

## Chapter 11

# Protected Shores Contaminated with Plastic: From Knowledge to Action

Juan Baztan<sup>1,2</sup>, Bethany Jorgensen<sup>3,2</sup>, Jean-Paul Vanderlinden<sup>1,2</sup>, Sabine Pahl<sup>4</sup>, Richard Thompson<sup>4</sup>, Ana Carrasco<sup>5</sup>, Aquilino Miguelez<sup>5</sup>, Thierry Huck<sup>6,2</sup>, Joaquim Garrabou<sup>7</sup>, Elisabetta Broglio<sup>7,2</sup>, Omer Chouinard<sup>8,2</sup>, Céline Surette<sup>8,2</sup>, Philippe Soudant<sup>9</sup>, Arnaud Huvet<sup>10</sup>, François Galgani<sup>11</sup>, Ika Paul-Pont<sup>9</sup>

<sup>1</sup>Université de Versailles Saint-Quentin-en-Yvelines, OVSQ, CEARC, Guyancourt, France;

<sup>2</sup>Marine Sciences for Society, [www.marine-sciences-for-society.org](http://www.marine-sciences-for-society.org); <sup>3</sup>The University of Maine,

Orono, Maine, USA; <sup>4</sup>Plymouth University, Drake Circus, Plymouth, UK; <sup>5</sup>Observatorio

Reserva de Biosfera, Cabildo de Lanzarote, Arrecife, Spain; <sup>6</sup>UBO-CNRS-LPO, UFR Sciences

F308, Brest, France; <sup>7</sup>Institut de Ciències del Mar, CSIC, Barcelona, Spain; <sup>8</sup>Université de

Moncton, Moncton, New Brunswick, Canada; <sup>9</sup>IUEM, CNRS/UBO, Laboratoire des Sciences

de l'Environnement Marin, Plouzané, France; <sup>10</sup>IFREMER, Centre de Brest, Laboratoire

Physiologie des Invertébrés, Plouzané, France; <sup>11</sup>IFREMER, Centre de Corse, Laboratoire

Environnement Ressources PAC/Corse Imm Agostini, ZI Furiani, Bastia, France

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### INTRODUCTION

Since the first use of the term “protected area” in 1933, at the International Conference for the Protection of Fauna and Flora in London, the number of protected areas has increased exponentially throughout the world. In early 2015, there were more than 209,000 designated marine and terrestrial protected areas. When taken together, these areas span over 30 million km<sup>2</sup> of the earth’s surface (Dequignet et al., 2014).

In parallel with efforts for environmental protection, the production is increasing of materials that if improperly disposed of are potentially harmful. Plastic production, for example, follows this trend, with annual production in

2012 reaching nearly 300 million metric tons (Plastics Europe, 2013). From its initial production until the moment it is discarded as waste, plastic's life cycle has advantages and disadvantages for our societies and the ecosystems in which we live.

