Chapter 5
Cruise Tourism Environmental Risks

Hrvoje Caric

Abstract Growth of cruising tourism in Croatian Adriatic is viewed by policy makers as only through financial benefit variables, neglecting perspectives of pollution issues and biodiversity degradation. Cruisers produce environmental damage and risks that are mostly unaccounted for although, paradoxically, they could be avoided or significantly decreased. In this article those claims will be discussed by disclosing environmental risks cruising tourism produces: air emissions, communal and hazardous waste, black and gray waters, eco-toxic metals from antifouling, invasive (alien) species, hydrocarbon pollution, etc. Dubrovnik will be used as a demonstration site to asses environmental risks by using three different sets of indicators: tourism trends, pollution costs, and pollution ratios. The methodology presented here is potentially replicable to other Mediterranean destinations. Paper will close with recommendations for environmental mitigation and monitoring that could help improve quality of existing environmental management practices.

5.1 Introduction

Cruise tourism is new economic, social and environmental phenomena with potential serious impacts on the three pillars of sustainability. This paper will look into the environmental impacts in order to disclose potential hazards in port of Dubrovnik. Subsequently, existing mechanisms to deal with the hazards will be analyzed to determine their effectiveness to mitigate the impacts. This process will use indicators from: tourism trends, direct pollution costs and by comparing environmental loads of cruise tourist vs. local inhabitant.

Goals of the article are:

H. Caric (✉)
Institute for tourism, Zagreb, Croatia
e-mail: hrvoje.caric@iztzg.hr

A. Papathanassis et al. (eds.), *Cruise Tourism and Society*,
DOI 10.1007/978-3-642-32992-0_5,

1. Confirm that the use of sea for tourism and transport is
   - Perceived by policy makers as free resource available for opportunistic exploitation and unlimited in pollution absorption and
   - Serious potential risk for environment.
2. Point to key pollution management issues and discuss possible solutions to some of the pollutions aspects.

The methodology used in this article was desk research and data gathering focusing on potential impacts on eco systems that might appear from the cruise tourism activity. The data gathering on the site level focused on tourism statistics and pollution indicators from existing empirical research and technical standards. This data was then used to calculate pollution loads and costs for Croatian Adriatic and Dubrovnik. Peak day, as maximum saturation situation was used for situation analysis where environmental loads of a cruiser were compared with those of a local inhabitant. Detailed calculations from this paper are available in the PhD thesis of Hrvoje Carić submitted and defended with Institute for oceanography and fisheries in Split (Carić 2011).

5.2 Risks to Environment from Cruisers

Risks to the marine environments are becoming extremely high due to pressures: population growth on the coast, unsustainable and large scale fisheries, exponential growth of merchant fleet, pollution from diverse sources and content, climate change, elimination of high-value biodiversity habitats, etc. National legislative framework and international treaties, conventions and agreements have produced very little protection, and additional pressures like development of large-scale cruise tourism should therefore raise concern.

International Convention for the Prevention of Pollution From Ships (MARPOL) is one of the most important international marine environmental conventions. It was designed to prevent and minimize pollution of the seas, including dumping, oil and air pollution. It was adopted by the International Maritime Organization (IMO) in 1973 and updated in 1978 and therefore is often referred as MARPOL 73/78. The convention includes both accidental pollution and pollution from routine operations through six technical annexes.

MARPOL have defined Mediterranean sea, due to reasons relating to their ecological condition, as Special Area in which is required adoption of special mandatory methods for the prevention of sea pollution. Under the Convention, the special areas are to be provided with a higher level of protection than other areas of the sea. However, since Adriatic Sea is very sensitive, complex, and valuable ecosystem rich in bio-diversity, six countries surrounding the Adriatic have initiated additional and even more rigorous protection one level higher of mentioned Special Area. A request for this protection was to be submitted to IMO titled

Particularly Sensitive Sea Area – PSSA Adriatic, but unfortunately the application was not submitted due to unjustified blocking of a partner country (Carić 2011).

Beside risks emerging from policy making and implementation of existing legislation there are real and significant threats to environmental and human health. In order to understand those here are described two key principles related to pollution paths and their impacts – bioaccumulation and biodiversity.

Bioaccumulation is accumulation of substances, such as eco toxic metals (heavy metals), pesticides or other chemicals in an organism or part of an organism. The process involves the biological accumulation of substances that enter organism through respiration, food intake, epidermal contact with the substance, and/or other means. Higher organism is on the food chain, higher the concentration of substances is going to be in it. For example toxic waste that enters ecosystem from ship waste dumped at sea enters food chain of humans via fish or muscles he or she consumes can create permanent damage (Rawling 1999). In a similar manner viruses and bacteria of human origin can enter marine ecosystem and transfer diseases to flora and fauna.

Biodiversity hotspots – coral reefs have suffered from anchoring that destroy marine organisms and damage sensitive ecosystems (Rogers et al. 1998). Mediterranean equivalent, in both value and risk, would be *Posedonia oceanica* that is listed in Adriatic as both endangered specie and habitat. Its slow growth (cca. 1.5 cm/year), climate change and invasive species introduced via anchors and ballast waters have raised concern over its future and related future of fisheries that directly depend on the health of *posidonia*.

5.3 Direct Pollution from Cruisers

Understanding risks requires understanding the cause-effect relationship of environmental impacts. Activities of cruise ships while anchored, on dock or in movement produce number of emissions that have wide range of impacts on the environment. The materials leaving the cruisers in form of solids, vapors, liquids, particles and energy are:

- Waste (communal, hazardous, floating, Persistent Organic Pollutants)
- Gases (SOx, NOx, Volatile Organic Compounds, particles)
- Nutrients
- Bacteria, viruses and pathogen organisms
- Biocides
- Hydrocarbons (oil and derivates)
- Invasive and alohtone species
- Noise
- Light.

Potential Negative effects of cruise activities on human and nature well-being and health are:

- Climate change
- Respiratory diseases
- Epidemics
- Viral and bacterial contamination
- Contamination with (eco toxic) metals
- Acidification
- Eutrofication
- Smog and ground-level ozone
- Biodiversity decrease
- Fragmentation and deterioration of ecosystems
- Collisions with larger and slower animals (especially mammals like whales).

