CleanSea

Towards a Clean Litter-Free European Marine Environment through Scientific Evidence Innovative Tools and Good Governance

Scientific Paper Portfolio

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Approved by	H. Leslie, Coordinator
Dissemination level	PU

SEVENTH FRAMEWORK PROGRAMME

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1 Executive Summary

This deliverable aims to present and give access in a consistent manner to CleanSea project research scientific results, which have been or are about to be published as scientific papers in peer reviewed journals.

During the three years of the project, 11 papers have been published in a series of journals covering both natural and social sciences findings. This number increases as to the planned publications as a good number of results are being consolidated at the end of the project life. There are already 12 scientific papers either on the pipeline, under review or under development. More results are expected to come available through publications in the near future.

The document presents first the overall picture through two tables devoted to published papers or those under development. Later on the document introduces each paper through a summary sheet including more in-depth information, the project abstract and a link to the publication when available.

All and all the intention is to provide structured, easy and clear access to the wealth of knowledge generated by the project.

2 Summary table of scientific publications during the project life

SCIENTIFIC PUBLICATIONS ALL PROJECT LIFE

No	Main leader	Main author and other authors	Title	Date	Place	Size of audience	Status
1	UNEXE	Micheal Depledge-UNEXE	Plastic litter in the Sea.	2013	Marine Environmental Research, 92, 279-281	2337	Published
2	UNEXE	Galgani F, Claro F, Depledge M, Fossi C.	Monitoring the impact of litter in large vertebrates in the Mediterranean Sea within the European Marine Strategy Framework Directive (MSFD): contraints, specificities and recommendations.	06/07/2014	Marine Environmental Research 2014 Sep;100:3-9 doi: 10.1016/j.marenvres.2014.02.003	2337	Published
3	UNEXE	Fossi MC, Depledge MH.	Exploring the potential of large vertebrates as early warning sentinels of threats to marine ecosystems, human health and wellbeing.	06/07/2014	Marine Environmental Research, 2014 Sep;100:1-2	2337	Published
4	UNEXE	Andrew Watts, Ceri Lewis, Tamara Galloway-UNEXE	Uptake and retention of microplastics by the shore crab *Carcinus maenas*	07/07/2014	Environmental Science & Technology.	5257	Published
5	UNEXE	Tamara Galloway UNEXE	Micro- and nano-plastics and human health	01/01/2015	In, 'Marine Anthropogenic Litter', Eds, L Gutow et al, Springer International Publishing		Published
6	Deltares	DANA STUPARU, MYRA VAN DER MEULEN, FRANK KLEISSEN, DICK VETHAAK, GHADA EL SERAFY	DEVELOPING A TRANSPORT MODEL FOR PLASTIC DISTRIBUTION IN THE NORTH SEA	July 2015	E-proceedings of the 36th IAHR World Congress		Published
7	ILVO	De Tender C, Devriese L, Haegeman A, Maes S, Ruttink T, Dawyndt P (2015)	Bacterial community profiling of plastic litter in the Belgian part of the North Sea	18/08/2015	Environmental Science & Technology.	5257	Published

8	NIMRD	George Tiganov, Eugen Anton, Madalina Galatchi, Lucian Oprea and Dragomir Coprean	The Outline of Marine Litter Collected During Demersal Fishing Surveys Oganised in the period 2011 – 2014 along the Romanian Black Sea Coast	01/09/2015	The Annals of the University Dunarea de Jos of Galati. Fascicle VI FOOD TECHNOLOGY, ISSN 1843 – 5157	200	
9	ECOLOGIC	Frans Oosterhuisa, Elissaios Papyrakisa and Benjamin Botelerd	Economic Instruments and marine litter control	Dec 2014	Ocean & Coastal Management, Volume 102, Part A, December 2014, Pages 47–54, Elsevier	1769	Published
10	Deltares	Sascha Sjollema, Paula Redondo-Hallelerharm, Heather Leslie, Michiel Kraak, Dick Vethaak	Do plastic particles affect microalgal photosynthesis and growth?	Jan 2016	Aquatic Toxicology, Volume 170, January 2016, Pages 259–261 Elsevier	>1000	Accepted manuscript
11	NIMRD	Eugen Anton, Gheorghe Radu, George Țiganov, Mădălina Cristea, Magda Nenciu	The Situation of Marine Litter Collected During Demersal Surveys in 2012 in the Romanian Black Sea Area	2013	Cercetări Marine“, Issue no. 43, ISSN :0250-3069 pages 350-357		Published

