Kotorska Bay in 2021 is directly related to the highly skewed survey effort to the northern section of Montenegro due to the travel restrictions during the COVID19 period (52 of the 53 surveys).

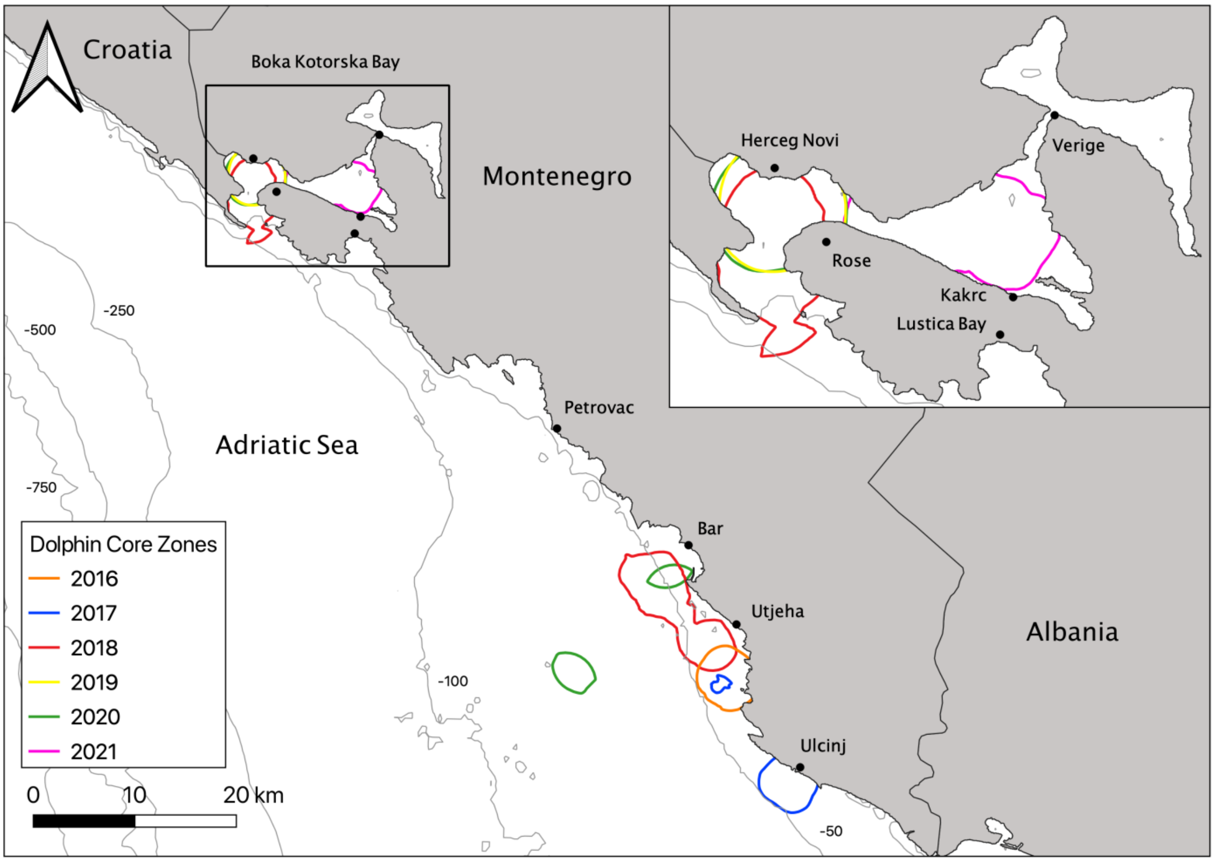


Figure 10. Bottlenose dolphin core zones in Montenegrin waters per year.

When the general core zones of bottlenose dolphins were mapped with the entire dataset between 2016 and 2021, the entrance of Boka Kotorska Bay and later the coastal waters of Bar, Utjeha and Ulcinj stood out in the entire country (Figure 11).

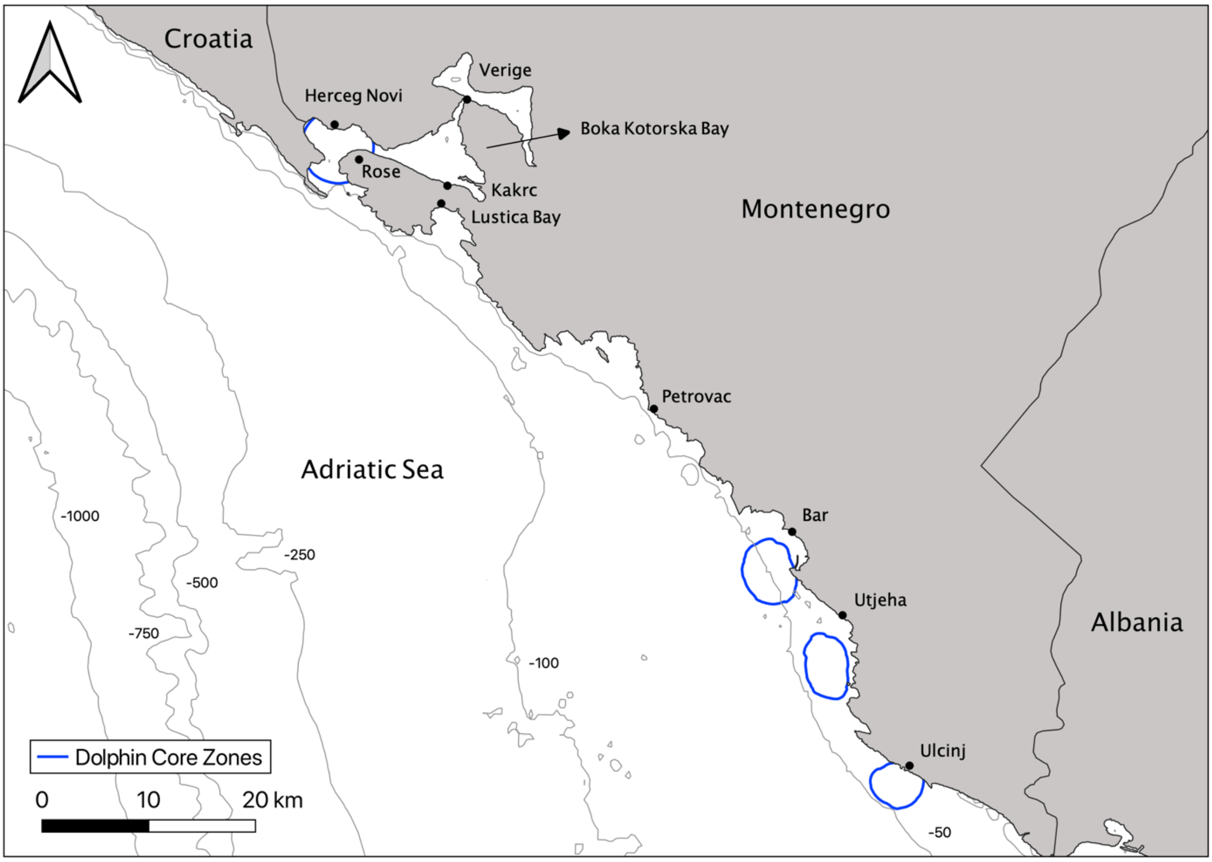


Figure 11. General bottlenose dolphin core zones in Montenegrin waters.

To visualize the impact of marine traffic on bottlenose dolphin distribution, maps were created showing the general dolphin core zones and the density of the different types of marine traffic (Figure 12). The total marine traffic showed the strongest overlap with the dolphin core zones in the coastal waters of Bar and in the entrance of Boka Kotorska Bay. The strongest overlap with the different types of marine traffic was then identified.

- Tourism: in the entrance of Boka Kotorska Bay and in the coastal waters of Bar
- Small fishing: in the coastal waters of Bar and Ulcinj and in the entrance of Boka Kotorska Bay
- Big fishing: in the coastal waters of Bar
- Transport: in the entrance of Boka Kotorska Bay
- Large ships: in the coastal waters of Bar