In order to disclose in more detail the cause (i.e. merchant shipping and cruise activities) – effects relationship some of the environmental issues will be briefly described.

5.3.1 Ballast Waters

Ballast waters transport organisms large distances and introduce them to new locations where they can become invasive and sometime dangerous for humans as for example is toxic phytoplankton *Pfiesteria piscada* or cholera. Smithsonian Institute have also conducted a research of ballast waters in Mexico bay and discovered disturbing findings of cholera in fish, muscles and shells (Rawlling 1999). Cholera originating from ship ballast can be extremely dangerous and have claimed 10.000 lives in South America during the 1991–1994 epidemic (Rawlling 1999). State of California have recognized the threat and banned discharge of ballast waters within their jurisdictions (Dobson and Gill 2006). This was based on number of research conducted, one of those have registered 230 invasive species in San Francisco bay (San Francisco Estuary Project 2009). It is not surprising that IMO, UNDP (United Nations Development Program) and GEF (Global Environment Facility) have proclaimed In their Global Ballast Water Management Programme (GloBallast) that "*Invasive aquatic species are one of the four greatest threats to the world's oceans, and can cause extremely severe environmental, economic and public health impacts*." (http://globallast.imo.org/). In relation to cruise ships some literature have named them as potential contributor to the problem (Copeland 2008, p. 6; Kurtela et al. 2007), however there is no research available to disclose specifics.

5.3.2 Air Pollution

Fuel type, engine type, travel speed, maneuvering and electricity production are all elements that determine air emission production on cruisers. The quantity and

Fig. 5.1 An incident in Dubrovnik (1) Soot discharge, (2) Soot deposited on the sea surface i (3) Pollution remains gathered from the sea surface (Source: Iris Čimić; Dubrovački vjesnik 2009; www.dubrovacki.hr/clanak/8199/aaa)

content can vary significantly but it is known that most cruisers use fuels rich in sulphur which is up to 1,000 times dirtier then the fuel used in the road transport (TRT – Trasporti e Territorio Srl 2007). Ship emissions consist of mainly NOx, SOx, and COx gases, and suspended particles.

Studies conducted in harbor areas such as Vancouver show that pollution coming from merchant shipping is responsible for 95 % sulphur emission of the region that inhabits 2.3 million people (Ware 2002). SOx and NOx gasses from ship's engines when inhaled as aerosols increase probability of asthma or lung cancer 5–10 times as the Los Angeles study showed (US Senate 2007). Smog is combination of fog (moisture) and smoke (gasses form emissions) that, besides described human health, also causes acidification of ecosystems (soil, lakes, green cover, coastal sea, etc.). Furthermore, emissions from waste incinerators can be dangerous for human health what stimulated State of California to ban the ship incineration 20 NM of their shores (State of California Act A.B.. 741 of 2003) Fig. 5.1.

5.3.3 Solid Waste

Content of cruiser solid waste is similar to communal waste. In international waters, ships dispose of the organic waste by grinding it and throwing over board. Fifteen year old study illustrated that shipping in general produces approximately one million tones of organic waste per year, 24 % of which originates from cruisers (NRC 1995). There is evidence that this practice also involves other inorganic waste. In new generation cruisers inorganic waste is incinerated and the ash disposed at sea, whilst in older ships inorganic solid waste is landed ashore (Copeland 2008).

Fig. 5.2 Floating waste probably arriving from Albania have "choked" the Old Port, one of Dubrovnik's main tourist attractions on Christmas 2010 (Source: Slobodna Dalmacija; www.slobodnadalmacija.hr/Dubrovnik/tabid/75/articleType/ArticleView/articleId/ 125165/Default.aspx#)

Plastic waste on surface of oceans has become a global environmental problem. Data gathered from US Coast Guard more than 15 years ago state that annually 1,000,000 birds and 100.000 mammals are suffocated due to plastic waste (NRC 1995). US Academy of Arts and Sciences have estimated that 13,000 pieces of plastic float per square kilometer of an ocean (Jeftic et al. 2005). Charles Moore, an American oceanographer discovered the "*plastic soup*" of waste twice the size continental United States – about 100 million tons of flotsam, floating 500 nautical miles off the Californian coast, across the northern Pacific, past Hawaii and almost as far as Japan (Marks and Howden 2008). Recent research conducted by French Ifremer Institute and University of Liege estimate 500 t of plastic micro-fragments in the Mediterranean sea (Cousteau Society 2011; Terre d'avenir 2010), with potential extreme consequences for contamination of ecosystems and humans Fig. 5.2.

5.3.4 Hazardous Waste and Emissions

Photo processing, laundry, photocopying, general maintenance, medical services, and household chemicals, etc. are sources of hazardous waste. Substances are diverse, ranging from heavy metals such as lead and mercury, to hydrocarbons, chlorinated hydrocarbons, benzene, toluene and other hazardous materials (Commoy 2005). There are serious concerns that cruise ships do not manage hazardous waste properly and that unknown quantities end up in the marine environments (Carić 2010, pp. 167–168). Source of hazardous emissions are also ship incinerators that emit eco-toxic metals and toxic plastic compounds (US EPA 2008).

