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Report on the state of the art – Overview on impact of tourism on marine coastal ecosystems

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TOURISM, A FUTURE CHALLENGE DRIVING WORLDWIDE ECONOMIES AND ENVIRONMENTAL CHANGES

Impact of tourism on wastewater production, services and management - Overview on the impact of tourism on marine coastal ecosystems due to increase in wastewater production and on legislation of different areas of the Mediterranean. Management practices adopted to minimize and/or mitigate such impacts will be critically analysed and a new strategy will be proposed to foster sustainable tourism.

Impact of tourism on coastal marine ecosystems due to wastewater: in general, and in small islands with high seasonality of tourism. Tourism represents a fundamental economic strategy for many cities, regions and countries around the world, therefore, this developing and growing sector is becoming also one of the main drivers of global environmental change showing to have deleterious effects on a number of critical environmental vectors such as water (Gössling, 2002). It is increasingly recognized the significant role of tourism in contributing to undesirable socio-economic and environmental change, including biodiversity loss and climate change (Hall, 2010; Hall and Lew, 2009; Scott et al., 2012a, 2012b; Hall et al., 2013).

In this context, the coastal areas, transitional areas between the land and the sea, globally characterised by a very high biodiversity and fragile ecosystems, are under a very high pressure due to both the rapid urbanisation process and the displacement of the highest concentration of tourist activities. The development of tourism in the Mediterranean basin raises special concerns mostly regarding water because of summer droughts and large concentrations of seasonal tourists; moreover, the coastal areas concentrate most tourist settlements and the largest number of visitors (Rico-Amoros et al., 2008). Due to its nature of semi-enclosed basin shared among countries and regulated by several different directives of environmental protection (e.g. EU Water Directive, Marine Strategy Framework Directive; Barcelona Convention; Mediterranean Action Plan; European Neighbourhood Policy), as well as to the highly recognised naturalistically value, the Mediterranean Sea is affected by tourism among other human activities (Cole et al., 2010; Coll et al., 2010; Borja et al., 2016; Pınarbaşı et al., 2017). The Mediterranean region is one of the world's top mass tourism destinations and the tourist flows to this region are under constant increase (4 % of the world total in 1990 and 6% in 2005). Generally, the tourism's trades benefit from the quality and variety of the region's natural heritage and landscapes (Eurostat/European Commission 2009). Tourism

represents the first economic activity for islands like Cyprus, Malta, the Balearic Islands and Sicily. A Mediterranean forecast study performed by the UN World Trade Organization (UNWTO) estimates that the international tourist arrivals to the coasts will amount to 270 million in 2010 and to 346 million in 2020 (in 2000, data estimations were of around 200 million foreign visitors *per year*).

Tourism can create a great pressure on local resources such as energy, food, land and water, which are often in short supply in Mediterranean coastal countries. According to the Europe Environment Assessment (EEA, 2003), the direct local impacts of tourism on people and the environment at destinations are strongly affected by its concentration in space and time (seasonality). Among the environmental impacts due to tourism we can list: *i*) intensive use of water and land by tourism and leisure facilities; *ii*) delivery and use of energy; *iii*) changes in the landscape due to the construction of infrastructures, buildings and facilities; *iv*) air pollution and waste; *v*) damage and destruction of vegetation; *vi*) disturbance of fauna and local people (as an example by noise). All these impacts generally threat local biodiversity and produce a local deterioration of environmental quality.

Tourism and wastewater production effects on the marine ecosystems. One of the main impact of tourism on Mediterranean coasts is mostly recognised in terms of wastewater production; the well-known close relationship between the tourism boom along the coasts and its visible effects on seawater quality has driven the biggest amount of economic and technologic investments to the wastewater management to produce an improvement of environmental quality (Gabarda-Mallorquí et al., 2016). The heterogeneous discharge of untreated wastewater into aquatic and/or marine ecosystems is one of the main environmental threats generated by tourist activities and may result in the pollution of valuable water resources (Stonich et al., 1988). The increasing trend of wastewater production due to tourism generally happens when the level of visitor use is greater than the environment's ability to cope with this use within acceptable limits of change (environmental carrying capacity). Additionally, several other factors can boost sewage production in space and time, generating local unbalance to the marine ecosystem, and specifically: *i*) the presence of undersized or not technologically developed treatment plants, *ii*) the seasonal illegal discharge and climate change-related factors, such as sea level rise (cause of flooding and wastewater facility damages *sensu* Phillips et al., 2015), *iii*) the diverse range of actors and activities in the tourism sector, *iv*) the absence of advanced monitoring technologies (e.g. remote control, automatic analyses of nutrients) and affordable civil construction techniques ("light" piping)

