



Governing plastic pollution in the oceans: Institutional challenges and areas for action

Gianluca Ferraro*, Pierre Failler

Centre for Blue Governance, University of Portsmouth, Richmond Building, Portland Street, Portsmouth, PO1 3DE, United Kingdom

ARTICLE INFO

Keywords:

Plastic waste
Marine pollution
Global environmental governance
National implementation
Coherence and coordination
Science advice

ABSTRACT

Marine plastic pollution has emerged as a global threat to our oceans. Although several instruments have been developed at the international level, the global governance of marine plastic pollution is still affected by several weaknesses. The article explores some of these weaknesses and attempts to define areas for action: harmonisation of international laws; coherence across national policies; coordination of international organisations; and science-policy interaction. The article presents the problem of marine plastic pollution and focuses on the policy response in place at the international level. It discusses the problem of national implementation in a web of intertwined sectoral policies and analyses the organisational structure competent for marine affairs at the global level. The role of science advice as a coordinating mechanism is also investigated. While analysing these institutional challenges, the article delineates a policy agenda for the future governance of plastic pollution at the global scale.

1. Introduction

Plastic has played an important role in our daily lives since the 1950s. Our society and economy have benefitted from plastic products in a variety of uses: packaging, construction materials, clothing, automotive, transportation, medical supplies, food safety, etc. (Vince and Hardesty, 2018; Worm et al., 2017). Due to the growing popularity of plastics over the years, plastic waste constitutes nowadays a large share of global litter both on land and at seas (Nyka, 2018; Raubenheimer and McIlgorm, 2017) and has become a global threat to our environment (EC, 2018; Worm et al., 2017).

Plastic pollution is particularly alarming in the oceans, where the abundance of plastics (as macro-, micro- and nano-plastics) damages the health of the marine biosphere (UN Environment, 2017). Plastic waste traps and kills marine lifeforms; fragmented plastic litter is ingested by marine organisms and incorporated into the food chain; marine plastics accumulate toxins and host distinct microbial communities (Chen, 2015; Haward, 2018; Hugo, 2018). Plastic debris concentrates around coastlines and in “convergence zones” known as gyres where it persists for hundreds of years (Chen, 2015; Worm et al., 2017). According to recent data, we dump 4.8–12.7 million tonnes of plastic waste in our seas every year (Haward, 2018; Worm et al., 2017). A total of 150 million tonnes of plastics has been estimated to be present in the oceans (Jambeck et al., 2015).

Marine plastic pollution originates from two major sources. The first, more obvious, is human activity at seas: plastic fishing gears and other plastic materials are dumped or lost into the oceans as a result of fishing activities and by merchant fleets (Nyka, 2018; UN Environment, 2017). The second, yet primary, source of marine plastic pollution is land-based activities. Plastic from land enters the oceans via rivers and wastewater outflows or is transported by wind and tides (Worm et al., 2017). According to Jambeck et al. (2015), about 80 % of marine plastic litter come from the land; this is mainly due to overloaded management and recycling systems that are inadequate for our increasing plastic production and consumption.

Waste management policies (including recycling and safe disposal) are national competences. However, marine debris can be transported long distance and the negative impact of marine plastic pollution clearly goes beyond countries’ borders (Raubenheimer and McIlgorm, 2017). The transboundary nature of this problem calls for international solutions (Hugo, 2018; Tessnow-von Wysocki and Le Billon, 2019). Although some measures have been taken at the international level, marine plastic pollution has continued to grow. The international policy response to the problem has, indeed, been inadequate (Raubenheimer and McIlgorm, 2017). In general, ‘current international instruments, state policies, nonstate rules, and consumer norms are simply not strong enough, nor comprehensive enough, to protect and conserve marine ecologies at a global scale’ (Dauvergne, 2018: 23).

* Corresponding author at: Centre for Blue Governance, University of Portsmouth, Richmond Building, Portland Street, Portsmouth, PO1 3DE, United Kingdom.
E-mail addresses: gianluca.ferraro@port.ac.uk (G. Ferraro), pierre.failler@port.ac.uk (P. Failler).

There are multiple regulatory gaps in the international ocean governance of plastics so that all critical aspects cannot be covered in this article. Most scholars and experts agree that solutions to the problem of marine plastic pollution have to be “integrated solutions” (Harward 2018) based on “integrated approaches” (Vince and Hardesty, 2016), where parts are put together into a whole (Underdal, 1980). This point also emerged from a workshop we conducted with experts in ocean governance¹. The workshop ran like a focus group and allowed for the collection of experiential evidence (Kahan, 2001; Krueger, 1994). Participants specified the quest for integration from several angles based on their experience in global ocean governance and marine plastic pollution. Once these insights were put in perspective with information available in academic literature and policy reports from international organisations, four aspects seemed to prevail and call for investigation: harmonisation of international laws; coherence across national policies; coordination of international organisations; and science-policy interaction. Such prioritisation received further confirmations from experts contacted via email during the general lockdown of Spring 2020 due to the COVID emergency. Therefore, in the light of a general claim for integration, we analyse the governance of marine plastic pollution under these four aspects, provide reflections and recommend improvements.

After introducing the problem addressed (this section), we focus on the policy response in place at the international level and the legal framework (section 2). We, then, discuss the problem of national implementation in a web of sectoral policies (section 3) and analyse the organisational structure competent for marine affairs at the global level (section 4). We also investigate the role of science advice as a coordinating mechanism (section 5). Section 6 concludes this article and delineates a policy agenda for the future governance of plastic pollution at the global scale.

2. Global policy framework

The United Nations Environment (UN Environment) defines marine litter as ‘any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment’ (UNEP, 2009: 13). Among the different types of marine litter, plastic waste has received attention internationally and efforts to regulate the problem started already in the 1970s. The topic has remained on international political agendas until our days and populates political discussions in the main global fora (e.g., G7, G20 and the 2017 World Oceans Summit) (Vince and Hardesty, 2018). Numerous international instruments have been adopted to regulate marine plastic pollution in the form of conventions, agreements, regulations, strategies, action plans, programs and guidelines (Chen, 2015) as we show in Table 1.