5.3.5 Eco-toxic Metal Emissions from Antifouling Coating

Ship bottoms are coated with antifouling paints that protect them from algal and other growth by preventing photosynthesis and reproduction through mutation of proteins and enzymes. Antifouling paint contains eco toxic metals such as Cu and Zn that are emitted to the marine environment and accumulate in sediments and organisms, especially mussels, but also fish and humans that consume them. The bioaccumulation and concentration of toxic metals in marine organisms through food chain has a long history of negative effects on environment and health (Kevin et al. 1999). Compounds used in antifouling coating such as tri-butil-copper is banned by IMO conventions, however still significant source of anthropogenic source of metals in marinas and harbors is caused by emission of antifouling. The research available calculating emission speed of eco toxic metals into the environment show that dissolved eco toxic copper (Cu) mass emissions are around 14 μg/cm^2/day (ACE 2000; Schiff et al. 2003; Valkirs et al. 2003) and an estimate surface of a large cruise carrying over 3,000 guests is around 9,700 m^2. Multiplying the 14 μg/cm^2/day with 9,700 m^2 gives the estimated figure of 1,358 g/day or 1.3 kg/day.[1]

5.3.6 Waste Waters

Cruisers emit black, gray and bilge waste waters. Black water are sewage from toilets, and gray water are wastewaters from sinks, showers, baths, washers, ship deck cleaning, swimming pools, saunas, etc. Bilge water is coming from the lowest part of the ship where residues of oil, lubricants, cleaning chemicals and metal and glass shards are gathered. Eutrofication is also known in marine environment as algal bloom – it is a process of dissolving nutrients that entered sea through wastewaters and waste. This process decreases available oxygen in sea and therefore decreases or eliminates marine life. Waste waters are also sources of viral and bacterial infections for humans that come in contact with contaminated sea water through bathing or contaminated fishes and shelves (Clark 2006) Fig. 5.3.

5.3.7 Underwater Noise Disturbance and Collisions

Noise is undermined pollutant that significantly influences marine environment due to increase of traffic and the fact that noise has amplifying effect in water. Source of marine noise pollution are mainly ship engines that create short and long term

[1] Ship surface was calculated from formulas (Hempel 2007) and dimensions of cruiser MSC Poesia, converted (μg/cm^2 to g/ m^2): $14 \times 10^{-6} \times 9{,}700 \times 10^4$, and finally multiplied with the eco toxic copper (Cu) mass emissions of 14 μg/cm^2/day (Schiff et al. 2003)

Fig. 5.3 In front of the Old Port of Dubrovnik protected by UNESCO – waste waters discharge of cruiser MSC Lirica 13.October 2006 (Source: dr.sc. Adam Benović)

Fig. 5.4 Most collision accidents were recorded in Alaska where Cruiser Summit have speared a whale (Kizza 2006; Source: Anchorage Daily News)

disruptions of eco system functioning. For example in Yakutat bay in the last 10 years cruise traffic have increased 10 times while the number of seals have decreased by two thirds (Cohen 2006). There are records of cruiser colliding with large mammals, most likely caused by disorientation caused by noise pollution Figs. 5.4 and 5.5.

5.3.8 Hydrocarbons (Oil and Derivates)

Big accidents in shipping gain allot of attention due to devastating impacts they have on polluted ecosystems and destroyed local economies. However only 2.5–12 % of (Clark 2006; Baker 2001, p 353) total hydrocarbon pollution come from this cause, the remaining majority come from standard operations in shipping such as bilge water management. Although MARPOL, Annex 1 regulates this issue the practice is concerning when consequences are presented such they are in the satellite image below Fig. 5.6.

Fig. 5.5 Cruise ship Sapphire Princess of Carnival Corporation 28th July 2010 discovered 13 m whale while on the route from Ketchikan to Juneauu, Alaska (Stojmenović 2010; Source: Reuters, www.24sata.hr/zivotinje/uginuli-grbavi-kit-zaglavio-na-pramcu-broda-na-aljasci-184472)

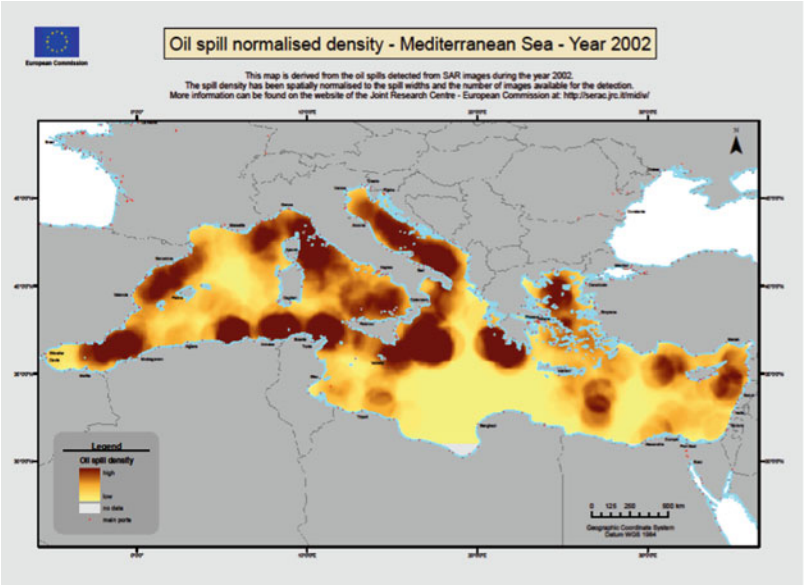

Fig. 5.6 Satellite image of Mediterranean from 2002 show the Adriatic sea shaded as having very high density of oil spill (Source: Joint Research Centre; Miaola et al. 2010)

5.3.9 An Example of Impact on Human Health

There is potential higher risk for human health especially when already polluted ecosystems are additionally polluted in densely populated regions. One of the examples of that type of concern comes from Ma'at Tours, an Australian tour agency operating in Egypt, and is quoted here:

> "*The Egyptian Organization for the Advancement of Children reiterated the conclusions of the Habi Center for Environmental Rights in its report on the pollution of the Nile waters. The studies confirm that every year some 17,000 children die from gastroenteritis caused by*

Fig. 5.7 Typical waste disposal at Nile river (Source: www.maat.com.au/floatinghotels.html)

polluted water. The same study indicated that kidney failure, also caused by polluted drinking water, is four times higher in Egypt than in the rest of the world. It notes that there are some three hundred floating hotels between Luxor and Aswan which are responsible for the pollution of the river water, due to their lack of efficient water treatment systems." (Source: allaboutegypt.org)

Concluding remark for this section could be that there are obvious environmental risks and health hazards coming from cruise ships that require serious consideration and further analysis Fig. 5.7.

