PHAROS4MPAS

# SAFEGUARDING MARINE PROTECTED AREAS IN THE GROWING MEDITERRANEAN BLUE ECONOMY

Interreg Mediterranean

PHAROS4MPAs

## RECOMMENDATIONS FOR THE CRUISE SECTOR

**Front cover:** Wooden traditional Maltese water taxi (dghajsa boat) offering trips from Valletta ferry port around Grand Harbour (Malta) © Reine Nassar


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# EXECUTIVE SUMMARY

The Mediterranean is the world's leading destination for coastal and maritime tourism, attracting about one third of all global visitors. [1] Within this, **the cruise sector is particularly fast-growing: in 2007 there were 8.7 million cruise passengers in the Mediterranean, by 2018 there were more than 25 million.** Cruise tourism is also rapidly changing as ships have evolved from an average capacity of less than a thousand people in the 20th century to today's mega-cruisers that can hold more than 6,000 guests and 2,000 crew. Their environmental impact is growing in volume and intensity.

One of the sector's main impacts is from the discharge of waste, which occurs mainly, and most intensely, on the open sea: this has broad implications for the environment as a whole, and regions with low water exchange in particular. The cruise sector also affects Marine Protected Areas (MPAs), where it can have a major impact on sensitive species and habitats. These MPAs are often very important conservation sites whose environmental riches attract visitors to the region, thereby sometimes undermining their original conservation objectives.

**The consumptive level of each passenger on board a cruise ship is much higher than that of people in local hosting communities, so this form of nautical tourism has the potential to overwhelm the regions where it takes place, with potential spillover effects on MPAs.** In Croatia, a study of cruise tourism found that environmental costs are up to seven times higher than the economic benefits received by local communities. [2] [3] This ratio may be even higher in some sensitive areas. Given that cruise tourism is promoted as contributing to economic stability, it is crucial to attempt to disclose its hidden environmental and social costs.

**Unless there is greater regional coordination towards implementing regulatory measures, the environmental impacts of the cruise sector's continuing expansion will keep growing.** Sustainable cruising practices – based on integration with local economies and communities, respecting MPAs – should be supported. Short-term and opportunistic exploitation should be discouraged.

States in the region need to cooperate to address transboundary pollution from cruisers. Mechanisms such as the Particularly Sensitive Sea Area (PSSA) of the International Maritime Organisation (IMO) can offer a level of control. Other policy initiatives promoting environmental, social and economic sustainability – such as the EU's Blue Growth initiative and the Horizon 2020 programmes – provide vehicles for research and coordination. Other ongoing regional efforts including the Ecologically or Biologically Significant Areas initiative (EBSAs) of the Convention on Biological Diversity may also be relevant.

MPA managers often play a leading role in establishing protective legislation for their local areas, but the willingness of the cruise industry to comply with regulations is questionable and enforcement remains a challenge.

Finally, a lack of transparency in the cruise industry makes it difficult to accurately estimate its environmental impact in different regions. Further research should include investigations into on-board practices, emissions and the development of technologies geared to reducing impacts on sensitive MPAs and neighbouring areas. Closer analysis of existing initiatives from around the world, such as the US Clean Cruise Ship Act initiative, could provide insights into a more sustainable future for the industry in the Mediterranean.

# INTRODUCTION

This report proposes a set of recommendations on how public and private stakeholders in the Mediterranean can work together to prevent – or minimize – the impacts of cruises in Marine Protected Areas (MPAs).

The Mediterranean is a popular destination for global travellers, many of whom visit it on a cruise ship. In recent years this activity has become more financially accessible, and the number of passengers has increased considerably.

The different projects considered by this study confirm that the cruise sector is on the rise, as is the overall coastal and maritime tourism sector: in terms of gross added value and employment it's the biggest sector in the tourism industry.

Such growth is leading to rising concerns over the sector's environmental impacts, particularly on areas of conservation importance. A lack of current knowledge is preventing the adoption of evidence-based strategies to limit the risks. This is not helped by the fact that many ports cannot afford to include pollution monitoring schemes, waste management policies, low emission technologies etc. in their development programmes. Meanwhile the industry is carrying on its operations and lobbying regardless, making it hard for authorities and local stakeholders to choose any other option than to follow the growth trends it's creating.

On the other hand, targeted policies and technological improvements offer a route towards more sustainable cruising. There is strong competition between cruise companies to gain market share, and sustainable cruising may turn out to be an important niche growth area.

The practical recommendations in this report address the negative interactions between the cruise sector and MPAs, and point the way to a more sustainable future.

The PHAROS4MPAs project explores how Mediterranean MPAs are affected by activities in the growing Blue Economy, and provides a set of practical recommendations for regional stakeholders on how the environmental impacts of key sectors can be prevented or minimized. Encouraging international collaboration across MPA networks and cooperation between state, industry and other actors, PHAROS4MPAs aims to enhance MPA management effectiveness and improve the conservation of marine ecosystems across the whole of the Mediterranean.

PHAROS4MPAs focuses on the following sectors of the Blue Economy:

- Maritime transport and industrial ports
- Cruise
- Leisure boating
- Offshore wind farms
- Aquaculture
- Recreational fisheries
- Small-scale fisheries

DOCKING CRUISE SHIPS: TUI DISCOVERY (FRONT), THOMSON CRUISES & NORWEGIAN EPIC (BEHIND) IN BARCELONA CRUISE PORT, SPAIN

© HALAND / SHUTTERSTOCK

# PART ONE
# BACKGROUND INFORMATION:
# CRUISE SECTOR

**OCEAN CRUISE** industry has witnessed an annual passenger compound growth rate of 6.63% from 1990-2020 an a global level. Several factors have contributed to this growth, including increasingly large cruise capacity, port availability, new technologies, and on-board and on-shore tourist activities geared to satisfying growing consumer demands. [4]

> Asero[5] defines cruise tourism as "a luxurious form of travelling, involving an all-inclusive holiday on a cruise ship of at least 48 hours, with a set and specific itinerary, in which the cruise ship calls at several ports or cities. It is characterised by the concentration of huge numbers of people in limited areas for brief periods, thus multiplying negative impacts that may lead to destruction of natural and cultural resources".

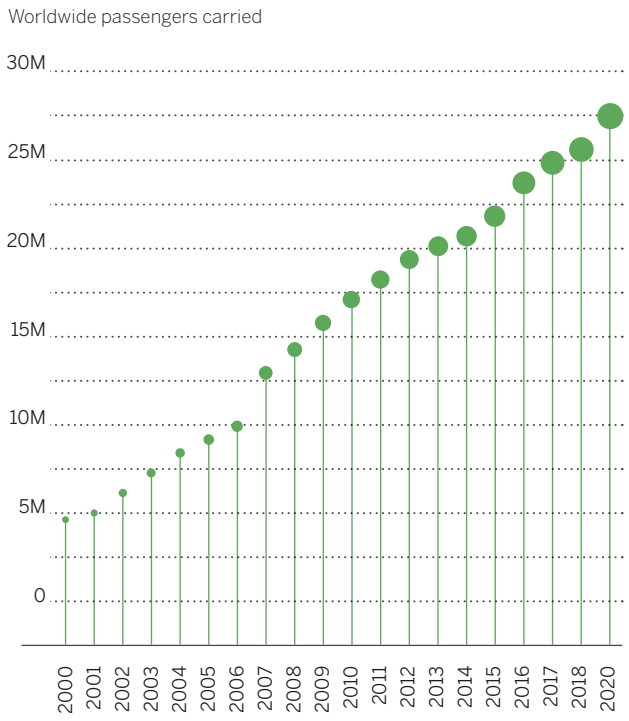



**FIGURE I.** Growth of worldwide passengers carried on cruises (2000-2020) (CRUISE MARKET WATCH, 2018)

**The Mediterranean is the most popular cruise destination for European travellers [6] [7] and the second largest market globally for the industry, accounting for 15.8% of cruises in 2017. [8]** The European market as a whole grew by 162% between 2002 to 2012, and despite the economic downturn it's expected to carry 10 million passengers a year by 2020. [9] Cruise activities in the Mediterranean and its adjoining seas are developing fast – the number of passengers in 2017 is double compared to 2006. [10]

**The Mediterranean Sea is among the largest cruise areas in the world, with a sustained increase of around 5% per year.** The cruise infrastructure is focused on its northern shores: 75% of Mediterranean cruise ports are in Italy, Spain, France, Greece, Croatia and Slovenia; while 9% of ports are in Turkey and Cyprus, and 7% are in Northern Africa. In terms of total number of passenger embarkations, the market is dominated by Italy (36.8%) and Spain (27.3%), followed by France (9.7%), Greece (8.0%) and Croatia (4.5%). [11]

**The Adriatic is the second-most-visited sea in the Mediterranean region, with 17% of all passengers.** It has more than 30 cruise ports, the most popular of which is Venice with a passenger share of 31.7%: it accounted for 1,605,660 passengers in 2016, followed by Dubrovnik with 833,588 passengers (16.5%) and Corfu with 748,916 (14.8%). [12]

In 2017 there were 166 cruises active in the Mediterranean, with a total passenger capacity of 215,697 and an average of 1,296 berths per ship. Collectively these ships carried up to 3.44 million passengers on a total of 2,577 cruises, offering a total capacity of 26.67 million passenger-nights. [13]
**The total capacity of ocean cruise ships worldwide increased to over 530,000 passengers [14] in 2018: around 90% of cruise ships now have capacity to carry more than 1,250 passengers. [15]**