Notwithstanding these developments, several shortcomings have been identified in the existing international policy framework: the focus on sea-based sources of marine plastic pollution; the prevalence of soft-law instruments; and the fragmentation of the existing international regulatory framework.

First, the United Nations Convention on the Law of the Seas (UNCLOS), the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping

Convention) and the International Convention for the Prevention of Pollution from Ships (MARPOL) regulate waste from sea-based activities (Chen, 2015). The development of international policy has been more advanced for ocean-based than land-based sources of marine litter in general (Raubenheimer and McIlgorm, 2017). However, it is now evident that most litter entering the seas comes from land-based sources that are more diffused and, thus, more difficult to control (Haward, 2018; Ryan, 2015). Similarly, in the case of plastic litter, ‘it was easier to create a relatively effective system for preventing pollution from ships than it has been from land-based sources’ (Nyka, 2018: 166). In particular, we lack hard law that deals specifically with land-based plastic marine pollution (Vince and Hardesty, 2018).

Second, most international instruments attempting to regulate marine plastic pollution from *all* sources are soft law instruments without any obligatory character (Vince and Hardesty, 2016; 2018). To simplify an articulated debate on the definition of soft law (Guzman and Meyer, 2010), we can state that soft law consists of non-binding arrangements that create a political commitment but no legal obligation of compliance (Victor et al., 1998a). In particular, international soft law relies on “political promises” that shape the expectation of states about their reciprocal future conduct (Higgins, 1994). Important examples are the Honolulu Strategy, the Resolution UNEP/EA.3/L.20 and the initiatives by G7 and G20 (Nyka, 2018). Formal treaties create, instead, a stronger commitment to cooperation (Lipson, 1991). As explained by Guzman and Meyer (2010: 175), ‘[c]ooperation might emerge without the treaty, but the presence of a legal obligation can increase the cost of violation and, therefore, improve the chances of successful cooperation’. In other words, hard law is believed to have a stronger “compliance pull” since its violation produces higher costs, for instance in terms of loss of reputation among international partner states. Hard law has, thus, a greater impact on states’ behaviours than soft law since it is more likely to increase compliance (Guzman and Meyer, 2010). The only international instruments of hard law (i.e. legally binding) in the issue area we are discussing are UNCLOS, London Convention (and its Protocol) and MARPOL. In these cases, states explicitly commit to transpose in their domestic jurisdiction international rules that they have accepted at the international level.

Third, multiple international instruments discipline aspects related to plastic pollution. In addition to the ones already mentioned, the Conference of the Parties (COP) of the Convention on Biological Diversity (CBD) and the UN Environment Assembly (UNEA) have promoted important initiatives (Table 1). However, these instruments discipline their own matters in a fragmented way. The danger of compartmentalisation in marine legislation at all levels – international, regional and national – is clear to marine experts and has been documented in the literature (e.g. Elliott, 2014). The lack of integration has led to a legislative “patchwork” in marine protection as the complex “horrendogram” elaborated by Boyes and Elliott (2014: 45) well represents. Regions around the world are also working (between the global and national level) to tackle the problem of marine plastic pollution at their geographical scale (Chen, 2015). Several regional instruments and initiatives exist, particularly in the European Union (EU), but they fall out of the scope of this article.

2.1. Action 1. Harmonisation of international laws

The governance of marine plastic pollution rests on multiple legal instruments and political initiatives but lacks a harmonious policy framework and a legally binding international agreement (Hugo, 2018). In particular, land sources of plastic pollution have for long time been overlooked and are now the object of soft law only. Two major options are available to strengthen the current international regulatory framework. The first option is to adopt a new international treaty regulating plastic pollution from land-based as well as sea-based sources (Tessnow-von Wysocki and Le Billon, 2019; UN Environment, 2017). The second option is to amend existing international instruments

¹ The workshop took place at the University of Portsmouth on 13th February 2020 in occasion of the launch of the ‘Centre for Blue Governance’. The launch of this newly born research group was accompanied by three parallel sessions; one session was dedicated to the problem of marine plastic pollution. The event brought together representatives of international organisations (e.g., IOC-UNESCO, FAO and Commonwealth Secretariat), regional bodies (e.g., UN Economic Commission for Africa and Indian Ocean Commission), industry (e.g., World Ocean Council), NGOs, scientific and policy experts, and scholars from UK and non-UK universities. (For more information: <https://www.port.ac.uk/research/research-centres-and-groups/centre-for-blue-governance>; last access: 13.05.2.2020).

Table 1
Global policy framework for marine plastic pollution^a.