5.4 Dubrovnik Case Study: How to Analyze Pollution Flows

Dubrovnik is one of the most significant cruising destinations in the Mediterranean and it takes majority of cruise tourism activity in Croatian Adriatic. In this section three different approaches will be demonstrated in order to illustrate the scope of the environmental risks from cruisers:

- First cruising tourism trends will be discussed,
- Then pollution loads and costs will be presented, and
- Pollution ratio of cruise guest vs. local person compared.

5.4.1 Cruising Tourism Trends

Rapid growth of cruise industry worldwide is evident in statistics. In 1970 there were 1.4 million, in 1980, 3.6 million passengers and by 2006 the growth speeded up to 16 million, increasing 250 % for the 10 year period (Dowling 2006). Current cruising tourism development trends show emphasis on building larger vessels of cca 3,000 or more passenger capacity (Passenger Shipping Association 2006).

Table 5.1 Cruise ship activity in Croatia. Sources: Central Bureau of Statistics 2010 a; Central Bureau of Statistics 2002–2010

Year	Number of passengers	No. Cruise calls (ships)	Days spent	Average stay (days)
2002	225,784	307	624	2.03
2003	420,542	582	1,086	1.87
2004	440,254	420	528	1.26
2005	511,417	456	658	1.44
2006	597,708	565	800	1.42
2007	694,104	628	990	1.58
2008	936,424	822	1,569	1.91
2009	989,272	754	1,264	1.68

Since this trend will mark the future of this industry and will deliver many different impacts on the ports and destinations, this paper is going to consider environmental issues typical for larger ships (over 500 guest capacity).

The Mediterranean is the most intensive tourism region in the world with growing cruise activity that in 2006 made 18 % of the world cruise market (McCalla and Charlier 2006). The growth of cruising tourism is increasing competition and pressure on the coastal resources and infrastructure additionally burdened by the new generation of cruise ships designed as floating resorts of mass tourism that create large environmental burden while providing limited economic benefits to local communities (Clark 2006; Klein 2008). These concerns will be investigated in this paper through scoping of Environmental Risks.

Dubrovnik is an icon of Croatian tourism, basing its attraction on the scenic medieval city and the city walls along with valuable, UNESCO recognized historic heritage that place Dubrovnik shoulder to shoulder with the top Mediterranean cruise destinations such as Venice. The cruising tourism in Croatia is evidencing a rapid growth. The statistics reveal an increase of 4–5 times in only 8 years. In 2009 there were registered 754 cruise trips (with port calls) that have spent 1,264 days in the territorial seas of Republic of Croatia. The 989,272 passengers on the average have spent 1.68 days in Croatia (a 12 % decrease compared to the previous 2008) and most of them have visited Dubrovnik. Compared to the 2008, number of cruise trips have decreased by 8.3 % and total days spent have decreased by 19.4 % while the total number of passengers increased by 5.3 %. The increase in passengers with simultaneous decrease in the number of cruise calls and average time spent in the ports, discloses a possible negative trend. Less time available for cruise guests in ports could mean less money spent in the destination, while the decrease in less ships arriving (cruise calls) with more guests on board means more large, or supersized cruisers with 3,000 or more guest capacity. Those newer types of cruisers as mentioned earlier are perceived as the mass tourism outfits (Weaver 2005) with significant environmental impact (Clark 2006) Table 5.1.

Population of Dubrovnik is 48,795 (Central Bureau of Statistics 2005). It has a long history and international visibility since the Classical Roman period and through famous medieval Republic up to the twentieth century when it started to host tourists.

Table 5.2 Parallel representation of cruising activity in Croatia and share of Dubrovnik port in it

Year	Republic of Croatia Number of passengers	Dubrovnik Number of passengers	Dubrovnik share %	Republic of Croatia No. Cruise calls (ships)	Dubrovnik No. Cruise calls (ships)	Dubrovnik share %
2009	989,272	845,603	85	754	628	83

Tourism capacities of Dubrovnik are 16,500 beds in all types of accommodation (BIST 2010). There are 31 hotels with the most significant 5-star hotels are located just outside the Old City – the zone that is most frequently visited by cruise guests. Cumulative tourism statistics of Dubrovnik are: 520,000 arrivals and 1.8 million overnights in 2009 (Central Bureau of Statistics 2010 b). The region of which Dubrovnik is the capital city (Dubrovnik – Neretva County) account for the total of 957,000 arrivals and 4.3 million overnights (Central Bureau of Statistics 2010b). The region accounts for 62,000 registered beds and this number represents the figure of potential visitors to the city of Dubrovnik, mostly in form of excursions to the old city, however the real statistics of 1-day, non stationary visits to Dubrovnik are not available.

Altogether the tourism intensity from stationary guests can be viewed as relatively high and an additional increase of tourism activity through cruising should result in practice of caution and environmental concern.

Dubrovnik hosts cruise ships on two main (see the picture below) and one alternative location. The Dubrovnik port Gruž holds 70 % and the anchoring area in front of the UNESCO protected Old Town around 30 % of the traffic, and an alternative location for anchoring near island Daksa. Over the 2009, Croatia recorded 754 cruise calls with 989,000 passengers (Central Bureau of Statistics 2010 a). Dubrovnik is dominating Croatian cruise market with shares of 83 % for cruise calls and 85 % for passengers, and this proportion does not represent actual situation due to the fact that Dubrovnik port recently have been through the 20 million Euro worth reconstruction and expansion of docking capacities for cruisers and now docking capacities are 1.205 m in length Table 5.2.

There is an estimation by Dubrovnik port authorities that around half of cruisers are larger ones (carrying 1,000 or more passengers) and that Dubrovnik port is hosting cruisers more than 200 days a year with peak loads in summer months of up to 10 cruise calls with 13,000 passengers in a day (Institute for Tourism 2007) Fig. 5.8.

5.4.2 Direct Pollution Loads and Costs

After viewing cruise tourism rends pollution costs will be allocated to in order to set up a cost-benefit analysis that will indicate financial benefits to the economy and costs to the environment.