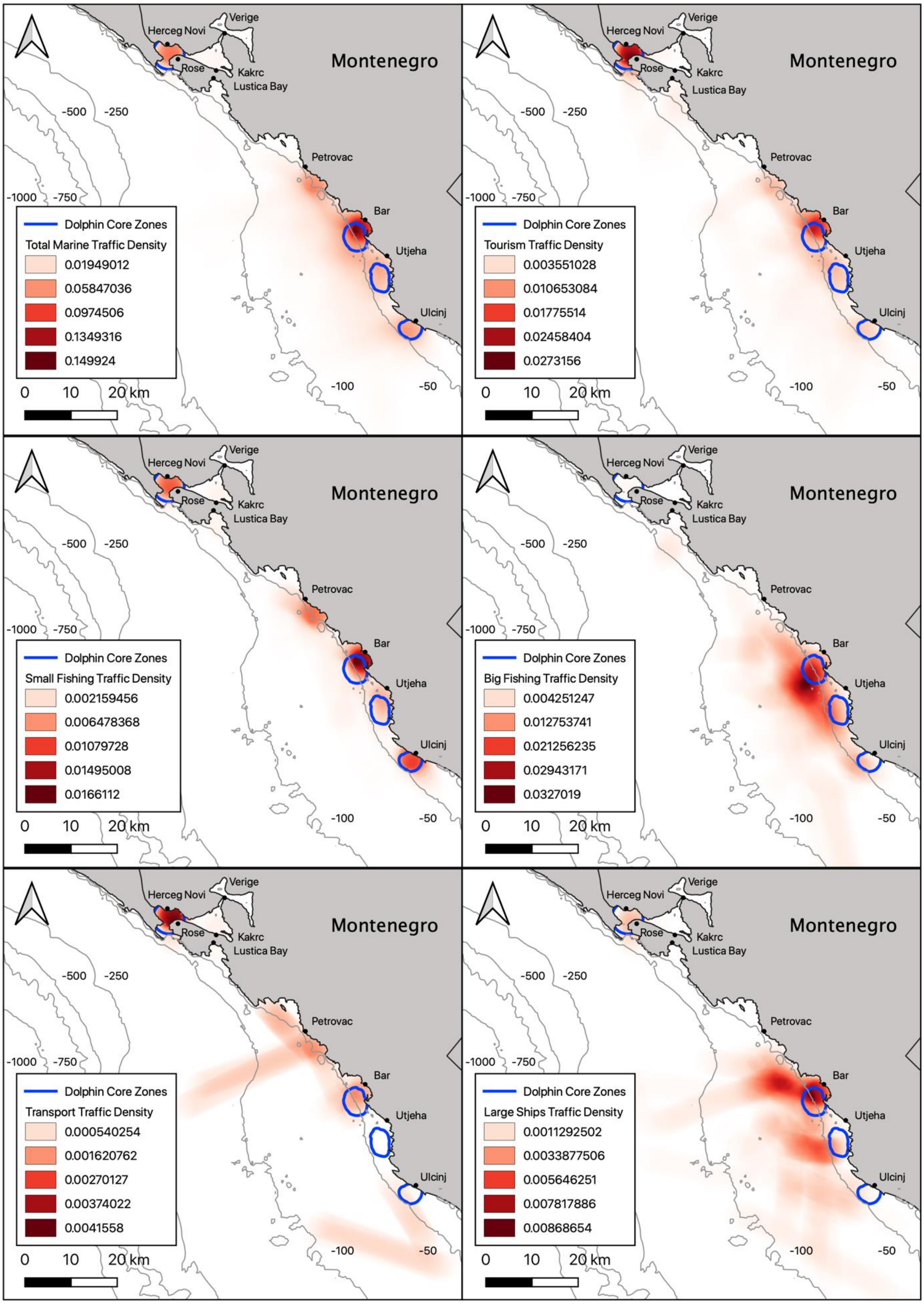


Figure 12. Overlap between general dolphin core zones and marine traffic density.

Finally, a map was created to show the impact of seismic activities on bottlenose dolphin distribution (Figure 13). An overlap was shown in the coastal waters of Utjeha and Bar.

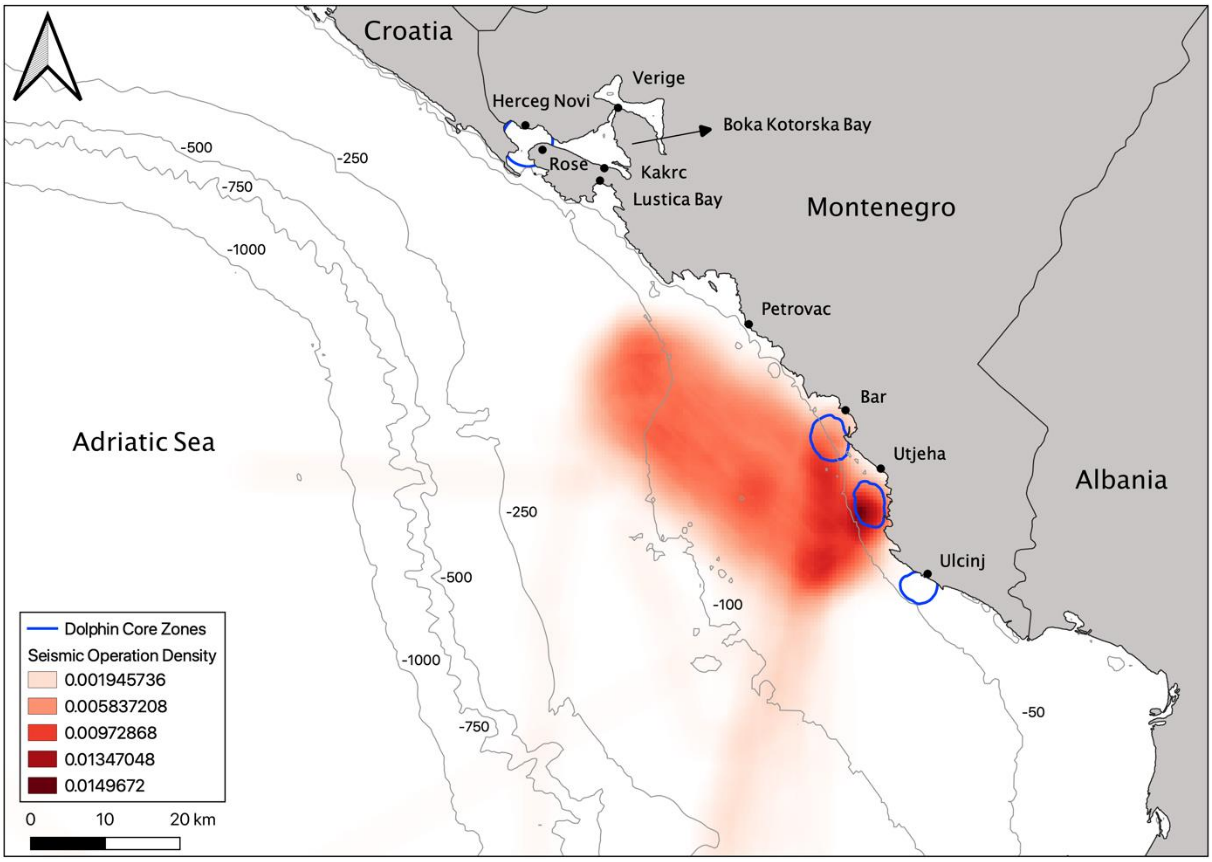


Figure 13. Overlap between general dolphin core zones and seismic operation density.

4. Enhancing Local Ecological Knowledge

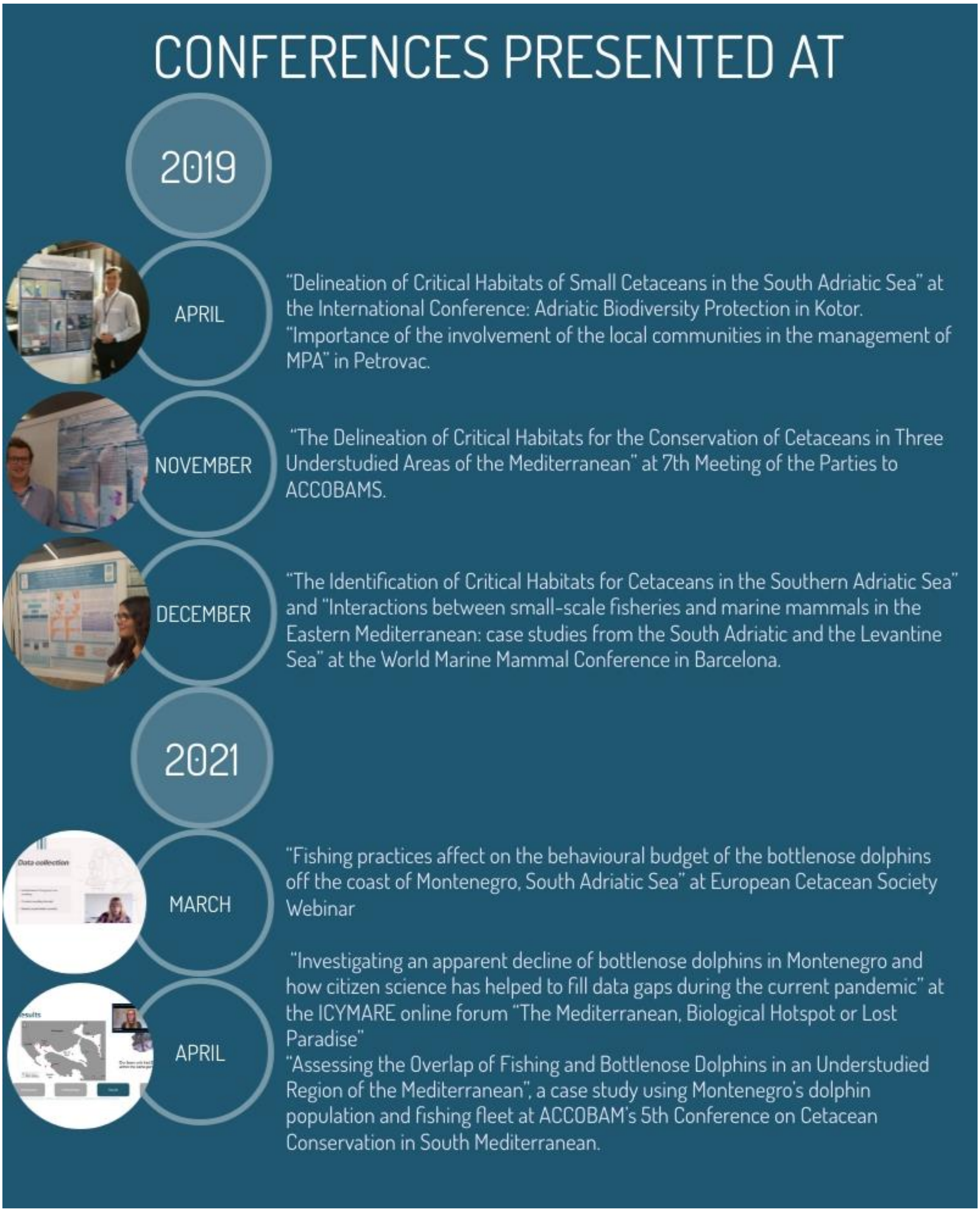
From January 2019 to May 2021, we performed various public outreach activities, from beach clean ups to presentations in schools and scientific outreach workshops (Picture 1, Picture 2). In 2020 and 2021 due to the COVID-19 pandemic we were mostly prevented from organising public outreach events. However, we quickly adapted to the situation by creating free QGIS lessons on YouTube and the kids' corner on our website with craft and recycling ideas and gave online presentations.