and electronic pump equipment (Oelofse and Godfrey, 2008), v) the lack of monitoring enforcement and policy implementation, as well as vi) the lack of analytical basis for decision-making, including environmental data, and economic information on the environment (e.g. environmental expenditure, environment-related taxes, resource prices, employment; OECD, 2010). Water consumption and wastewater production may differ depending on the predominant land use patterns and the associated densities (*i.e.*, campsites, hotels, holiday resorts, apartments, residential homes, etc.), two crucial variables for understanding the economic, social, and environmental effects of tourism (Gössling, 2002; Gössling and Hall, 2006). Moreover, each tourist location has its own unique tourist sector profile in terms of seasonal variability, proportion of holiday homes and day visitors relative to its permanent resident population, variable itinerant population, and industrial and commercial demands. Therefore, a common framework can simply explain the mechanism acting under the environmental consequences of tourism.

The increase of tourism [generally due to the presence of high local environmental quality (e.g. natural landscape and high biodiversity) plus socio-economic reasons (e.g. presence of infrastructures, good food and historical heritage)] generates, as a direct consequence, the increase in wastewater production and load at sea. From here, a set of cascade events may generate: the nutrient increase produces a local productivity increase with consequent eutrophication phenomena that facilitate a dramatic loss of both local biodiversity and water quality. Of special concern is the alteration of important ecosystems providing natural cleaning services to the water column, hosting high level of biodiversity, and providing ecosystem goods and services to the society (*e.g.* mussel and oyster beds, vermetids reef, *Posidonia oceanica*, coral reefs, coastal wetlands; UNWTO 2010; Beck et al., 2011; Milanese et al., 2011; Campagne et al., 2015). The loss of environmental quality and biodiversity leads to direct negative consequences on tourism through the alteration, degradation and loss of nature-depending simply ecosystem services, such as seawater quality, biodiversity, presence of key-stone and/or umbrella species, highly attractive for the visitors. According to UNEP, *“Failure to incorporate biodiversity concerns in destination planning and investment will have detrimental effects on the natural environment, increase conflict with local communities, and lead to reduced value-creation potential for both the destination and investors (notably as interest in nature-based tourism is growing rapidly around the world)”* (UNEP, 2011).

Interestingly, the tourism industry shows a double-faced nature, it can provide opportunities for backward and forward economic linkages, foreign exchange earnings, economic diversification, increased income, employment and poverty reduction, and on the other side, it

may threaten the preservation of culture and environmental resources, vital amenities for attracting tourists. Based on these considerations, there is a wide consensus on the importance to address national strategies and to make efforts to minimize the adverse impact of tourism on the environment and on cultural heritage. If the role of tourism in structural economic progress and sustainable development is a well-recognised topic on the international agenda, *“how to make tourism more sustainable and contribute to developing countries’ sustainable development objectives is still a challenge that requires urgent attention”* (litt. United Nations Conference on Trade and Development 2013 TD/B/C.I/EM.5/2).

Some authors have recently underlined that the tourist sector has forced public administrations to minimize the environmental impact derived from tourist activities (e.g. wastewater treatment has contributed to achieve improved and optimal bathing conditions in beaches; Gabarda-Mallorquí et al., 2016). Generally, all the water-related management costs have been progressively financed by tax-payers in addition to private capital, to date probably considered as the only way to maintain present infrastructures and to invest in new ones. To date, measuring and assessing the impacts of tourism represent a key goal recommended by the Mediterranean Strategy for Sustainable Development (MSSD), which suggests to take into account environmental, social and economic issues, in line with the global requirements of the 10YFP Sustainable Tourism Programme (SDG 12.1), a platform to bring together and scale up existing initiatives and partnerships, and facilitate new projects, to accelerate the shift to sustainable consumption and production (SCP).

The articulated legislative patchwork. To establish for a common legislative framework across the Mediterranean basin can represent a true challenge due to its articulate geographic structure and political nature. The competition for water resources and complex institutional constraints has generated multiple viewpoints; the decision-making process is often lengthy and involves many participants to include various stakeholders, factors of the human environment, and aspects of natural water systems (Bogdanovic et al., 2011). A wide set of structural and non-structural measures has been historically applied to control/manage natural and human-made water resource systems. Numerous sources of law are applied into the Mediterranean region; specifically, the Middle East and North Africa East Mediterranean countries (Jordan, Syria, Lebanon, Israel, and the Occupied Palestinian Territories), particularly in the big cities, have shown incoherent legal framework for water management (Bogdanovic et al., 2011).

