

DIRECT POLLUTION COST ASSESSMENT OF CRUISING TOURISM IN THE CROATIAN ADRIATIC

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Abstract

Cruise tourism is one of the fastest growing sectors of the tourism industry and one that has significant environmental, economic and social impacts on target destinations. Yet, tourism decision makers, developers and managers rarely incorporate or estimate environmental impacts in their tourism development planning. Indeed, the analysis of the resulting resource exploitation is rarely undertaken until carrying capacity is breached and attractiveness diminished. In this article an assessment is offered that determines, quantifies and financially estimates emissions and waste streams so they can be compared with the direct income generated to the local economy by cruising tourism. It is applied to the Croatian part of the Adriatic and financially evaluates environmental impacts, arguing that they are negative externalities due to inappropriate internalization and management. The purpose of the assessment is to give a "snapshot" of the situation, and also to create the groundwork for a model that will assist decision makers and stakeholders, at different levels and of different interests, to prevent and reduce the ecological, health and economic risks associated with dead-end tourism development.

Key words: valuation of environmental effects, environment and development, tourism, pollution control adoption costs, externalities

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1 Introduction

The development of infrastructure, consumption of local resources and the creation of waste are all obvious signs of the environmental effect of tourism (Butler, 1991). The environment of tourism destinations is generally considered to be an open-access system, where multiple users gain advantage from the use of resources and may affect the environment without being held responsible. Sustainable tourism (ST) is a term that has emerged as a reaction to negative effects of tourism on the environment and local communities; it now dominates the discourse of tourism development (Hunter and Green, 1995). Given that the term emerged from the concept of sustainable development (SD), it has inherited its vague, superficial and diverse interpretations. This has resulted in diverse uses of the term in practice and in understanding, evident from its use in various planning, scientific and other policy documents (Hunter, 2002). Sustainable tourism is generally interpreted as a balance between tourist industry development and environmental protection, satisfying the needs of both tourists and local people. However, in practice it remains unclear how to identify the level of environmental degradation that will compromise this balance. The model presented in the article aims to contribute to the clarification of this threshold level by allocating environmental indicators and related direct costs.

Cruising tourism has been promoted in the Croatian media as a possible vehicle for the development of more sustainable tourism in destinations. Although cruising has not been considered as having a major environmental effect, it does bring an additional form of tourism into the coastal zone. Questions remain over the extractive element of tourism, and the subsequent loss of environmental amenity values (Briassoulis, 2002; Ostrom et al., 1999). Although a single user may have little effect on the resource, cumulative use may significantly degrade it. This leads to the issue of admitted responsibility by users, a significant dilemma for addressing a problem that requires collective action (Hardin, 1968). In multiple-use tourism this may be exacerbated, particularly since some groups will be in conflict with and may not communicate with others. In this case it is important to identify and quantify the environmental effects of all forms of tourism. However, answering the question “what is the limit to the growth of tourism at a destination?” can prove to be very challenging for multiple users in complex arrangements. Yet it is possible to examine them individually in a system with clear boundaries, inputs and outputs, such as cruising tourism.

The sudden growth of cruising tourism in the eastern Adriatic has created many different perceptions of its economic effect. The dominant business logic is that cruise ships are a potential market for existing destinations. They present new tourism opportunities, especially beyond the peaks of the tourist season of July and August. This business logic makes sense in itself, but when integrated into the basic three dimensions of SD: economic, social and environmental, it becomes obvious that this “business only” one-dimensional approach generates a huge burden for the environment and yields related negative externalities¹ (Mowforth and Munt, 2003). In the fields of tourism and there marine envi-

¹ Negative externality is defined by Črnjar as any “...impact on any economic activity of producers, consumers or authorities that cause external costs ...those costs therefore are transferred to the society” and the polluter avoids any compensation (Črnjar, 2002:67-68). In other words externalities are “instances where one individual action’s impose a cost on others” (Stiglitz, 2000:80).

ronment there is very little or no available literature or information on negative externalities. Accordingly, this paper offers the calculation of direct pollution costs as the first reasonable step in the direction of the understanding of negative impacts and a possible indication of related externalities, therefore providing a contribution to the emerging field.