3 Summary table of scientific publications under development at the end of the project life

Nº	Main leader	Main author and other authors	Title	Date	Place	Size of audience	Countries
1	ECOLOGIC	Susanne Altvater, Ina Krüger, Benjamin Boteler	Most promising measures to combat marine litter Baltic Sea region	Dec 2015	Environmental Science & Policy	>2000	Global
2	Deltares	Jan Gerritse, Heather Leslie, Dick Vethaak	Fragmentation of Plastic Materials in a Marine atory Mesocosm	Dec 2015	To be likely submitted to PLoS ONE	>1000	Global
3	Ecologic	Susanne Altvater, Stefanie Schmidt, Nicolien van der Grijp, Agni Kalfagianni, Dariya Hadzhiyska	Institutional and legislative barriers to achieving elated to marine litter	Jan 2016	Marine Policy		
4	Ecologic	Ina Krüger, Stefanie Schmidt, Ben Boteler	Institutional and legislative barriers to achieving relation to marine litter in the Baltic Sea region	Feb 2016	Marine Pollution Bulletin	>2000	Global
5	Ecologic	Katrina Abhold, Lucy Smith, Ina Krüger, Pedro Fernandez	Incentives to avoid litter caused by tourism in the erranean Sea region	Feb 2016	Environmental Pollution		
6	Deltares	Tineke Troost, Dick Vethaak, Heather Leslie et al.	Predicted effects of microplastics on production in arine ecosystem in the North Sea, a modeling study	February 2016	To be likely submitted to PLoS ONE	>1000	Global
7	ECOLOGIC	Susanne Altvater , Nicolien M. van der Grijp , Joana Mira Veiga	A mix of policy options to prevent and reduce e litter	March 2016	Ocean & Coastal Management	1769	Global
8	Deltares	Ghada El Serafy, Dana Stuparu, Frank Kleissen et al.	Transport modeling of microplastics	June 2016	To be likely submitted to PLoS ONE	>1000	Global
9	ECOLOGIC	Susanne Altvater, Nicolien van der Grijp, Pedro Fernandez, Joanna Veiga Mira , Denitza Pavlova , Dariya Hadzhiyska	Overlappings of CleanSea "best practice examples" National Action Plans - lessons learned	Dec 2016	Marine Pollution Bulletin	>2000	Global
10	NIMRD	Mariana Golumbeanu, Magda Nenciu, lina , Galatchi, Victor Nita, Eugen , Andra Oros, Christos Ioakeimidis, ança Belchior	Marine Litter Watch Sea coast (2015)	Under review	Cercetări Marine, ISSN :0250-3069 under review		

11	IVM-VU	Roy Brouwer, Dariya Hadzhiyska, os Ioakeimidis, Hugo Ouderdorp	The social costs of beach litter along European coasts	Under review	Ecological Economics	>5000	Global
12	IVM-VU	Marianna Galantucci, Roy Brouwer	Composition and sources of floating debris in the port of Barcelona: A comparison of methods and time series analysis	Under review	Marine Pollution Bulletin	>2000	Global

4 Portfolio of published – and accepted- scientific papers

4.1 Plastic litter in the Sea

Author(s)	M.H. Depledge, F. Galgani, C. Panti, , I. Caliani, S. Casini, M.C. Fossi
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Published at	Marine Environmental Research 92 (2013) 279e281
Key words	European MSFD; Marine litter; Microplastics
Abstract	On June 2013 a workshop at the University of Siena (Italy) was organized to review current knowledge and to clarify what is known, and what remains to be investigated, concerning plastic litter in the sea. The content of the workshop was designed to contribute further to the European Marine Strategy Framework Directive (MSFD) following an inaugural workshop in 2012. Here we report a number of statements relevant to policymakers and scientists that was overwhelming agreement from the participants. Many might view this as already providing sufficient grounds for policy action. At the very least, this early warning of the problems that lie ahead should be taken seriously, and serve as a stimulus for further research.
Full paper	*http://www.sciencedirect.com/science/article/pii/S0141113613001736*

4.2 Monitoring the impact of litter in large vertebrates in the Mediterranean Sea within the European Marine Strategy Framework Directive (MSFD): constraints, specificities and recommendations