International instrument/initiative	Year	Rationale	Relevant international body
The UN Convention on the Law of the Seas (UNCLOS)	(1982; 1994 ^b)	UNCLOS frames ocean governance in general. Part XII (articles 192–237) contains provisions for preventing, reducing and controlling pollution of the marine environment from any source (art. 1, art. 194). UNCLOS does not regulate in detail the problem of marine plastic pollution.	UN General Assembly
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention)	(1972; 1975)	The Dumping Convention eliminates one of the sources of plastic pollution, i.e. dumping of plastic waste.	International Maritime Organisation
• Protocol to the London Convention	(1996; 2006)		
International Convention for the Prevention of Pollution from Ships (MARPOL)	(1973; 1983)		International Maritime Organisation
• Annex V of MARPOL “Prevention of Pollution by Garbage from Ships”	(1973; 1988)	Annex V forbids ships from dumping garbage overboard.	
• Revision of Annex V ^c	(2013 and 2018)	The revised Annex V specifically prohibits the disposal of plastic into the ocean. Ships must dispose waste at land-based facilities.	
Decision XI/18	2012	The Decision addresses the impact of marine debris on marine and coastal biodiversity.	Conference of the Parties to the Convention on Biological Diversity
• Strategic Plan for Biodiversity	(2011–2020 ^d)	The Plan includes the Aichi Biodiversity Targets. Target 8 covers pollution.	Conference of the Parties to the Convention on Biological Diversity
Honolulu Strategy	(2011)	The Strategy improves cooperation to prevent land-based plastic debris from entering the oceans.	UN Environment
• Global Strategy on Marine Litter (GPML)	(2012)	The document supports the implementation of the Honolulu Strategy.	
• Clean Seas Campaign	(2017)	The document supports the Partnership by raising awareness and facilitating dialogue.	
Sustainable Development Goals – SDG14	(2015)	SDG14: Conserve and sustainably use the oceans, seas and marine resources. Target 14.1 covers marine pollution.	UN General Assembly
Action Plan to Combat Marine Litter	(2015)	The Action Plan includes both land and sea-based priorities to reduce marine debris.	G7 ^e
Ocean Plastics Charter	(2018)		
Action Plan on Marine Litter	(2017)		G20
Resolution UNEP/EA.3/L.20 (non-binding resolution) on marine litter and microplastics	(2017)	The Resolution encourages states to develop integrated and source-to-sea approaches to combat marine litter and microplastics from all sources.	UN Environment ^f
Ministerial Declaration “Toward a Pollution Free Planet”	(2017)		UN Environment Assembly

^a We exclude from this overview the Stockholm Convention (on persistent organic pollutants) and the Basel Convention (on the control of transboundary movements of hazardous wastes and their disposal) because they were not specifically designed to tackle marine plastic pollution.

^b The first date indicates the year of adoption, the second refers to the year the act came into force.

^c MARPOL has 6 Annexes; each is devoted to a different type of operational discharge from ships. Annex V is on garbage (Lyons et al., 2019).

^d The time frame indicates the duration of the strategy.

^e The G7 includes Canada, France, Germany, Italy, Japan, the United Kingdom and the United States. However, Japan and the United States did not sign the Ocean Plastics Charter.

^f UN Environment has also issued several guidelines on marine pollution (see Vince and Hardesty, 2018).

and create a more coordinated and comprehensive legal framework (Raubenheimer and McIlgorm, 2017; UN Environment, 2017).

Many scholars (Chen, 2015; Hugo, 2018; Raubenheimer and McIlgorm, 2017; Tessnow-von Wysocki and Le Billon, 2019; Vince and Hardesty, 2016; Worm et al., 2017) believe that most institutional challenges in marine plastic governance can be solved by a new legally binding international agreement. It is argued that a global plastics treaty is needed to drive policy change at both international and national level. At the international level, such instrument could improve synergies among the existing initiatives. At the national level, it could promote reforms on the current system of production and consumption, and the way plastic waste is managed. The urgency of solving marine plastic pollution was confirmed by in the Sustainable Development Goals (SDGs) (Table 1); this momentum could be used to move forward towards a new international treaty on plastics (Hugo, 2018).

The formation of a new legally binding global instrument ruling marine plastic pollution will undoubtedly take time since it will have to rely on the agreement among states with diverse levels of capacity, resources and waste management infrastructures (Vince and Hardesty, 2018). In general, ‘[i]nternational agreements are not easily developed

and are often criticised for the time taken to reach agreements and the tendency for a minimal tolerable consensus to shape outcomes’ (Haward, 2018: 2). Additional time will also be needed for its national implementation (Hugo, 2018). Moreover, the same relationship between a new global treaty on plastics and the existing international environmental agreements will not be automatically solved and will have to be clarified in order to avoid overlapping, duplication and contradiction (Hugo, 2018; UN Environment 2017); this will also take time. The time needed for the formation and implementation of a new treaty conflicts with the urgency of the problem, which makes the first option more plausible.

In this context, a possible approach could follow a double track: pursuing an alignment among the existing instruments in the short term, while starting discussions for the development of a global treaty on plastics.

3. National implementation

Once international agreements are adopted, national compliance with their obligations largely depends on the implementation of

domestic policies (Vince and Hardesty, 2016). International obligations can solve the problem they address only if they are voluntarily incorporated by states into their national legislation, and applied and enforced in their territory and areas that follow under national jurisdiction (e.g., the Exclusive Economic Zone) (Cicin-Sain et al., 2006). As put by Vince and Hardesty (2018: 5), ‘[w]hile global decision making can direct national incentives, national-level policy actions are the mechanisms for steering action’.

The effectiveness of international arrangements for marine plastic pollution, too, is mediated by national implementation, a process of execution that is highly political; it intertwines with different layers of existing national (and local) policies, different levels of development and organisations of waste management infrastructures, and different industry conducts across countries (Dauvergne, 2018). This is not only true for international instruments of soft law; compliance is a problem often faced by hard law, too (Ryan et al. 2015). Gaps in implementation are recorded for several of the instruments summarised in Table 1, in terms of national transposition (of hard-law conventions) or enactment (of soft-law guidelines), execution and enforcement (Chen, 2015).

A complex set of factors hinders the domestic implementation of international agreements (see Ferraro, 2014 for a comprehensive overview). We focus here on policy coherence that we consider pivotal for any national action on plastics. More precisely, we refer to horizontal coherence across policy areas within one country. Other forms of policy coherence (e.g., vertical and internal) have been studied (see Nilsson et al., 2012), but they fall out of our scope. Our argument is the following. If domestic implementation – in general – can hinder the effectiveness of international (hard and soft) law, such process of execution of international obligations becomes even more problematic when we deal with a policy issue like plastic pollution that is caused by several human activities falling under different policy areas and regulated by multiple national policies.