2 Methodology

The assessment presented in this paper will review selected environmental impacts and related direct pollution costs (DPC) of cruising tourism in the Croatian context through the following steps:

- determination of pollution aspects and externalities
- estimation of pollution quantities and direct pollution costs
- comparing direct pollution costs with direct income from cruise tourism.

The first stage determines environmental impacts² using available research (scientific and expert literature) and discusses the existing environmental protection mechanisms in the Croatian context to identify their efficiency. The second stage uses official statistics on total tourism activity to calculate the cumulative values of total pollution for a given region in a given time-frame. A monetary evaluation is then conducted by multiplying the total pollution figures with existing calculations of market prices for environmental management services available in the Croatian and EU markets. Finally, the DPC are compared with the previously calculated direct income (Institute for Tourism, 2006) accruing to the local economy from cruising tourism.

Therefore, the purpose of this model is to help prevent Hardin's tragedy of the commons through a DPC assessment that aids decision making or development scoping processes. It complements the following methodologies, concepts, practices and principles:

- Cost Benefit Analysis in Environmental Impact Assessment (MZOPU, 2000: Article 5; UNEP, 2002:272; Hundloe, 1990).
- An "engineering approach" that measures pollution control legislation implementation costs, US Environmental Protection Agency (in Goodstein, 2003:149-152).
- Environmental management strategies and systems³ and a life cycle assessment approach that calculate mass flows and allocate pollution costs in a production process.
- Carrying capacity in tourism "...the maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic and socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction" (PAP-RAC, 1997).

² Literature used in this article that analyzes environmental impacts of "cruise ship" generally refers to those vessels with 1,500 to 3,000 guest capacities and crew capacities of 400-1,200 persons.

³ This is directly related to a variety of concepts/approaches: Environmental Engineering and Technology, Cleaner Production, Eco Efficiency, Waste Minimization, Pollution Prevention. Also represented in EU legislation regarding Integrated Pollution Prevention and Control (Directive 2008/1/EC) and EMAS – Eco Management and Audit Scheme (EC 761/2001), US EPA Executive Order 13148 "Greening the Government through Leadership in Government", and International Standards Organization 14000 series.

- Precautionary principle: “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically” (Hayes, 2005)⁴.

3 The assessment

3.1 *Determination of pollution aspects and negative externalities*

The available literature describes the intensity of cruise ship pollution as significant (Clark, 1986), and potentially damaging to the attractiveness of the target destination (Klein, 2008). Although the public reaction to cruisers is not the subject of this paper, there is growing evidence of opposition to cruisers (Bluewater, 2000). The opposition is based on the premise that cruise ship tourism is neither environmentally sound nor responsible, the fear being that once the environmental quality and attractiveness of a destination is degraded, cruisers can simply move on to the next port. This flexibility and the lack of long-term commitment make cruise tourism a new and unique phenomenon in both tourism and environmental management. The environmental management perspective analyzed here will show that cruisers do represent a new aspect of environmental impact. Pollution aspects analyzed in this section are: solid waste, air pollution, waste waters, and hazardous waste.

Each environmental impact is discussed to clarify and quantify an indicator that will be applied to the Croatian context.

3.1.1 *Solid waste*

Solid waste consists of around 75-85% inorganic waste and 15-25% organic waste. The content of the solid waste generated from the cruisers is similar to that found in household and communal waste, i.e. paper, plastic, glass, food, and kitchen waste. Estimates vary on the amount of daily waste produced per passenger. The US Environmental Protection Agency (US EPA) reports two figures, the first from cruise companies that claim production to be 0.3 to 0.8 kg/person/day. The second from independent sources suggest a higher figure of 2.6 to 3.5 kg/person/day (US EPA, 2008). Yet the Carnival Corporation published the much higher figures of 13.4 to 16 kg/person/day (Carnival Corporation, 2007). Generally average figures suggest an estimate of 2.4 to 4 kg/person/day (Herz and Davis, 2002; Klein, 2003; Commoy et al., 2005; Cohen, 2008). Taking these figures, a week long cruise generates over 50 tonnes of solid waste (Nowlan and Kvan, 2001).