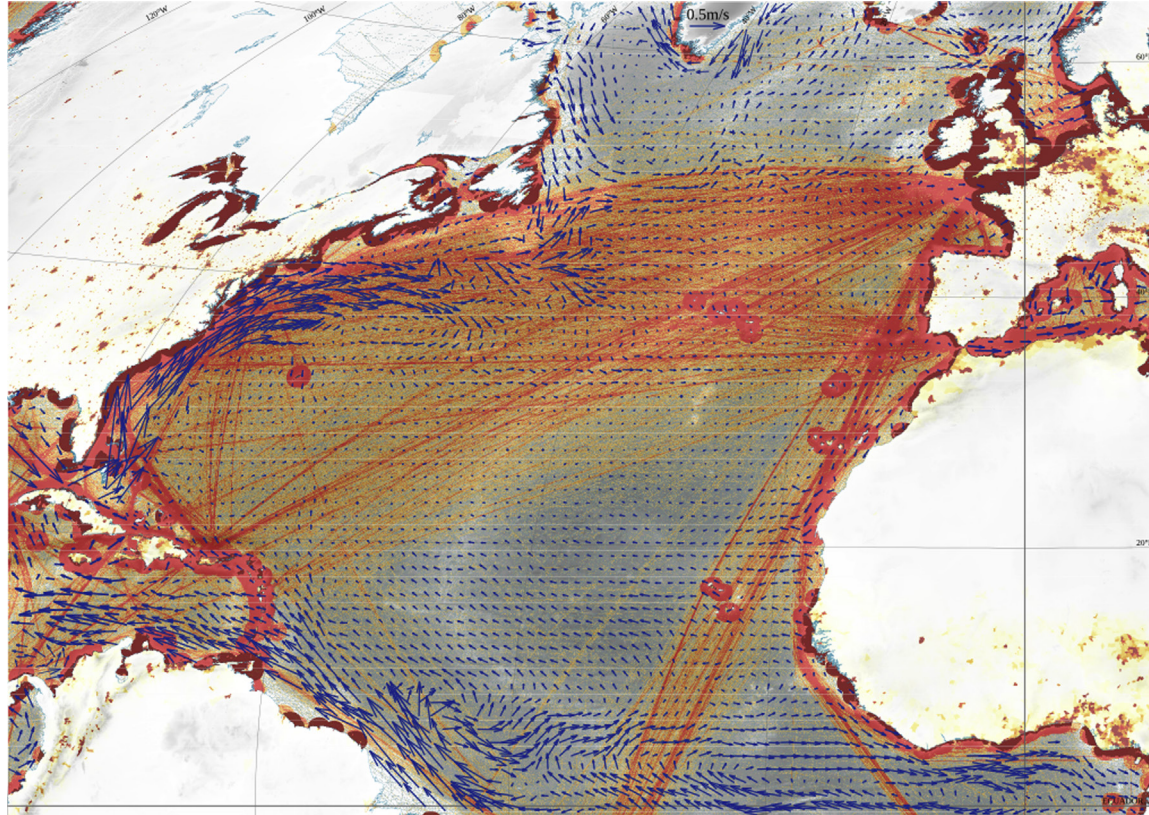
Five years ago, a working group formed to focus on the question of plastics contaminating the shores of protected areas in the Canary Islands. In this chapter, we will share the story of that working group's collaborative efforts to date, and also describe future directions in the shape of a larger regional working group: Communities-Based Observatories Tackling Marine Litter (COASTAL). As an entry point into the key elements presented in this chapter, we offer a brief case study highlighting work unfolding on the island of Lanzarote, followed by a concise summary of the plastic pollution problem, and a description of the aims and vision proposed by the COASTAL working group.

## PLASTIC DEBRIS THREATENS PROTECTED AREAS

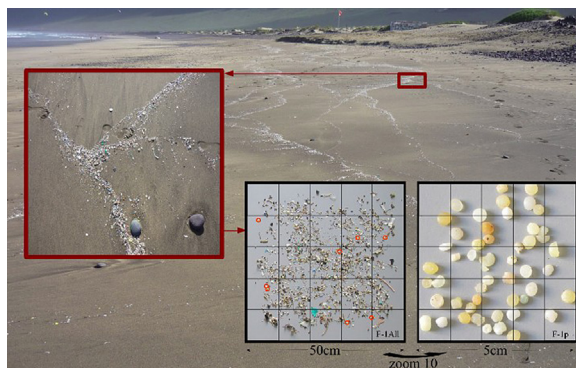
In 1993, Lanzarote was designated a Biosphere Reserve by the Man and Biosphere UNESCO program, and it is a founding member of the World Network of Islands and Coastal Zones, created in 2012. Lanzarote exemplifies issues related to marine debris for several reasons: (1) from the oceanographic perspective, it is strategically positioned in the Canary Current; (2) from a conservation perspective, it includes natural and national parks, and is one of the biggest Marine Protected Areas in Europe; (3) socially, its residents actively and enthusiastically support an ongoing plastic debris awareness campaign in schools, they spontaneously organize beach cleanings, they seek out scientific and technical support, and they take questions into their own hands and develop locally relevant solutions; and (4) politically, local administrations identify tackling plastic pollution as one of their priorities for the coming years, they support local initiatives, and look for ways to connect local efforts with regional and global endeavors.