Picture 1. Public outreach activities during 2019.

Picture 2. Public outreach activities during 2020 and 2021.

5. Conferences and workshop presentations

In the time frame from 2019 to 2021, the Montenegro dolphin research team attended in total 3 conferences, 2 workshops, 1 meeting with ACCOBAMS (Picture 3). Due to COVID-19 the 2020 conferences were online or cancelled. The team did 4 presentations at online conferences.



Picture 3. Conference and workshop presentations during 2019 and 2021.

6. DMAD'S Reach

DMAD has had a global reach since its establishment (Figure 14). Our onsite interns make a huge contribution to DMAD's data collection and analysis. In return we hope that they gain many key skills required for scientific research. This knowledge can then continue to progress and be shared as our interns move on, back in their home countries or wherever their future research takes them.

The COVID-19 pandemic meant restrictions reduced the possibility of onsite interns. During this time, we created our remote internship and to date have had 40 remote interns. We are hoping to continue this alongside our onsite internships as restrictions are lifted, as we have seen the benefit of this more accessible way of learning to those who for whatever reason are unable to join us in person.

Finally, we are thrilled to see how many people have viewed our free online GIS (Geographical Information System) courses (56,000 so far) and the number of countries it has reached. The aim of these was to minimise the disruption to learning that was brought about by the pandemic. However, this has reached further than we could have imagined and although we are a small NGO, we are pleased with how these free courses have increased the accessibility and would encourage those that are able to, to do the same.

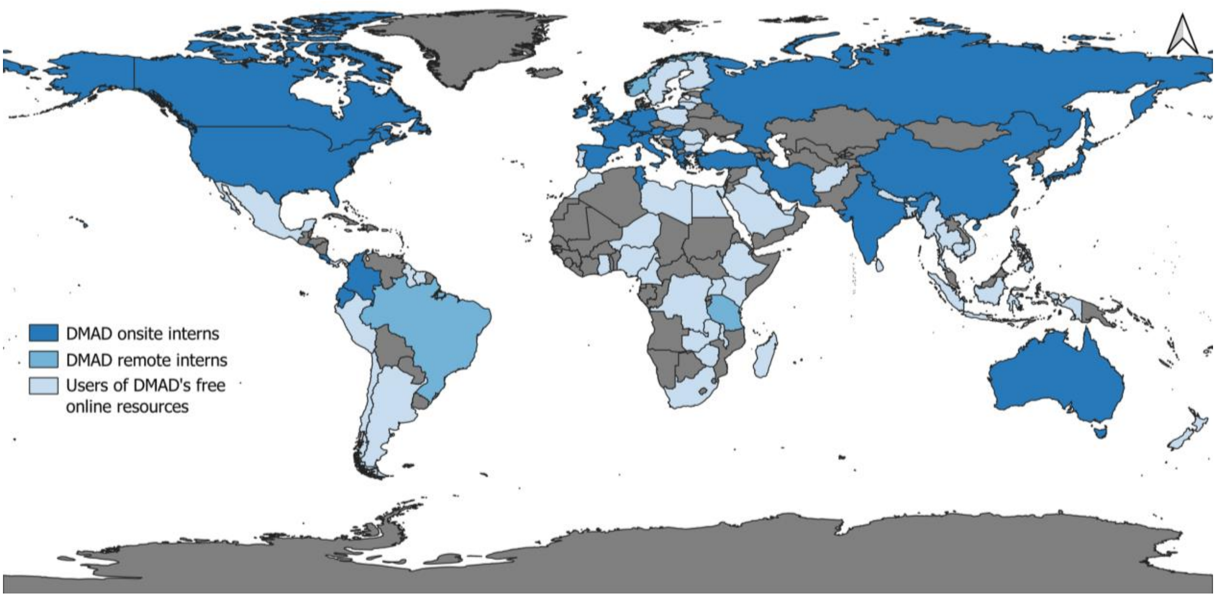


Figure 14. DMAD's Reach: Where our interns (onsite and remote) are from and Countries our free online GIS courses have been viewed.

7. Discussion

Since 2016, Montenegro has conducted dedicated cetacean surveys. The ongoing survey efforts of Montenegro Dolphin Research (MDR) has generated species baseline knowledge and the identification of critical habitats. The gained knowledge has come from the collection and analysis of 699 days of survey effort, equating to land and boat surveys having been conducted on just over 40% of days in the nearing five-year study period. Further, despite a tendency for cetacean surveys to be highly skewed to the warmer seasons in the Mediterranean, the current research had a similar survey effort in each season, allowing an understanding of the seasonal variation in dolphin sightings as well as the effect of season on the behavioural patterns of the species.

Two species of delphinids were encountered during the five years of survey effort. Bottlenose dolphins were the most common coastal cetacean species in Montenegro, responsible for 95% of the encounters while striped dolphins only made up 5% of encounters. It is known that bottlenose dolphins are the only cetacean species regularly sighted in the Adriatic (Bearzi et al., 2008; Bearzi, Notarbartolo Di Sciara, 1995; Notarbartolo Di Sciara et al., 1993). The Adriatic Sea previously held an important ground for common dolphins, which was the most common species of the basin up until the mid-19th century, but in the late 1970s, the abundance of the species decreased (Pilleri, Gihr, 1977) and common dolphins are now considered locally extinct (UNEP-MAP-RAC/SPA, 2014). Despite the relatively high survey effort of MDR, the species wasn't encountered in Montenegrin waters. It is important to bear in mind that the majority of the survey effort of the current research was coastal, leaving a gap in knowledge regarding species distribution in the offshore waters.

Even though only two delphinid species were sighted during the coastal research effort, it is more than plausible that other cetaceans are abundant in the deeper waters. This may explain the low number of sightings for striped dolphins, as the species is known to show offshore preferences in the Mediterranean Sea (Aguilar, 2000). Furthermore, the Adriatic Pit has previously been identified as an important habitat for cetaceans with the regular presence of 8 cetacean species (Holcer et al., 2014). To understand the species presence and distribution within the South Adriatic, it is vital that the research effort should include both coastal and offshore waters. Each species present in Montenegro and in the Adriatic Pit, is classified as either vulnerable, threatened or data deficient by the IUCN Red List (Aguilar, Gaspari, 2012; Bearzi et al., 2012; Cañadas, 2012: Gaspari, Natoli, 2012; Notarbartolo di Sciara et al., 2012; Panigada, Notarbartolo di Sciara, 2012). Cetaceans are not only important species themselves but also have critical roles in ecosystem balance and are often an indication of a healthy habitat (Bowen, 1997; Bunke et al., 2008; Goedegebuure et al., 2017). Therefore, understanding the presence, distribution and population statuses of these species in a country and its neighbouring waters plays a critical role in protecting not just the species but also the marine environment as a whole. Montenegro, being the first ecological country of the Mediterranean Sea, has identified the cetaceans to be protected (Constitution of Montenegro, Article 1, 2007; UNEP-MAP-RAC/SPA, 2014). For this reason, the research efforts on these species are critical to form accurate and effective in-situ conservation strategies.

Current research indicates that the coastal waters of Montenegro have year-round presence of bottlenose dolphins with each season revealing a similar number of sightings. Despite striped dolphins mostly being sighted in summer and autumn, conclusions regarding their seasonality cannot be drawn from the current data due to the low survey effort in offshore waters. According to the previous studies in the Adriatic Sea, bottlenose dolphins show year-round presence in the area, however, their distribution range changes depending on the season. Especially in the summer, where a displacement of cetacean populations was recorded, possibly due to the higher number of marine traffic in the area (Awbery et al., 2019a; Bearzi et al., 1997; Rako et al., 2013). Other previous studies show that there is no clear seasonal distribution and long-distance movements recorded in the North-eastern Adriatic (Ribarič, 2018; Velike, 2009). Exchange of photo ID data between the NGO's and institutes of the Adriatic seas is highly recommended, this way the seasonal distribution and long-distance migration can be researched.