In international waters, ships dispose of the organic portion of solid waste by grinding it and throwing it overboard. Shipping in general produces approximately one million tonnes 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 generati-

⁴ The principle is the basis for European Environmental Law (EC, 2000), Rio Declaration (Principle 15), Convention on Biological Diversity (Preamble), and is used in environmental decision-making in Canada, USA, Australia, Japan, Denmark, Sweden, Germany, and other countries. It is based on the collection of risk information for public health and the environment. At the moment the ongoing debate is whether the principle should embrace the “polluter pays” (i.e. negative externalities) directive and place the responsibility for providing risk assessment on industry.

on cruisers inorganic waste is incinerated and the ash disposed at sea, whilst in older ships inorganic solid waste is landed ashore (Copeland, 2008).

In general waste management in Croatia is in a transitional phase. Currently activities and policies focus on the removal of illegal land-fills and the establishment of a system that will eventually recycle and treat most household and communal waste (CRO EPA – Croatian Environmental Protection Agency, 2007). Although the current waste management system invoices its users, cruisers included, the application of the “polluter pays” principle does not provide sound environmental protection, therefore is a negative externality.

3.1.2 Air pollution

Generally air pollution has a direct and serious effect on human health (Energy Foundation, 2001). Growing research shows increased risk from lung cancer and asthma among children due to transport emissions (Nafstad et al., 2003; Lee et al., 2006; Vineis et al., 2006). In addition, air pollution may have a local smog effect, a regional effect on acid rain, and a global effect with climate change. Air pollution effects such as acid rain, acidification of lakes and seas, and climate change have triggered an array of research and analysis that has identified transport as one of the most significant causes (Hunter and Shaw, 2006).

Air emissions from cruisers vary significantly in intensity and composition, depending on the quality of fuel used, engine quality, speed, manoeuvring, and electricity production. Most cruisers use cheap fuels rich in sulphur which is up to 1,000 times “dirtier” than the fuel used in road transport (TRT – Trasporti e Territorio Srl, 2007). Ship emissions consist of mainly NO_x, SO_x, and CO_x gases, and suspended particles. A study of regional air pollution showed that ship emissions create cancer risks of more than 100 in 1 million for the Los Angeles and Long Beach port areas (South Coast AQMD, 2008). An analysis conducted for shipping transport in Vancouver harbour concluded that ship transportation emissions contribute 58% of greenhouse gases, and 95% of sulphur emissions of the region (Klein, 2003). A Santa Barbara study showed that in their region shipping emits 37% of total nitrogen oxide, and that this will increase to 61% by 2015 (Copeland, 2008). The Carnival Corporation report that on average there is a release of 637kg of CO₂ per cruise ship kilometre or 0.35 kg CO₂ per passenger kilometre (Carnival Corporation, 2007). On average the number of passengers on a Carnival ship is 1,776, which produces an emission calculation of 401g of CO₂ per passenger per kilometre (Starmer-Smith, 2008). An overview of other emission quantities is presented below.

List of emission factors of medium-speed marine engines (Bennis, 2000).

Pollutant emission factor	kg pollutant/ton fuel
Nitrogen oxides (NO _x)	57.0
Particulate matter (PM)	1.2
Hydrocarbons (HC)	2.4
Carbon monoxide (CO)	7.4
Sulphur dioxide (SO ₂)	60.0

Air pollution from cruisers also comes from the incineration of solid wastes. Although there is very limited information on this, it is clear that the new generation of cruisers will rely on this method as a priority waste management option thereby creating a new set of problems. The incineration of plastics has the potential for the release of toxic emissions such as dioxins and other dangerous particles (Carnival Corporation, 2007; RCI – Royal Caribbean International, 2009; Klein, 2003). Furthermore, in order to produce the energy required for incineration, cruiser engines and generators will have to work more and produce more exhaust fumes. The global merchant shipping fleet is expected to triple in size by 2020 and the EU estimates that “emissions of SO₂ and NO_x from ships are a serious concern, as they are expected to exceed those of all land-based sources in the EU by 2020” (EC, 2005, paragraph 4.2.2.3. *Shipping*). The cruising industry is expected to follow the same trend with an emphasis on the construction of large cruisers increasing the problems of air pollution (CruisePage, 2009).