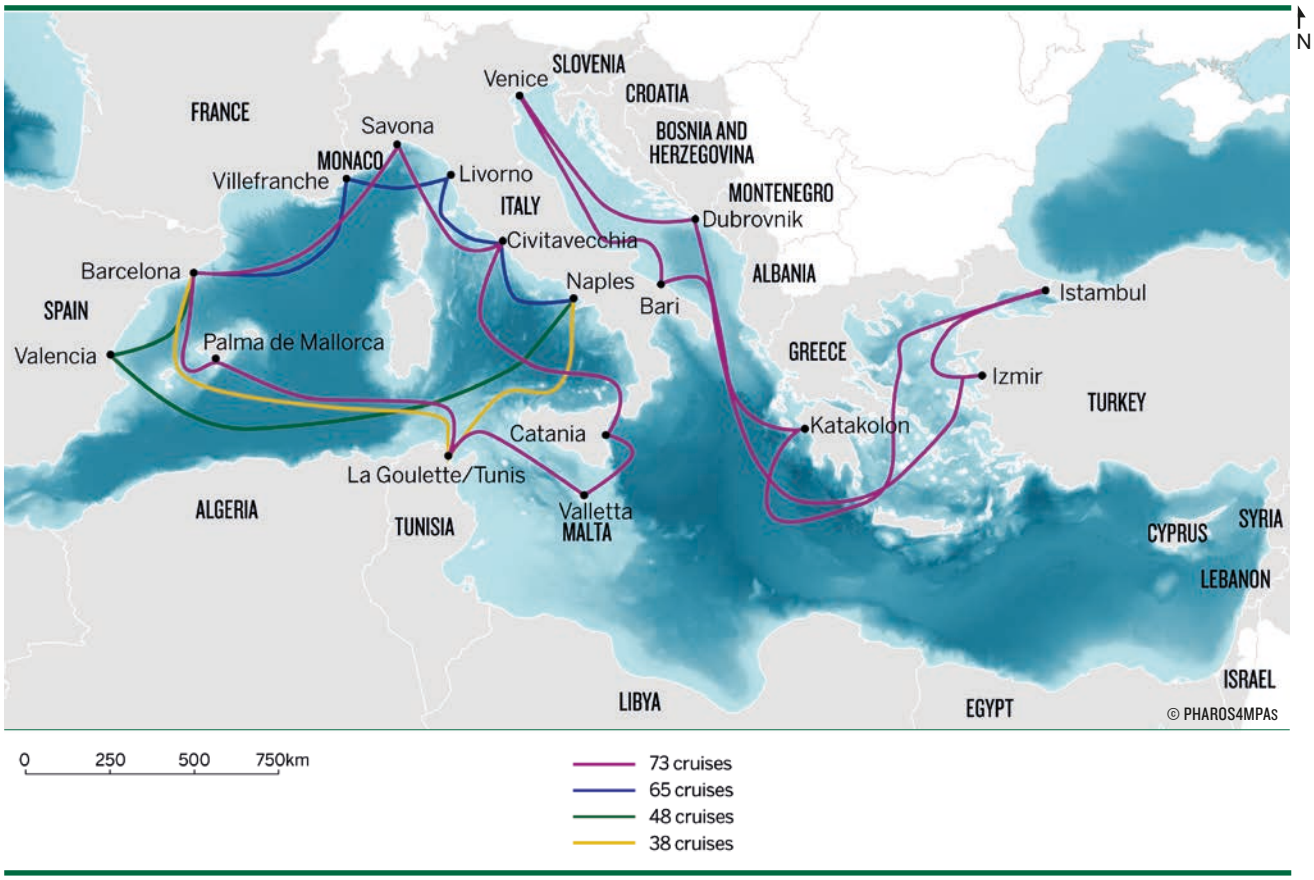



**FIGURE 2.** The most frequent Mediterranean cruise itineraries in 2010 (ADAPTED FROM MARUSIC ET AL. 2012)

## KEY FACTS

The Mediterranean is the most popular cruise destination for European travelers, and the second market globally for the industry, accounting for **15,8%** in 2017

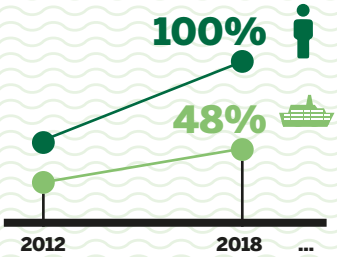
**27** million

The Mediterranean Sea features among the biggest cruise areas in the world: it reached **27** million passengers in 2013

**14,7** million

The 10 major MedCruise ports hosted a total of nearly 14,7 million passengers in 2017 (in terms of cruise passengers)

**75%** of Mediterranean ports are in Italy, Spain, France, Greece, Croatia




**+48%** increase in the number of the active cruise ships (reaching more than 314 in 2018)

**+100%** increase in the number of passenger capacity (reaching 500,000 in 2018)

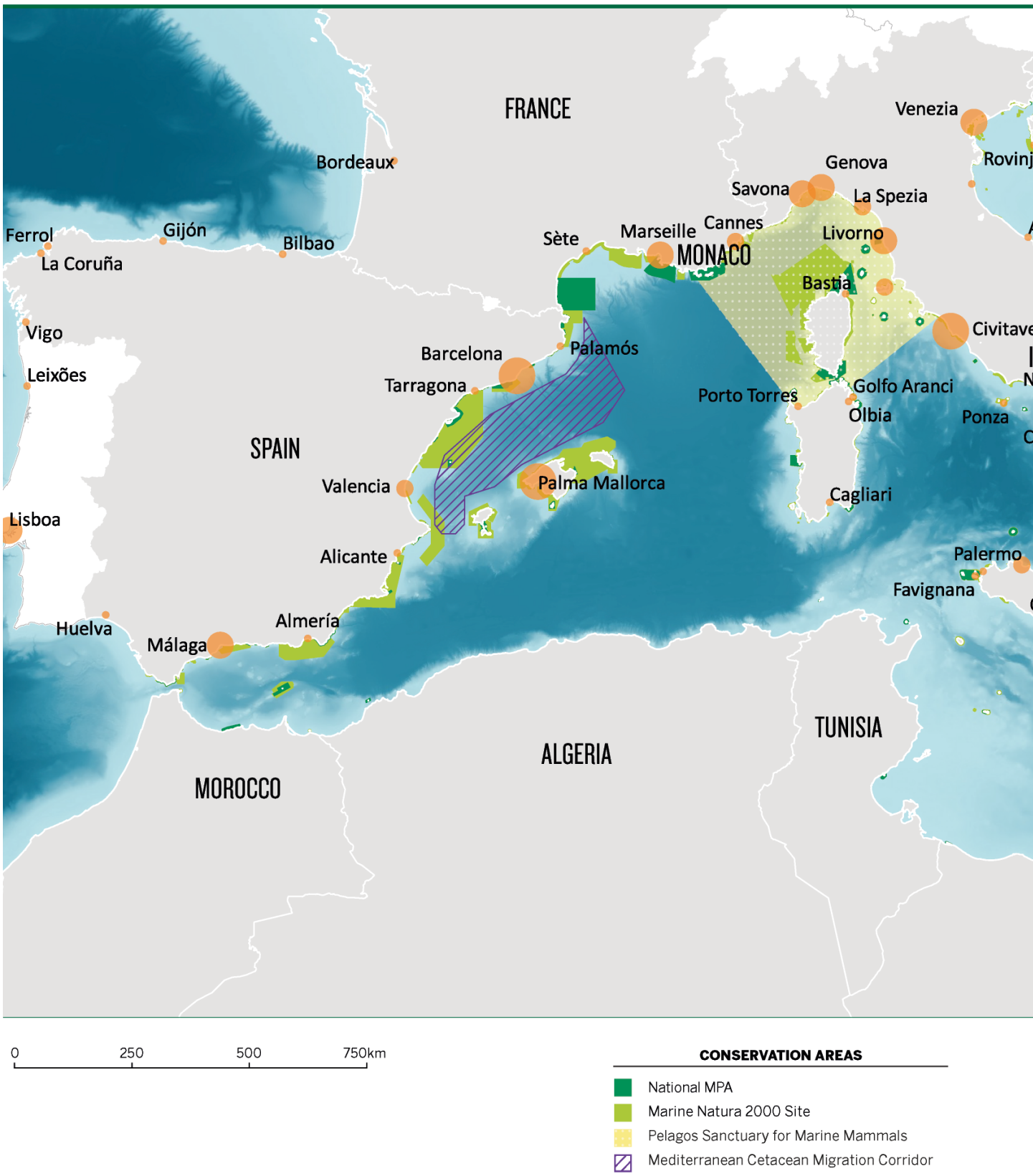
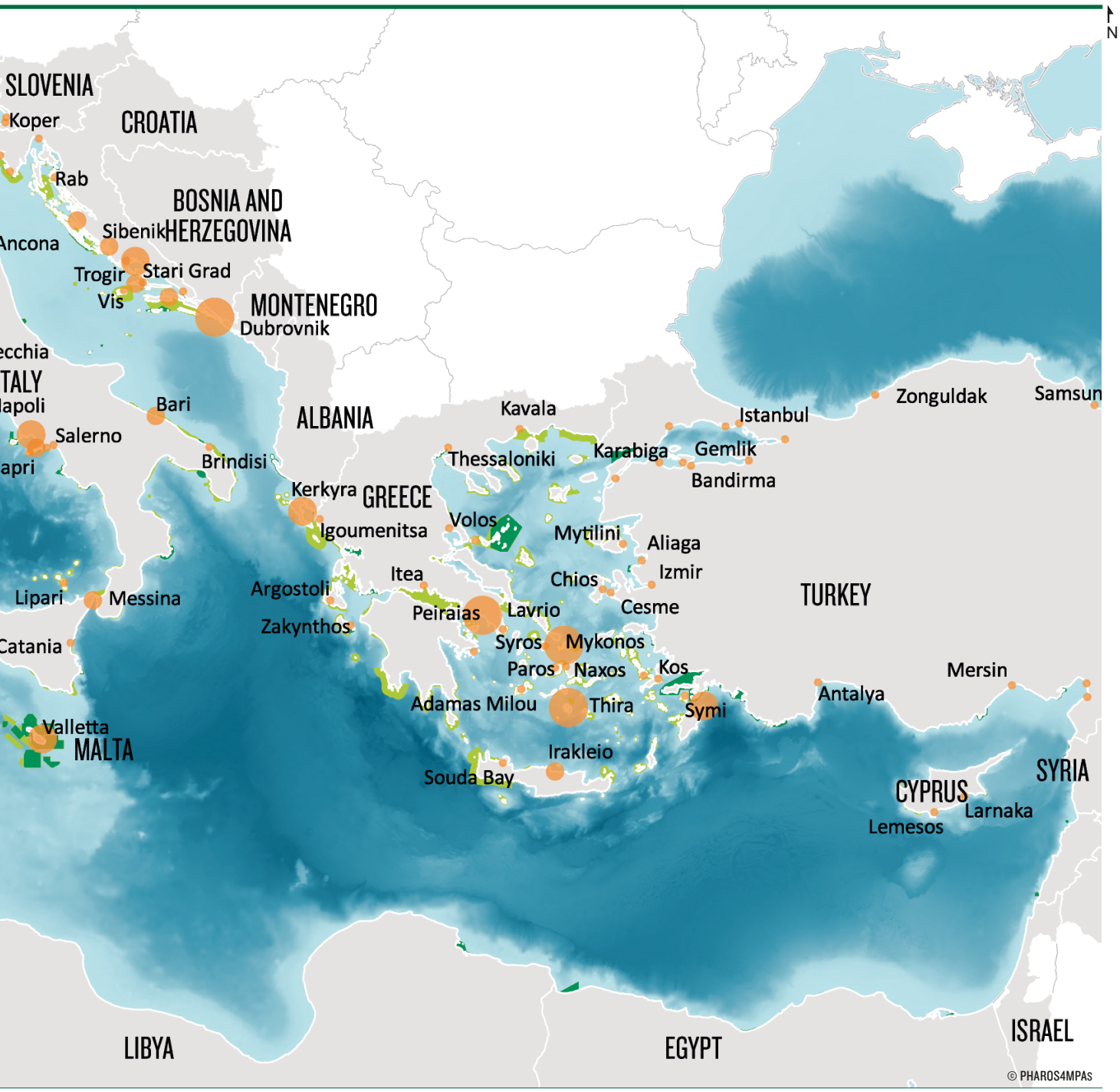