For these reasons, we begin at this place and with these people who “seek to reconcile conservation of biological and cultural diversity and economic and social development through partnerships between people and nature” ([www.unesco.org](http://www.unesco.org) 2015). From here, our work has grown into COASTAL, at the North Atlantic regional scale, aiming to build solutions between locations in the oceanic circulation system in [Figure 11.1](#), from sources to sinks.

During our preliminary fieldwork session in Lanzarote, from December 2008 to January 2009, we were astonished by the amount of accumulated plastic on the northern shores of the three visited Canary Islands. One of the first pictures we took of Famara Beach (Lanzarote) shows the overwhelming extent of this contamination, most of which is transported via the ocean from abroad and does not come from the island's inhabitants or visitors. We quickly realized that even if local solutions could be implemented, an



**FIGURE 11.1** North Atlantic–Mediterranean system: We illustrate here the combination of (1) the oceanographic conditions, (2) the anthropogenic impact at sea (Halpern et al., 2008), and (3) population density (GPWv3, 2011).



**FIGURE 11.2** Microplastic deposition on Famara Beach. The background image shows extensive white lines of microplastics deposited on the beach by successive waves. The left box shows a closer view of the sampled area. The middle box displays the plastic extracted from the sample, and the right box shows the pellets found.

integrated regional approach would be necessary to truly solve the problem (Figure 11.2).

From here, we began a participatory strategizing process with local stakeholders at different levels: the fishermen’s institute, municipal governments, the national park, the natural park, the marine reserve, and the biosphere reserve. We built a coordination team, which is managed at the island level by the biosphere reserve through an “inaugural contract.” The contract helps dissipate the fuzziness inherent in the interdisciplinary approach (Blanchard and Vanderlinden, 2010). Once plastic pollution was identified as a top priority for these stakeholders, the first move was to transition from the identification of plastics, one of the most salient concerns at the local level, to selecting and implementing solutions at the regional scale.

As an initial step toward this goal, in January and February of 2013, we completed extensive microplastic sampling on every beach of Lanzarote and two other islands sharing its volcanic platform: Fuerteventura and la Graciosa. We found that despite being located in highly protected natural areas, all beaches on these three islands are substantially affected by microplastic pollution. On some beaches, pollution levels reached concentrations greater than 100 g of plastic per liter of sediment (Baztan et al., 2014). These results show that the plastic debris problem is shared by at least three of the islands in the Canary Islands archipelago. Moreover, it reflects conditions of extensive contamination in our oceans on a global scale (e.g., Thompson et al., 2009a,b; Law and Thompson, 2014).

To bring the public’s attention to plastic pollution on Lanzarote and highlight plastic’s accumulation in coastal zones around the world, in February 2013 the working group started a social media group (<https://www.facebook.com/Aguitaconelplastico>). This group continues to gain active followers who post news, alerts, questions, and local initiatives. Some posts



have been read by over 25,000 people, and as of March 2015, there are more than 7000 participating members.

This social media method of raising awareness is one of many approaches taken to inform the public of the ongoing campaign. The message has also been spread via radio, newspapers, and television. In March 2013, a program from Spain's national television network focused two of its episodes on plastic pollution and the work being done on Lanzarote to combat it. The episodes were first aired in June 2013, and then again in September 2013, February 2014, and July 2014. They were shown during prime time, and with each broadcast, participation in the social media group jumped. After the last broadcast, 1000 new participants joined the social media group within the span of one week. This increase in membership appears to be associated with an increase in the diversity and richness of the information participants share with each other, as well as the pertinence and legitimacy of their shared messages.

In January 2014, the Spanish National Research Council (CSIC) connected with the working group through the Institute of Marine Sciences (ICM), and launched a program called "Plastic 0" This program introduced a focus on plastic pollution into ICM's Seawatchers initiative (<http://www.seawatchers.org>), a web-based platform where citizens and institutions can share geo-referenced observations or pictures of plastic pollution in marine and coastal areas. The goal is to construct an open database of common facts that help users visualize the extent of this global problem. As such, beach walkers, divers, sailors, and others who enjoy marine recreation can participate actively in refining the global picture of plastic pollution.