At the moment neither international nor local law enforces any “polluter pays” principle for ship air emissions, despite enforcement on land-based air polluting industries and transport. The dominant international legislative tool is Annex VI of the MARPOL Convention entitled “Regulations for the prevention of air pollution from ships”. This convention has, however, been heavily criticised by environmental groups and experts due to low requirements and lack of effective mechanisms to guarantee significant improvements (Acidrain, 2008; Friedrich et al., 2007). Croatian legislation does not impose any restrictions or charges for cruiser air emissions, and therefore air pollution from cruisers can also be deemed a negative externality.

3.1.3 *Waste waters*

Ship waste waters pose a potential danger for both ecosystems and the humans that depend on them (British Columbia, 2001). Cruise ships recognize three types of waste water: black water – sewage from toilets; gray water – wastewater from sinks, showers, baths, washers, ship deck cleaning, swimming pools, saunas, etc.; and bilge water.

Each passenger produces between 20 to 40 litres of black water (Commy et al., 2005; Cohen, 2008) and 120 to 451 litres of gray water daily (US EPA, 2008; Commy et al., 2005; Klein, 2003). The release of organic nitrates and phosphates from gray or black waters may lead to eutrophication in enclosed seas, ports or bays leading to widespread floral and faunal die-off. Their contents may also include bacteria, pathogenic organisms, heavy metals, and other materials (Kay, 1989; Rawlings, 1999; San Francisco Estuary Project, 2009). Generally only a few newer ships have onboard water treatment equipment and, according to inspections in Alaska, they are of questionable quality and efficiency. Gray water was found to have a high content of faecal coliform bacteria (FCB) and total suspended solids (TSS), and black water did not meet the US federal standards on either FCB or TSS (ADEC, 2001). Furthermore, residue from water treatment left in filters is usually a solid or sludgy residue and regarded as hazardous substance to be treated accordingly.

Many older cruisers do not have waste water treatment plants on board. In this instance waste waters ought to be pumped to port-side facilities. Due to the absence of the

appropriate port-side facilities in Croatia, most waste waters are unaccounted for and should be regarded as an externality.

The bilge is the part of the ship where oil, lubricants, cleaning chemicals and metal and glass shards collect. In order to maintain ship stability and eliminate potential hazardous conditions from oil vapours, bilge water must be periodically pumped out. Before pumping it is processed through an oily-water separator capable of producing an effluent with an oil content of less than 15ppm (ADEC, 2000). Estimates place the production of bilge water to be between 3.3 and 10 litres per person per day, dependent on the ship (Klein, 2003; ADEC, 2000). In addition to variations in quantities of bilge water produced, there are even more significant variations in bilge water toxicity concentration and content.

Although Croatia has official inspectorates responsible for this matter there is no published information on their procedures or findings. Due to the lack of information and ability to estimate the risks the bilge water issue will be considered a negative externality.

3.1.4 Hazardous waste

Hazardous waste on cruisers is a by-product of photo processing, laundry and dry cleaning, photocopying, general maintenance, medical services, and household chemicals, among other things. It is diverse, ranging from heavy metals such as lead and mercury, to hydrocarbons, chlorinated hydrocarbons, benzene, toluene and other hazardous materials (Commoy, 2005). Handling of hazardous waste should be done only by licensed shore facilities.

There is very limited information on the amounts of the hazardous waste produced on cruisers (US EPA, 2008). In their annual environmental report the Carnival Corporation state that average production is between 0.13 and 0.16 kg/person/day (Carnival Corporation, 2007). This corresponds with other available figures of 0.098 litre/person/day (Commoy, 2005). Other hazardous wastes that are often neglected are residues from waste water treatment and incineration. Invariably these are of a hazardous nature due to the concentration of impurities from handling huge quantities of sewage or solid waste. There is little recorded information on the disposal of filter residue from cruiser waste water treatment plants. Furthermore, there is no information on the quality of the maintenance and control of the incineration and water purification equipment, although some reports claim mismanagement (Nowlan and Kwan, 2001).