**FIGURE 3.** Annual cruise vessels frequentation in North Mediterranean cruise ports (2016)




**Nº OF CRUISE VESSELS IN NORTH MEDITERRANEAN CRUISE PORTS IN 2016**

- 10 - 100
- 100 - 200
- 200 - 500
- 500 - 914

Conservation areas
SOURCES: MAPAMED (2017), EMODnet (2018)
Cruise ports
SOURCE: EMODnet (2016) adapted by ISMAR (2018) and NSO Malta

| COMPANY | SHIPS | CAPACITY | % MARKET |
|---|---|---|---|
| Costa | 11 | 721.404 | 19,00% |
| MSC | 10 | 706.352 | 18,60% |
| Royal Caribbean | 9 | 326.794 | 8,60% |
| Norwegian | 4 | 238.200 | 6,30% |
| AIDA | 6 | 233.144 | 6,10% |
| Thomson | 5 | 189.496 | 5,00% |
| Celestyal | 3 | 162.290 | 4,30% |
| P&O | 7 | 157.320 | 4,10% |
| Celebrity | 5 | 151.698 | 4,00% |
| TUI | 5 | 120.768 | 3,20% |
| **TOTAL** | **65** | **3.007.466** | **79.20%** |

**TABLE I.** 2016 cruise passenger capacity in the Mediterranean, for the 10 market leading companies. Just two companies account for almost 40% of the total market (Adapted from MedCruise Statistics Report 2017)

| RANK 2017 | VS. RANK 2016 | PORT | TOTAL PAX 2017 | TOTAL PAX 2016 | 2017/ 2016 | 2017/ 2013 |
|---|---|---|---|---|---|---|
| 1 | -1 | Barcelona | 2.712.247 | 2.683.594 | 1,07% | 4,35% |
| 2 | -2 | Civitavecchia | 2.204.336 | 2.339.676 | -5,78% | -13,16% |
| 3 | -3 | Balearic Islands | 2.110.663 | 1.957.429 | 7,83% | 36,93% |
| 4 | -5 | Marseille | 1.487.313 | 1.597.213 | -6,88% | 25,19% |
| 5 | -4 | Venice | 1.427.812 | 1.605.660 | -11,08% | -21,37% |
| 6 | -7 | Piraeus | 1.055.559 | 1.094.135 | -3,53% | -18,96% |
| 7 | -10 | Tenerife Ports | 964.337 | 884.173 | 9,07% | 21,43% |
| 8 | -6 | Naples | 927.458 | 1.306.151 | -28,99% | -21,07% |
| 9 | -8 | Genova | 925.188 | 1.017.368 | -9,06% | -11,89% |
| 10 | -9 | Savona | 854.443 | 910.244 | -6,13% | -9,01% |
| **Total major ports** | | | **14.669.356** | **15.395.643** | **-4,72%** | **-1,84%** |

**TABLE 2.** Major MedCruise ports. The market is heavily dominated by Italian and Spanish destinations (Adapted from MedCruise Statistics Report, 2017)

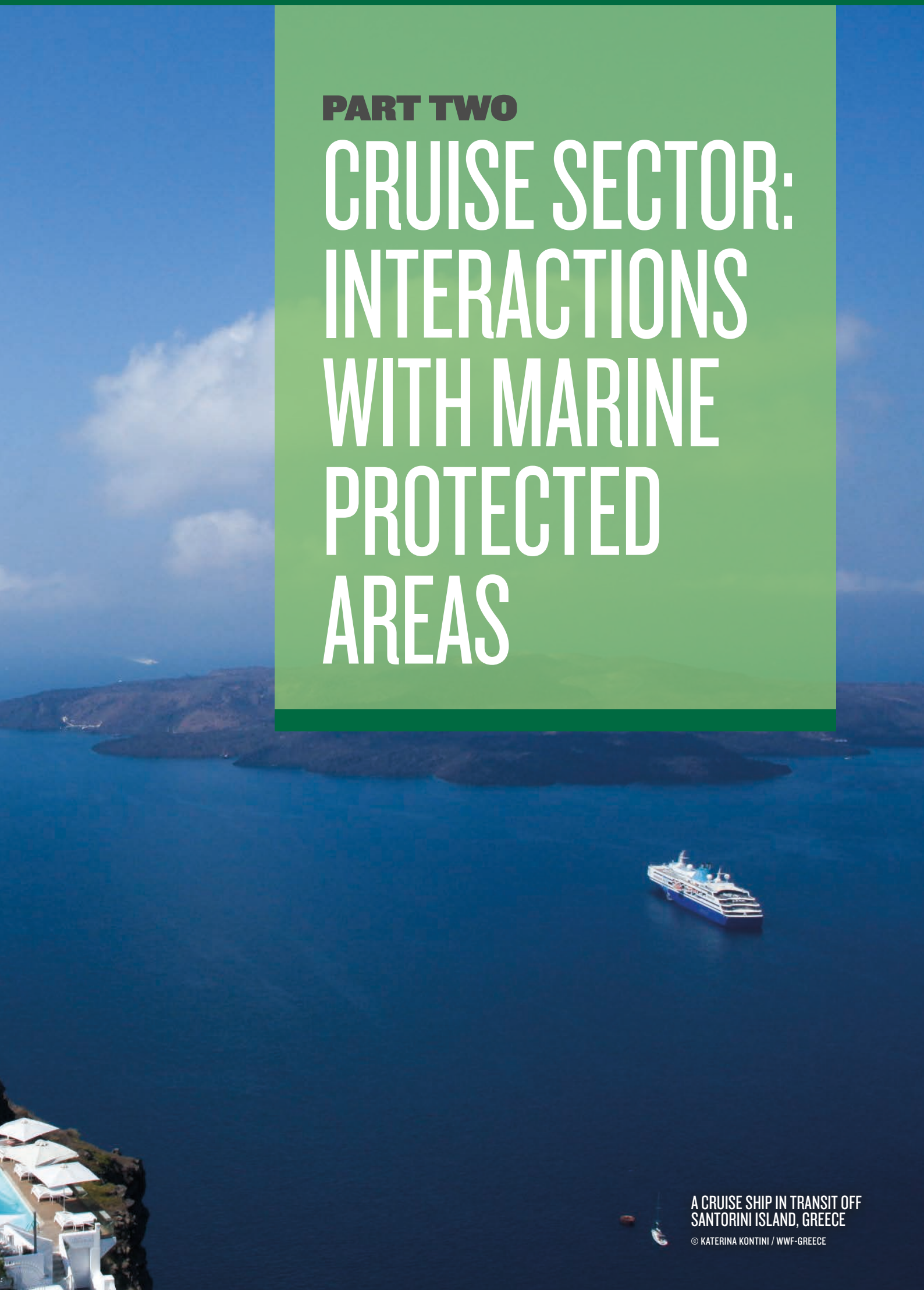
AERIAL VIEW OF THE MALTA PORT

© VALLETTA CRUISE PORT PLC

Porto Fira
Suites

PART TWO

# CRUISE SECTOR: INTERACTIONS WITH MARINE PROTECTED AREAS



A CRUISE SHIP IN TRANSIT OFF SANTORINI ISLAND, GREECE

© KATERINA KONTINI / WWF-GREECE

# 2.1. HOW THE CRUISE SECTOR AFFECTS THE MARINE ENVIRONMENT

The majority of the Mediterranean region's MPAs and other effective area-based conservation measures (OECMs) are located in coastal and shallow areas. Cruise traffic routes are most likely to interact with them in locations where vessels are approaching ports or passing through narrow zones (e.g. straits).

Some MPAs or marine Natura 2000 sites in fact are located very close to cruise ports (e.g. Côte Bleue Marine Park and Calanques National Park in France), and in the unique case of the city of Venice and its lagoon, the cruise port is in fact located inside a marine Natura 2000 site.

In the case of large MPAs such as the Pelagos Sanctuary and offshore Natura 2000 sites recently designated under the Habitats and Birds Directives, interactions are increasingly likely to occur during navigation.

It should also be noted that MPAs have in themselves become important attractions for the Mediterranean cruise industry. MPAs may receive large numbers of visitors from cruise ships on daily excursions – the MPA at Portofino is a prominent example – with potentially massive impacts from littering and damages to the precious natural resources of the area. This trend is likely to continue in the future, as tourists' desire for pristine destinations and unique experiences continues to grow.

Cruise ships anchor in close proximity to the borders of many Mediterranean MPAs. One notable example is the Scandola Nature Reserve in Corsica, France, that recently adopted zoning regulations to create a buffer and manage this phenomenon.

SCANDOLA NATURE RESERVE, CORSICA (FRANCE)

© LYCIA W / SHUTTERSTOCK

COSTA MEDITERRANEA CRUISE SHIP

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# 2.2 IMPACTS OF THE CRUISE SECTOR ON MARINE ECOSYSTEMS

**Although modern ships have significantly reduced their environmental impacts relative to their size, cruises remain a major source of air, noise and marine pollution.** While the capacity of the new boats – which can accommodate up to 8,000 passengers, equivalent to the size of a small Mediterranean town – is a key factor, smaller boats can also be extremely detrimental for the marine environment.

**Environmental impacts from cruises affect a wide range of habitats and species, and originate from multiple sources over the course of a cruise's itinerary.** Making an accurate quantified measurement of the impact of the entire life cycle of a ship is therefore challenging, and to date there is still a lack of data bringing all relevant aspects together. However, several studies have attempted to measure one impact or another, and combining these various sources can provide an idea of the magnitude of the cruise industry's environmental footprint.

**During their operational phase, cruise ships are either at berth, navigating, or anchored. Each state has its own impacts on the natural environment, and these fall into two categories:**

- **Emissions and discharges (solid, gaseous or liquid)**
- **Physical disturbance (noise, light, collision)**[16] [17].