Author(s)	F. Galgani F. Claro, M. Depledge, C. Fossi
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Published at	Marine Environmental Research 100 (2014) 3e9
Key words	Marine litter; MSFD; Good Environmental Status; Monitoring; Sea turtles; Marine mammals; Seabirds; Fulmar
Abstract	In its decision (2010/477/EU) relating to the European Marine Strategy Framework Directive (MSFD, 2008/56/EC), the European Commission identified the following points as focuses for monitoring: (i) 10.1.1: Trends in the amount, source and composition of litter washed ashore and/or deposited on coastlines, (ii) 10.1.2: Trends in the amount and composition of litter in the water column and accumulation on the sea floor, (iii) 10.1.3: Trends in the amount, distribution and composition of micro-particles (mainly microplastics), and (iv) 10.2.1: Trends in the amount and composition of litter ingested by marine animals. Monitoring the impacts of litter will be considered further in 2014. At that time, the strategy will be discussed in the context of the Mediterranean Sea, providing information on constraints, protocols, existing harm and research needed to support monitoring efforts. The definition of targets and acceptable levels of harm must take all factors into account, whether entanglement, ingestion, the transport and release of pollutants, the transport of alien species and socio-economic impacts. It must also reflect on the practical deployment of “ingestion” measures (10.2.1). The analysis of existing data will reveal the potential and suitability of some higher trophic level organisms (fish, turtles, birds and mammals) for monitoring the adverse effects of litter. Sea turtles appear to be useful indicator species, but the definition of an ecological quality objective is still needed, as well as research on alternative potential indicator species.
Full paper	*http://www.sciencedirect.com/science/article/pii/S0141113614000385*

4.3 Exploring the potential of large vertebrates as early warning sentinels of threats to marine ecosystems, human health and wellbeing

Author(s)	Fossi MC[1], Depledge MH[2].
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Published at	Marine Environmental Research 100 (2014) 1e2
Key words	
Abstract	
Full paper	*http://www.sciencedirect.com/science/article/pii/S0141113614001081*

4.4 Uptake and Retention of Microplastics by the Shore *Crab Carcinus maenas*

Author(s)	Andrew J. R. Watts*†, Ceri Lewis†, Rhys M. Goodhead†‡, Stephen J. Beckett§, Julian Moger‡,Charles R. Tyler†, and Tamara S. Galloway†
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Corresponding author(s)	Andrew Watts a.watts.research@gmail.com
Published at	*Environmental Science & Technology* 2014, *48*, (15), 8823-8830.
Key words	
Abstract	Microplastics, plastics particles <5 mm in length, are a widespread pollutant of the marine environment. Oral ingestion of microplastics has been reported for a wide range of marine biota, but uptake into the body by other routes has received less attention. Here, we test the hypothesis that the shore crab (*Carcinus maenas*) can take up microplastics through inspiration across the gills as well as ingestion of pre-exposed food (common mussel Mytilus edulis). We used fluorescently labeled polystyrene microspheres (8-10 μm) to show that ingested microspheres were retained within the body tissues of the crabs for up to 14 days following ingestion and up to 21 days following inspiration across the gill, with uptake significantly higher into the posterior versus anterior gills. Multiphoton imaging suggested that most microspheres were retained in the foregut after dietary exposure due to adherence to the hairlike setae and were found on the external surface of gills following aqueous exposure. Results were used to construct a simple conceptual model of particle flow for the gills and the gut. These results identify ventilation as a route of uptake of microplastics into a common marine nonfilter feeding species.
Full paper	http://dx.doi.org/10.1021/es501090e