There are companies in Croatia that deal with the disposal of hazardous waste. Yet the national system as a whole is at best inefficient; research suggests that only 42% of all hazardous waste is officially reported in Croatia (Kučar Dragičević et al., 2006). In absence of an effective system there is clear potential for the illegal disposal of hazardous wastes without incurring costs by cruisers. It can therefore be concluded that hazardous waste is also a negative externality.

3.1.5 Environmental management practices

The following paragraphs discuss pollution aspects from the perspective of cruise management practices that contribute to externality and the tragedy of the commons discourse (also discussed in science literature under “moral hazard”). Cruise companies regularly

communicate care for the environment and a commitment to comply with environmental regulations. This claim is not, however, sufficient to determine the probability of unsound environmental behavior. In the 2003 the Californian EPA stated that “it would be impossible for inspectors to track the disposal path of all onboard generated hazardous waste without cooperation of the cruise line” (EPA, 2008:4-6). The following section seeks to disclose the willingness of the cruise industry to follow rules, regulations and codes of conduct, regarding intentional pollution and illegally dumped waste.

In the period between 1993 and 1998 the US General Accounting Office recorded 104 cases of intentional illegal dumping of wastes from cruisers (General Accounting Office, 2000). In total the cruise industry was fined 30 million US dollars in this period (Nowlan and Kwan, 2001:5). In the ten year period from 1996 to 2006 the US government sued and fined cruisers in the amount of 100 million US dollars (Klein, 2003; Cohen, 2008). This suggests that there is an increasing trend to imposed fines on cruisers, which may indicate an increasing willingness on the part of ships to pollute intentionally and risk being fined. In this regard the following cases illustrate the illegal and intentional environmental misconduct of global cruising companies (Cruise Junkie, 2006; Cohen, 2008; Dobson and Gill, 2006), some of which visit the Adriatic:

- Royal Caribbean was charged in 1999 on 21 counts of tampering with log books, illegal dumping and the obstruction of justice.
- Norwegian Sun admitted dumping 60,000 litres of sewage in the straits of *Juan de Fuca*.
- Carnival Cruise Lines was convicted of dumping oily sludge and tampering with a log book in 2002.
- Holland America’s Westdam cruiser was caught dumping black/gray waters, then later dumping 76,000 litres of wastewater sludge in Juneau harbor in 2001.
- Cristal Cruisers broke a local agreement by discharging 136,000 litres of wastewaters in the Monterey Bay protected area in 2003.
- Close to Miami Norwegian Cruisers dumped hundreds of litres of oily sludge that consisted of toxic and carcinogenic substances. They subsequently paid a one million US dollar fine in 2003.

This is significant because if cruisers are willing to take risks in US waters, which are considered to be one of the most effectively monitored maritime systems, then it does not bode well for cruiser practices in lesser controlled regions, such as the Croatian Adriatic. As yet there has been no public information of similar pollution practices in the Adriatic, and no prosecutions for illegal waste dumping. However the monitoring and enforcement of the Croatian Coast Guard has not been fully operational.

3.2 Estimation of pollution quantities and direct pollution costs

The previous sections outlined the environmental indicators, quantified them and argued for their status as negative environmental externalities, as summarized in the Table 1.

Table 1: *Review of environmental indicators, daily pollution quantities for a cruiser of 3,000 guest capacity*

Environmental indicator	Daily pollution quantity per a cruiser	Daily pollution quantity per cruise guest
Solid waste	10.5 – 12 tonnes	4 kg
Air pollution CO ₂	1,203 kg/km	0.40 kg/km
Black waters	60,000 – 120,000 litres	40 litres
Gray waters	1,020,000 litres	340 litres
Bilge water	30,000 litres	10 litres
Hazardous waste	390 – 480 kg	0.16 kg

Source: *Author's calculation.*

Direct pollution cost calculation

Based on the above indicators, this section will propose calculations of direct pollution cost (DPC). Cost estimations are generated from available government reports (see calculations of air pollution in TRT, 2007) and price lists of companies providing related waste management services in the European Union and Republic of Croatia. This financially weighted DPC is then calculated into the actual cruising tourism activity so it can be compared with the direct revenues of cruising tourism.