Impact analysis should take all these factors into consideration.

| CRUISE IMPACTS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emissions and discharges | | | | | | | | | Physical disturbance | | | |
| Solid | | Liquid | | | | Gaseous | | | Collision | | Noise | Light |
| Marine litter | Plastics | Grey water | Black water | Bilge water | Ballast water | SOx | NOx | $CO_2$ | Lethal | Non lethal | | |

**FIGURE 4.** Cruise ships' main operational impacts

# EMISSIONS AND DISCHARGES

Cruise ships – while anchored, on dock, or in movement – produce a number of emissions that have a wide range of impacts on the environment. Based on the available literature, these are listed below. [18] [19] [20] [21] [22] [23] [24]

**SOLID WASTE,** including marine litter, plastics and other inorganic and organic materials, is a growing problem. Waste management practices on cruise ships often fail to meet basic technical conditions for communal and hazardous waste disposal, resulting in emissions of hazardous substances such as dioxins (through incineration), floating macro waste and micro and nano plastics, with consequent impacts on marine fauna. Each cruise ship passenger produces an average of 4 kilos of solid waste each day [2]: this would mean that a cruise ship carrying 2,000 people [27] would produce 8 tonnes of solid waste per day.

**WASTEWATERS** Result in a decrease of available dissolved oxygen and the potential for algal blooming when they are released. In addition, enterobacteria and viruses can be released into the sea and transferred to other organisms via untreated 'black waters'.

On a large cruise ship each passenger can use up to 40 litres of water per day through the 'black water' system (heavily contaminated wastewater from toilets)[24] and 340 litres of 'grey water' (e.g. wastewater generated from bathing and washing onboard with higher potential for reuse than black water).

According to Oceana [26]: "A large proportion of international legislation on the dumping of waste at sea by vessels was made during the decades when cruise ships were a quite inconsequential part of the bulk of merchant marine traffic, and carrying passengers was merely an accessory activity to the transportation of merchandise. For this reason, the growth of the cruise ship industry has taken place peripherally and without a parallel evolution in legislation. At the same time, any such agreements are less stringent in international waters. In addition, the majority of the world cruise ship fleet sails under 'flags of convenience' which makes it difficult to apply legislation."

**BALLAST WATER** can contain wastewaters, oil and other hydrocarbons, bacteria and invasive species (e.g. *Caulerpa taxifolia* and *C. cylindracea* [27][28][29][30]). This has numerous consequences for marine resources, human health, and the state of the ecosystem and the economic activities depending on it; the cumulative extent of which has yet to be measured. Ballast waters and hull fouling (when species attach to ships' hulls) are among the main vectors for the introduction of non-indigenous species, which can cause declines in abundance and local extinctions of native species.[31]

**ANTIFOULING COATINGS** contain high concentrations of antifouling biocides, which can have serious consequences for marine organisms. For example, elevated levels of copper have been associated with changes in benthic assemblages, reduced species richness and enhanced dominance. [32] At a local level this can be a major issue, particularly as cruise ships tend to use non-industrial harbours close to towns, cities and MPAs. The submerged antifouling surfaces of cruise ships can have a significant localized effect compared to local boats, fishing boats and yachts.[16][33][34]

**HYDROCARBONS** enter the marine environment through 'routine' activities such as the discharge of bilge water, ballast waters, and fuel intake. Complex ecosystems (including the key endemic Mediterranean seagrass *Posidonia oceanica* [35]) are highly sensitive to hydrocarbons. Carcinogenic aromatic hydrocarbons have significant consequences for populations of marine birds, as well as marine mammals and turtles.

Globally, chronic pollution from bilge waters and fuel released in standard ship operations accounts for as much as three times more pollution than acute spills and collisions.[36] On large passenger ships bilge water is accumulated in significant quantities, of up to 8 litres per passenger per day.[37] If levels of hydrocarbons exceed permitted limits (10-15 ppm), the water in question is considered as contaminated and should be treated as hazardous.[20]

**ACID RAIN** caused by emissions of sulphur dioxides (SOx) and nitrogen oxide (NOx) can travel large distances from the site of emission. It has the potential to reduce green cover in coastal areas[38][39] and modify the pH of the water: in turn, acidification alters the life cycle of marine ecosystems.[40]

**AIR POLLUTION** from ships' exhausts is a widely discussed topic internationally: for decades there have been concerns about the contribution of the shipping industry to local and global air pollution, health and environmental problems.

Gaseous emissions cause localized smog and ground-level ozone, increasing ocean acidification and contributing to global climate change. This may affect coastal and marine ecosystems as well as human health. Cruise ships also add to air pollution in ports, which causes lung and cardiovascular diseases responsible for 60,000 deaths globally each year.

A study found that more than 2,500 tonnes of nitrogen oxides (NOx), sulphur dioxide ($SO_2$) and particulate matter with a diameter of less than 2.5 micrometers (PM2.5) were released by cruise ships across the five busiest Greek cruise ports during 2013 [82]. The researchers also examined the costs of the potential health impacts of this pollution, finding they could be as high as €24.3 million.

The new 0.50% limit on sulphur in ships' fuel oil will enter into force globally on 1 January 2020 under IMO's MARPOL treaty*: this will have benefits for the environment and human health.[41] However, to date, there has been no systematic monitoring by public authorities of ship discharges, and fuel quality is very rarely monitored.

* MARPOL, the International Convention for the Prevention of Pollution from Ships was signed in 1973, amended by the MARPOL Protocol in 1978.

GASEOUS EMISSIONS PRODUCED BY THE COSTA MEDITERRANEA WHILE NAVIGATING

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# PHYSICAL DISTURBANCE

**COLLISIONS** with marine mammals and sea turtles represent a major issue of concern. Ship velocity and mass has significantly increased in recent years, as well as the total number of ships, and so have the chances of collision. In many sensitive regions cruise ships have been recorded colliding with whales[42][43][44][45][46] or disturbing small cetaceans[47][48], particularly in the Ligurian Sea.[49]

On a global scale, collisions with large vessels represent the main fatal threat for whales[50]. In the Mediterranean this is a serious conservation issue for fin whales (*Balaenoptera physalus*) and sperm whales (*Physeter macrocephalus*), especially in the western basin[49][51]. Ship strikes are made more likely by underwater noise, which can interfere with cetacean communication and prevent animals from detecting and reacting to threats.

**NOISE POLLUTION** is a ubiquitous form of marine pollution – it is particularly acute on busy maritime routes. The EU's Marine Strategy Framework Directive (2008/56/EC) directly addresses the introduction of noise into marine waters, stating that noise should be limited so that the marine environment is not adversely affected.[52] Establishing an MPA can be an effective way of reducing the impact of underwater noise – restrictions on maritime activities inside or even outside MPA borders can prevent noise spreading into critical areas.

Noise can alter ecosystems by displacing fish and/or predators. Long-term exposure to intensive sound results in modification of behaviour and use of habitat in some fish species.[53][54][55] Studies in the Adriatic Sea show that the bottlenose dolphin (*Tursiops truncatus*) avoids areas with frequent nautical vessel traffic during the tourist season[56], spending less time on feeding and resting activities, and more time on avoiding contact.[57]

Underwater noise hotspots in the Mediterranean overlap with several protected areas and/or with areas of importance to noise-sensitive marine mammal species. These include the Pelagos Sanctuary in the Ligurian Sea, the Strait of Sicily, parts of the Hellenic Trench, and the waters between the Balearic Islands and continental Spain[58].

**LIGHT POLLUTION** poses problems for organisms that need darkness for orientation in daily and seasonal migrations, feeding and breeding. Brightly-lit cruise ships on a dark sea can disorient birds that fly low and migrate at night, resulting in collisions[59]. The creation of permanent 'moonlight' by ship lights may cause localized problems with migrations of zooplankton, cephalopods, fish and potentially other marine species, putting them at risk of intensive and frequent predation.[59]

Table 3 summarizes the different factors through which the cruise sector affects the marine environment, and the physical impacts of each.

## KEY FACTS

There is no comprehensive monitoring system in place to analyse the true socio-economic and environmental impacts of the cruise industry, so it is not clear how far value chains stretch outside the industry itself

It would be worthwhile to collect and compare data on the cruise ship activities that occur in each Mediterranean country, beyond the statistical stocktake run by organizations sponsored by the industry, such as MedCruise

Detailed monitoring and data on specific impacts and pressures from cruise ships would aid in the creation of national and international cruise ship policies

BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*) AND THE COSTA MEDITERRANEAN IN THE NORTHERN ADRIATIC SEA

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| | | EMISSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Waste communal | Gasses: Sox; Nox, colloidal particles | Nutrients | Bacteria, viruses and other pathogenes | Antifouling, biocide | Oil and derivatives | Allochtone, invasive species | Collisions | Noise | Light |
| ACTIVITIES | AT BERTH | | | | | | | | | | |
| | Maneuvering | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| | Docked | ✓ | | | | ✓ | ✓ | | | | ✓ |
| | Electrical generating unit | | ✓ | | | | | | | ✓ | |
| | Embarkment and disembarkment | ✓ | | | | | ✓ | | | | |
| | Intake/discharge of ballast waters | | | | ✓ | | ✓ | ✓ | | ✓ | |
| | Wastewater tanks discharge | | | ✓ | ✓ | | | | | ✓ | |
| | Bilge water tanks discharge | ✓ | | ✓ | | | ✓ | | | ✓ | |
| | AT SEA | | | | | | | | | | |
| | Sailing | | ✓ | | | ✓ | | | ✓ | ✓ | ✓ |
| | Discharge (garbage, ash, chemiclas) | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | |
| | Garbage incineration | ✓ | ✓ | | | | | | | | |
| | Intake/discharge of ballast waters | | | | ✓ | | ✓ | ✓ | | ✓ | |
| | Wastewater tanks discharge | | | ✓ | ✓ | | | | | ✓ | |
| | Bilge water tanks discharge | | | ✓ | | | ✓ | | | ✓ | |
| | ANCHORING | | | | | | | | | | |
| | Lowering the anchor | | | | | | | ✓ | | ✓ | |
| | Raising the anchor | | | | | | | ✓ | | ✓ | |
| | Still | ✓ | | | | ✓ | ✓ | | | ✓ | ✓ |
| | Electrical generating unit | | ✓ | | | | | | | | |
| IMPACTS | Climate change | ✓ | ✓ | | | | ✓ | | | | |
| | Acidification | | ✓ | | | | | | | | |
| | Air contamination | | ✓ | | | | | | | | |
| | Contamination by viruses and bacteria | ✓ | | ✓ | ✓ | | | | | | |
| | Contamination by metals | ✓ | | | | ✓ | ✓ | | | | |
| | Eutrophication | ✓ | | ✓ | | | ✓ | | | | |
| | Reduction of biodiversity | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Fragmentation/loss of habitat (biotope) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**TABLE 3.** Activities, emissions and related impacts of cruise vessels on the marine environment (Carić, 2011, 2016)

# 2.3 CRUISE SHIPS IN MPAS: WHERE ARE THEY PERMITTED?

The IUCN divides MPAs into six categories depending on their primary conservation objectives.[60] There are only three types where shipping (including cruises) is allowed, unless it's unavoidable under international law:

- **Category IV,** aimed at **protection of particular species or habitats** (e.g. sanctuaries for marine mammals), often including active management to limit the impacts of human activities
- **Category V,** aimed at **seascape protection**, typically in coastal areas with a focus on the interaction of people and nature
- **Category VI,** aimed at **sustainable use of natural resources,** where social and economic benefits for local communities are included among secondary objectives.