4.5 Micro- and nano-plastics and human health

Author(s)	Tamara S. Galloway
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Published at	M. Bergmann et al. (eds.), Marine Anthropogenic Litter,
Key words	
Abstract	Plastics are highly versatile materials that have brought huge societal benefits. They can be manufactured at low cost and their lightweight and adaptable nature has a myriad of applications in all aspects of everyday life, including food packaging, consumer products, medical devices and construction. By 2050, however, it is anticipated that an extra 33 billion tonnes of plastic will be added to the planet. Given that most currently used plastic polymers are highly resistant to degradation, this influx of persistent, complex materials is a risk to human and environmental health. Continuous daily interaction with plastic items allows oral, dermal and inhalation exposure to chemical components, leading to the widespread presence in the human body of chemicals associated with plastics. Indiscriminate disposal places a huge burden on waste management systems, allowing plastic wastes to infiltrate ecosystems, with the potential to contaminate the food chain. Of particular concern has been the reported presence of microscopic plastic debris, or microplastics (debris ≤1 mm in size), in aquatic, terrestrial and marine habitats. Yet, the potential for microplastics and nanoplastics of environmental origin to cause harm to human health remains understudied. In this article, some of the most widely encountered plastics in everyday use are identified and their potential hazards listed. Different routes of exposure to human populations, both of plastic additives, microplastics and nanoplastics from food items and from discarded debris are discussed. Risks associated with plastics and additives considered to be of most concern for human health are identified. Finally, some recent developments in delivering a new generation of safer, more sustainable polymers are considered.
Full paper	*http://link.springer.com/chapter/10.1007%2F978-3-319-16510-3_13#page-1*

4.6 Developing a transport model for Plastic Distribution in the North Sea

Author(s)	DANA STUPARU(1), MYRA VAN DER MEULEN(1), FRANK KLEISSEN(1), DICK VETHAAK(1,2), GHADA EL SERAFY(1,3)
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Published at	E-proceedings of the 36th IAHR World Congress
Key words	pollution, plastic litter, modeling, probabilistic, North Sea
Abstract	As a result of the rising plastic usage worldwide, the abundance of plastic litter in the sea and ocean has steadily increased over the last few decades. However, there is considerable uncertainty regarding the occurrence and effects of plastic litter on the marine environment. This uncertainty is visible both at the level of physical impacts but also with respect to the adaptation measures to reduce the negative environmental consequences. Aiming for a better representation of this uncertainty, the EU Marine Strategy Framework Directive was published in 2008 and requires EU member states to achieve 'good environmental status' (GES) in Europe's seas by 2020. The present study aims to improve the knowledge regarding the distribution and possible accumulation of plastic litter in the North Sea. The litter transport in the North Sea is modeled by further development of the Delft3d software. By combining hydrodynamics with particle tracking concepts, the model calculates how the position of plastic particles evolves in time from their release (discharge from rivers such as the Rhine or the Meuse) until the end of the simulation. The settling velocity of the particles in the water system is dependent on the ambient conditions (temperature/salinity) as well as on the particle characteristics (density/size). The results for micro-sized plastics are presented, while ongoing work is extending the concept for the larger macrosized plastic litter items. Different types (polyethylene, polystyrene, PET, PVC) and sizes (10 µm, 330 µm and 5 mm) of plastics were simulated. The results demonstrate that density is the main determining factor for plastic settlement and that size also has an effect on the final location of accumulation. Modeling results are then compared with field measurements in sediments as a validation step. This research demonstrates that modeling can provide a regional or global overview and aid in identifying monitoring questions.
Full paper	*http://89.31.100.18/~iahrpapers/81691.pdf*

4.7 Bacterial community profiling of plastic litter in the Belgian part of the North Sea

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Published at	*Environmental Science & Technology,* Just Accepted Manuscript • DOI: 10.1021/acs.est.5b01093 • Publication Date (Web): 23 Jul 2015
Key words	
Abstract	Bacterial colonization of marine plastic litter (MPL) is known for over four decades. Still, only a few studies on the plastic colonization process and its in fluencing factors are reported. In this study, sea floor MPL was sampled at different locations across the Belgian part of the North Sea to study bacterial community structure using 16S metabarcoding. These marine plastic bacterial communities were compared with those of sediment and seawater, and resin pellets sampled on the beach, to investigate the origin and uniqueness of plastic bacterial communities. Plastics display great variation of bacterial community composition, while each showed significant differences from those of sediment and seawater, indicating that plastics represent a distinct environmental niche. Various environmental factors correlate with the diversity of MPL bacterial composition across plastics. In addition, intrinsic plastic-related factors such as pigment content may contribute to the differences in bacterial colonization. Furthermore, the differential abundance of known primary and secondary colonizers across the various plastics may indicate different stages of bacterial colonization, and may confound comparisons of free-floating plastics. Our studies provide insights in the factors that shape plastic bacterial colonization and shed light on the possible role of plastic as transport vehicle for bacteria through the aquatic environment
Full paper	*http://www.cleansea-project.eu/drupal/sites/default/files/De_Tender.pdf*

4.8 The Outline of Marine Litter Collected During Demersal Fishing Surveys in the Period 2011 - 2014 along the Romanian Black Sea Coast