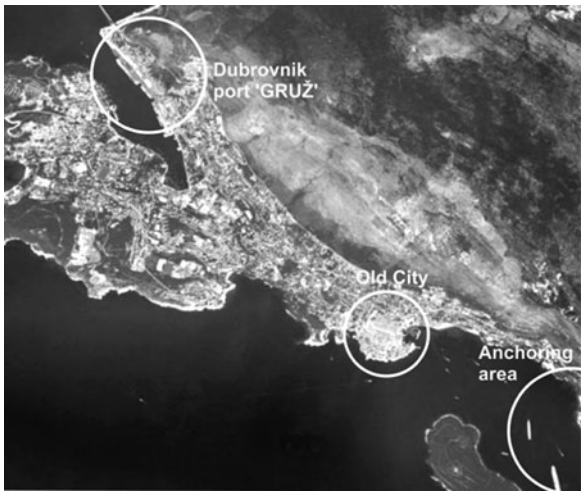

Fig. 5.8 Dubrovnik harbor Gruž is located a couple of kilometers from the Old City. 30 % of cruisers anchor in front of the Old City harbor as well, especially in the peak season (Source: Google Earth)

Table 5.3 Direct pollution loads for Croatian Adriatic and Dubrovnik port in 2009

Pollution type	Daily pollution quantity/guest	Direct pollution for Croatian Adriatic	Total pollution for Dubrovnik port
Solid Waste	4 kg	6,648 t	1,777 t
Air pollution CO_2	0,40 kg/km	1,063,835 t	904,115 t
Black waters	40 L	66,480,000 L	23,676,000 L
Gray waters	340 L	565,080,000 L	201,253,000 L
Bilge water	10 L	16,620,000 L	5,919,000 L
Hazardous waste	0.16 kg	265,920 kg	94,708 kg
Eco-toxic metal	0.45 g	748 kg	266 kg

Note on Air pollution calculation: to calculate the annual emission of CO_2 for Croatian Adriatic in 2009, it is necessary to reasonably estimate the travel route of a typical cruiser. The estimation here is that the vast majority of cruisers visit destinations in Croatia as part of their travel to Venice. This indicates that most cruisers travel the full length of Adriatic to the north and back, totaling approximately 1,600 km (Average length of Croatian Adriatic is 783 km and width is 170 km. Therefore calculation of total CO_2 emission in Adriatic is: 401 g CO_2 × 989,272 passengers × 1.68 days × 1,600 km = 1.063665×10^{12} g CO_2 = 1,063,665 t CO_2. Since Dubrovnik holds 85 % of cruise ship traffic their share would equal 904,115 t CO_2

Note on Eco-toxic metal calculation: is based on commercial prices of extracting and processing contaminated sediment of Gruž harbor. Emissions of metals were calculated based on ships' submerged surfaces and anchoring time. Source: Carić 2011

Total pollution loads calculations for Dubrovnik port were presented in the paper *Direct pollution cost assessment of cruising tourism in the Croatian Adriatic* (Carić 2010). They are based on the multiplications of daily pollution quantities with number of cruise guests and days they have spent in Table 5.3:

- Croatian Adriatic (989,272 cruise guests × 1.68 average days spent) = 1,662,000 guest/days
- Dubrovnik port (845,603 × 0.7 average days spent) = 591,922 guest/days

Direct pollution costs are calculated under assumption that all pollution loads are negative externalities, meaning that pollution is not properly treated and subsequently have an effect on the environment (Carić 2010). The calculation of pollution costs was done based on multiplying above pollution loads with already established costs as presented in the Table 5.4.

Direct pollution costs are between 390 million Euros for Croatian Adriatic and 328 million Euros for Dubrovnik port.

The Institute for Tourism conducted a survey that analyzed the expenditures of cruise ship visitors in Croatia in 2006 (Institute for Tourism 2006). Based on the findings of that report, and subsequent work presented in a study on cruising tourism in Croatia (Institute for Tourism 2007), it was possible to calculate that the total income for Croatian economy from cruising tourism in 2006 was 29–32 million Euros. Since the base year in this study is 2009, this figure should be increased according to the growth in cruise tourism of 65 % from 2006 to 2009. This would give an economic benefit of 47.9–52.8 million Euros for the Croatian economy in 2009. Hence, the analysis equation (cost minus benefit) produces a negative balance of approximately 337 million Euros. Since Dubrovnik share of cruising in 2009 is 85 % the negative balance would be $52.8 \times 0.85 - 328 = 283$ million Euros.

In short, cost – benefit analysis show that cruise tourism pollution costs are more then six times larger then financial benefits.

5.4.3 Pollution Ratio of Cruise Guests Verses Locals: Comparing Environmental Footprints

The calculations presented here compare environmental loads of cruise guests with those of local inhabitants, i.e. the footprinting. Available literature and research indicate that cruising tourist's lifestyle pollutes much more than the lifestyle of local people relating to which the presented calculations are trying to determine ratios that would disclose the proportions. The ultimate purpose of this exercise is to create easy to understand pollution interpretation that can help communication with decision makers and broader public. The comparations are going to be conducted for three groups of pollution: air, waste and waste water. The intensity of cruiser pollution will be analyzed in the context of a typical peak, or a very busy, day in Dubrovnik as it was recorded on May 10th 2008 when five cruisers visited Dubrovnik carrying a total of 12,500 guests (Dubrovački list, May 2008).

The pollution ratios were calculated in a research (Carić 2011) in order to see how many times more a cruise guest pollutes compared to the local person is presented in the Table 5.5 below.