These media efforts have been complemented by (1) our participation in more than five international conferences; (2) an awareness campaign using posters on public transportation and in markets, small shops, and shopping centers; and (3) an educational campaign in more than 50 schools. These shared efforts behind the local "Plastic 0" campaign were recognized in 2014, when it won the Social Innovation Prize from Laguna University.

At this point, after five years of work, the working group has arrived at the question: What is the best way to continue efforts and participate in constructing solutions to solve the problem locally and at the regional scale?

As we consider this question, we draw upon lessons learned in the first five years of this process. We recognize the need to (1) connect with other regions in the North Atlantic and Mediterranean system; (2) formalize and synchronize a working group at this scale; (3) reach political implications through scientific and social engagement; and (4) work for the sustainability of the process politically, socially, and scientifically.

These four points are the basis for a new regional-level working group, Communities-Based Observatories Tackling Marine Litter (COASTAL). The core of the working group is composed of researchers from Versailles University, Plymouth University, CNRS, IFREMER, ICM-CSIC, Moncton University, and UNESCO-MaB. It is open to other colleagues as an initiative of the research

network Marine Sciences for Society. From our case study in Lanzarote, we now shift to a brief summary of the available literature on the plastic debris problem, followed by an overview of the suggested solutions we are beginning to implement through the COASTAL working group.

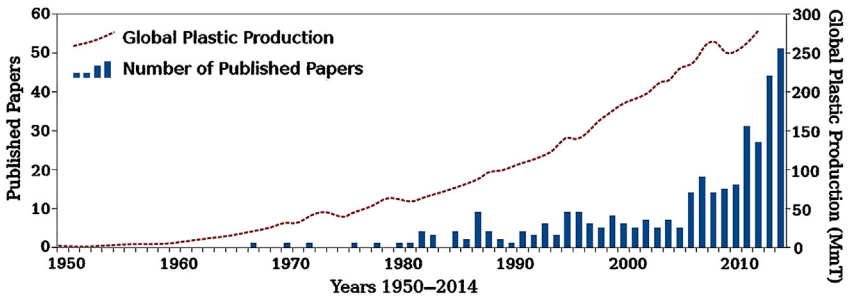
## WHY PLASTIC POLLUTION?

In the 1970s, reports clearly documenting plastic pollution in oceans and coastal zones began to be published (e.g., [Carpenter and Smith, 1972](#); [Wong et al., 1974](#)). It took several years, and many more reports, before this work was seen as a red flag. Meanwhile, plastic pollution spread and has become established throughout the marine environment. Currently, its range extends to coastal areas, both poles, throughout the water column, and the open ocean, sea floor, and ocean surface (e.g., [Day and Shaw, 1987](#); [Shomura and Godfrey, 1989](#); [Galgani et al., 2000](#); [Thompson et al., 2004](#); [Eriksen et al., 2014](#); [Law and Thompson, 2014](#)). It is estimated that plastics constitute the majority of marine litter ([Derraik, 2002](#)), and in some places microplastics make up over 80% of intertidal plastic debris ([Browne et al., 2007](#)). This material is ubiquitous, and can even be found washed up on the remote island beaches of highly protected natural areas (e.g., [Barnes et al., 2009](#); [Baztan et al., 2014](#)).

Plastic contamination is a proxy for other types of contamination as well. When viewed this way, it seems we have reached an ecological tipping point, and must be ready for unanticipated consequences and changes ([Rockström et al., 2009](#); [Steffen et al., 2015](#)). This is why it is crucial to bring attention to the plastic debris problem on coasts and in oceans. We must work to better understand the extent of the problem, how it is changing over time and across scales, and the short- and long-term consequences of marine plastic pollution. Alongside ongoing research, we must use the knowledge we already have to inform political, civic, and industrial responsibilities and solutions.

As global rates of plastic production continue to increase, so too does our understanding of marine litter's detrimental impact on marine and coastal zones and the wildlife that live there. Given the unsolved question of plastic's fate once it reaches the ocean, the little we know about effectively removing it from marine environments, and the need for further investigation into its potential environmental effects, the plastic debris problem is more relevant today than ever ([Figure 11.3](#)).