Factors affecting seasonal variation are prey distribution (Torres et al., 2005) and hydrological variables, such as oxygen saturation, water temperature, density anomaly, gradient of density anomaly, turbidity, distance from the nearest coast and depth (Bearzi et al., 2008). Changes in prey distribution due to these hydrological variables should be reflected in changes in dolphin distribution. However, no seasonal variation was observed for bottlenose dolphin distributions in Montenegro. The lack of variation is likely explained by the survey areas that are mostly limited to waters close to shore. Land surveys focus on the first few kilometres of the coastal waters and boat survey distances are limited by the type of boat, operation costs and time. Further research in a larger area is therefore necessary to fully investigate the effects of prey distribution and hydrological variables in Montenegro, where marine traffic greatly varies seasonally due to tourism. Even so, no detected seasonal variation for the bottlenose dolphins in Montenegro highlights the yearly importance of the country's neritic waters for this vulnerable species.

However, when the sightings in each year were investigated, there appeared to be a worrying decline from a 49% sighting rate in 2016 to 24% in 2019. An interesting point is that bottlenose dolphins showed a steady increase since 2020 with the sighting rates reaching up to 46% by 2021 which the timeframe intersects with the global epidemic, COVID-19. COVID-19 pandemic reached Montenegro by 2020 with a continued presence in 2021. Research continued to be conducted throughout the pandemic duration, only stopping effort during lockdowns. These lockdowns also indirectly minimised the human activities in the marine environment. MDR documented an average of 61 vessels in the presence of dolphins per survey pre-COVID19 time (between 2016 and 2019), this halved to 29 vessels per survey during the COVID19 pandemic (2020 and 2021). Marine traffic can have direct and indirect negative impacts on cetaceans, including disruption of the prey distribution, noise and chemical pollution, and collisions (Bilandžić et al., 2012; Cardellicchio, 1995; Rako et al., 2013; Waereebeek et al., 2007). These negative impacts could cause temporary or permanent habitat displacement, behavioural alterations, injuries and in some cases mortalities (Bas et al., 2017; Peltier et al., 2019; Rako et al., 2013). While the reason behind this striking variation on the bottlenose dolphins' sightings within the last five years in Montenegro could be credited to the natural causes, the fluctuation in the intensity of human pressure should not be ignored. Despite the damaging consequences of the COVID-19 pandemic on human populations, it created research opportunities to understand what happens when human pressure in the marine environment is reduced. Our research effort documented a rapid increase in the sightings of bottlenose dolphins in the Boka Kotorska Bay when indeed the marine traffic density was comparably lower than the previous years.

Despite the increase in the sighting rate on bottlenose dolphins within 2020 and 2021, average number of individuals in a group was similar with three individuals in each year, except 2016 and 2021 with an average group size of four and two respectively. The recorded group sizes of bottlenose dolphins are notably low in Montenegro. Bottlenose dolphins tend to form smaller groups between seven to 12 individuals in the Mediterranean Sea (e.g. Carlucci et al., 2016; Forcada et al., 2004; La Manna et al., 2020), and a survey of the entire Adriatic reported a mean value of 6.5 individuals per group (Fortuna et al., 2011). The average group size of the species is recorded as 9.27, 7.4 and 5.73 to 7.46.in three different Croatian waters regions (Bearzi et al., 1997; Pleslić et al., 2020; Ribarič, 2018), which is relatively higher than the ones in Montenegro. Bottlenose dolphins have been previously recorded with an average group size of 3.87 within the South Adriatic Sea (UNEP-MAP-RAC/SPA, 2014) and a preliminary study in Albania reported a mean group size of 2.81 (Awbery et al., 2019b). The species are categorized as "vulnerable" in the Mediterranean Sea and the reported group sizes have shrunk within the last decades (IUCN, 2012) that highlights the necessities of immediate conservation and mitigation actions within Montenegro.

Group size and behaviour has previously been found to be linked to one another (Shane et al., 1986). While dolphins tend to have larger group sizes during feeding, socialising and resting activities, they have found to be smaller during travelling and diving (Affinito et al., 2019; Rogers et al., 2004). The dominant behaviour in each year and season was diving followed by travelling in Montenegro. Therefore, the low group size during travelling activities overlaps with the previous information, yet the documented group size in Montenegro is still comparably low for a traveling group. Diving behaviour is known to be linked to foraging activities or even vertical avoidance strategies to the human impacts (Bas et al., 2017; Clarkson et al., 2020; Vermeulen et al., 2015). When acoustic behaviour was complemented by the visual data, a high number of echolocation clicks and burst pulses were recorded during the diving activity. This information can indicate that instead of group foraging techniques, bottlenose dolphins tend to develop individual foraging strategies as the low group sizes might complicate the group foraging behaviour. Therefore, diving behaviour is likely to indicate the foraging techniques of the bottlenose dolphins, specifically in the Boka Kotorska Bay. Travelling was also the second most recorded behaviour of the dolphins. This suggests that the country does not only hold foraging habitats but also the migration corridors within and possibly between countries. Knowing that 80 individuals of bottlenose dolphins have already been identified in Montenegro with transient individuals being the most dominant residency type, transboundary research between the Adriatic countries should be the main approach in understanding the home range of the species which will eventually lead us to the development of effective strategies.

When the spatial-temporal distribution of bottlenose dolphins was mapped, bottlenose dolphins revealed the presence of year-round core zones in Boka Kotorska Bay which highlights the importance of this specific location for the bottlenose dolphin populations of Montenegro. It is also important to point out that the southern sections between Bar and Ulcinj showed autumn dominant core zones within their coastlines. Seasonal variations in area preference pose an importance consideration in the development of conservation strategies and increase its impact zone. Therefore, the results of this report have to be considered carefully and should be included in the development of future protection strategies.

Additionally, when the annual variation of the core zones was under the scope, Boka Kotorska Bay once again stands out with its importance not only within the year but also between the years. Yet, in 2016 and 2017 the entrance of Boka Kotorska Bay did not have a core zone due to the low number of survey efforts. Back then, DMAD was located in Ulcinj and Bar respectively and therefore fewer surveys were organised in Boka Kotorska Bay (1 of the 51 surveys in 2016 and 30 of the 192 surveys in 2017). Therefore, the absence of core zones in this specified location is only the result of biased survey effort to the southern waters, rather than reflecting the actual preferences of dolphins.

When the entire dataset between 2016 and 2021 was pooled, the total spatial distribution of the bottlenose dolphins in Montenegro revealed a high-density presence once again in the Boka Kotorska Bay, followed by the neighbouring waters of Bar, Utjeha and Ulcinj.

Regarding the marine traffic density, Bar holds the highest density within its waters, followed by the Boka Kotorska Bay. However, the same locations are also identified as core habitats for bottlenose dolphins due to the high species sighting rates. In an additional pressure, seismic activities for oil and gas exploration take place in the waters immediately off Utjeha and Bar which again shows area overlap with the dolphin core habitats. The identification of these overlapping zones with human activities that are proven to have direct and indirect negative impacts on the threatened species, alters them as “critical habitats” for protection. Montenegro became the first ecological country, declared by Parliament of the Republic of Montenegro in 1991 (Government of Montenegro, 2011). The same country is also under negative pressures from unrestrained human activities. Habitat destruction takes place not only in the coastal waters for unregulated and clustered tourism development but also in the deeper waters during drilling operations for oil and gas exploration. The steep increase in the presence of cruise ships, luxury yachts, and jet skis during the tourism season (summer months) add an additional concentrated pressure through marine traffic with consequences including increased amounts of marine debris and beach litter (da Silva, 2018; Galangi, 2014). All the above pressures have direct and indirect consequences to the marine environment (da Silva, 2018), including the marine top predators. Acknowledging the importance of travel and tourism to Montenegro's economic growth, ecologically responsible human activities will not only protect its wildlife but also unlike the rapid and short-term beneficial tourism practices, well-structured ecotourism increases the economic growth further.

Montenegro Tourism Development Strategy 2020 stated that:

"….our challenge - a challenge that this strategy is designed to address – is not just to continue this growth, but rather to assure that it is growth which is sustainable, balanced and which brings both immediate and long term benefits to the people of Montenegro, while protecting and preserving the natural assets that are the engine of tourism growth in the first place. This we must do, and this we are doing."

"Commitment to sustainable development is not just a matter of respecting ethical principles. The values protected in this way - landscape, nature, culture and lifestyles - also make up the basic capital of the tourism industry. The more attractive they are as experiences for the market, the better the prospects of success for the whole industry and all allied sectors."

As the Strategy summarises, despite the current unregulated and uncontrolled trend on the mass coastal development, sustainable eco-tourism activities will be the most beneficial to the resources and the economic growth of the country.

Montenegro holds critical habitats for bottlenose dolphins throughout its coastline from Boka Kotorska Bay to Ulcinj that provide foraging, nursing grounds and migration corridors. Further, its offshore waters are home to not only offshore delphinid species, such as striped dolphins, but also deep-divers such as sperm whales, Cuvier's beaked whales and one of the least known species of the Mediterranean Sea, Risso's dolphins. The same deep-sea habitat that holds high marine biodiversity is also currently under the heavy threat of loud, impulsive and continuous noise of seismic and drilling operations. Despite the presence of several important habitats of dolphins, the decline in sighting rate, coupled with low group sizes must be taken into consideration. It is imperative that conservation strategies are implemented urgently in both coastal and offshore waters, to ensure the survival of Montenegro's cetaceans and indeed its entire marine environment.