Ports and related dredging are only considered appropriate in Categories V and VI, and in Category IV in some strictly controlled cases [60].

Cruises are definitely not appropriate for **Category I** MPAs, as strictly protected areas or relatively

undisturbed seascapes are to be left free of human disturbance.

In **Categories II and III,** shipping (and cruises) may be permitted, but only with proper approval and where no alternative is possible.

In all MPAs, large cruise ships (>40.000 tons) should be avoided altogether. Rerouting measures should be applied if needed.

Management and enforcement, however, are challenging. MPAs have multiple access points, and it's difficult to patrol remote areas. What's more, vessel passage rights through MPAs are commonly permitted by international laws.[61]

| CATEGORIES | Ia | Ib | II | III | IV | V | VI |
|---|---|---|---|---|---|---|---|
| Description | Strict nature reserve | Wilderness area | National park | Natural monument or feature | Habitat/ species management area | Protected landscape/ seascape | Sustainable use of natural resources |
| Shipping** | ✗ | ✗ | ⊛ | ⊛ | ✓ | ✓ | ✓ |
| Works (ports, harbours, dredging) | ✗ | ✗ | ✗ | ✗ | * | ✗ | ✓ |

⊛ Only after proper approval and where no alternative is possible
* Depends on managing activity in line with MPA's objectives
** Except where permitted under international law

**TABLE 4.** MPA categories and appropriate maritime transport activities (Day et al, 2012)

AERIAL VIEW OF THE PORT OF LA VALETTA, MALTA

© VALLETTA CRUISE PORT

PART THREE

# PREVENT OR MINIMIZE IMPACTS OF THE CRUISE SECTOR ON MPAS: RECOMMENDATIONS FOR MEDITERRANEAN STAKEHOLDERS

The following sections address three key groups:

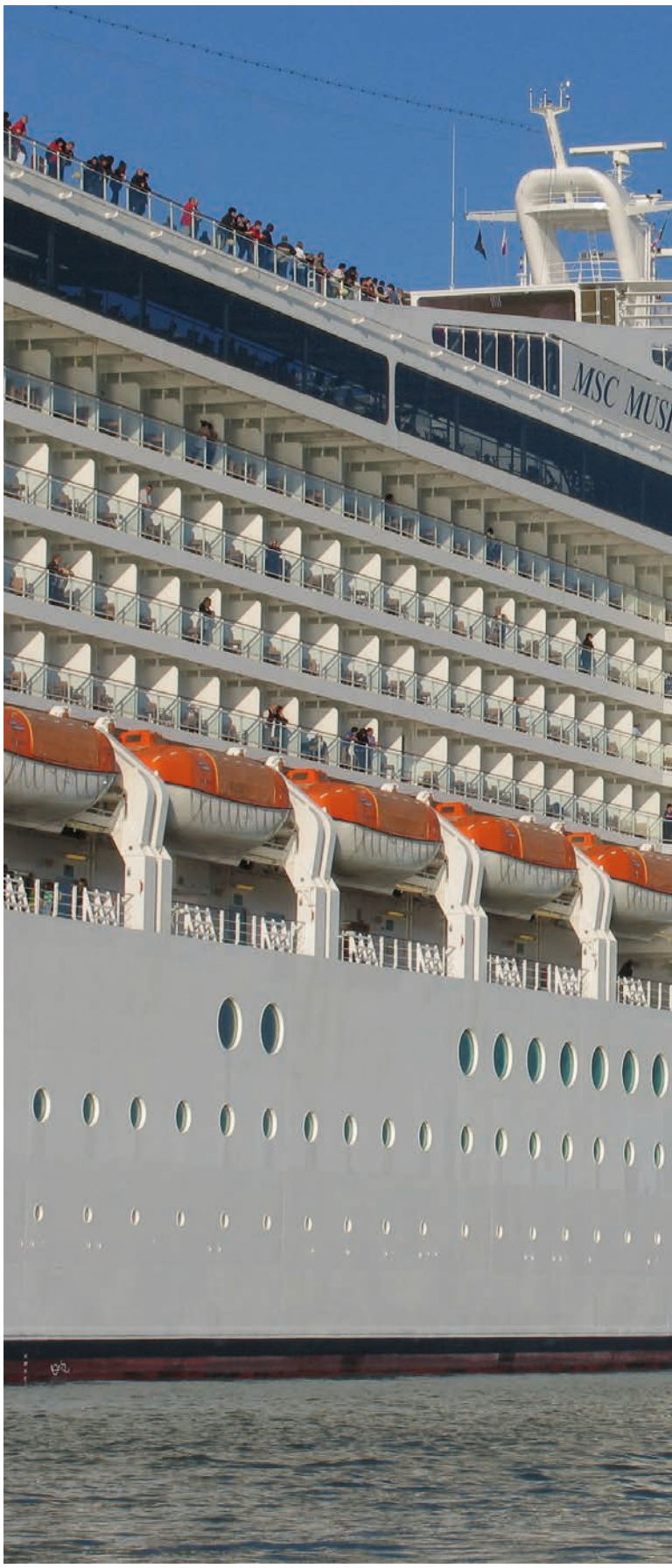
- MPA managers
- Public authorities
- Cruise companies

In them, we discuss actions that could contribute towards more sustainable future development of the cruise sector in relation to MPAs and the environment in general.

# 3.1. MPA MANAGERS

MPA management bodies rarely have the power to regulate maritime traffic; this is generally left to public authorities, in particular port agencies, which have a particularly important role in this sense from both policy and economic perspectives. However, as the case studies in the following section show, MPA managers can nevertheless influence public decisions. In some instances MPA managers can take local actions, such as identifying measures to regulate navigation and anchoring, carrying out environmental monitoring and research, reporting violations of regulations, and contributing to education and awareness-raising.

Marine spatial planning (MSP) and transit regulations (whether limits or an outright ban) help prevent accidents during vessel navigation, and MPA managers can play an important role by participating actively in MSP processes and in promoting initiatives such as the establishment of Particularly Sensitive Areas (PSSA), Areas To Be Avoided (ATBA), or Traffic Separation Schemes (TSS).



CRUISE BOAT APPROACHING VENICE, ITALY

© MARKO PREM

# 3.1.1. PREVENT IMPACTS ON MARINE ECOSYSTEMS

In the Scandola Reserve, France, this was addressed when a large cruise ship anchored very close to the border of the MPA and disembarked a large number of passengers without previous notice to the MPA management body. Following the incident, the manager of Scandola MPA asked the Maritime Prefect for the French Mediterranean coast to establish a buffer zone around the MPA, to provide pre-emptive protection against an expected increase in moorings by large ships.

As a consequence, Decree N° 021/2017 was published by the French national authorities in 2017: this forbids the navigation and mooring of very large vessels (all vessels > 500 UMS or > 45m long), whether under a French or foreign flag.

In Australia in 2003, the Great Barrier Reef Marine Park and the Queensland Parks and Wildlife Service (managing agency) published 'the Great Barrier Reef Marine Park Zoning Plan', which included cruise policies. This strategic instrument was established to improve the Great Barrier Reef's health and resilience under multiple uses.

The managing authority set nine transit corridors and specific anchorage sites for cruise ships, to limit damage from anchoring while allowing carefully tailored access to reefs and islands in order to enhance the passengers' experience of the Park. There is a limit of one cruise ship per anchorage site. Ecosystem, social, cultural, economic, and ease and safety of access considerations are taken into account when managing agencies consider new designated anchorages; and consultations are conducted with traditional boat owners (including indigenous groups), other state and federal government agencies, Great Barrier Reef-related industries and businesses, and the community.[62]

Potential grounding issues are addressed by requiring specific pilotage licensing to enter certain parts of the MPA, due to concerns about the tidal range and flows between the small bays, islands and reefs. In addition, cruise waste discharge is prohibited in these areas. The number of cruise ships entering the park is limited through a booking system, which also takes into account cruise ship size.

The Great Barrier Reef Marine Park Authority (GBRMP) supports ecologically sustainable cruise ship operations within its area, looking to foster stewardship and best practices in this Particularly Sensitive Sea Area[63].

Through the promotion of high standards in tourism and responsible reef practices[64] and advice on a wide range of activities including permits, licenses and travel routes, the managing authorities encourage the cruise ship industry to contribute to the protection of the Great Barrier Reef and the preservation of the outstanding universal value of the Great Barrier Reef World Heritage Area (find out more about policies and practices in the GBRMP regarding cruises in Section 3.2.).

## RECOMMENDATIONS TO **MPA MANAGERS**

**OBJECTIVE:**
**Prevent impacts on marine ecosystems**

- MPA managing authorities should work with local authorities to set specific routes and anchorage zones for cruise ships to allow passengers controlled access to key sites while protecting fragile resources and limiting seabed damage.
- MSP and transit regulations are key to preventing accidents during vessel navigation. MPA managers must be part of the formal MSP process, where they can play an important role in promoting initiatives to public authorities. MSP processes represent critical opportunities for MPA managers to make the case for Particularly Sensitive Areas (PSSA), Areas To Be Avoided (ATBA), or Traffic Separation Schemes (TSS).