Cumulative knowledge about plastic pollution is expanding rapidly. In the past 10 years, hundreds of papers have been published, including works like the special issue of *Philosophical Transactions of the Royal Society* entitled "Plastics, the environment and human health," compiled by [Thompson et al. \(2009a\)](#). This issue contains the review paper, "Plastics, the environment and human health: Current consensus and future trends," which concisely summarizes perspectives on plastic pollution from many natural scientists'



**FIGURE 11.3** This graph shows global plastic production (red dotted line) and (in blue) the number of papers published by Elsevier between 1950 and 2014 with “plastic pollution” in the title, abstract, or keywords. This figure raises the question: How do we move from knowledge to action?

points of view. The synthesis of these perspectives is reflected in this quote: “Plastics offer considerable benefits for the future, but it is evident that our current approaches to production, use and disposal are not sustainable and present concerns for wildlife and human health” (Thompson et al., 2009b). Since 2009, hundreds more scientific articles have contributed to our understanding of the issue (e.g., Galgani et al., 2010; Cole, 2012; Law and Thompson, 2014; Gall and Thompson, 2015; Moore, 2014). All of these works address the same concern: even if it is one of the most useful materials in our societies, plastic represents an explicit hazard if we continue to treat it the same way we do now.

Additionally, the role of human decisions and behavior is increasingly recognized within the context of the plastic debris problem. The Lanzarote case study and the EU-funded MARLISCO project ([www.marlisco.eu](http://www.marlisco.eu)) are only two examples of many ongoing efforts working to integrate different stakeholder perspectives into collaborative solutions. These approaches focus on a systematic understanding of different actors in this complex problem, and take into account perceptions and behavioral patterns, using social science methods and interventions to bring about change.

In January 2014, more than 100 specialists in microplastic pollution came together in Plouzané, France for the international workshop “Fate and Impacts of Microplastics in Marine Ecosystems” (see <http://micro2014.sciencesconf.org/>). Participants were surveyed for their opinions about the challenges facing the scientific community, the commitments they were willing to make related to plastic, and their suggestions for solutions to the plastic debris problem. We grouped their responses under two broad questions: “What are we struggling with?” and “How will we solve the plastic problem?” Most of the suggested solutions were related to three themes: alternative materials, public awareness, and regulation of plastic’s use and disposal or reuse. Many participants made commitments to continue researching the effects of microplastics on human health and the environment. Participants also committed to sharing data, monitoring strategies, and protocols. With these insights in mind, we transition into the next section of this chapter.

## MOVING FROM KNOWLEDGE TO ACTION TO FACE THE PLASTIC DEBRIS CHALLENGE

From 2008 to 2012, our community-based work on the plastic debris problem in Lanzarote was extremely local, focused on, and for the island. We recognized, however, that as critical as this local effort is, it is clearly not enough. Plastic debris is a complex human problem, and to address it, we must connect different scales of action—local, regional, and global—while reconciling environmental, political, and industrial priorities. Additionally, we must weave together the web of available knowledge to inform and be informed by sustainable development actions.

But how?

Drawing from collaborative experiences, stakeholder theory, interdisciplinary frameworks, perspectives on risk perception and communication (e.g., [Morgan et al., 2001](#)), and behavior change (e.g., [Darnton, 2008](#)), we offer the following steps toward a reflexive research/action program.

- Establish a collaborative working group that includes world experts on marine litter and experts on other complementary and cross-cutting topics (e.g., governance, policy, behavior change, communication) to work together toward shared goals.
- Define a geographic context in which stakeholders share similar challenges and in which solutions could be implemented.
- Start with pilot study sites to develop protocols, apply methodologies, and test solutions.
- Gradually expand the working group to include stakeholders to enrich and legitimize deliberation and action processes.
- Work with policymakers, industry leaders, and the general public to implement and monitor solutions.
- Develop local, regional, and global actions that reduce new inputs of plastic debris while respecting community values and individuals.