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Corresponding author(s)	George Tiganov, e-mail: gtiganov@alpha.rmri.ro
Published at	The Annals of the University Dunarea de Jos of Galati. Fascicle VI FOOD TECHNOLOGY, ISSN 1843 – 5157
Key words	Black Sea, seabed, marine litter,plastic
Abstract	Marine life worldwide is contaminated with man-made litter. Plastic items consistently represent the major categories of marine waste by material type on a global basis. Plastic is extremely harmful: it damages fisheries and tourism, affects a wide range of marine life, has the capacity to transport potentially harmful chemicals and invasive species and can represent a threat to human health. Although neither national nor regional programs are in place to monitor seabed litter in Romania, the National Pelagic and Demersal Fish Species Status Evaluation Program, which uses bottom sampling trawling, allowed the National Institute for Marine Research and Development to collect and assess types and quantities of marine litter on the seabed. This sampling started on a voluntary basis, with the support of two European Projects, Perseus and CleanSea. The abundance and distribution of marine litter present on the bottom of the sea varies. The geographical distribution of waste is strongly influenced by hydrodynamic, geomorfological and human factors. In terms of items, plastic is by far the most abundant material, followed by processed wood and fishing nets.
Full paper	

4.9 Economic instruments and marine litter control

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Published at	Elsevier, Ocean & Coastal Management 102 (December 2014) 47e54
Key words	
Abstract	This paper provides a comprehensive up-to-date review of the literature on the economic instruments that can reduce marine litter. We assess their cost of implementation, level of effectiveness as well as indirect environmental and socio-economic effects (externalities) that may arise as a result of their implementation. The evidence points to an overall beneficial impact of environmental taxes on items such as plastic bags in terms of reduced use, as well as a corresponding low cost of implementation. In the same vein, deposit-refund schemes can achieve high return rates for bottles although at a relatively high cost (especially when the scheme targets a wide range of packaging types). In the case of municipal waste collection, a 'pay-as-you-throw' charge can be applied to incentivise waste reduction. In coastal areas, waste collection and treatment can be further supported by the collection of tourist taxes, although there is a high risk that these funds might be used for other purposes. In the fishing industry, rewards for fishing vessels that return waste to shore has been shown to both reduce marine litter as well as complement fishermen's income. Since the vast majority of marine litter comes from land-based sources and consists of plastic, economic instruments that target relevant sources of land-based litter more broadly stand to make the greatest contribution to marine litter reduction. The choice of an appropriate intervention is case specific, largely depending on the tackled source of pollution, the country's institutional characteristics and infrastructure, consumer preferences and habitual behaviour, and the economy's overall sectoral composition.
Full paper	*http://www.sciencedirect.com/science/article/pii/S096456911400249X*

4.10 Do plastic particles affect microalgal photosynthesis and growth?

Author(s)	Sasha Sjollema[a], Paula Redondo-Hasselerharm [a,] Heather Leslie[b], Michiel Kraak[a], Dick Vethaak[b,c]
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Published at	Aquatic Toxicology,Volume 170, January 2016, Pages 259–261 Elsevier
Geographical scope	Global
Key words	primary production; plastic pollution; microplastics; nanoplastics; polystyrene particles; PAM assay
Abstract	The unbridled increase in plastic pollution of the world's oceans raises concerns about potential effects these materials may have on microalgae, which are primary producers at the basis of the food chain and a major global source of oxygen. Our current understanding about the potential modes and mechanisms of toxic action that plastic particles exert on microalgae is extremely limited. How effects might vary with particle size and the physico-chemical properties of the specific plastic material in question is equally unelucidated, but may hold clues to how toxicity, if observed, is exerted. In this study we selected polystyrene particles, both negatively charged and uncharged, and three different sizes (0.05, 0.5 and 6 µm) for testing the effects of size and material properties. Microalgae were exposed to different polystyrene particle sizes and surface charges for 72 h. Effects on microalgal photosynthesis and growth were determined by pulse amplitude modulation fluorometry and flow cytometry, respectively. None of the treatments tested in these experiments had an effect on microalgal photosynthesis. Microalgal growth was negatively affected (up to 45%) by uncharged polystyrene particles, but only at high concentrations (250 mg/L). Additionally, these adverse effects were demonstrated to increase with decreasing particle size.
Full paper	*http://www.sciencedirect.com/science/article/pii/S0166445X15301168*