Figures of cruising tourism activity in Croatia in 2007 (CBS, 2008) are:

- 1) 694,104 cruise guests entered Croatia;
- 2) Average stay was 1.6 days;
- 3) 1,110,566 guest days in the year calculated by multiplying 1 and 2;
- 4) There was a 16.1% increase of cruise activity from 2006 to 2007.

3.2.1 Solid waste management costs

In Croatia waste management charges vary, but a typical coastal town charges 0.408 HRK/kg (0.057 Eur/kg⁵) (Komunalni servis d.o.o., 2008). This figure is then multiplied with 4 kg/day production of waste (Table 1) and 1.1 million guest days in a year, giving a Croatian waste DPC of 253.7 thousand euro.

EU waste management charges also vary significantly. For the purpose of this study the costs from neighbouring Italy were used. The price is 0.15 Eur/kg (Hogg, 2002), and using the formula above, the EU waste DPC would be significantly higher at 666.3 thousand euro.

According to the official statistics, cruisers visiting Croatia in 2006 were charged 118.4 thousand euro for waste management (Institute for Tourism, 2006). Given the 16% growth in cruise activity from 2006 to 2007, this charge for 2007 would be approximately 137.3 thousand euro. Comparing this figure with the above Croatian waste DPC of

⁵ HRK – Croatian Kuna. Conversion rate used: 1 HRK = 0.14 EUR and 1 EUR = 7.2 HRK.

253.7 thousand the difference is 116.4 thousand euro, almost 50%. This also serves as an indication that much of the waste produced is not treated within Croatian waste management systems as estimated by CRO EPA (CRO EPA, 2007).

3.2.2 Air pollution costs

The European Parliament Committee on Transport and Tourism issued the report "External Costs of Maritime Transport"⁶ that calculates the damage caused by air emission from passenger and cruise ships to be 0.2413 euro (1.74 HRK) per person per km. (TRT, 2007:12, Table 8). The vast majority of cruisers visit destinations in Croatia as part of their voyages to Venice. This indicates that most cruisers travel the full length of the Adriatic to the north and back, totaling approximately 1,600 km⁷.

The Croatian air DPC is estimated to be: 694,104 cruise guests x 1,600 km x 0.24 euro = 266.5 mill euro.

3.2.3 Black and gray wastewater treatment cost

The cost of processing drinking water and treating wastewater in Croatia is approximately 0.0189 HRK/litre (0.00265 euro) (MZOPU, 2008). The cost of similar services within the EU varies according to the available infrastructure, national legislation and other requirements. Generally, costs range from 180 to 800 euro per capita per year (EEA, 2005). Taking an average value of 490 euro per annum and breaking into a daily rate, the average cost is 1.34 euro/day (9.65 HRK) and divided by the average daily consumption of water in EU of 150 lit/day⁸ gives 0.00893 euro/litre. The average daily production of gray and black waters according to the data from Table 1 is 380 litres per cruise guest; when this is applied to 1.1 million guest days per year; it gives a total wastewater (gray and black) of 422 million litres emitted in 2007.

The Croatian DPC cost is total wastewater of 422 million litres multiplied with 0.00265 euro = 1.1 million euro. The EU wastewater DPC is total wastewater of 1.1 million guest days multiplied with 1.34 euro/day = 1.5 mill euro.

3.2.4 Bilge water treatment cost

Bilge water from engine rooms is considered hazardous liquid waste and is produced in the amount of 10 litres a day per guest. The cost of treatment of oily water in Croatia is 1.55 HRK/litre (0.22 euro/litre) (HWMA, 2008).