These steps should be taken in tandem with the efforts already set in motion by thousands of people working on this problem—from volunteers to professionals, using spontaneous approaches or highly sophisticated protocols. For all the diverse work on the plastic debris problem, we often hear the following two solutions: (1) put a stop to plastic debris entering the oceans; and (2) where feasible, clean up the “sinks” where plastic has accumulated.

These steps sound deceptively simple.

Plastic products are widely used because they are convenient and inexpensive. Their production is increasing exponentially for these reasons. In this sense, we must consider the roles played by consumers, producers, recyclers, waste managers, and policymakers; in other words, those whose choices drive trends in plastic manufacturing, use, and disposal. To be successful, we must consider the perspectives of these individuals and find integrative solutions while being mindful of the barriers.



For example, since the ascription of responsibility is associated with taking action (e.g., [Dietz et al., 1999](#)), who shoulders the responsibility for solving the plastic debris problem?

People differ on who should ultimately take ownership of such a diffused problem. The most popular choice is to externalize the blame: “Someone other than me is responsible.”

Here the waters swirling around the question of responsibility become even muddier. Although it is widely recognized that plastic debris poses a global environmental and waste management problem, perceptions and representations of the plastic debris problem vary. For example, some argue that the products are not the problem—the challenge is in their disposal. To make progress, we must first reconcile the various perspectives relating to this problem.

Once we calibrate our perceptions of the problem, there is the question of how to solve it. For a consumer who uses plastic because it is the most cost-effective option for his or her household, it may seem that solutions need to be supplied by the plastic industry, who have the means to make their products more “environmentally friendly.” But, from the industry’s side, they have responsibilities to their shareholders, investors, employees, etc., and need to base their decisions on staying competitive. So, does the responsibility then fall back on the consumers to use their purchasing power to drive change in manufacturing practice? Or is it on voters to get their elected officials to pass legislation that regulates manufacturers and recycling? And what of citizens without enough genuine political agency to influence national policy?

This list of questions could go on and on, but in the end our question is: How do we implement solutions when we may not share the same values and motivations and we operate within different yet geographically overlapping and linked contexts?

Our approach to addressing this question is the COASTAL initiative. Its focus is on compiling existing knowledge about marine litter and working with and for stakeholders to improve ocean literacy and enhance social engagement around the issue of marine litter. Our end goal is to move from awareness to action through social engagement and integrated stakeholder collaboration, and to continue using what we learn from our experiences to inform our efforts.

To do this, COASTAL is taking the basic steps outlined earlier, and proposes the following work streams to realize our goals.

- Social engagement with tourists to create geographical connections between (potentially remote) causes and consequences.
- Recreational and social activities as elements of community building and encouraging participation from diverse stakeholders.
- Open dialog with the media to help raise awareness.
- Sea and land roaming actions.
- Creation of an open-source Atlas of Marine Litter.
- Development of the Knowledge and Action Observatory.
- Devising and testing mutually acceptable solutions.

Between technical, scientific, and local communities, there is so much we already know. By forming a solid base through COASTAL, we hope to create opportunities to share this knowledge and foster efforts with stakeholders in affected communities to help reduce the sources and driving factors behind marine litter. In doing so, we will work toward solutions that are acceptable to a wide range of stakeholders.

Today, we conclude that (1) there is a wealth of knowledge and information on the extent and impacts of plastic debris; but (2) this knowledge is currently not used optimally to communicate with and engage stakeholders; so (3) we need to draw conclusions from, and base our actions upon, what we already know, with the explicit aim of working toward mutually acceptable solutions.

Pressures from human activities are causing unprecedented changes in the marine environment, especially in coastal zones. Our societies are responsible for identifying ways to reverse, mitigate, or adapt to these changes, which collectively pose one of the biggest challenges we face. Marine litter is an unequivocal expression of human activity, threatening wildlife, economies, and human health and well-being. The COASTAL consortium effort hopes to (1) integrate technical and scientific knowledge with that of local communities and stakeholders; (2) improve awareness through increasing ocean literacy; and (3) implement pertinent local, regional, and transnational action plans.

Let us commit to working collaboratively and actively implementing solutions to truly solve the plastic debris problem.

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