9. Acknowledgements

We would like to thank all of the on-site and remote interns and volunteers of DMAD-Marine Mammals Research Association, both present and past as without their continued support, this project wouldn't be possible. Rufford Small Grants have been the main financial support of this project and they have played a fundamental role in the implementation of Montenegro Dolphin Research and its continued existence.

We want to thank everyone who sent us information and pictures/videos when they had sightings of dolphins in the Kotor Bay or along the coastline. This really helped with collecting data when we were unable to collect it due to COVID-19.

An additional thank you goes to all the Montenegrin captains that have taken us out in their boats over the last years. A special thanks to Fiona and Dave who helped us with lending their boat.

We are grateful that we made new collaborations and friends this last year, which helped us in connecting with the local inhabitants. This is why we decided to continue our research in Crna Gora!!

Together we are DMAD

10. References

Abgrall, P., Moulton, V.D., Richardson, W.J. and Department of Fisheries and Oceans, Ottawa, ON(Canada); Canadian Science Advisory Secretariat, Ottawa, ON(Canada), 2009. *Updated Review of Scientific Information on Impacts of Seismic Survey Sound on Marine Mammals 2004-present*. Canadian Science Advisory Secretariat= Secrétariat canadien de consultation scientifique, pp.1-72.

ACCOBAMS, 2021. Estimates of abundance and distribution of cetaceans, marine mega-fauna and marine litter in the Mediterranean Sea from 2018-2019 surveys. By Panigada S., Boisseau O., Canadas A., Lambert C., Laran S., McLanaghan R., Moscrop A. Ed. ACCOBAMS - ACCOBAMS Survey Initiative Project, Monaco, 177 pp.

Affinito, F., Meza, C.O., Bas, A.A., Brill, D., Whittaker, G. and Capel, L., 2019. On the behaviour of an under-studied population of bottlenose dolphins in the Southern Adriatic Sea. *Journal of the Marine Biological Association of the United Kingdom*, *99*(4), pp.1017-1023.

Aguilar, A., 2000. Population biology, conservation threats and status of Mediterranean striped dolphins(Stenella coeruleoalba). *J. Cetacean Res. Manag.*, *2*(1), pp.17-26.

Aguilar, A. and Gaspari, S., 2012. Stenella coeruleoalba (Mediterranean subpopulation). *The IUCN Red List of Threatened Species, 1,* p. 2012:e.T16674437A16674052. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16674437A16674052.en. Downloaded on 27 November 2018.

Antica, G., Huber, Đ. and Gomerčić, H., 1994. Public survey on the state of Mediterranean monk seal (Monachus monachus, Hermann) in the Croatian part of the Adriatic Sea. In *Proceedings of Abstracts of the Papers of the Fifth Congress of Croatian Biologists, Pula, Croatia*.

Arcangeli, A., Crosti, R., del Leviatano, A. and Rome, I., 2009. The short-term impact of dolphin-watching on the behaviour of bottlenose dolphins (Tursiops truncatus) in western Australia. *Journal of Marine Animals and their Ecology*, *2*(1), pp.3-9.

Artegiani, A., Paschini, E., Russo, A., Bregant, D., Raicich, F. and Pinardi, N., 1997. The Adriatic Sea general circulation. Part II: baroclinic circulation structure. *Journal of physical oceanography*, *27*(8), pp.1515-1532.

Awbery, T., Nikpaljevic, N., Clarkson, J., Abbiss, L., van der Pouw Kraan, D., Liebig, P., Todorovic, S. and Baş, A.A. 2019a Bottlenose and striped dolphins of Montenegro: an insight into sighting variations, behavioural patterns, photo-identification, core habitats, marine traffic and conservation initiatives (2017–2018). Annual Report of Montenegro Dolphin Research, DMAD, Antalya.

Awbery, T., Akkaya, A., Clark, H., Nikpaljevic, N., Abbiss, L., Clarkson, J., Hardy, J., Guimard, E., Beqiri, K., Konomi, A., Rudd, L., Basmaci, M. and Bakiu, R., 2019b. The Identification of Critical Habitats for Cetaceans in the Southern Adriatic Sea. [Poster] World Marine Mammal Conference. 9th -12th December 2019, Barcelona.

Awbery, T., Rudd, L. and Akkaya, A., 2021. Assessing the Overlap of Fishing and Bottlenose Dolphins in an Understudied Region of the Mediterranean. 5th Conference on Cetacean Conservation in South Mediterranean Countries, April 2021, Lebanon [online].

Azzolin, M., Arcangeli, A., Cipriano, G., Crosti, R., Maglietta, R., Pietroluongo, G., Saintingan, S., Zampollo, A., Fanizza, C. and Carlucci, R., 2020. Spatial distribution modelling of striped dolphin (Stenella coeruleoalba) at different geographical scales within the EU Adriatic and Ionian Sea Region, central-eastern Mediterranean Sea. *Aquatic Conservation: Marine and Freshwater Ecosystems, 30*(6), pp.1194-1207.

Barry, S.B., Cucknell, A.C. and Clark, N., 2012. A Direct Comparison of Bottlenose Dolphin and Common Dolphin Behavior During Seismic Surveys When Air Guns Are and Are Not Being Utilized. In *The effects of noise on aquatic life* (pp. 273-276). Springer, New York, NY.

Bas, A.A., Christiansen, F., Öztürk, B., Öztürk, A.A., Erdoğan, M.A. and Watson, L.J., 2017. Marine vessels alter the behaviour of bottlenose dolphins Tursiops truncatus in the Istanbul Strait, Turkey. *Endangered Species Research*, *34*, pp.1-14.

Bas A.A., Affinito, F., Martin, S., Vollmer, A., Gansen, C., Morris, N., Frontier, N., Nikpaljevic, N. and Vujović A. 2018 Bottlenose dolphins and Striped dolphins: Species distribution, behavioural patterns, encounter rates, residency patterns and hotspots in Montenegro, South Adriatic. *Montenegro Dolphin Project Annual Report.*

Bearzi, G. and Notarbartolo di Sciara, G., 1995. A comparison of the present occurrence of bottlenose dolphins, Tursiops truncatus, and common dolphins, Delphinus delphis, in the Kvarneric (northern Adriatic Sea). Annales (Annals for Istrian and Mediterranean Studies). 7. pp.61-68.

Bearzi, G., Notarbartolo di Sciara, G. and Politi, E., 1997. Social ecology of bottlenose dolphins in the Kvarnerić (northern Adriatic Sea). *Marine mammal science*, *13*(4), pp.650-668.

Bearzi, G., Politi, E. and di Sciara, G.N., 1999. Diurnal Behavior of Free-Ranging Bottlenose Dolphins in the Kvarnerić (Northern Adriatic Sea) 1. *Marine Mammal Science*, *15*(4), pp.1065-1097.

Bearzi, G., 2002. Interactions between cetacean and fisheries in the Mediterranean Sea. *Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies. A report to the ACCOBAMS Secretariat, Monaco*, *9*, p.20.

Bearzi, G., Holcer, D. and Notarbartolo di Sciara, G., 2004. The role of historical dolphin takes and habitat degradation in shaping the present status of northern Adriatic cetaceans. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *14*(4), pp.363-379.

Bearzi, G., Azzellino, A., Politi, E., Costa, M. and Bastianini, M., 2008. Influence of seasonal forcing on habitat use by bottlenose dolphins Tursiops truncatus in the Northern Adriatic Sea. *Ocean Science Journal*, *43*(4), pp.175-182.

Bearzi, G., Fortuna, C.M. and Reeves, R.R., 2008. Ecology and conservation of common bottlenose dolphins Tursiops truncatus in the Mediterranean Sea. *Mammal Review*, *39*(2), pp.92-123.

Bearzi, G., Fortuna, C. and Reeves, R. 2012. Tursiops truncatus Mediterranean subpopulation. *The IUCN Red List of Threatened Species* 2012: e.T16369383A16369386. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16369383A16369386.en. Downloaded on 27 November 2018.

Bernal, M., Breuil, C., Carlson, A., Carpentieri, P., De Rossi, F., Emma, R., Ferri, N., Morello, E., Cruz, E., Nastasi, A., Sessa, M., De Martiis, S., Vannuccini, S., Ulman, A., Ünal, V., Hidalgo, M., Vasconcellos, M., Scougal, C., Arneri, E. and Westlund, L., 2020. The State of Mediterranean and Black Sea Fisheries 2020. 10.4060/cb2429en.

Bigović, M., 2011. Quantifying seasonality in tourism: a case study of Montenegro. *Academica Turistica: Tourism & Innovation Journal*, *4*(2), pp.15-32.

Bilandžić, N., Sedak, M., Đokić, M., Gomerčić, M.Đ., Gomerčić, T., Zadravec, M., Benić, M. and Crnić, A.P., 2012. Toxic element concentrations in the bottlenose (Tursiops truncatus), striped (Stenella coeruleoalba) and Risso's (Grampus griseus) dolphins stranded in Eastern Adriatic Sea. *Bulletin of environmental contamination and toxicology,* 89(3), pp.467-473.

Blue World Institute, 2018. *Obični dupini ponovo u Jadranu | Institut Plavi svijet*. [Online] Available at: https://www.plavi-svijet.org/obicni-dupini-ponovo-u-jadranu/ [Accessed 30th of November 2018].

Bowen W. D., 1997. Role of marine mammals in aquatic ecosystems. *Marine ecology progress series, vol.158*, pp.267-274.