Indeed, diffuse sources are at the origin of marine plastic pollution. It originates from a plurality of land-based sources (i.e. plastic production, packaging, street litter, dumping, etc.) and multiple human activities at seas (e.g., fishing, aquaculture, commercial ships and recreational vessels) (Haward, 2018). All these sources are regulated under different national public policies with their diverse sets of rules, regulations, legislations, procedures and processes (Dauvergne, 2018). The array of intertwined sources of marine plastic pollution makes its governance difficult, since we need to envisage the inclusion of a broad range of activities and sectors (Chen, 2015). Therefore, the common challenge of national implementation of international obligations is further complicated by the need of ensuring coherence across the relevant national policies ruling production practices and waste management systems.

Policy coherence is an attribute of policy that reduces (or eliminates) conflicts and promotes synergy between different policy areas (den Hertog and Stross, 2013; Nilsson et al., 2012): ‘[a] minimal level of coherence is achieved if policies do not contradict one another; a high level of coherence implies mutually reinforcing policies²’ (Lenschow et al., 2018: 323). Conflicts (or synergies on the other extreme) can take place between national policies at multiple levels, in terms of objectives guiding each policy, instruments adopted to achieve those objectives, or the implementation practices put in place to execute a national policy in one specific sector (Nilsson et al., 2012). A clearer understanding of these three levels of potential conflicts requires in-depth case studies and comparative analyses around key questions: Are objectives across relevant policy fields in line with the general aim of decreasing the production, use and disposal of plastics? What are the obstacles in adopting coherent policy instruments across intertwined policy fields?

² Lenschow et al. (2018) also clarify that coordination, collaboration or cooperation are mechanisms (or processes) contributing to policy coherence, but distinct concepts.

How do national laws and regulations reinforce or hinder coherence in the implementation practices? We leave these questions for future research on national cases, while we present here considerations that are not context-bound and allow for generalisation.

3.1. Action 2. Coherence across national policies

Plastic pollution is being addressed by many countries around the world through a large range of national initiatives (e.g., legislations, policies and action plans) (Hugo, 2018; Vince and Hardesty, 2016) that we are unable to cover in this article. We prefer to guide policy choices across diverse contexts by discussing policy coherence in more general terms at the level of policy objectives, policy instruments and implementation practices (see Nilsson et al., 2012 above).

At the level of policy objectives, Chen (2015, based on Liffmann et al., 1997) recommends the establishment of comprehensive management schemes at country-level such as “national marine litter programmes”. These strategic documents would represent a high-level political commitment that should permeate and drive all policy sectors towards actions for the prevention, mitigation and removal of marine plastic pollution. The adoption of national inventories (of plastic production, consumption, disposal and trade) and reduction targets would help quantify efforts and improvements (UN Environment 2017). Starting from this political commitment around the overarching objective of plastic reduction, national administrations should avoid that public policies work separately as silos, thus causing externalities in related domains.

National governments could also envisage an integration of policy instruments. The process of policy formulation, decision-making, implementation and enforcement directs societal actors’ behaviour towards the expected change. This can be done by using substantial policy instruments that include multiple types of tools. Policy instruments can consist of voluntary interventions as in the case of community initiatives (e.g., cleaning of coasts) and self-regulatory arrangements of the private sector (e.g., business’s codes of practice). Policy instruments can also have a less voluntary nature and imply some activities from the side of the state as it happens for information campaigns and education programmes for citizens, or economic incentives for companies. Finally, (substantial) policy instruments can be coercive like taxes, bans, sanctions and regulations for the collection and reduction of waste (Howlett et al., 2009). Another important set of tools, called procedural policy instruments, are used by governments when they want to enhance citizens’ involvement by facilitating information, consultation and public participation (e.g., through working groups and advisory mechanisms). These policy instruments ultimately aim at increasing communities’ engagement, ownership and responsibility (Howlett et al., 2009). A mix of policy instruments should be employed to move closer to a solution for marine litter (Vince and Hardesty, 2018).

Finally, in the pursuit of policy coherence, efforts of administrative coordination, political collaboration and stakeholder engagement would be crucial to improve national implementation practices. The production, manufacturing, consumption and disposal of plastic are commonly dispersed; there is little coordination within each country between governments, waste management organisations, industry and consumers, and between ministries within government (Tessnow-von Wysocki and Le Billon, 2019). Instead, we need institutional coordination among government agencies, the private sector and civil society to create synergies, avoid overlaps and surmount constraints in the reduction of plastic pollution (Vince and Hardesty, 2018). In general, ‘[a]ddressing global environmental challenges can be most effective with the participation of, and successful dialogue and cooperation with, academics, the private/business sector, policy-makers, civil societies and local constituencies’ (Coscieme et al., 2020: 37). The use of adequate procedural policy instruments might help in this endeavour of strengthening stakeholder engagement.

4. International agencies

The UN Environment (2017) states that marine plastic pollution is handled at the international level in a “fragmented and uncoordinated” way. Several international organisations have competences in the area of marine plastic pollution. Two UN agencies seem to be particularly important: the United Nations Environment Programme (UN Environment, previously known as UNEP) and the International Maritime Organisation (IMO) (Haward, 2018; Lyons et al., 2019; UN, 2000). A third body worth mentioning here is the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO). The missions, roles and activities of these organisations are summarised in Table 2. Other UN agencies and international bodies (e.g., FAO and WHO) have secondary involvement in the topic of marine plastic pollution, but they cannot be included in this article for matter of space limitation. The aspect that we want to stress here is that several UN agencies have sectoral competences in the policy area of marine environmental protection (IMO, 2005). The same applies to the specific issue of marine plastic pollution.

In the presence of multiple centres of authority, organisational missions can be ‘coherent, conflicting and/or duplicative’ (Olawuyi, 2020: 6). When we analyse the missions of the three organisations directly involved in marine plastic pollution (i.e. UN Environment, IMO and IOC-UNESCO), we do not find conflicting missions (Table 2). While the UN Environment constitutes the leading environmental authority in the UN system, the IOM enters in the area of marine environmental protection with regard to international shipping in order to prevent marine and atmospheric pollution by ships. The IOC-UNESCO has a special position as a UN body dealing with marine science in support of better management of the marine environment and the use of marine resources. Despite the absence of evident conflicts in their missions, coordination across these bodies could be improved to avoid overlaps and duplication, and promote coherence (Schrijver, 2010). According

to a UN’s internal review reported by Schrijver (2010: 136), the current framework of international environmental governance within the UN is weakened by ‘the lack of a clear distinction among the work programmes of UN system organisations regarding environmental protection and sustainable development and to the absence of a single strategic planning framework’.