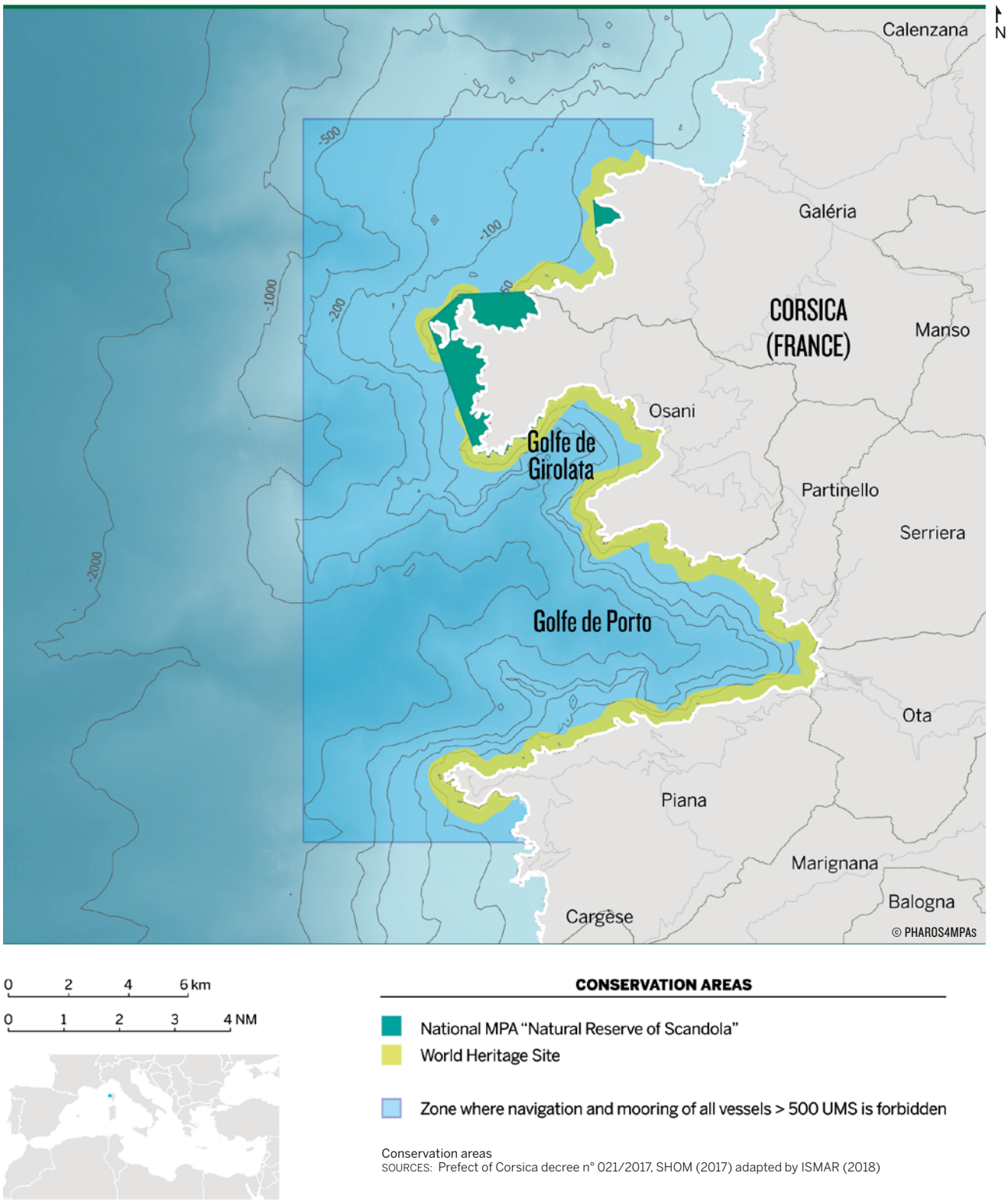
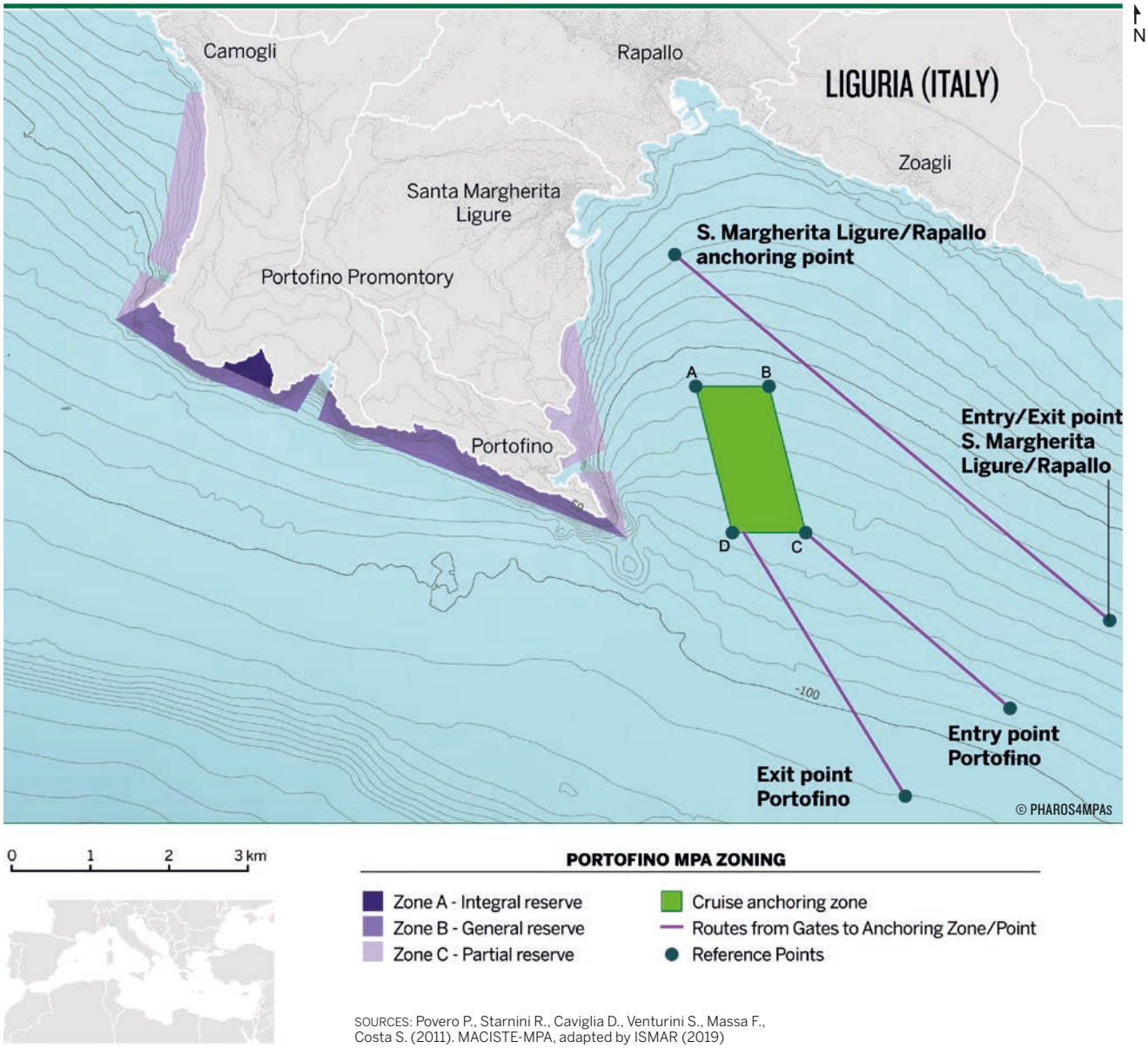



**FIGURE 5.** Navigation regulation in the Natural Reserve of Scandola (France)

# 3.1.2. MINIMIZE IMPACTS ON MARINE ECOSYSTEMS

Decisions taken in the MPA of Portofino, Italy, illustrate how zoning and monitoring can contribute to controlled growth and a limitation on potential impacts from cruising.

First of all, boats with a hull length greater than 24 metres are not allowed in the MPA. Beyond this, different regulations apply to different zones of the MPA. For instance there is a zone of integral protection where no boats are allowed (Zone A), and a zone where anchoring is completely banned but transit is allowed for vessels smaller than 24m (Zone B) – this enables cruise passengers to be transferred ashore in shuttle boats. Zone C marks seasonally flexible anchoring zones [65].




SOURCES: Povero P., Starnini R., Caviglia D., Venturini S., Massa F., Costa S. (2011). MACISTE-MPA, adapted by ISMAR (2019)

**FIGURE 6.** Navigation regulation in the Marine Protected Area of Portofino (Italy)

AERIAL VIEW OF THE GULF OF TIGULLIO, ITALY

© MPA PORTOFINO ARCHIVE

In collaboration with the Liguria Regional Agency for Environment Protection (RAPAL) and the University of Genoa (DISTAV) the MPA also led a study and monitoring plan focusing on cruise ship activities (Ordinance No. 56/2012), aiming to identify their impacts on the Protected Area. Chemical and biological monitoring were included in the list of parameters (in line with the Water Directive 2000/60/EC).

The study was carried out in 2013 [66], and highlighted how the number of ships visiting the Gulf of Tigullio had increased since 2011. The MPA managing authority concluded that while one law (Ordinance No. 56/2012) had discouraged ships from stopping in Portofino by increasing the ship to port distance, it did not significantly diminish the overall pressure of activities/uses on the area of study as the site was also subject to many other pressures (maritime traffic, leisure boating etc) (Table 5).

In 2015, Ordinance No. 138 established that the municipality of Portofino, in collaboration with the town's marina (Marina di Portofino), should provide for the installation of two Meda buoys with technical and scientific instrumentation to enable continuous monitoring of the area over time.

Such studies are fundamentally important for warning authorities about cruise-related impacts in the MPA. Monitoring key environmental parameters and the factors which put them under pressure is essential: it provides a basis for strategic MSP which reconciles the need to protect areas of high environmental value while allowing cruise tourism to develop sustainably and contribute to socio-economic growth in the locality.

## RECOMMENDATIONS TO **MPA MANAGERS**

**OBJECTIVE:**
**Minimize impact on marine ecosystems**

- MPA managers should implement and promote continuous monitoring programmes (cultural, economic and environmental) to identify in real time potential impacts from the cruise sector. The study of cruise impacts on ecosystems in the MPA or its immediate vicinity (e.g. adopting MSFD/EcAP or Water Framework Directive indicators) can help local authorities to better plan management actions, and influence the definition of programmes and public policies to counter (or at least contain) the negative effects of maritime sectors such as the cruise industry. However, political will is needed to guarantee their implementation.
- Networks of MPA scientific boards, especially at eco-region level, should be strengthened to monitor and study the impacts of the cruise sector on MPAs in order to inform management decisions.
- Close cooperation between managing authorities and cruise operators would ease the process of compliance with new regulations, enhance the awareness of cruise operators and tourists of the value of marine ecosystems, highlight the risks at stake, promote good practices in tourism, and enhance visitors' quality of experience. It would also help MPA managing authorities with the development and implementation of carrying capacity controls, such as restricted mooring, limited visitor permits etc.

### KEY FACTS

If an MPA management team are aware of specific threats from cruise ships in the MPA, they can request that national authorities take measures to prevent possible major impacts

The managing authorities set specific routes and anchorages for cruise ships to limit damage from anchoring, while allowing closer access to sensitive areas (e.g. reefs, islands) in order to enhance the passengers' experience of the MPA (e.g. GBRMP)

DISTAV, SAMPLING OCEANOGRAPHIC VARIABLES WITH MULTI-PARAMETRIC PROBE, GULF OF TIGULLIO (ITALY)

© MPA PORTOFINO ARCHIVE

# 3.2. PUBLIC AUTHORITIES

Public authorities can play a major role in preventing and mitigating the cruise sector's impacts on MPAs. There are a wide range of potential solutions available at different levels, from cruise companies to port authorities. Cross-border, sub-regional and regional cooperation between public authorities are particularly important given the geographical scale across which the sector operates. Transnational action is needed to balance the lobbying force of the industry to gain market shares at sea.