The Croatian bilge DPC is 1.1 million guest days multiplied by 10 litres per guest per year multiplied by 0.22 euro/litre = 2.4 million euro. EU prices for this service were not available; hence it is assumed that they would be the equivalent to the Croatian prices.

⁶ Methodology used is Impact Pathway that calculates impacts of each subject (i.e. ships in different categories) and produces monetary valuation for impact factors: greenhouse gas, air quality, discharges at seas, waste and resource consumption.

⁷ Average length of Croatian Adriatic is 783 km and width is 170 km.

⁸ ATV – A118 Standard: Hydraulic Dimensioning and Verification of Drainage Systems.

3.2.5 Hazardous waste management cost

The cost of treatment of hazardous waste in Croatia is 24 HRK/kg (3.36 euro/kg) (HWMA, 2008). Cruisers produce 0.16 kg per cruise guest a day⁹.

The Croatian hazardous waste DPC is 1.1 million guest days in a year multiplied by 0.16kg = 177.7 million kg/year x 3.36 euro/kg = 597 thousand euro.

EU hazardous waste management costs vary from 0.22 to 2.28 euro/kg (Hogg, 2002). For this calculation the mean value of 1.53 euro/kg yields a EU DPC cost of 271.9 thousand euro.

3.3. Cost-benefit analysis

Cost-benefit analysis (CBA) is the highlight in processes such as environmental impact assessment because it aims to assist a decision maker to grasp the effects of an activity, a plan or a policy (Hundloe, 1990). For this purpose CBA is limited to a simple comparison of direct pollution costs with direct revenue from cruising tourism.

The findings of the negative externality calculations for the five selected indicators are presented in Table 2. In total, pollution costs are estimated to be around 272 million euro. The largest proportion of the DPC is from air emissions, approximately 98%.

Table 2: Estimated quantities and direct pollution costs of negative externalities for Croatian cruising tourism in 2007 based on Croatian and EU prices of environmental management charges

Indicators	Quantity	Unit	DPC		Unit	Sum for DPC, in thousands of euro	
			CRO	EU		CRO	EU
Solid waste	4,442,264	kg	0.057	0.15	€/kg	254	666
Air pollution	1,110,566,400	km	0.24	0.24	€/km	266,536	266,536
Black and gray waste waters	422,015,080	lit.	0.0026	0.0089	€/lit	1,118	3,769
Bilge water	11,105,660	lit.	0.22	0.22	€/lit	2,443	2,443
Hazardous waste	177,691	kg.	3,36	1.53	€/kg	597	272
						270,948	273,686

Source: Author's calculation.

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, 2007:74.), it was possible to calculate that the direct income for the Croatian economy from cruising tourism in 2006 was 29 to 32 million euro. Since the base year in

⁹ The amount is calculated from Table 1: 85 lit/3,000 cruise guests.

this study is 2007, this figure should be increased according to the growth in cruise tourism of 16% from 2006 to 2007. This would give an economic benefit of 33.7 to 37.2 million euro for the Croatian economy in 2007. Hence, the CBA equation of DPC minus direct income produces a negative balance of approximately 238 million euro.

4 Discussion

The environment is tourism's most important resource. At a tourism destination, tourists compete for the same resources, among each other and with the local community. Often the effect on the environment is overlooked, and only when tourists complain of overcrowding or loss of amenity values is carrying capacity considered. Apportioning blame for environmental decline is difficult without clear environmental protection cost calculations that can be presented to tourism managers and the industry as a whole. The analysis shows that cruisers can create large negative externalities due to the lack of appropriate systems to manage environmental protection. There are however other general shipping environmental impacts that have not been considered or quantified.