Bunke, M.,Díaz López, B. and Shiray, J., 2008. The role of bottlenose dolphins in a coastal ecosystem assessed using mass-balanced models. DOI:10.13140/RG.2.2.34485.68323.

Buskovic, V., and Kapa, M. 2010. Fourth National Report of Montenegro to the Convention on Biological Diversity. Podgorica: Ministry of Spatial Planning and Environment.

Campana, I., Crosti, R., Angeletti, D., Carosso, L., David, L., Di-Méglio, N., Moulins, A., Rosso, M., Tepsich, P. and Arcangeli, A., 2015. Cetacean response to summer maritime traffic in the Western Mediterranean Sea. *Marine Environmental Research*, *109*, pp.1-8.

Cañadas, A., 2012. Ziphius cavirostris (Mediterranean subpopulation). The IUCN Red List of Threatened Species 2012: e.T16381144A16382769: http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16381144A16382769.en [Accessed April 2017]

Cardellicchio, N., 1995. Persistent contaminants in dolphins: an indication of chemical pollution in the Mediterranean Sea. *Water Science and Technology*, *32*(9-10), pp.331-340.

Carić, H. and Mackelworth, P., 2014. Cruise tourism environmental impacts–The perspective from the Adriatic Sea. *Ocean & coastal management*, *102*, pp.350-363.

Carlucci, R., Fanizza, C., Cipriano, G., Paoli, C., Russo, T. and Vassallo, P., 2016. Modeling the spatial distribution of the striped dolphin (Stenella coeruleoalba) and common bottlenose dolphin (Tursiops truncatus) in the Gulf of Taranto (Northern Ionian Sea, Central-eastern Mediterranean Sea). *Ecological indicators*, *69*, pp.707-721.

Carrillo, M. and Ritter, F., 2010. Increasing numbers of ship strikes in the Canary Islands: proposals for immediate action to reduce risk of vessel-whale collisions. *Journal of cetacean research and management*, *11*(2), pp.131-138.

CAU, ELARD, ITI., 2015. Strategic Environmental Assessment (SEA) of Hydrocarbon E&P Activities in Offshore Montenegro. Draft Scoping Report. Ministry of Economy, Montenegro.

Ćetković, I., 2018. Composition and abundance of shark by-catch in Montenegrin fisheries.

Christiansen, F., Lusseau, D., Stensland, E. and Berggren, P., 2010. Effects of tourist boats on the behaviour of Indo-Pacific bottlenose dolphins off the south coast of Zanzibar. *Endangered Species Research*, *11*(1), pp.91-99.

Christiansen, F. and Lusseau, D., 2015. Linking behaviour to vital rates to measure the effects of non-lethal disturbance on wildlife. *Conservation Letters, 8*, pp.424–431.

Cimbaljevic, I. and Muratovic, B., 2018. Foreign vessels on cruise (2017), MONSTAT, Montenegro Statistical Office, Vol 49, Iss. 2, p.1-4. Available at: https://www.monstat.org/userfiles/file/turizam/kruzna%20putovanja/2017k/Foreign%20vessels%20on%20cruise%20in%20Montenegro,%20Release%202017.pdf [Accessed 5th of December 2018].

Cimbaljevic, I., 2013. Foreign vessels on cruise (2012).Release no. 70. Statistical Office of Montenegro (MONSTAT), Podgorica

Cimbaljevic, I., 2020. MONSTAT, Foreign Vessels on Cruise (2019). Release no 42/2. Statistical Office of Montenegro., Podgorica. available at: https://www.monstat.org/cg/. [Accessed 5th of July 2021]

Clarkson, J., Christiansen, F., Awbery, T., Abbiss, L., Nikpaljevic, N. and Akkaya, A., 2020. Non-targeted tourism affects the behavioural budgets of bottlenose dolphins Tursiops truncatus in the South Adriatic (Montenegro). *Marine Ecology Progress Series*, *638*, pp.165-176.

Coll, M., Santojanni, A., Palomera, I., Tudela, S. and Arneri, E., 2007. An ecological model of the Northern and Central Adriatic Sea: analysis of ecosystem structure and fishing impacts. *Journal of Marine Systems*, *67*(1-2), pp.119-154.

Coll, M., Piroddi, C., Steenbeek, J., Kaschner, K., Lasram, F.B.R., Aguzzi, J., Ballesteros, E., Bianchi, C.N., Corbera, J., Dailianis, T. and Danovaro, R., 2010. The biodiversity of the Mediterranean Sea: estimates, patterns, and threats. *PloS one*, *5*(8), p.e11842.

Constantine, R., Bunton, D. H., and Dennis, T., 2004. Dolphin-watching tour boats change bottlenose dolphin (Tursiops truncatus) behaviour. *Biological Conservation, 117(3)*, 299-307.

Constitution of Montenegro, Article 1. Ratified 2007. [Online] Available at: https://www.constituteproject.org/constitution/Montenegro_2007.pdf.

Cushman-Rosin, B., Gačić, M., Poulani, P., Artegiani, A. and (Eds). 2001. Physical oceanography of the Adriatic Sea. Past, present and future. Dordrecht: Kluwer Academic Publishers.

da Silva, M.L., Castro, R.O., Sales, A.S. and de Araújo, F.V., 2018. Marine debris on beaches of Arraial do Cabo, RJ, Brazil: An important coastal tourist destination. *Marine pollution bulletin*, *130*, pp.153-158.

Đurovic, M., Holcer, D., Joksimovic, A., Mandic, M., Fortuna, C., Ikica, Z., and Vukovic, V., 2016. Cetaceans in the Boka Kotorska Bay. In *The Boka Kotorska Bay Environment* (pp. 411-437). Springer, Cham.

Draganovic, E., 1991, May. Distribution and legal protection of the monk seal along the eastern Adriatic coast of Yugoslavia. In *Seminar on Conservation of the Mediterranean Monk Seal–Technical and Scientific Aspects, Antalya, Turkey* (pp. 1-4).

Farina, A., 2013. Soundscape ecology: principles, patterns, methods and applications. Springer Science & Business Media.

Forcada, J., Gazo, M., Aguilar, A., Gonzalvo, J. and Fernández-Contreras, M., 2004. Bottlenose dolphin abundance in the NW Mediterranean: addressing heterogeneity in distribution. *Marine Ecology Progress Series*, *275*, pp.275-287.

Fortuna, C.M., Bearzi, G. and Delfino, G., 1996. Surfacing pattern of bottlenose dolphins following bottom trawlers in the Kvarneric (northern Adriatic Sea). *European Research on Cetaceans*, *10*, p.244.

Fortuna, C.M., Vallini, C., Filidei Jr, E., Ruffino, M., Consalvo, I., Di Muccio, S., Gion, C., Scacco, U., Tarulli, E., Giovanardi, O. and Mazzola, A., 2010. By-catch of cetaceans and other species of conservation concern during pair trawl fishing operations in the Adriatic Sea (Italy). *Chemistry and Ecology*, *26*(S1), pp.65-76.

Fortuna, C.M., Holcer, D., Filidei, E., Donovan, G. and Tunesi, L., 2011, March. The first Cetacean Aerial Survey in the Adriatic Sea: summer 2010. In *7th Meeting of the ACCOBAMS Scientific Committee* (p. 16).

Fortuna, C.M., Holcer, D. and Mackelworth, P., 2015. Conservation of Cetaceans and Sea Turtles in the Adriatic Sea: status of species and potential conservation measures. *Report produced under WP7 of the NETCET project, IPA Adriatic Cross-border Cooperation Programme, 135*.

Gales, R.S., 1982. *Effects of noise of offshore oil and gas operations on marine mammals: an introductory assessment*(Vol. 844). Naval Ocean Systems Center..

Gales, N., Hindell, M. and Kirkwood, R. eds., 2003. *Marine Mammals: Fisheries, Tourism and Management Issues: Fisheries, Tourism and Management Issues*. Csiro Publishing.

Gaspari, S. and Natoli, A., 2012. Grampus griseus Mediterranean subpopulation. *The IUCN Red List of Threatened Species, (IUCN, 2012).*

Gaspari, S., Holcer, D., Mackelworth, P., Fortuna, C., Frantzis, A., Genov, T., Vighi, M., Natali, C., Rako, N., Banchi, E. and Chelazzi, G., 2015. Population genetic structure of common bottlenose dolphins (Tursiops truncatus) in the Adriatic Sea and contiguous regions: implications for international conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *25*(2), pp.212-222.

Goedegebuure, M., Melbourne-Thomas, J., Corney, S. P., Hindell, M. A. and Constable, A. J., 2017. Beyond big fish: The case for more detailed representations of top predators in marine ecosystem models. *Ecological Modelling*, *359*, 182-192.

Gomercic, H. and Huber, D., 1989. Craniometric characteristics of the Mediterranean monk seal (Monachus monachus Hermann 1779) from the Adriatic Sea. *Period biol*, *91*, p.132.

Gonzales, L.M., 2004. Mediterranean Monk seal (Monachus monachus): Up-date of the status and conservation progress. CMS.

Gonzalvo, J., Forcada, J., Grau, E. and Aguilar, A., 2014. Strong site-fidelity increases vulnerability of common bottlenose dolphins Tursiops truncatus in a mass tourism destination in the western Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom*, *94*(06), pp.1227-1235.

Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. and Thompson, D., 2003. A review of the effects of seismic surveys on marine mammals. *Marine Technology Society Journal*, *37*(4), pp.16-34.

Government of Montenegro, 2008. Montenegro Development Strategy to 2020. [Online] Available at: https://www.gov.me/dokumenta/9b158c2a-90d8-46bf-92e6-9374d4b7a24b [Accessed 10th of June 2021].

Government of Montenegro, 2011. Analiza o ostvarenjima i izazovima ekoloske drzave - 20. godina ekoloske Crne Gore. [Online] Available at: https://www.gov.me/en/documents/30a40b44-1f0b-48c0-bf04-bbd1b61d4d08 [Accessed 4th of June 2021]

Grbec, B., Morović, M. and Zore-Armanda, M., 1998. Some new observations on the long-term salinity changes in the Adriatic Sea. *Acta Adriatica*, *39*(1), pp.3-12.

Heiler, J., Elwen, S.H., Kriesell, H.J. and Gridley, T., 2016. Changes in bottlenose dolphin whistle parameters related to vessel presence, surface behaviour and group composition. *Animal Behaviour*, *117*, pp.167-177.

Holcer, D., Mackelworth, P.C. and Fortuna, C.M., 2002. Present state of understanding of the cetacean fauna of the Croatian Adriatic Sea. *European research on Cetaceans 16*.

Holcer, D., 2012. *Ecology of the common bottlenose dolphin, Tursiops truncatus (Montagu, 1821) in the Central Adriatic sea* (Doctoral dissertation, Prirodoslovno–matematički fakultet, Sveučilište u Zagrebu).

Holcer, D., Notarbartolo di Sciara, G., Fortuna, C.M., Onofri, V., Lazar, B. and Tvrtkovic, N., 2003, September. The occurrence of Cuvier's beaked whale (Ziphius cavirostris) in Croatian Adriatic waters. In *Proceedings of the 8th Croatian Biological Congress* (Vol. 27, pp. 255-256).

Holcer, D., Fortuna, C.M. and Mackelworth, P.C., 2014. Important areas for conservation of cetaceans, sea turtles and giant devil rays in the Adriatic Sea: summary of existing knowledge. UNEP/MAP-RAC/SPA Internal report. Contract N° 08/RAC/SPA_2013 MedOpenSeas, 67 pages.

Impetuoso, A., Wiemann, A., Antollovich, W., Holcer, D., Mackelworth, P.C. and Fortuna, C.M., 2003. A preliminary study of Cetacean presence and abundance in the archipelago of the Kornati National park (Croatia). In *Proceedings of abstracts of the 8th Croatian Biological Congress*.

Ingram, S.N., 2000. The Ecology and Conservation of Bottlenose Dolphins in the Shannon Estuary Ireland (Doctoral dissertation, NUI).

IUCN, 2012. Marine Mammals and Sea Turtles of the Mediterranean and Black Seas. Gland, Switzerland and Malaga, Spain: IUCN. p.32.

Kulovic, N., 2021. Eni and Novatek kicking off drilling ops off Montenegro - Offshore Energy. [online] Offshore Energy. Available at: <https://www.offshore-energy.biz/eni-and-novatek-kicking-off-drilling-ops-off-montenegro/> [Accessed 26th of May 2021].

Kuşku, H., Yiğit, M., Ergün, S., Yiğit, Ü. and Taylor, N., 2018. Acoustic noise pollution from marine industrial activities: Exposure and impacts. *Aquatic Research*, *1*(4), pp.148-161.

La Manna, G., Rako-Gospić, N., Sarà, G., Gatti, F., Bonizzoni, S. and Ceccherelli, G., 2020. Whistle variation in Mediterranean common bottlenose dolphin: The role of geographical, anthropogenic, social, and behavioral factors. *Ecology and evolution*, *10*(4), pp.1971-1987.

Lusseau, D., 2003. Effects of tour boats on the behavior of bottlenose dolphins: using Markov chains to model anthropogenic impacts. *Conservation Biology*, *17*(6), pp.1785-1793.

Lusseau, D. and Higham, J.E.S., 2004. Managing the impacts of dolphin-based tourism through the definition of critical habitats: the case of bottlenose dolphins (Tursiops spp.) in Doubtful Sound, New Zealand. *Tourism Management*, *25*(6), pp.657-667.

Macic, V., Antolic, B., Thibaut, T. and , Svircev, Z., 2010. Distribution of the most common Cystoseira C. agardh species (Heterokontophyta, Fucales) on the coast of Montenegro (South-East Adriatic Sea). *Fresenius Environmental Bulletin*, *19*(6), pp.1191-1198.

Maglio, A., Pavan, G., Castellote, M. and Frey, S., 2016. Overview of the Noise Hotspots in the ACCOBAMS Area, Part I-Mediterranean Sea. *Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contigous Area*.

Maragos, J.E., 1993. Impact of coastal construction on coral reefs in the US-affiliated pacific Islands. *Coastal Management*, *21*(4), pp.235-269.

Marine Conservation Research, 2019. Research Software. [ONLINE] Available at: http://www.marineconservationresearch.co.uk/downloads/logger-2000-rainbowclick-software-downloads/. [Accessed 8th of January 2019].

Markovic, M., 2008. Coastal Area Management Programme Montenegro: Feasibility Study. Podgorica: Montenegro Ministry of Tourism and Environment.

Meissner, A.M., Christiansen, F., Martinez, E., Pawley, M.D., Orams, M.B. and Stockin, K.A., 2015. Behavioural effects of tourism on oceanic common dolphins, Delphinus sp., in New Zealand: the effects of Markov analysis variations and current tour operator compliance with regulations. *Plos one*, *10*(1), p.e0116962.

Miočić-Stošić, J., Holcer, D., Đurović, M., Pleslić, G., Ikica, Z. and Vuković, V., 2020. Photo-Identification of Common Bottlenose Dolphins (Tursiops truncatus) in Montenegrin Waters.

Ministry for Spatial Planning and Environment, 2015. National Biodiversity Strategy with the Action Plan for the period 2010-2015. [Online] Available at: https://www.cbd.int/doc/world/me/me-nbsap-01-en.pdf [Accessed 3th of June 2021].

Monaco, C., Ibáñez, J.M., Carrión, F. and Tringali, L.M., 2016. Cetacean behavioral responses to noise exposure generated by seismic surveys: how to mitigate better?. *Annals of Geophysics*, *59*(4), p.0436.

Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P. and Goslin, J., 2012. Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. *The Journal of the Acoustical Society of America*, *131*(2), pp.1102-1112.

Notarbartolo di Sciara, G., 2016. Marine Mammals in the Mediterranean Sea: An Overview. *Advances in marine biology*, *75*, pp.1-36.

Notarbartolo di Sciara, G. and Birkun, A., 2010. Conserving whales, dolphins and porpoises in the Mediterranean and Black Seas. *An ACCOBAMS status report-ACCOBAMS, Monaco*.

Notarbartolo di Sciara, G., Frantzis, A., Bearzi, G. and Reeves, R., 2012. *Physeter macrocephalus*. *The IUCN Red List of Threatened Species* 2012: e.T41755A2955634. Downloaded on 25 May 2021.

Notarbartolo di Sciara, G., Venturino, M.C., Zanardelli, M., Bearzi, G., Borsani, F.J. and Cavalloni, B., 1993. Cetaceans in the central Mediterranean Sea: distribution and sighting frequencies. *Italian Journal of Zoology*, *60*(1), pp.131-138.

Nowacek, D.P., Thorne, L.H., Johnston, D.W. and Tyack, P.L., 2007. Responses of cetaceans to anthropogenic noise. *Mammal Review*, *37*(2), pp.81-115.

Nowacek, D.P., Clark, C.W., Mann, D., Miller, P.J., Rosenbaum, H.C., Golden, J.S., Jasny, M., Kraska, J. and Southall, B.L., 2015. Marine seismic surveys and ocean noise: time for coordinated and prudent planning. *Frontiers in Ecology and the Environment*, *13*(7), pp.378-386.

Panigada, S. and Notarbartolo di Sciara, G., 2012. Balaenoptera physalus Mediterranean subpopulation. The IUCN Red List of Threatened Species 2012: e.T16208224A17549588. http://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T16208224A17549588.en. Downloaded on 21 December 2018.

Panigada, S., Pesante, G., Zanardelli, M., Capoulade, F., Gannier, A. and Weinrich, M.T., 2006. Mediterranean fin whales at risk from fatal ship strikes. *Marine Pollution Bulletin*, *52*(10), pp.1287-1298.

Pennino, M.G., Roda, M.A.P., Pierce, G.J. and Rotta, A., 2016. Effects of vessel traffic on relative abundance and behaviour of cetaceans: the case of the bottlenose dolphins in the Archipelago de La Maddalena, north-western Mediterranean sea. *Hydrobiologia*, *776*(1), pp.237-248.

Pennino, M.G., Arcangeli, A., Prado Fonseca, V., Campana, I., Pierce, G.J., Rotta, A. and Bellido, J.M., 2017. A spatially explicit risk assessment approach: Cetaceans and marine traffic in the Pelagos Sanctuary (Mediterranean Sea). *PloS one*, *12*(6), p.e0179686.