Table 5.4 Estimated direct pollution costs (DPC) for cruising tourism in Croatian Adriatic and Dubrovnik port in 2009 based on EU prices of environmental management charges. Source: Author's calculation (Carić 2010)

Pollution type	DPC (EU)	Unit	Direct pollution for Cro. Adriatic	Direct pollution for Dubrovnik	DPC for Cro. Adriatic	DPC for Dubrovnik
Solid Waste	0.15	€/kg	6,648,000	2,367,688	997,200	355,153
Air pollution	0.24	€/km/passenger	1,582,835,200	1,352,964,800	379,880,448	324,711.552
Black & gray waste waters	0.0089	€/L	631,560,000	224,930,360	5,620,884	2,001,880
Bilge water	0.22	€/L	16,620,000	5,919,220	3,656,400	1,302,228
Hazardous waste	1.53	€/kg	265,920	94,708	406,858	144,903
					390,561,790	328,515,716

Note on Air pollution calculation: Average route of a cruiser is 1,600 km multiplied with 989,272 cruise guests in Croatia for 2009 gives 1,582,835,200 km/passenger. Same goes with Dubrovnik port where 845,603 cruise guests multiplied with1,600 km give 1,352,964,800 km/passenger

Table 5.5 Cruise guest pollution in local person equivalents for the 'peak day' of 12,500 guests

Pollution	Ratios	Peak day visitors from cruise ships
	(in local persons)	
CO_2 air pollution	7.9	98,750
NOx air pollution	11.1	138,750
Wastewater	2.9	36,250
Waste	4.4	55,000

Comparative per capita calculations in the context of the peak day in Dubrovnik produced the ratios of the indicators analyzed here: CO_2 and NOx air emissions, wastewater and waste show that cruise guests have an environmental impact of 7.9; 11.1; 2.9 and 4.4 times more intensive compared to domicile population. The numbers indicate that on peak days like the one observed carrying capacity of the destination could be jeopardized.

The confirmation of this may be found in incidents caused by cruise ships: due to overcrowding in the anchoring area in front of historic part of Dubrovnik cruise ships collided and caused damage to underwater installations (Index 2004), on the other occasion they have slightly collided without serious damage (Dubrovački list 2008). More recently a cruiser have accidentally discharged soot, impure carbon particles resulting from the incomplete combustion, polluting a local beach (Dubrovacki vjesnik 2009).

5.5 Mitigation

Mitigation of environmental impacts from cruise tourism should become a policy priority in destinations such is Dubrovnik. Developing an effective system should be initiated via local decision-makers that should formally commit to environmental quality and ensure effective protection. The system could be generally divided in sections:

1. Monitoring
2. Management of communal services,
3. "Cleaner" solutions for cruise ship operations,
4. Direct ecological threats.

5.5.1 Monitoring : 'To Measure is to Know'

Monitoring changes in biodiversity or analysis of toxic substances in sea and air are priorities in minimum level – basic environmental management. Available scientific and expert methods can produce reliable information on key environmental indicators within reasonable or low cost. Sampling air emissions or opacity approach in monitoring is commonly used and can produce quick and significant

improvements in air quality. Monitoring biodiversity, metal content in sediment, and DNA change in harbor shells or mussels can be done periodically and available methods are not expensive.

5.5.2 Management of Communal Services

Management of communal services needs an accurate charting of pollution flow, i.e. mapping activities and quantifications of solid waste and waste waters. For example, the material flow would show, most likely, that cruise ships are separating waste according to the MARPOL protocol Annex V and that this waste is then improperly managed and disposed. The central waste management site for Dubrovnik and the region with needed recycling facilities and ground filling is not constructed so most of the waste is mixed and dumped in improvised and poorly managed sites. Therefore, expanding the regular waste loads with the ones coming from cruisers, diminish sanitary and ecological safety.

In regards to the waste water management – there is no system available to treat black and gray waters from the cruisers, so it is only to hope that cruise ships discharge wastewaters according to MARPOL protocol Annex IV.

Named waste and wastewater management issues create serious limitations to tourism development. Lack of infrastructure and poor management makes carrying capacity level very low.

5.5.3 "Cleaner" Solutions for Cruise Ship Operations

"Cleaner" solutions should aim at the problems that have significant environmental effect, and are not properly managed. Those kinds of impacts should be treated from the perspective of precautionary principle.

Air pollution is that type of significant pollutant that is not adequately regulated nor controlled. Cruisers burn so called Bunker or No. 6 Heavy Fuel Oil. This is probably the dirtiest fuel available with confirmed serious environmental impacts such as acidification and health-respiratory impacts such as asthma or increased risks of lung cancer. Cleaner solution here can be found in switching to the low-sulphur (Su) fuel that can be conducted quickly and with reasonable economic costs to the cruise operations. IMO have established Emission Control Areas where the sulphur content is 0.1 % in opposition to existing global standard of 4.5 %.

Other significant pollutant is antifouling coating that emits eco toxic metals to marine environment. Eco toxicology is complex scientific field and many parameters contribute to the final impacts on environmental and human health. To mitigate those risks the biocide free options should be considered. For example, Hempel company has developed so called *hydrogel technology* that use non-reactive polymers to prevent fouling organisms from attaching. The efficiency of

the new antifouling system produce cost savings in fuel consumption and maintenance making it a very sound investment (Hempel 2010).

5.5.4 Direct Ecological Threats

There are other impacts to consider such as ballast waters and invasive species, destruction of *posidonia oceanica* due to anchoring, underwater noise effect on sea mammals etc. Available research point that marine ecosystems are under considerable stress. For example, there is already noted presence of invasive species in Adriatic (*caulerpa taxiofolia and racemosa*) also biodiversity reach meadows *posidonia oceanica* are already on the list of endangered ecosystems. Furthermore, an issue like underwater noise that creates problems in communication of marine mammals is under-researched but none the less is a serious problem.

Here are described only a few ecological problems with a purpose only to superficially sketch the risks to marine ecosystems.

5.6 Conclusion

The paper argues that pollution from cruisers and maritime traffic is significant from perspectives of both varieties and volumes – subsequently resulting in potential environmental risks and health hazards.

Dubrovnik is following global trends of higher presence of larger cruise ships that produce more pollution per person onboard and leave fewer earnings to the local communities. Existing stationary tourism is already intensive and additional pressure from cruisers will produce environmental instability.