One way to pursue better coordination could be by establishing a “focal institution” (Olawuyi, 2020), as we discuss in the following subsection. In the absence of a clear leadership among the UN bodies involved in marine environmental protection, coordination efforts might be jeopardised by a plurality of decision-making points. In addition, in this context of weak leadership and dispersed authority, any change lacks a “champion” that supports and drives reform, and works to overcome political divergences between the various actors. A second way to promote inter-agency coordination is through science advice. This point leads us to the issue of science-policy interactions and call for a more extensive discussion that we present in section 5.

4.1. Action 3. Coordination of international organisations

Several solutions can be adopted to enhance coordination among bureaucratic agencies. Although less hierarchical ways to improve coordination have been studied in political science and public administration (e.g., resource exchange and network linkages) (see Peters, 1998), political leadership is certainly one of the most recurrent ones (Greer and Lillvis, 2014). We have known for long time that leadership plays a key role in the process of development and formation of new institutions, instruments and arrangements both in national policies (Elcock, 1990) and international governance (Young, 1991). For the purpose of our article, leadership is understood as the ability to exercise significant influence on institutional processes. For instance, leaders are actors that can promote an agreement on a common problem (Tessnow-von Wysocki and Le Billon, 2019). Leaders can also improve

Table 2
Missions, roles and activities of key international agencies.

	UN Environment	IMO	IOC-UNESCO
<i>Year of foundation</i>	1972	1959	1960
<i>Main role</i>	The leading global environmental authority	The global standard-setting authority for the safety, security and environmental performance of international shipping	The only competent organisation for marine science within the UN system
<i>Mission</i>	To provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations ^a	To ensure the safety and security of shipping and the prevention of marine and atmospheric pollution by ships ^b	To improve the governance, management, institutional capacity, and decision-making processes with respect to marine resources and climate variability and to foster sustainable development of the marine environment ^c
<i>Key activities</i>	<ul style="list-style-type: none"> ● It sets the global environmental agenda and promotes its coherent implementation within the UN system ● It serves as an authoritative advocate for the global environment ● It encourages partnerships among industry, scientific community, NGOs and community groups to the benefit of the global environment 	<ul style="list-style-type: none"> ● Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented ● It develops and implements global standards 	<ul style="list-style-type: none"> ● It promotes and coordinates programmes and activities in the field of ocean observations, ocean science, and reduction of marine hazards for the sustainable development of the marine environment, especially in developing countries ● It promotes international cooperation in marine research and for capacity development
<i>Organisational features</i>	Its work is organised into seven broad thematic areas: climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste, resource efficiency, and environment	The body of the IMO that deals with negotiations of new regulations, amendments to old ones and review of implementation of treaties with respect to impact on the marine environment is its Marine Environmental Protection Committee (MEPC)	It deploys the best ocean science through intergovernmental cooperation around key focus areas: capacity development, climate change, Small Island Developing States (SIDS) and gender equality
<i>Administration of international conventions and secretariats^d</i>	<ul style="list-style-type: none"> ● Convention on Biological Diversity ● Stockholm Convention ● Basel Convention 	<ul style="list-style-type: none"> ● London Convention and Protocol ● MARPOL 	

^a Online source: <https://www.unenvironment.org/about-un-environment/why-does-un-environment-matter> (last access: 02.04.2020).

^b Online source: <http://www.imo.org/en/About/Pages/Default.aspx> (last access: 02.04.2020).

^c Online source: <http://www.unesco.org/new/en/natural-sciences/ioc-oceans/about-us> (last access: 02.04.2020).

^d We only list here the international conventions of relevance for this article (Table 1).

coordination by defining common plans and targets (Greer and Lillvis, 2014), which is exactly what seems to be missing in the UN system – see Schrijver (2010) above. Leaders can be individuals or collective entities, such as states and international organisations. Although some scholars (e.g., Elcock, 1990; Young, 1991) have preferred to take individuals as leaders, we look, instead, at leaders as collective entities, more precisely as international agencies and organisations.

For effective global governance of marine plastic pollution, coordination among the various organisations involved around a leading UN agency will be crucial. Such leading entity could coordinate efforts not only among the organisations presented in this section. It could embrace a wider set of bodies of the UN system, such as those with competences on the environment (e.g., the COP of the CBD) and on the marine environment and its living resources (e.g., FAO), to name but a few. The importance to identify, establish and strengthen one international body as the leading coordinating organisation was also recommended by the UN Environment (2017).

Thanks to its long and broad involvement in marine plastic pollution (UNEP, 2009), the UN Environment seems to be a strong candidate for this role. This agency of the UN has a long history in environmental protection (Table 2) and experience in marine plastic pollution (Table 1). It has not only facilitated international negotiations on environmental agreements, but it also already hosts the Secretariats for the Regional Seas Programme, the Secretariat of the Basel, Rotterdam and Stockholm Conventions and the Secretariat for the Convention on Biological Diversity (UN Environment, 2017). However, bureaucracies (at any level) tend to preserve their autonomy (Wilson, 1989), which could make the formal recognition of a focal institution (based on an explicit political mandate) somewhat difficult.

5. Science advice

In any attempt to respond to policy issues that are increasingly complex, international coordination has become crucial. In the absence of a clear centre of authority among the several international agencies that are competent over marine affairs, science advice could facilitate inter-agency coordination.