On a regional scale, each country should comply with the MARPOL rules, and enforce the application of international standards. On this point, the new lower 0.5% limit on sulphur in ships' fuel oil will be in force from 1 January 2020, under IMO's MARPOL treaty, and it should be implemented. The new limit will be applicable globally, while in designated Emission Control Areas it will remain even lower, at 0.1% (scrubbers can be used to achieve the sulphur content compliant fuel).

## VENICE AND ITS LAGOON

On a more local scale, Italian Law (171/1973) states that the protection of **Venice and its lagoon** is a matter of pre-eminent national interest; since 2007, the area has been a designated Natura 2000 site with 122 species protected under the Nature Directives and 8 habitat types under the Habitats Directive.

MSC MUSICA CRUISE SHIP IN THE GIUDECCA CANAL, VENICE, ITALY

© MARKO PREM

Maritime transport –and cruise traffic– has led to a deterioration of the natural and environmental characteristics of the lagoon. This has occurred through the deepening of channels for sea-going vessels, which exacerbates erosion and hinders the removal of lagoon sediments, increasing the salinity of the water; while the wave motion induced by water traffic increases the erosion of the edges of the salt marshes and of the lagoon bed, leading to the removal of its finer components and consequent change in its benthic biocoenosis [67].

The Venice Blue Flag voluntary agreements (2007 and 2013) signed by local authorities and cruise companies aimed to reduce the use of fuel with high levels of sulphur within and around the city. Research conducted by the local environmental protection agency showed that the two Blue Flag agreements helped to balance economic and environmental aspects [68].

Since then the only major legislative development has been the 2014 Clini-Passera Decree 79/2012, by which the Italian government attempted to forbid cruise ships with a gross tonnage above 40,000 tonnes from passing through the Venice lagoon. However, since the existing route was the only way for cruise ships to reach Venice, the Decree was postponed by Order 178/2014 until an alternative route could be defined. In 2019, without any new proposal or agreement, cruise traffic continues in the lagoon as normal.

Reducing the impacts of the cruise sector is also the subject of the 2012-2018 UNESCO World Heritage Management Plan for Venice and its Lagoon. In November 2017, new measures were proposed for cruise navigation routes which aim to divert large cruise ships (55,000 – 96,000 tonnes) towards the Marghera port, hence decreasing traffic in the Giudecca Canal. While little has so far changed as a result, voices supporting the initiative – from local residents and UNESCO alike – continue to grow louder.

CRUISE SHIP IN THE VENETIAN LAGOON ON OCTOBER 22, 2011 IN VENICE (ITALY)

© SHUTTERSTOCK

## NATURE PARK OF THE CORAL SEA

In August 2018, the Government of New Caledonia adopted an ordinance that prohibited access to the **Nature Park of the Coral Sea** for all vessels with a capacity of more than 200 passengers. For vessels with a capacity of 13 to 200 passengers, in addition to an authorization order required from the authorities, a convention is in place to clarify measures for supervision and monitoring of their navigation routes, mooring and anchorage areas [69].

MSC MAGNIFICA

COSTA CONCORDIA CRUISE SHIP SINKING NEXT TO GIGLIO ISLAND (ITALY)

© DVOEVNORE / SHUTTERSTOCK

# THE COSTA CONCORDIA ACCIDENT

The **2012 Costa Concordia** disaster was one of the largest cruise accidents to have ever been recorded. The cruise ship (114,500 tonnes, 290m, max. capacity 3,780 guests and 1,100 staff and crew) sank two hours after the ship left its home port of Civitavecchia, 32 people died.

In addition to the human tragedy, a major environmental disaster threatened to unfold - but thankfully efforts to remove oil from the ship's fuel tanks over the course of four weeks proved successful, and a spill was prevented. As a result in 2012 several countries, not least among them Italy, imposed regulations on large ships navigating close to MPAs, as well as close to "culturally and ecologically important areas" in response to a request from UNESCO.

For example, a decree by the Italian government ( n°02/03/2012 "Save the coast") prohibits the navigation, anchoring and stopping of vessels engaged in the carriage of goods and passengers exceeding 500 UMS at a distance less than two marine miles from the outer perimeter of national, marine and coastal protected areas.

# NORWEGIAN MARITIME AUTHORITY CRUISE DISCHARGES AND EMISSIONS STUDY

On assignment from the Ministry of Climate and the Environment, **the Norwegian Maritime Authority (NMA)** carried out a survey to map discharges and emissions from cruise ships in Norway's three world heritage fjords: the Geirangerfjord, the Nærøyfjord and the Aurlandsfjord. All three have heavy cruise traffic [70].

The study [71] found that a majority of cruise ships operating in these areas were built before 2000, and thus fell short of the latest standards of environmental technology, mostly regarding energy consumption and NOx emissions. Levels of NOx in the fjords at times exceeded values that could have a negative impact on health, while NOx together with soot particles and water vapour also contributed to the formation of smoke clouds. Most of the ships used electric-diesel power systems, while 12% used heavy fuel oil with scrubbers to meet SOx emission standards.

In 2018, based on the results of the survey, the NMA suggested several measures for cruises operating in the fjords. The main measures are:

- The emission of NOx from ships shall not exceed the values set out in MARPOL Annex VI (The regulations for the Prevention of Air Pollution from Ships)
- Only allow use of fuel with a low sulphur content, regardless of whether the ship has air pollution control devices (scrubbers) installed
- Reporting requirements for all ships entering world heritage fjords
- Determination of maximum speed in defined zones in the fjords to keep consumption of fuel and emissions to a minimum
- Reducing the number of port calls (total number or per day/week) to limit capacity
- Prohibition against discharge of scrubber water, grey water, untreated and treated sewage

These measures continue to be reviewed, with a recent amendment banning the use of scrubbers entirely.

TUI CRUISE LINER MOORED AT GEIRANGER VILLAGE IN THE GEIRANGERFJORD, NORWAY

© FRANCESCO BONINO / SHUTTERSTOCK

## TOWARDS AN ECA IN THE MEDITERRANEAN?

As of 2018, the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) administered by IMO in cooperation with UN Environment (UNEP), is coordinating a technical and feasibility study to examine the possibility of designating the Mediterranean Sea, or parts of it, as a SOx-ECA under IMO's prevention of pollution convention, MARPOL's Annex VI. In June an international consortium led by Energy & Environmental Research Associates (EERA) signed the contract with REMPEC to carry out the study, which was expected to be completed in 2019.

The establishment of a **Particularly Sensitive Sea Area (PSSA)** through the IMO can be a very powerful tool to prevent accidents and consequent environmental impacts. The clear overlap among busy maritime traffic areas and ecologically or biologically significant areas (EBSAs) in the Mediterranean makes a strong case for the designation of more PSSAs in future, especially bordering coastal states. Synergies between the two are clear: further PSSA designations could be supported both by further analysis of maritime traffic (including cruising) data, particularly at the local level, and by more detailed scientific investigation of EBSAs in coastal areas.

## PARTICULARLY SENSITIVE SEA AREA

A PSSA is an area "that needs special protection through action by IMO because of its significance for recognized ecological, socio-economic, or scientific attributes where such attributes may be vulnerable to damage by international shipping activities"[72].

Designating a marine area as a PSSA confirms its international importance, highlighting its sensitivity and the need to respect protection measures.

Each PSSA needs its own protection regime. This may include areas to be avoided, compulsory ship routeing, ship reporting, or recommendations on how shipping should navigate through an area. PSSAs can vary in size from large marine areas and ecosystems to small biodiversity hotspots.

Proposals for new PSSAs must come from coastal states, and need to be formally recognized and adopted by IMO. The process is coordinated between the IMO Marine Environment Protection Committee (MEPC) and state governments.

The Joint Commission for the Protection of the Adriatic Sea and Coastal Areas against Pollution, consisting of Italy, Slovenia, Croatia and Montenegro, working with UN Environment/MAP provides coordination on problems such as ballast waters, combating pollution caused by solid and hazardous waste, and the development of a PSSA proposal for the Adriatic [73].

## OTHER TRANSIT REGULATIONS

The establishment of Areas To Be Avoided (ATBA) can be another useful tool in protecting MPAs. In the words of the IMO, ATBAs are limited to areas where "either navigation is particularly hazardous or it is exceptionally important to avoid casualties and which should be avoided by all ships, or by certain classes of ships". [74] Marine traffic operators should apply ATBA measures – either recommended or compulsory – on a case by case basis.

A Traffic Separation Scheme (TSS) is defined by IMO as a routeing measure aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes. Vessels passing through a TSS need to comply with specific rules and to follow routing coordinates. This allows marine traffic flow to be directed in a coordinated and organized way to reduce the risk of incidents and increase the efficiency of traffic management. TSS are typically implemented in areas where marine traffic is heavy (e.g. in straits).

# GLACIER BAY NATIONAL PARK (ALASKA)

A mandatory 13 km/h speed limit specifically to protect North Pacific humpback whales (Megaptera novaeangliae) [75] was set for vessels greater than or equivalent to 80m in **Glacier Bay National Park and Preserve, Alaska**. The operator of a vessel inadvertently positioned within 1/4 nm of a whale must immediately slow the vessel to 10 knots/h or less, without shifting into reverse unless impact is likely [76]. The Park Service introduced the regulation to combat the increasing number of collisions and to limit acoustic impact on whales [77], following scientific guidance from the the US National Oceanographic and Atmospheric Administration.

An additional measure to minimize the environmental impacts of cruise ships has been introduced, requiring all vessels entering Glacier Bay to have a permit. This permit system helps control the number and types of vessels, but also their length of stay and their activities within the Park. The National Park Service allows two cruise ships each day from 1 June to 31 August, meaning a maximum of 184 cruise ships can visit Glacier Bay during this time of the year.

## KEY FACTS

Public authorities can play a major role in minimizing the cruise sector's impacts on MPAs. National or local regulation enforcement can provide a series of compulsory measures applying to cruises, especially on fuel characteristics and speed reduction

The establishment of a Particularly Sensitive Sea Area (PSSA) via IMO can be a powerful tool to prevent accidents and consequent environmental impacts

The new lower 0.50% limit on sulphur in ships' fuel oil will be in force from 1 January 2020, under IMO's MARPOL treaty, with benefits for the environment and human health

The possible establishment of an ECA in the Mediterranean is under study within the framework of IMO and UN Environment Mediterranean Action Plan cooperation

HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) IN FREDERICK SOUND, SOUTHEAST ALASKA (USA)

© RENEE DEMARTIN

## RECOMMENDATIONS TO **PUBLIC AUTHORITIES**

- National authorities should establish strict limitation and buffer zones regarding the minimum distance cruise ships are allowed to navigate, moor or stop from the coasts of protected areas. This is a preventive step against a projected increase in interest from the industry in visiting these areas.
- National authorities should foster continuous monitoring of cruise activities, with close cooperation between MPA managers and relevant public authorities (e.g. registration of operational data, emissions and discharges, fuel type).
- The granting of authorization by relevant authorities for navigation in highly sensitive natural areas must be a well-informed process with the close involvement of MPA managers to help limit the risks (e.g. grounding, collisions).
- Authorities should implement speed restrictions as an important and effective measure to mitigate collision risk. In addition, lower speeds reduce potential acoustic impacts and emissions.
- Regional regulations promoting stricter controls to minimize airborne emissions from the cruise industry (e.g. ECAs) must be encouraged to limit impacts on ecosystems, both in MPAs and at the level of eco-regions and regional seas.