Therefore, potential of environmental hazards cannot be ignored. Calculations of total pollution loads and costs show that current cruise tourism is being conducted on the expense of the environment. The calculation shows that pollution costs are 6–7 times larger than economic benefits. Confirmation of this can be found in environmental footprinting where comparation of cruise tourist vs. local inhabitant confirm that, due to much larger cruiser tourist footprint, cruisers on a peak day create enormous environmental burden. In numbers: 12.500 cruise gests produce wastes and waste-water as much as whole city of Dubrovnik together, and CO_2 and NOx two to three times the city.

Croatian legal framework dealing with pollution and regulations emerging from the MARPOL convention often are not fully placed in the practice (Carić 2010, 2011). Due to EU integration processes it is expected that waste and wastewater infrastructure and pollution monitoring will improve. This will remove some of negative impacts in relation to solid and hazardous waste, and maybe waste waters, however environmental issues of air emissions, eco toxic antifouling, ballast waters, and endangered marine ecosystems remain. In order to control and mange

the risks and impacts local and national decision makers should moving along the lines proposed in the Mitigation chapter. More concretely *"Cleaner" solutions for cruise ship operations* paragraph offers some alternatives to air and antifouling pollution. Key idea here is to mitigate through imposing more environmentally sound solutions. This practice coincided with environmental management strategy often used: BATNEEC (Best Available Technology Not Entailing Excessive Cost) aiming to propose alternatives that are economically feasible while environmentally friendly. This also presents a marketing opportunity that could additionally stimulate ports and cruise lines to engage in environmental management more seriously. Consumer awareness trend show inclinations to use more environmentally friendly products and services so cruise corporations cannot afford to ignore this fact because they risk being labeled polluting mass tourism business as some concerned stakeholders have already marked them (Cohen 2006; Klein 2008).

At this point cruising tourism is far from the concept of sustainability or sustainable tourism as the World tourism organization promotes it (WTO 2010), making it everyone's concern and responsibility to ensure that cruisers' environmental impacts are monitored, managed and reduced.

References

ACE (2000). Assessment of antifouling agents in coastal environments. MAS3-CT98-0178, Annual Report. Feb 1999–2000.

Baker, J. M. (2001). Oil pollution. In J. Steele, S. Thorpe, & K. Turekian (Eds.), *Encyclopedia of ocean sciences*. London: Academic Press.

BIST (2010). Online statistical system of the Institute for tourism based on the official data from Central Bureau of Statistics. www.iztzg.hr/bist/.

Carić, H. (2010). Direct pollution cost assessment of cruising tourism in the Croatian Adriatic. *Financial Theory and Practice, 34*(2), 161–180. Institute for Public Finance, Zagreb.

Carić H. (2011). Pollution valuation modelling and the management of the marine environment – the case of cruise tourism. PhD thesis. Institute for oceanography and fisheries in Split.

Central Bureau of Statistics (Državni zavod za statistiku) (2002–2010). Selected publications for crousing tourism for periods 2002–2010 (Odabrana izdanja prema programu publiciranja za 2002–2010. Poglavlje: Trgovina, ugostiteljstvo i turizam. Paragraf: Kružna putovanja stranih brodova u Republici Hrvatskoj), Crostat, Republic of Croatia, at www.dzs.hr.

Central Bureau of Statistics (Državni zavod za statistiku) (2005). Statistical yearbook 2004, Crostat, Republic of Croatia, at www.dzs.hr.

Central Bureau of Statistics (Državni zavod za statistiku) (2010a). Statistical yearbook for 2009. Paragraph 25–15. Foreign vessels on cruise in the Republic of Croatia p.419, Crostat, Republic of Croatia, at www.dzs.hr.

Central Bureau of Statistics (Državni zavod za statistiku) (2010b). Report: Tourism – cumulative data for 2009 (Priopčenje: Turizam – kumulativni podaci. Razdoblje od siječnja do prosinca 2009). Crostat, Republic of Croatia, at www.dzs.hr.

Clark, R. B. (2006). *Marine pollution*. Oxford, UK: Clarendon Press.

Cohen G. (2006). Campain to Safeguard Americas Waters (C-SAW): Overview of cruise ship facts, criminal history, regulatory status and threats to the environment. Earth Island Institute.

Commoy, J. et al. (2005). The Environmental impact of cruise ships. American Society of Civil Engineers. Proceedings: World Water and Environmental Resources Congress 2005. Anchorage, Alaska, USA.

Copeland, C. (2008). CRS report for Congress – cruise ship pollution [online]. Congressional Research, No. RL32450. www.ncseonline.org/NLE/CRSreports/08Aug/RL32450.pdf

Cousteau Society (2011). Plastic pollution in the Mediterranean Sea. http://www.cousteau.org/news/mediterranean-plastic-pollution. 2. Feb 2011.

Dobson, S., & Gill, A. (2006). Environmental policy challenges for the cruise industry: Case studies from Australia and USA. In R. K. Dowling (Ed.), *Cruise ship tourism*. Oxfordshire, OX10 8DE.

Dowling, R. K. (2006). The cruising industry. In R. K. Dowling (Ed.), *Cruise ship tourism* (pp. 3–17). Oxfordshire, OX10 8DE

Dubrovacki List (2008). The city hosts 5 cruisers with 12500 guesta. http://www.dulist.hr/content/view/1029/128/.

Dubrovački vjesnik (2009). "Erupcija s cruisera!". www.dubrovacki.hr/clanak/8199/aaa.

Hempel (2007). Coating reference handbook, Hempel A/S Centre for Applied Coatings Technology / Group Technical Service. 9. Edition, 1. Print, November 2007.

Hempel (2010). HEMPASIL X3, BASE 87509 fouling release coating. www.hempel.com/internet/inecorporatec.nsf/vHEMPELDOC/A4269DA5B905F263C1257508004B44EA?OpenDocument.

Index news portal (2004). Izbjegnuta tragedija u Dubrovniku: Brod skoro udario u hotel. http://www.index.hr/vijesti/clanak/izbjegnuta-tragedija-u-dubrovniku-brod-skoro-udario-u-hotel/217764.aspx. 16 Aug 2004.