A key role in international coordination is recognised by Haas (1992) to epistemic communities understood as networks of professionals and experts in a domain whose knowledge is relevant for policies in that domain. These professionals often provide their expertise as science advice to decision-makers in national administrations and international secretariats. According to Haas (1992), science can provide an objective common ground to stimulate policy developments even in the presence of diverse interests among stakeholders and those responsible for policy decisions. The mobilisation and sharing of scientific knowledge by experts can also create channels of communication and trust among decision-makers, and promote a more comprehensive pattern of work and coordinating arrangements (Haas, 1992).

We know that science can catalyse cooperation at the international level among states (Koppelman et al., 2010). Epistemic communities can also influence international organisations by sitting in the advisory and regulatory bodies of international secretariats (Haas, 1992). Scientists gather to discuss public problems, conceive agendas and develop beliefs on possible policy alternatives outside national and international bureaucracies, but they also pursue those shared ideas once they serve as advisors to bureaucrats and elected officials for decision-making. Aligned through international channels, specialists can have an impact on the international coordination around policy issues (Haas, 1992).

Therefore, we argue that science advice may facilitate coordination among international agencies involved in the governance of marine plastic pollution. This section does not aim at a comprehensive study of epistemic community's influence in international decision-making. It looks at the production and use of science in the framework of the global governance of marine plastic pollution and discusses the role of science advice as a channel for fostering cooperation and coordination

among the different organisations involved. Organisations can indeed rely only on their own expertise or refer to inter-agency collaborations or joint committees for evidence-based decision-making (Olawuyi, 2020).

We rely on a broad definition of “science advice” that embraces all those practices used to mobilise and incorporate scientific knowledge in the process of policy-making (Arimoto and Sato, 2012; Kenny et al., 2017). More extensively, Quirion et al. (2016: 2) define science advice as ‘the process, structures and institutions through which governments and decision-makers receive and consider science and technology inputs to public policy development’. Governments and other organisations use several institutional arrangements to base policy decisions on the best available science (Bressers et al., 2018; Kenny et al., 2017): science advice is delivered by advisory councils, advisory committees, scientific panels, technical advisory groups, etc. Despite the different names, they all constitute bodies where individuals and organisations with relevant expertise provide scientific evidence to decision-makers for the purpose of making public decisions (Glynn et al., 2003; Groux et al., 2018).

5.1. Action 4. Science-policy interaction

Within the UN system one mechanism of science advice seems to serve the purpose of catalysing coordination among the large number of international bodies involved in the governance of marine plastic pollution. This science advice mechanism is the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection or, more briefly, GESAMP.

GESAMP is a scientific advisory body of the UN system bringing together experts (17 today) from a wide range of disciplines related to marine environmental protection. These experts act in an individual capacity; they do not represent governments or any other organisation (IMO, 2005). This group of experts is jointly managed by the UN Environment and the IOC-UNESCO (Vince and Hardesty, 2018). Established as an inter-agency body by several UN agencies in 1969 to provide independent, interdisciplinary, scientific advice, this body went under review and was subsequently reformed and revamped in early 2000s (Haward, 2018; IMO, 2005). It provides science advice in the field of marine environmental protection to several UN organisations and agencies that have responsibilities in the marine environment including plastic pollution. GESAMP conducts and supports studies, analyses, reviews and marine environmental assessments; it also scans and identifies emerging issues on the state of the marine environment. Reports from GESAMP are the basis for many intergovernmental organisations that adopt international laws and policies. A key role covered by GESAMP is its function as “mechanism for coordination and collaboration” among the UN agencies that it serves with its research on the marine environment (Lyons et al., 2019). Indeed, it constitutes the only formal mechanism of the UN system for inter-agency scientific coordination about the marine environment (IMO, 2005).

Another important UN body in the specific field of marine plastic pollution is the Global Partnership on Marine Litter (GPML). The GPML was established in 2012 between UN Environment and other UN bodies such as IMO, IOC-UNESCO and FAO; it is hosted by the UN Environment (Hugo, 2018). It consists of a global coordinating forum gathering all stakeholders – i.e. international agencies, governments, NGOs, academia, private sector, civil society and individuals – working on marine debris prevention and management (Lyons et al., 2019; Vince and Hardesty, 2016). The Partnership has several objectives of which we can only mention few here: assessing and reducing the impacts of marine litter (e.g., through waste prevention and reuse); promoting knowledge management and information sharing; and enhancing international cooperation and coordination. According to the UN Environment (2017), the GPML could play a stronger role, for instance through the establishment of a scientific advisory body that could work as a platform for information sharing between industry, researchers,

Table 3
Institutional challenges and areas for action.

	Institutional challenges	Areas for action
<u>Global policy framework</u>	<ul style="list-style-type: none"> ● Focus on sea-based sources of marine plastic pollution ● Prevalence of soft-law instruments ● Fragmentation of the existing international regulatory framework 	<p><i>Action 1. Harmonisation of international laws</i></p> <ul style="list-style-type: none"> ● Develop a new global plastics treaty ● Amend existing international instruments ● Follow a double-track approach
<u>National implementation</u>	<ul style="list-style-type: none"> ● Hindrances of domestic implementation ● Sectoral policies 	<p><i>Action 2. Coherence across national policies</i></p> <ul style="list-style-type: none"> ● Adopt strategic planning ● Use a mix of policy instruments ● Strengthen stakeholder engagement
<u>International agencies</u>	<ul style="list-style-type: none"> ● Fragmented authority ● Weak leadership 	<p><i>Action 3. Coordination of international organisations</i></p> <ul style="list-style-type: none"> ● Identify a leading coordinating organisation (e.g., UN Environment)
<u>Science advice</u>	<ul style="list-style-type: none"> ● Coordination in international decision-making 	<p><i>Action 4. Science-policy interaction</i></p> <ul style="list-style-type: none"> ● Rely on advisory bodies for coordinating purposes (e.g., GESAMP) ● Rely on advisory bodies for international cooperation with all stakeholders (e.g., GPML)

entrepreneurs, NGOs and policy-makers. The integration of several sources of knowledge could help overcome some data gaps (e.g., about the quantities and degradation of litter in the marine environment and its potential physical and chemical impacts on marine life) (Chen, 2015).