4.11 The Situation of Marine Litter Collected During Demersal Surveys in 2012 in the Romanian Black Sea Area

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Published at	Cercetări Marine", Issue no. 43, 2013 ISSN :0250-3069 pages 350-357
Geographical scope	Black Sea
Key words	Black Sea, marine litter, bottom trawl
Abstract	Currently, there are no national or regional programs for the strict monitoring of the existing litter on the seabed. However, adjacently, by carrying-out activities at sea (demersal trawlings,) the collection of wastes from the seabed was favored, which allowed a quantitative and assortment assessment thereof. In general, the abundance and distribution of the existing marine litter on the seabed shows a considerable spatial variability. Their geographical distribution on the seabed is strongly influenced by hydrodynamics, geomorphology and human factors. Romania, through the national pelagic and demersal fish species status evaluation program, was favored by trawling operations performed on the seabed to obtain data which allowed the quantitative and qualitative assessment of such wastes in the areas of activity.
Full paper	*http://www.rmri.ro/Home/Downloads/Publications.RecherchesMarines/2013/paper17.pdf*

5 Portfolio of scientific papers under development

5.1 Most promising measures to combat marine litter in the Baltic Sea region

Author(s)	Susanne Altvater, Ina Krüger, Benjamin Boteler
Contact details	
Corresponding author(s)	
Published at	Environmental Sciences and Policy , to be published early 2016
Key words	
Abstract	
Full paper	*Not yet available*

5.2 Fragmentation of Plastic Materials in a Marine Laboratory Mesocosm

Author(s)	Jan Gerritse[a], Heather Leslie[b], Dick Vethaak[a,b]
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Corresponding author(s)	Jan Gerritse, jan.gerritse@deltares.nl
Published at	Likely to be published in PLosONE
Geographical scope	Global
Key words	Plastic, fragmentation, marine mesocosm
Abstract	Fragmentation rates of marine plastic litter have only been roughly estimated, with rare attempts to determine loss of tensile strength or surface area. In fact, it is currently unknown to what extent plastic litter in the sea is converted into micro- and nanometer-sized plastic particles, and how long it takes under ambient marine environmental conditions for plastic to be mineralized. Measuring weathering, fragmentation and mineralization rates of plastic objects in a marine environment with commonly used methods is not straightforward. We hypothesize that weathering and release of small fragments results in absorption of seawater into a plastic object, which can be measured as a decrease of its electrical resistance. Therefore we tested if the electrical resistance of plastic objects can be used as simple, cheap indicator of plastics weathering and fragmentation. In addition we compared the fragmentation of variety of conventional durable and compostable plastic materials in a mixture of consumer plastics in a marine laboratory mesocosm.
Full paper	*Not yet available*

5.3 Institutional and legislative barriers to achieving GES related to marine litter

Author(s)	Susanne Altvater, Stefanie Schmidt, Nicolien van der Grijp, Agni Kalfagianni, Dariya Hadzhiyska
Contact details	
Corresponding author(s)	
Published at	Marine Policy, planned February 2016
Key words	
Abstract	
Full paper	*Not yet available*

5.4 Institutional and legislative barriers to achieving GES in relation to marine litter in the Baltic Sea region

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Published at	Marine Pollution Bulletin, planned February 2016
Key words	
Abstract	
Full paper	*Not yet available*

5.5 Incentives to avoid litter caused by tourism in the Mediterranean Sea region

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Published at	Environmental Pollution, planned February 2016
Key words	
Abstract	
Full paper	*Not yet available*

5.6 Predicted effects of microplastics on production in the marine ecosystem in the North Sea, a modelling study

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Published at	Likely to be published in PLosONE
Key words	microplastics, Delft3D, ecosystem effects, primary production, secundary production, DEB-modeling, North Sea
Abstract	Marine algal productivity may be negatively affected by microplastics, resulting in potential loss of primary productivity in marine waters. Negative effects on primary production may in term have an impact on secondary productivity, i.e. zooplankton. Models are a valuable tool in predicting possible ecosystem effects of microplastics. We therefor extended the Delft3D-GEM ecosystem model for the North Sea to include zooplankton on the basis of Dynamic Energy Budget (DEB-) theory. The model output predicted that effects of microplastics on algal biomass are negigable. In contrast, the model predicted that direct effects of microplastics on zooplankton would considerably reduce zooplankton biomass and productivity.
Full paper	*Not yet available*