In this context, the Water Framework Directive (WFD) (2000/60/CE), approved by the European Parliament in 2000, represents the starting point for an integrated water resource management and the improvement of aquatic and marine ecosystems for the Mediterranean EU countries. This was seen as a “modern Bible for water managers” by promising to break up the poor record of ineffective legal instruments, maladapted to the needs posed by reality and the expectations of the Europeans (*sensu* Bogdanovic et al., 2011). In fact, due to the WFD, all the European states should adopt the proper mechanisms to achieve the main European Union principles, specifically, the environmental improvement of water bodies must go through the management of wastewater treatment systems funded by public administration. The directive represented a breakthrough in European Water Policy, it has been developed by the European Commission, right from the start, in an open and transparent way involving all stakeholders, NGOs and the scientific community; affecting 27 countries (15 Member State countries and the 12 pre-accession countries which should conform in the long term with Community law). Additionally, since the last decade it marks an important trend towards an ecosystem-based approach for water policy and water resource management (Kallis and Butler 2001). The overall goal of the WFD is a non-deteriorated “good status” for all waters (surface, underground and coastal). This directive has effected considerable changes in national legislative statutes even in the countries with the most developed environmental regulation. By the WFD, a surface water is in a good ecological quality status if “*there is only slight departure from the biological community that would be expected in conditions of minimal anthropogenic impact*” (a standard process is provided for defining local standards). Quality elements for assessment are: biological elements (*e.g.* composition and abundance of flora and fauna), hydro-morphological elements (*e.g.* depth variation, structure and substrate of the coastal bed conditions, the structure of the intertidal zones, tides, current, waves exposition) and supporting physico-chemical elements (*e.g.* thermal/oxygenation conditions, salinity, nutrients, etc.) for rivers, lakes, transitional and coastal waters and also “artificial/modified” waters (created or resulting from a human physical modification and serving economic activities). For each element, a descriptive definition of a high, good, moderate, poor and bad status is given. Each authority has set standards for the elements most relevant to the pressures faced by the water body under its responsibility and classified waters accordingly. The WFD promotes a process which coordinates the sectors of conservation, management and development of water, land and related resources by maximizing the economic and social benefits (*ecosystem services*)

derived from water resources (*ecosystem goods or functions*) in an equitable manner, while preserving and, where necessary, restoring ecosystems (Bogdanovic et al., 2011).

Since 1991 and prior to the WFD, the “Urban Waste Water Treatment Directive” UWWTD has provided for an obligation to collect and treat wastewater from all settlements and agglomerations; set the treatment objective as a rule as secondary treatment (biological carbon removal), plus for nutrient removal (in the catchment of all areas being either eutrophic or potentially eutrophic); defined eutrophication and the catchment of waters suffering from this phenomenon giving clear guidance for technical, financial and political decision; set staged deadlines of 1998, 2000 and 2005, depending on the size of the waste water discharge and the characteristics of the affected water. Among the objectives reached by the UWWTD, there is a compliance rate of about 2/3 of the pollution load covered by the 1998 and 2000 deadlines, leading to significant improvements in water quality. The UWWTD as for the future, underlines and recommends the need to ensure adequate performance of constructed treatment plants, and a transparent and accessible reporting system.

Mitigation and adaptation solution to feed more holistic management strategies and plans in the next future. Planned strategies to monitor seawater quality should be applied in monitoring the impact of tourism, when focusing on wastewater production and the related sewage issues (e.g. recycling and reuse; Kamizoulis et al., 2003). Scientists and stakeholders should also move from the classical monitoring strategies to more proactive and integrated management plans, promoting the application of mitigation/reduction and adaptation measures as similarly done, since a decade, in the framework of climate change and the related climate adaptive management plans (IPCC 2007).

In fact, up to date, no efforts have been made to mitigate the impact of tourism wastewater *once at sea*, instead, more frequently solutions have been suggested at the production/origin sewage sites (e.g. wastewater treatment plants; beach resorts).