To sum up, science advice can foster coordinated actions from many relevant international organisations, like the case of GESAMP exemplifies. Joint reports and joint studies among agencies seem to be recurrent in the UN system also on the topic of marine litter (Lyons et al., 2019). Finally, integration of science with further knowledge from practitioners (e.g., through arrangements like the GPML) can also enhance cooperation with stakeholders at the international level.

6. Conclusion

The problem of marine plastic pollution is rooted in the production-consumption pattern of our societies and the way countries manage and dispose their waste (Chen, 2015; Hugo, 2018). In this article we have stressed several institutional challenges in the effort to prevent, reduce and manage marine litter at the global level. In particular, we focused on four aspects that we consider essential for a global, holistic and integrated approach to the problem of plastic waste in our oceans: harmonisation of international laws; coherence across national policies; coordination of international organisations; and science-policy interaction. The article recommends some actions that we summarise in Table 3.

Many of the solutions presented in this article are not free from difficulties. For instance, a new global plastics treaty requires a long process of negotiations among many political and economic stakes. The pursuit of coherence among national policies faces several institutional and historical obstacles as well as interests' opposition within countries. Coordination among international organisations certainly needs to cope with considerations of inter-organisational power balance and political opportunity. The role of science in international governance still needs strengthening through institutionalised platforms for knowledge exchange.

Despite such difficulties, changes in the existing global governance for marine plastic pollution can be pursued by acting simultaneously at many levels, as we tried to indicate. In normal times, reform is typically incremental, but any gradual change implies time. In the current situation of oceans depletion at a planetary scale due also to marine plastic pollution, we believe that actions and radical changes are urgently needed.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.envsci.2020.06.015>.

References

- Arimoto, T., Sato, Y., 2012. Rebuilding public trust in science for policy-making. *Science* 337, 1176–1177.
- Boyes, S.J., Elliott, M., 2014. Marine legislation – the ultimate ‘horrendogram’: international law, European directives & national implementation. *Mar. Pollut. Bull.* 86, 39–47.
- Bressers, D., van Twist, M.J.W., van der Steen, M.A., Schulz, J.M., 2018. The contested autonomy of policy advisory bodies: the trade-off between autonomy and control of policy advisory bodies in the Netherlands, the United Kingdom, and Sweden. In: Ongaro, E., van Thiel, S. (Eds.), *The Palgrave Handbook of Public Administration and Management in Europe*. Palgrave Macmillan, London.
- Chen, C.-L., 2015. Regulation and management of Marine litter. In: Bergmann, A., Gutow, L., Klages, M. (Eds.), *Marine Anthropogenic Litter*. Springer, Berlin.
- Cicin-Sain, B., Vandeweerdt, V., Bernal, P.A., Williams, L.C., Balos, M.C., 2006. Meeting the Commitments on Oceans, Coasts and Small Island Developing States Made at the 2002 World Summit on Sustainable Development. How Well Are We Doing? paper presented at the Global Forum on Oceans, Coasts, and Islands, Paris June 2006.
- Coscieme, L., Håkon da Silva, Hyldmo, Fernández-Llamazares, A., Palomo, I., Mwampamba, T.H., Selomane, O., Sitas, N., Jaureguiberry, P., Takahashi, Y., Lim, M., Barral, M.P., Farinaci, J.S., Diaz-José, J., Ghosh, S., Ojino, J., Alassaf, A., Baatuwwe, B.N., Balint, L., Vallem, M., 2020. Multiple conceptualizations of nature are key to inclusivity and legitimacy in global environmental governance. *Environ. Sci. Policy* 104, 36–42.
- Dauvergne, P., 2018. Why is the global governance of plastic failing the oceans? *Glob. Environ. Chang. Part A* 51, 22–31.
- den Hertog, L., Stross, S., 2013. Coherence in EU external relations: concepts and legal rotting of an ambiguous term. *Eur. Foreign Aff. Rev.* 18, 373–388.
- EC, 2018. A European Strategy for Plastics in a Circular Economy. {SWD(2018) 16 final}.
- Elcock, H., 1990. Implementing management change: leading and following. In: Younis, T. (Ed.), *Implementation in Public Policy*. Aldershot, Dartmouth.
- Elliott, M., 2014. Integrated marine science and management: wading through the morass?. *Maritime Pollution Bulletin* 86 (1-2), 1–4.
- Ferraro, 2014. International Regimes in China. Domestic Implementation of the International Fisheries Agreements. Routledge, London.
- Glynn, S., Cunningham, P., Flanagan, K., 2003. *Typifying Scientific Advisory Structures and Scientific Advice Production Methodologies – Final Report*. University of Manchester.
- Greer, S.L., Lillvis, D.F., 2014. Beyond leadership: political strategies for coordination in health policies?. *Health Policy (New York)* 116, 12–17.
- Groux, G.M.N., Hoffman, S.J., Ottersen, T., 2018. A typology of scientific advisory committees?. *Glob. Chall.* 1–7.
- Guzman, A.T., Meyer, T.L., 2010. International Soft law. *J. Leg. Anal.* 2 (1), 171–225.
- Haas, P.M., 1992. Introduction: epistemic communities and international policy coordination. *Int. Organ.* 46 (1), 1–35.
- Haward, M., 2018. Plastic pollution of the world's seas and oceans as a contemporary challenge in ocean governance. *Nat. Commun.* 9 (667), 1–3.