5.7 A mix of policy options to prevent and reduce marine litter

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Published at	Elsevier, Ocean & Coastal Management (planned March 2016)
Geographical scope	All four European sea regions
Key words	
Abstract	The article provides a portfolio of policy options for the relevant authorities at multiple levels to prevent and reduce marine litter in particular in support for the implementation of the Marine Strategy Framework Directive (MSFD). Options for action in relation to the product-to-waste cycle have been identified and a region specific mix of measures in response to the main challenges for each of the 4 EU sea-basins has been proposed. Existing measures as well as planned ones by the Regional Seas Action Plans (RAP) or the Programme of Measures (PoM) of the Member States have been evaluated with a multi-criteria analysis (MCA). Results show that main impact is achieved when the focus is on specific marine litter types or more than one item. Furthermore, when addressing key drivers of marine litter or barriers to GES with a broad geographic scope, or targeting the first two stages of the waste hierarchy – design and production as well as use and consumption – the impact is expected higher. The combination of different legal tools at different levels is another very important precondition for an effective framework. These legal tools should be accompanied with co-governance, for instance regional management plans that are legislatively grounded via national environmental protection acts, or backed by awareness raising and capacity building. Furthermore, standard settings provide guidance to industry and other stakeholders. These tools seem to have an even greater effectiveness when combined with market-based instruments.
Full paper	

5.8 Transport modeling of microplastics

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Published at	Possible PlosONE
Key words	Plastic, marine litter modelling, hotspots of marine litter
Abstract	Plastics are ubiquitously present in the marine environment. It is included as a descriptor of "good environmental status" in the Marine Strategy Framework Directive of the EU. In order to determine effects on the marine environment, the knowledge base for microplastic presence and the exposure that habitats have to them should be expanded. With the use of the three dimensional models for microplastic tracking, more insight can be gained on exposed areas. The current model acts a preliminary step to identify microplastics in the North Sea and their accumulation zones. It includes several aspects of the transport and fate of plastics. It also describes the relevant characteristics of plastics such as density, shape and size that affect the behaviour of the plastic in the marine environment (i.e. settling velocity and fragmentation). The model provides the microplastic distribution in the North Sea on a scale (both spatial and temporal) that could not be done with sampling alone. It contributes to the description of spatial distribution and possible risks associated with marine organism exposure to microplastics. The model describes the natural variability of plastics through probabilistic modelling. In the model simulations, the highest predicted concentrations of microplastics were found near the River influents and along the coast. Here, habitats have an increased exposure to microplastics. The preliminary model results indicates that the model is generic and can help in cleanup actions and guided monitoring for microplastics in the North Sea, for surface as well as sediment layers.
Full paper	*Accepted manuscript*

5.9 Overlappings of CleanSea "best practice examples" with National Action Plans - lessons learned

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Abstract	
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5.10 Marine Litter Watch Sea coast (2015)

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Published at	Cercetări Marine, ISSN :0250-3069 under review
Geographical scope	
Key words	Black Sea, ecological education, MLW, cigarette butts, plastic containers
Abstract	Litter, accumulating in European seas and coasts, is impacting marine ecosystems, causing problems to human activities that use and depend on the sea and raising human health concerns. European Member States are developing measures to tackle marine litter with the Marine Strategy Framework Directive (MSFD), but the information base is still insufficient. The National Institute for Marine Research and Development "Grigore Antipa" Constanta (NIMRD) has been actively involved in marine litter related activities: • Involvement in CLEANSEA, MARLISCO and PERSEUS projects. • Sea surveys for seabed marine litter monitoring; • Terrestrial surveys along Romanian Black Sea coast sectors for beach marine litter monitoring; • Laboratory analyses for macroplastics; • Participation in actions to identify the main polluters, developing proposals for measures to reduce litter pollution of the marine environment (MSFD); • Beach clean-up activities, education and awareness raising campaigns; Marine Litter Watch App was applied at the Romanian Black Sea Coast. Surveys have been implemented both off-season (January, April), as well as during the high tourist season, and the main wastes identified

	were cigarette butts and plastic containers.
Full paper	

5.11 The social costs of beach litter along European coasts

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Geographical scope	
Key words	
Abstract	
Full paper	

5.12 Composition and sources of floating debris in the port of Barcelona: A comparison of methods and time series analysis

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Geographical scope	
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