Peraš, I., Divanović, M., Pešić, A., Joksimović, A., Marković, O., Đurović, M. and Mandić, M., 2017. Composition and abundance of beach litter in Montenegro (South Adriatic Sea). *Studia Marina*, *30*(1), pp.17-27.

Pilleri, G. and Gihr, M., 1977. Some records of cetaceans in the Northern Adriatic Sea. *Investigations on Cetacea*, *8*, pp.85-88.

Pešić, A., Mandić, M., Kasalica, O., Đurović, M., Ikica, Z. and Joksimović, A., 2011. Marine fisheries in Montenegro in the last decade (2000-2010). Agriculture and Forestry, 51(1/4), pp.51-59.

Pleslić, G., Rako-Gospić, N., Miočić-Stošić, J., Blazinić Vučur, T., Radulović, M., Mackelworth, P., Frleta-Valić, M. and Holcer, D., 2019. Social structure and spatial distribution of bottlenose dolphins (Tursiops truncatus) along the Croatian Adriatic coast. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *29*(12), pp.2116-2132.

Pleslić, G., Rako-Gospić, N. and Holcer, D., 2020. Bottlenose dolphins (Tursiops truncatus) in North Dalmatia, Croatia: Occurrence and demographic parameters. *Marine Mammal Science*. 37. doi: 10.1111/mms.12735.

Pleslić, G., Rako Gospić, N., Mackelworth, P., Wiemann, A., Holcer, D. and Fortuna, C., 2015. The abundance of common bottlenose dolphins (Tursiops truncatus) in the former special marine reserve of the Cres-Lošinj Archipelago, Croatia. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *25*(1), pp.125-137.

Przeslawski, R., Huang, Z., Anderson, J., Carroll, A.G., Edmunds, M., Hurt, L. and Williams, S., 2018. Multiple field-based methods to assess the potential impacts of seismic surveys on scallops. *Marine pollution bulletin*, *129*(2), pp.750-761.

Rako, N., Fortuna, C.M., Holcer, D., Mackelworth, P., Nimak-Wood, M., Pleslić, G., Sebastianutto, L., Vilibić, I., Wiemann, A. and Picciulin, M., 2013. Leisure boating noise as a trigger for the displacement of the bottlenose dolphins of the Cres–Lošinj archipelago (northern Adriatic Sea, Croatia). *Marine pollution bulletin*, *68*(1-2), pp.77-84.

Read, A.J., Drinker, P. and Northridge, S., 2006. Bycatch of marine mammals in US and global fisheries. *Conservation biology*, *20*(1), pp.163-169.

Regner, S., Vukanic, D., Vuksanovic, N., Jerkovic, L., Kljajic, Z., Mandic, S., . . . Regner, D. (2003). Geneticki resursi morskih organizama. Beograd: Jugoslovenska inzenjerska akademija, Bulletin no. 1.

Ribarič, D., 2018. First report on abundance and distribution of common bottlenose dolphins (Tursiops truncatus) in the NATURA 2000 area, Istria, North-eastern Adriatic Sea. *Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom*, *98*(5), pp.1039-1053.

Richardson, W.J., Finley, K.J., Miller, G.W., Davis, R.A. and Koski, W.R., 1995. Feeding, social and migration behavior of bowhead whales, Balaena mysticetus, in Baffin Bay vs. the Beaufort Sea—regions with different amounts of human activity. *Marine mammal science*, *11*(1), pp.1-45.

Rogers, C. A., Brunnick, B. J., Herzing, D. L. and Baldwin, J. D., 2004. The social structure of bottlenose dolphins, Tursiops truncatus, in the Bahamas. *Marine Mammal Science*, *20*(4), 688-708.

Sackl, P., Smole, J., Saveljic, D. and Stumberger, B., 2007, July. Inland observations of common bottlenose dolphins Tursiops truncatus (Montagu, 1821) in the Delta of the Bojana/Buna river, Albania and Montenegro. In *Annales: Series Historia Naturalis* (Vol. 17, No. 2, p. 191). Scientific and Research Center of the Republic of Slovenia.

Šćepanović, L., Milošević, B., Đukanović, G., Tadić, I., Đoković, T., Božović, A., Bataković, M., Novaković, V., Bulatović, I., Vukčević, M. and Žarković, S., 2013. Indicator-based State of the Environment Report of Montenegro. Podgorica: Environmental Protection Agency of Montenegro.

Shane, S.H., Wells, R.S. and Würsig, B., 1986. Ecology, behavior and social organization of the bottlenose dolphin: a review. Marine Mammal Science, 2(1), pp.34-63.

Shane, S.H., 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. *The bottlenose dolphin*., pp.245-265.

Šilc, U., Küzmič, F., Caković, D. and Stešević, D., 2018. Beach litter along various sand dune habitats in the southern Adriatic (E Mediterranean). *Marine pollution bulletin*, *128*, pp.353-360.

Simmonds, M.P. and Lopez-Jurado, L.F., 1991. Whales and the military. *Nature*, *351*(6326), pp.448-448.

Širović, A. and Holcer, D., 2020. Ambient Noise from Seismic Surveys in the Southern Adriatic Sea, in *The Handbook of Environmental Chemistry.* Springer, Berlin, Heidelberg. doi: 10.1007/698_2020_710.

Stirling, I. and Calvert, W., 1983. Environmental threats to marine mammals in the Canadian Arctic. *Polar Record*, *21*(134), pp.433-449.

Stockin, K.A., Lusseau, D., Binedell, V., Wiseman, N. and Orams, M.B., 2008. Tourism affects the behavioural budget of the common dolphin Delphinus sp. in the Hauraki Gulf, New Zealand. *Marine Ecology Progress Series*, *355*, pp.287-295.

Štrbenac, A., 2015. Strategy on the conservation of sea turtles in the Adriatic Sea for the period 2016–2025. *Document produced under the NETCET project. IPA Adriatic Cross-border Cooperation Programme*.

Torres, L.G., Mclellan, W.A., Meagher, E. and Pabst, D.A., 2005. Seasonal distribution and relative abundance of bottlenose dolphins, Tursiops truncatus, along the US mid-Atlantic coast. *Journal of Cetacean Research and Management*, *7*(2), pp.153-161.

Tudela, S., 2004. *Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats* (No. 74). Food & Agriculture Org..

Turl, C.W., 1982. Possible effects of noise from offshore oil and gas drilling activities on marine mammals: A survey of the literature.

UNDP., 2008. Strengthening the sustainability of the protected area system of Montenegro, UNDP Project Document. United Nations Development Programme.

UN Environment-CBD., 2016. The Clearing House Mechanism of the Convention on Biological Diversity, Ecologically or Biologically Significant Areas (ESBAs), South Adriatic Ionian Straight. Available at: . [Accessed 24th of May 2021].

UNEP/MAP, 2012. Initial integrated assessment of the Mediterranean Sea: Fulfilling step 3 of the ecosystem approach process. Athens: United Nations Environment Programme, Mediterranean Action Plan.

UNEP-MAP-RAC/SPA., 2014. Status and Conservation of Cetaceans in the Adriatic Sea. By D. Holcer, C.M. Fortuna and P. C. Mackelworth. Draft internal report for the purposes of the Mediterranean Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas, Malaga, Spain, 7-11 April 2014.

UNEP-MAP-RAC/SPA, 2015. Adriatic Sea: Ecology (draft report). Twelfth Meeting of Focal Points for Specially Protected Areas, Agenda item 10: Marine and Coastal Protected Areas, including in the open seas and deep seas. Tunis: United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP) Regional Activity Centre for Specially Protected Areas (RAC/SPA).

Velike, I.P.S., 2009. Towards identification of the bottlenose dolphin (Tursiops truncatus) population structure in the north-eastern Adriatic Sea: preliminary results. *Varstvo narave*, *22*, pp.73-80.

Vermeulen, E., Holsbeek, L., Das, K., 2015. Diurnal and seasonal variation in the behaviour of bottlenose dolphins (Tursiops truncatus) in Bahía San Antonio, Patagonia, Argentina.

Waereebeek, K.V., Baker, A., Félix, F., Gedamke, J., Iñiguez, M., Sanino, G.P., Secchi, E.R., Sutaria, D., Helden, A.V. and Wang, Y., 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, an initial assessment.

Walker, D.I. andKendrick, G.A., 1998. Threats to macroalgal diversity: marine habitat destruction and fragmentation, pollution and introduced species. *Botanica marina*, *41*(1), pp.105-112.

Weaver, A., 2021. An Ethology of Adaptation: Dolphins Stop Feeding but Continue Socializing in Construction-Degraded Habitat. *Frontiers in Marine Science*, *8*, p.226.

Weilgart, L.S., 2007. A brief review of known effects of noise on marine mammals. *International Journal of Comparative Psychology*, *20*(2).

Weilgart, L.S., 2013, November. A review of the impacts of seismic airgun surveys on marine life. In *CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity. London, United Kingdom* (pp. 1-10).

Wilson, S.P. and Verlis, K.M., 2017. The ugly face of tourism: Marine debris pollution linked to visitation in the southern Great Barrier Reef, Australia. *Marine pollution bulletin*, *117*(1-2), pp.239-246.

Zavatarelli, M., Raicich, F., Bregant, D., Russo, A. and Artegiani, A., 1998. Climatological biogeochemical characteristics of the Adriatic Sea. *Journal of Marine Systems*, *18*(1-3), pp.227-263.