- Higgins, R., 1994. *Problems and Process: International Law and How We Use It*. Oxford University Press, New York.
- Howlett, M., Ramesh, M., Perl, A., 2009. *Studying Public Policy – Policy Cycles and Policy Subsystems*. Oxford University Press, Oxford.
- Hugo, T.G., 2018. *The Case for a Treaty on Marine Plastic Pollution*. Norwegian Academy of International Law.
- IMO, 2005. *The New GESAMP: Science for Sustainable Oceans*. International Maritime Organisation, London.
- Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., Law, K.L., 2015. Plastic waste inputs from land into the ocean. *Science* 347, 6223.
- Kahan, J.P., 2001. Focus Groups As a Tool for Policy Analysis. *Analysis of Social Issues and Public Policy*, pp. 129–146.
- Kenny, C., Washbourne, C.-L., Tyler, C., Blackstock, J.J., 2017. *Legislative Science Advice in Europe: the Case for International Comparative Research*. *Palgrave Communications* Published 10 May 2017.
- Koppelman, B., Day, N., Davison, N., Elliott, T., Wilsdon, J., 2010. *New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power*. The Royal Society, London.
- Krueger, R.A., 1994. *Focus Groups. A Practical Guide for Applied Research*. Sage Publications, Newbury Park.
- Lenschow, A., Bocquillon, P., Carafa, L., 2018. Understanding coherence between policy spheres. *Environ. Policy Gov.* 28, 323–328.
- Liffmann, M., Howard, B., O'Hara, K., Coe, J.M., 1997. Strategies to reduce, control, and minimize land-source marine debris. In: Coe, J.M., Rogers, D.B. (Eds.), *Marine Debris: Sources, Impacts, and Solutions*. Springer, Berlin, pp. 381–390.
- Lipson, C., 1991. Why are some international agreements informal? *Int. Organ.* 45 (4), 495–538.
- Lyons, Y., Su, T., Neo, M.L., 2019. *A Review of Research on Marine Plastics in Southeast Asia: Who Does What?* Crown, London.
- Nilsson, M., Zamparutti, T., Petersen, J.E., Nykvist, B., Rudberg, P., McGuinn, J., 2012. Understanding policy coherence: analytical framework and examples of sector–environment policy interactions in the EU”. *Environ. Policy Gov.* 22, 395–423.
- Nyka, M., 2018. Legal approaches to the problem of pollution of marine environment with plastic”. *Scientific Journals of the Maritime University of Szczecin* 59 (131), 162–167.
- Olawuyi, D., 2020. Sustainable development and the water-energy-food nexus: legal challenges and emerging solutions. *Environ. Sci. Policy* 103, 1–9.
- Peters, B.G., 1998. Managing horizontal government: the politics of co-ordination”. *Public Adm.* 76 (2), 295–311.
- Quirion, R., et al., 2016. Reflections on science advisory systems in Canada. *Palgrave Commun.* 2, 16048.
- Raubenheimer, K., McIlgorm, A., 2017. Is the Montreal Protocol a model that can help solve the global marine plastic debris problem? *Mar. Policy* 81, 322–329.
- Ryan, P.G., 2015. The brief history of marine litter research. In: Bergmann, M., Gutow, L., Klages, M. (Eds.), *Marine Anthropogenic Litter*. Springer, Cham, pp. 1–25.
- Schrijver, N., 2010. *Development Without Destruction – the UN and Global Resource Management*. Indiana University Press, Bloomington and Indianapolis.
- Tessnow-von Wysocki, I., Le Billon, P., 2019. “Plastics at sea: treaty design for a global solution to marine plastic pollution. *Environ. Sci. Policy* 100, 94–104.
- UN, 2000. *Basic Facts About the United Nations*. United Nations, New York.
- UN Environment, 2017. *Combating Marine Plastic Litter and Microplastics: An Assessment of the Effectiveness of Relevant International, Regional and Subregional Governance Strategies and Approaches*. United Nations Environment Programme, Nairobi.
- Underdal, A., 1980. Integrated marine policy: what? Why? How? *Mar. Policy* 4, 159–169.
- UNEP, 2009. *Marine Litter: a Global Challenge*. United Nations Environment Programme, Nairobi.
- Victor, D.G., Raustiala, K., Skolnikoff, E.B., 1998a. “Introduction and overview. In: Victor, D.G., Raustiala, K., Skolnikoff, E.B. (Eds.), *International Environmental Commitments – Theory and Practice*. The MIT Press, Cambridge and London.
- Vince, J., Hardesty, B.D., 2016. Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restorat. Ecol.* 25, 123–128.
- Vince, J., Hardesty, B.D., 2018. Governance solutions to the tragedy of the commons that marine plastics have become. *Front. Mar. Sci.* 5, 214.
- Wilson, J.Q., 1989. *Bureaucracy: What Government Agencies Do and Why They Do It*. Basic Books, New York.
- Worm, B., Lotze, H.K., Jubinville, I., Wilcox, C., Jambeck, J., 2017. Plastic as a persistent marine pollutant. *Annu. Rev. Environ. Resour.* 42, 1–26.
- Young, O.R., 1991. Political leadership and regime formation; on the development of institutions in international society. *Int. Organ.* 45 (3), 281–308.

Dr. Gianluca Ferraro is a Research Fellow of the University of Portsmouth. He has worked as a policy researcher and analyst in academia and international organisations; his work has focused on policy implementation, public involvement and evidence-based policy-making. His area of specialisation is environmental and energy governance. He has analysed the national implementation of international environmental and energy policies in the European Union (EU) and non-EU countries. Out of the EU, he has conducted policy research in emerging and developing countries in Asia and Africa. Gianluca Ferraro holds a PhD in Social Sciences.

Prof. Pierre Failler is the Director of the Centre for Blue Governance. He is coordinating complex research projects with multidisciplinary teams for more than 25 years in Europe, Africa, Asia, Caribbean and Pacific coastal countries in collaboration with national research institutions and universities and a close link with policy bodies. He has recently coordinated the Blue Economy Strategy for the African Union, the Regional Action Plan for the Blue Economy of the Indian Ocean Commission, the Blue Economy Strategy of the Intergovernmental Authority for development (IGAD) as well as the Blue Economy Strategy for the Bangladesh.