Institute for Tourism. (2006). *Survey on attitudes and expenditures of cruise ship visitors in Croatia in 2006*. Zagreb: Institute for Tourism.

Institute for Tourism. (2007). *Study of Sustainable Development of Cruising Tourism in Croatia*. Zagreb: Institute for Tourism.

Jeftic, L., Hagerhall, B., & Anianson, B. (2005). *Marine litter*. Zagreb: UNEP.

Kevin, T., Raymond, K., Chadwick, J., & Waldock, M. (1999). The effects of short-term changes in environmental parameters on the release of biocides from antifouling coatings: cuprous oxide and tributyltin. *Applied Organic Chemistry, 13*(1999), 453–460.

Kizzia Tom (2006, August 20). Whale carcass docks in Seward. *Anchorage Daily News*.

Klein, R. A. (2008). *Paradise lost at sea, rethinking cruise vacations*. Halifax: Fernwood Publishing.

Kurtela Ž., Jelavić V., Novaković T. (2007). Štetno djelovanje ispuštenog balasta na morski okoliš. Naše more. 54.

Marks K., Howden D. (2008). The world's rubbish dump: A garbage tip that stretches from Hawaii to Japan accessed. *The Independent*. http://www.independent.co.uk/environment/the-worlds-rubbish-dump-a-garbage-tip-that-stretches-from-hawaii-to-japan-778016.html. Tuesday, 5 Feb 2008.

McCalla, R. J., & Charlier, J. J. (2006). Round-the-world cruising: A geography created by geography? In R. K. Dowling (Ed.), *Cruise ship tourism* (pp. 206–222). Oxfordshire, OX10 8DE

Miola A., Ciuffo B., Giovine E., Marra M. (2010). Regulating air emissions from ships. The state of the art on methodoligies, technologies and policy options. *Joint Research Centre of the European Commission*. Institute for Environment and Sustainability.

NRC – National Research Council. (1995). *Clean ships, clean ports, clean oceans: Controlling garbage and plastic wastes at sea*. Washington, DC: National Academy Press.

Passenger Shipping Association (2006). Discover cruises – Annual cruise review.

Rawlings T., Ruiz G.M., Schoenfeld S., Dobbs F.C., Drake L.A., Huq A., Colwell R.R., (1999). Ecology and ballast mediated Transfer of Vibrio Cholerae 01 and 0139. Conference Paper: 1st National Conference on Marine Bioinvasions January 1999, MIT Cambridge, USA.

Rogers, C. S., McLain, L., & Zulo, E. (1998). Damage to coral reefs in Virgin Islands national park and biosphere reserve from recreational activities. *Coral Reefs, 2*, 405–410.

San Francisco Estuary Project (2009). How boat sewage discharges affect the environment [online]. San Francisco Bay Regional Water Quality Control Board and California Department of Boating and Waterways. Oakland CA, USA. http://sfep.abag.ca.gov/sewage.html.

Schiff, K., Diehl, D., & Valkirs, A. (2003). *Copper emissions from antifouling paint on recreational vessels, Technical Report #405*. Westminster, CA, USA: Southern California Coastal Water Research Project.

US Senate (2007). Legislative hearing on the Marine Vessel Emissions Reduction Act of 2007, S. 1499," U.S. Senate, Committee on Environment and Public Works, 14 Feb 2008, p. 1.

Stojmenović, R. (2010). Uginuli grbavi kit zaglavio na pramcu broda na Aljasci. 24 sata. Petak. www.24sata.hr/zivotinje/uginuli-grbavi-kit-zaglavio-na-pramcu-broda-na-aljasci-184472. 30 July 2010.

Terre d'avenir (2010). Mediterranean endangered – For a sea free of waste. Expédition M.E.D. – Meditteranee en danger. www.expeditionmed.eu/fr/.

TRT – Trasporti e Territorio Srl (2007). External costs of maritime transport. Report prepared by TRT for the European Parliament's Committee on Transport and Tourism, European Parliament Directorate General. Internal Policies of the Union. www.europarl.europa.eu/activities/expert/eStudies.do?language=EN.

US EPA – United States Environmental Protection Agency (2008). Cruise ship discharge assessment report. US EPA Oceans and Coastal Protection Division. Washington. EPA 842-R-07-005.

Valkirs, A. O., Seligmnan, P. F., Haslbeck, E., & Caso, J. S. (2003). Measurement of copper release rates from antifouling paint under laboratory and in situ conditions: implications for loading estimation to marine water bodies. *Marine Pollution Bulletin, 46*, 763–779.

Ware, B. (2002, 15 December). How badly do ships pollute halifax? *Halifax Daily News*, .

Weaver, A. (2005). The mcdonaldization thesis and cruise tourism. *Annals of Tourism Research, 32*(2), 346–366. Elsevier Ltd.

WTO – World Tourism Organization (2010). Concepts and definitions, available at: http://www.world-tourism.org/frameset/frame_sustainable.html Accessed Feb 2010.

Schiff K., Diehl D, Valkirs A. 2003. Copper emissions from antifouling paint on recreational vessels", Technical Report #405, Southern California Coastal Water Research Project, Westminster, CA, USA.

Alexis Papathanassis · Tihomir Lukovic · Michael Vogel *Editors*

Cruise Tourism and Society

A Socio-economic Perspective

The growth and increased popularity of cruises is accompanied by a number of sustainability issues concerning the environment, the port economies and societies; on board and at shore. The sustainability imperative ultimately leads to operational, economical as well as image-related challenges for the sector's decision-makers and stakeholders. This collection of peer-reviewed papaers, presented during the 3rd International Cruise Conference (Dubrovnik, Croatia), seeks to address those issues and contribute to their management in the mid-term.

Business/Economics

ISBN 978-3-642-32991-3

9 783642 329913

▶ springer.com

Papathanassis · Lukovic Vogel *Eds.*

Cruise Tourism and Society

Alexis Papathanassis
Tihomir Lukovic
Michael Vogel *Editors*

Cruise Tourism and Society

A Socio-economic Perspective

Springer