In the next future, the traditional national monitoring plans should be adapted with the integration of *in situ* early warning indicators of impact, building tailored mitigation strategies replying to local, seasonal, nature and charge of sewage impact. Similarly, no efforts have been made to adapt to the presence of sewage impact by applying *in situ* biological or chemical-physical structure able to reduce or, at least minimise, the local organic load at sea (e.g. filter barriers). The alteration of the ecosystem carrying capacity, due to the local wastewater emission, can be balanced and buffered using biological solution by, as for example, placing selected species able to use (e.g. ingest or store) the inputs from the land

(e.g. nutrients, organic matter, pollutants) in proximity to the “receiving environment” (the marine area in front of a sewage). In the next future, scientists should apply their knowledge to test “buffering model species” more efficient in filtering wastewater and clean it, developing single species or multi-trophic sets of species able to buffer the sewage generated by tourism. Several species from vegetal to animal real are already well-know and have been widely studied in natural ecosystems as able to provide remediation solution; macroalgae, phanerogames, and invertebrate filter-feeders or deposit-feeders can feed on fluxes of nutrients and organic matter from external input (i.e. anthropic origin). This routinely happens within Integrated Multi-Trophic Aquaculture - IMTA - whose working principles might be translated in proximity to highly urbanised areas to reduce the impact of wastewater resulting from tourism activities.

Based on this overview, the strategy proposed to foster a sustainable tourism must be based on a holistic approach, where policies for tourism and the climate need to be in place for efficiency measures to be long-lasting in the next future, including, as an example, the conservation of specific coastal landscapes or habitats that make the area attractive or are protected under nature conservation legislation and the application of Integrated Coastal Zone Management models. A mitigation strategy to reduce the impact of tourism industry should not only be based on monitoring and mitigation measures, but also additionally on the integrated approach of cooperation among the main tourist sectors and related actors.

A winning mitigation strategy should be based on a holistic and integrated approach, including environment (conservation needs), economy (stakeholder interests, local authorities, policy makers) and society (end-users, both tourists and residents). Efforts to have clear evidence-based tourism’s target impact reductions could be scaled up, so tourism can further lead in the change towards sustainable consumption and production. A more sustainable strategy to tourism management should ensure the following:

- (a) Make optimal use of environmental resources that constitute a key element in tourism development, while, at the same time, maintaining ecological balances and helping to conserve natural heritage and biodiversity - Creating awareness of how environmental damage can reduce the attractiveness of destinations.
- (b) Ensure viable, long-term economic operations, providing socioeconomic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation - Providing tourism firms with access to market information and financial resources and

Enhancing coordination between government departments dealing with tourism and the environment and private investors in the tourism sector.

(c) Respect the sociocultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to intercultural understanding and tolerance.

Knowledge baseline and stakeholder involvement. As the overall absolute emissions for tourism companies remain untracked, we need better measurement (statistical data), which will in turn lead to better management (mitigation measures). The mitigation of the impacts should pass through a more in deep-knowledge and monitoring of the existing wastewater plants (statistical should be made available on the size and the effectiveness of existing plants) to set-up improvement plans and to address the sectorial technologies in producing more performing solutions in order to better tailor feasible economic plans and to propose them to local authorities and managers (cost-effective solutions with less impact on end-users). Impacts should be monitored paying more attention to the detection of illegal undersized discharges, generally showing a seasonal nature due to the increase of tourism in specific months (summer season), again with the application of a more strictly enforcement of local, regional and European rules.

To specifically monitor the “tourism and environment” and more in detail the “tourism and water” issue, new indicators should be defined to take into account:

- the characteristics of the tourism sector, or rather hotels and other types of accommodation (campsites, rentals, ungraded hotels), forms of rural accommodation, non-market accommodation (with family or friends, second homes), informal accommodation (bed and breakfast, rental of apartments, villas);
- the identification of water-consuming-waste-producing tourist activities and facilities (swimming pools, golf courses, amusement parks, well-being centers);
- the characteristics of the water sector, or rather water consumption of tourism establishments (monthly/seasonal), type of water resources used, identification of consumption points, volumes of water treated and re-used; identification of informal uses of water, inventory of private wells and of tapped volumes;
- the monitoring of seawater quality and the implementation of mitigation measures.

Local administration, stakeholders and scientists should *i*) promote the monitoring of tourism nature and the connected impacts (Gössling, 2006) - Analysis of status-quo; *ii*) generate

transnational and regional cooperation plans and projects - a cross-border stakeholder analysis; *iii*) improve local value chains on the ground; *iv*) create more attractive products for local markets; *v*) increase awareness in end-users on the importance to respect and protect the environment because of the ecosystem services they provide. The participation of all stakeholders is essential; local authorities, financial institutions, and companies that promote innovation and embrace employee ideas are essential enablers for tourism impacts' measurement and reporting and for society involvement.

Investment of promotion agencies can also play an important role in reaching out to foreign investors, guiding them towards sustainable development, and targeting investors in economically, socially and environmentally sustainable projects. In the end, a better dissemination and communication of the existing information should be achieved. For that purpose, a better coordination of the existing governmental bodies that deal with coastal management is necessary, as well as an improvement of the environmental education is essential for a sustainable development of the coast.

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