# 3.3. CRUISE COMPANIES

Cruise companies already have access to a variety of knowledge and technological solutions to greatly reduce their impacts on the marine environment. However, even though implementing environmentally friendly practices also brings clear benefits for corporate image, the sector's current environmental performance remains poor.

Of all the cruise companies in the world, only Disney Cruise Lines scored an overall 'A' grade against the four environmental criteria – sewage treatment, water quality compliance, air pollution reduction and transparency – on the Friends of the Earth (FOE) 2016 Cruise Ship Report Card. It is evident that despite the legislation and policies currently in place, a great deal more needs to be done by the industry to improve its sustainability, including increasing its dialogue with MPA managers.

Moreover, analysis of the websites of 31 cruise companies worldwide showed that only seven of them offer a specific link to information on environmentally sustainable practices [78].

CRUISE LINER DISNEY MAGIC AT THE PORT OF VALLETTA, MALTA

© EUGENIE PHOTOGRAPHY / SHUTTERSTOCK

**"French cruise ship company and captain fined by New Zealand after Snares Islands grounding on January 9th 2017"** (The New Zealand Herald, October 2nd, 2018)

In January 2017, passengers of the cruise ship L'Austral had spent the morning in small boats observing shoreline wildlife on the Snares Islands south of New Zealand. While the master focused on recovering the boats, the ship inadvertently entered the 300-metre protected unauthorized zone and struck an uncharted rock. The hull was pierced and an empty void space was flooded.

The NZ Transport Accident Investigation Commission issued an investigation report, which found that:

- The unauthorised zone was a Department of Conservation-controlled zone, where charts indicated dangers unsafe for ships the size of L'Austral.
- There were deficiencies in the way the crew worked together (bridge resource management), insufficient planning for boat recovery and inadequate monitoring of the ship's position.

The enquiry led to a short series of useful recommendations, particularly relevant for cruise ships operating in the proximity of protected areas:

- The ship operator needed to improve voyage planning, and bridge resource management
- The ship operator should have reviewed staff training in the correct use of electronic chart display and information systems

Finally, the DoC was mandated to appoint a person to manage safe navigation in the sub-Antarctic islands, where the accident occurred [79].

Sewage treatment plants on cruisers have very similar principles to land-based systems that have developed over centuries. They consist of primary, secondary and tertiary treatment before the treated water is released to the outside environment. Compared to terrestrial plants the equipment used on cruisers has been miniaturized and enhanced using separation chambers, centrifugal machinery and ultraviolet light filters. However, there have been very few recent new technological advances, and there is still a possibility that systems will be bypassed when in operation [80].

Generally, cruise companies are considered to score highly with sewage treatment with more than half of the companies reviewed in the FOE (2016) report card score a 'B' or higher. Most vessels have the technological requirements outlined by the relevant conventions with regards to processing ballast, bilge and grey waters, however monitoring is lacking and reporting is poor.

## AIDA CRUISE COMPANY LAUNCHED FIRST LNG POWERED SHIP, 2015

"LNG offers an alternative to diesel, and is now emerging as a viable solution to the stringent regulation laid out by the 2020 sulphur cap. With virtually zero NOx and particulate emissions, and 80 – 90% less SOx, LNG also promises a healthy on-board experience for passengers and could go a long way to abating the rising friction in port towns such as Marseille, which is near Calanques National Park.

"Currently, there are at least 18 LNG-powered cruise ships under construction, seven of which will be launched under the Carnival brand by 2022. Despite the huge demand for natural gas as a marine fuel, only 22 ports in the world are equipped with the infrastructure required for LNG bunkering, and most of these are concentrated in North-West Europe and the US Gulf and East Coast." (Source: LNGindustry.com)

The reduction of air pollution is becoming one of the most important technical issues for the cruise industry to address, not least because of the harm it causes to human health. Desulfurization of ship exhausts has shown that treating fumes with seawater then treating them with aeration and pH adjustment may allow subsequent discharge into the sea. The addition of electrical charges to filters may also increase cleaning efficiency and help remove dust particles from exhausts [81].

## KEY FACTS

Low disclosure of technological progress by individual companies hampers open source approach to solving waste and water treatment issues, plus technological fixes are not matching rapid scale of industry growth

Monitoring is lacking and reporting is poor regarding onboard sewage treatment, water quality compliance and air pollution reduction

The reduction of air pollution is becoming one of the most important technical issues, particularly because of concerns for human health. The sulphurous particles collected in scrubbers are concentrated residues which are considered hazardous, so close attention must also be paid to their safe disposal

Cruise companies should use low-sulphur fuel to reduce emissions and cleaner land-based sources of power. However, to access the latter (necessary when the vessel is moored for a longer period of time, usually >12 hours) requires appropriate port "plug-in" facilities. These represent major investments for port authorities

CRUISE SHIP DOCKED IN LA VALLETTA HARBOUR, MALTA

© REINE NASSAR

## RECOMMENDATIONS TO **CRUISE COMPANIES**

- Higher disclosure on vessel specifics (e.g. onboard sewage treatment, water quality compliance, air pollution reduction) and their impacts on the environment is needed from the cruise sector to help create a more comprehensive picture of the best available technology. This information should be shared with authorities and customers alike.
- Cruise companies should use low sulphur fuel to reduce gaseous emissions. The use of scrubbers helps limit emissions of sulphurous particles, but scrubbers themselves pose environmental risks and must be carefully disposed of.
- Establishing collaborations between the sector and MPA management bodies might help cruise companies to identify critical measures and information to reduce impacts. For example, ship strikes on marine mammals in areas of complex bathymetry could be reduced using seasonal and temporal patterns of whale distribution, with appropriate routing instructions and training for captains and crews.
- Ship operators should adopt appropriate voyage planning and bridge resource management. Regular staff training in the correct use of electronic chart displays and information systems should be carried out.
- Cruise companies can improve their market image by taking their efforts to avoid strikes on whales seriously, and including them in their marketing. This information will be well received by potential customers.
- Reports of collisions and near-misses should be encouraged, and information should be made available widely to all vessel types, e.g. through the collision reporting platform at http://iwc.int/ship-strikes. As more information becomes available through co-operation between cruise companies and the maritime transport industry in general, the development of more effective mitigation measures is likely. There is currently no technological solution available to ensure ships strikes can be effectively avoided. However, cruise companies should consider applying existing technological solutions, e.g. night vision binoculars, infrared cameras, passive acoustic systems and real-time transmission of whale sightings.

# ACRONYMS

| | |
|---|---|
| ACCOBAMS | Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area |
| ADEC | Alaska Department of Environmental Conservation |
| AIS | Automatic Identification System |
| BWMC | Ballast Water Management Convention |
| CBD | Convention on Biological Diversity |
| CEREMA | *Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement* (Centre for studies and expertise on risks, environment, mobility and development – France) |
| CITEPA | *Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique* (Technical interprofessional centre for air pollution studies – France) |
| CLIA | Cruise Lines International Association |
| CNT | Naval Technology and Sea Centre (Spain) |
| CPMR | Conference of Peripheral Maritime Regions |
| EBSA | Ecologically or Biologically Significant Areas |
| ECA | Emission Control Area |
| ECDIS | Electronic Chart Display and Information Systems |
| EERA | Energy & Environmental Research Associates |
| EMODnet | European Marine Observation and Data Network |
| EU | European Union |
| FOE | Friends of the Earth |
| GBRMPA | Great Barrier Reef Marine Park Authority |
| HFO | Hydrofluoroolefins |
| ICZM | Integrated Coastal Zone Management |
| IMAP | Integrated Monitoring and Assessment Programme |
| IMO | International Maritime Organization |
| INERIS | *Institut national de l'environnement industriel et des risques* (National institute for industrial environment and risks – France) |
| ISMAR-CNR | Institute of Marine Sciences – National Research Council |
| IUCN | International Union for Conservation of Nature |
| LNG | Liquefied Natural Gas |
| MedPAN | Mediterranean Protected Areas Network |
| MPA | Marine Protected Area |
| MSP | Maritime Spatial Planning |
| NIS | Non-Indigenous Species |

| | |
|---|---|
| NMA | Norwegian Maritime Authority |
| PAP/RAC | Priority Actions Programme / Regional Activity Centre |
| PPM | Parts Per Million |
| MARPOL | MARine POLlution (Convention) |
| NOx | Nitrogen Oxide |
| NPS | National Park Service (USA) |
| PSSA | Particularly Sensitive Sea Area |
| POP | Persistent Organic Pollutants |
| REMPEC | Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea |
| SDG | Sustainable Development Goals |
| SOx | Sulphur Oxides |
| SPAMI | Specially Protected Areas of Mediterranean Importance |
| SPA/RAC | Regional Activity Centre for Specially Protected Areas |
| TBT | Tributyltin |
| UMS | Universal Measurement System |
| UNEP/MAP | United Nations Environment Programme / Mediterranean Action Plan |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| USEPA | United States Environmental Protection Agency |
| VMS | Vessel Monitoring Systems |
| WWF | World Wide Fund for Nature |

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# THE PHAROS4MPAs PROJECT IN NUMBERS

**7.14%** of the Mediterranean Sea is under some form of **protection**, 1,231 MPAs and OECMs covering **179,798** km$^2$

With **€395** bn Gross Marine Product (GMP) the Mediterranean Sea economy is the **5th largest** in the region

**7**
MARITIME SECTORS

**17** PARTNERS / **10** COUNTRIES

- MARITIME TRANSPORT
- LEISURE BOATING
- RECREATIONAL FISHERIES
- CRUISE
- OFFSHORE WIND FARMS
- AQUACULTURE
- SMALL SCALE FISHERIES

**PHAROS4MPAs' core partners**

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PAP/RAC
REGIONAL DEVELOPMENT FUNDS of the N. AEGEAN REGION
AKZM NATIONAL AGENCY OF PROTECTED AREAS
INSTITUTE OF THE REPUBLIC OF SLOVENIA FOR NATURE CONSERVATION
CNR Consiglio Nazionale delle Ricerche
ISMAR Istituto di Scienze Marine
Universitat de Girona

**PHAROS4MPAs' associated partners**

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