Antifouling paints emit bio-toxic metals in marine environments and pose a direct threat to both living marine organisms and humans through bio-accumulation processes. Ballast waters are recognized to have transported numerous organisms world-wide, introducing them to new locations where they become invasive and sometime dangerous for humans. Of particular concern is the spread of *Caulerpa spp.* which places the future of the sea grass meadows and the ecosystems they support in jeopardy. Cruisers may also physically disturb an environment; inappropriate anchoring may disturb biodiversity hotspots (Rogers et al., 1988) such as *Posedonia oceanica* meadows. Noise is often neglected as a pollutant, whilst in reality it is very significant due to the increase of marine traffic, and the fact that noise is amplified in seawater. This can have a significant effect on both fish and marine mammal populations (Kizzia, 2006). Marine litter, particularly plastic waste on the surface of oceans, has become a global environmental problem. It is estimated that up to 13,000 pieces of plastic are afloat in every km² of open ocean (Jeftic et al., 2005; Marks and Howden, 2008). Another potential environmental indicator not analyzed here is the impact of the journey that the cruise tourist takes to and from the cruise ship, before and after the cruise takes place. Hence, there are many other environmental aspects to be considered, with possible significant and unrevealed effects on the environment and human health.

This paper does not address the multiplier effect of cruise tourism economy¹⁰, but only the direct contribution made to the local economy based on the survey (Institute for Tourism, 2006). Why? As was explained, there are immeasurable multiplying "domino" effects in damage that occur when the environment is polluted. This damage is most likely transferred to human systems in the form of reduced economic opportunity and health risks. Although there are different attempts by scientists to assess ecosystem values, the ecological damages and related multiplier effects of that damage are rarely discussed in the literature. At best, in very rare occasions such as large oil spills, they are consid-

¹⁰ The multiplier effect in economy was introduced by Keynes and refers to the idea that an initial spending leads to a number of subsequent spending multiplying the initial amount by a factor.

red an opportunity cost. Therefore, only direct and measurable effects were considered, for both the environment and the economy.

5 Conclusion

The sustainable development concept has significant difficulties finding its way in practice. Even new forms of mass tourism such as cruising tourism in Adriatic are welcomed and rarely viewed together with their environmental, economic and social sustainability impacts.

The model presented here focused on the environmental field of sustainability, defining solid waste, air pollution, waste waters (black, gray, bilge), and hazardous waste as measurable indicators for which an estimation of mass (pollution quantities) and related costs was conducted. The outcome of the calculation for the Croatian cruising tourism activity in 2007 is that the total cost of the negative externalities is seven times larger than the benefits to local economy.

This is a typical “intervention failure” where one industry is preferred by decision-makers over the other sectors (Garrod, 1995), or “information failure” where government, as a result of not possessing and not having gathered the information, does not intervene to protect the resource (Stiglitz, 2000:83). Since the environment is a finite resource, as the above evidence shows, the Adriatic exhibits the characteristic problems of common pool resources: overuse and a lack of incentive to invest in maintaining or improving them (Healy, 1994).

Although cruising corporations are not to be blamed for the lack of domestic or international regulations, they take advantage of an imperfect system to utilize common resources they do not own nor maintain. The absence of effective polluter-pays regulations and other control mechanisms in the cruising industry leads to a situation where the majority of users are free-riding. In the absence of clear rules of management and enforcement of environmental legislation this style of marine management could lead to a tragedy of the commons of global proportions.

As the current transition anomalies of Croatian society do not allow for fully transparent involvement of civil society or community interests in tourism development issues (Machelworth and Carić, 2009), DPC assessment contributes to the needed clarifications of basic environmental costs of new activities such as cruising. Information needed for the assessment presented here is related to pollution: aspects, quantities, costs, charges, and environmental management mechanism effectiveness. DPC calculation provides quantifications (volume, mass, and monetary) that describe the risk to the resource and signal to the environmental managers/policy-makers the crucial points of intervention: solid waste, hazardous waste, bilge, wastewaters and air emissions. All of the named aspects can be significantly mitigated and there is a wide variety of tools at the disposal of the executive government on all different levels: from technological and fiscal to organizational. The choice of tools and interventions will depend on the context, but most of all on proper inter-disciplinary monitoring. Without monitoring it is impossible to define carrying capacity that consists of the three elements (Carić, 2010): sensitivity of eco-

system, state of national and/or municipal environmental management system, and development and societal interests of local community.

Limits set by carrying capacity calculation are crucial for participatory and transparent development planning process that does not give preferential treatment to any specific interests (Carić and Marković, 2010), and represent the next logical step in the development of this model.

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