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AWARENESS ACTIONS TO REDUCE SINGLE-USE PLASTICS FROM LAND, BASED SOURCES INTO RIVERS AND OCEANS, IN MINHO RIVER: OUTCOMES FROM LOWPLAST PROJECT

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Abstract

There is an imperative need to reduce disposable plastics and enhance the value of plastic waste. Stakeholders from the HORECA network and the general public participated in 11 awareness actions at Minho river, riverbanks, and at Caminha beach. The aim of these actions was to raise awareness about plastic reduction from land-based sources into the oceans, especially single-use plastics. Over 4.300 plastics were collected and organized in a TOP 5 of predominance: Fragments (< 2,5 cm); Cigarette butts; Fragments (> 2,5 cm); Cotton buds; Bio filters pieces. A digital pedagogical "Collection Litter 365" was created with photographs of waste removed from the aquatic environment and art works that used it as raw material for the artistic process. Simultaneously, 42 restaurants, cafes, hotels and accommodation establishments were surveyed and motivated to eliminate or minimize the use of disposable plastics and improve it's separation for recycling. Plastic water bottles (43%), plastic straws (40%) and plastic bags with handles (26%) were the most decreased items. Plastic separation for recycling reached 29%. Art works were exhibited in Minho river, at the Art Biennale of Cerveira and disseminated via digital communication. These actions were performed during LowPlast Project, promoted by Aquamuseu do rio Minho - Vila Nova de Cerveira Municipality, in partnership with the Portuguese Marine Litter Association, the Foundation Biennale of Art of Cerveira and the Interdisciplinary Art Institute - DTK, in Norway, and financed by EEA Grants. https://aquamuseu.cm-vncerveira.pt/pages/893.

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1 Introduction

More than 3 billion people rely on the Oceans for their livelihoods, but these precious resources are under various and severe threats, including pollution by marine litter.
The Sustainable Development Goal 14 - Underwater life, of the United Nations (UN, 2022), states that by 2025, marine litter should be prevented and significantly reduced, particularly what is originated from land-based activities.
The major category of marine litter is plastic. This comes hand-to-hand with an escalation in plastic production and consumption.

More than 350 million tons of plastic are produced every year in the world, manufactured mainly in China (32%), North American Free Trade Agreement (19%), rest of Asia (17%), Europe (15%), Middle East, Africa (7%), Latin America (4%), Japan (3%) and Commonwealth of Independent States (3%), according to Plastics Europe (2021).

At the same time, around 14 million tons of it enters the oceans, mainly from land-based sources, harming marine species, affecting food safety, human health and tourism, and contributing to climate change (IUCN, 2022).

The United Nations Environment Programme (UNEP, 2022) refers to a dramatic increase of plastic pollution leakage into aquatic ecosystems, in recent years, and the possibility of more than doubling it, by 2030.

In fact, the scientific community has been warning about this emerging problem for decades. The Ellen MacArthur Foundation alerts that, by 2050, the quantity of plastics in the oceans will outweigh fish (THE ELLEN MaCARTHUR FOUNDATION, 2022).

Single - use plastics, defined by the European Directive on the reduction of the impact of certain plastic products on the environment (EUROPEAN UNION DIRECTIVE 2019/904), as “products (..) typically intended to be used just once or for a short period of time before being disposed of”, contribute to this massive plastic invasion in the aquatic environment.

At Aquamuseu do Rio Minho, in Vila Nova de Cerveira, north of Portugal, there is a preoccupation with plastic pollution, and continuous work is developed to promote literacy, consciousness and preservation of the resources of Minho River and therefore contribute to the health of the river basin.

In former clean-up actions, carried out in the riverbanks and in the estuary of this river, with school groups, and the general public, with the scope of promoting awareness raising about littering, especially plastic pollution impacts in the aquatic environment, and trying to implement positive changes, high quantities of plastic were collected, such as cigarette buts, plastic bags, bottles, caps, packaging, balloons, straws, cotton swabs, pieces of styrofoam, fishing nets, plastic resin pellets, and numerous plastic fragments from the breakdown of plastic products.

LowPlast - The Art of Reducing Plastic, was an environmental education project, conducted between June 2020 and December 2021, that comprised actions in two Portuguese geographic regions: in the north - Vila Nova de Cerveira, where Minho river flows, and in the South - Setúbal, where Sado river flows.

In this communication we refer particularly to the activities performed in Vila Nova de Cerveira, hence in Minho River, the riverbanks and a sandy beach at the mouth of Minho River.
Three complementary bonds of awareness raising activities to prevent and reduce the entry of plastics from land-based sources into the aquatic environment were developed:
1. Activities in rivers and beaches targeted at stakeholders from HORECA network and the general public
2. Activities in local commerce targeted at stakeholders from HORECA network and fisherman
3. Art works, art installations, and audio-visual products

2 Material and Methods

Awareness actions concerning plastic pollution, with emphasis on single-use plastics were developed between September 2020 and November 2021.
Activities in rivers, riverbanks and beaches, complied 11 actions, designed for distinct publics:

Terrestrial actions, for the general public, based on clean-up of the riverbanks and the beach, which consisted of an initial briefing about marine litter problem and the relationship with our consumption habits, followed by a litter observation along a stretch of the river bank or sandy beach, data record of the litter categories on registration sheets, remove it from the riverine or coastal areas, whenever possible and secure for the participants, and take note of the overall weight of the collected waste.

Aquatic actions, targeted at stakeholders from the HORECA network, which were invited to boat trips in Minho river. During these expeditions they received information about the impacts of marine litter, perceived the litter on the water surface, collected it with a fishing net and registered it in registration sheets created for that purpose.

After this experience, they were invited to engage in a Best Practice Seal, to reduce single-use plastics in their own establishments.
The aim was to provide stakeholders with tools to understand the issue and prevention strategies related to best practices to expand the Circular Economy.

Door-to-door actions began with a complete diagnosis of the disposable plastics in each establishment, a deeper conversation to explain the impacts of waste mismanagement and the benefits of reducing plastic waste, followed by the commitment to find and implement alternatives to chosen *indicators*, which consisted of types of plastic to reduce or eliminate (e.g. plastic water bottles, plastics straws, plastic take-away packaging). Improving the separation of plastics for recycling was also an *indicator*.

Information about the Best Practice Seal criteria, the *indicators*, the commitment and the follow-up, was delivered to the owners/managers of the establishments, and remained available in the Regulation published on the project´s webpage:
https://aquamuseu.cm-vncerveira.pt/cmvncerveira/uploads/writer_file/document/3558/regulamento___selo_de_boas_praticas.pdf

When an establishment fulfilled all the *indicators* from the beginning, it earned the Seal, as stated in the Regulation.
The achievements to reduce or eliminate the use of disposable plastics and improve waste separation for recycling were registered and published on the project webpage and on social media.

During the project period, several artworks were created by Portuguese and Norwegian artists, using waste as raw material.
The artworks were exhibited in such a unique place as Minho river, as well as, at Art Biennale, and in digital channels.
Also, several audio-visual elements were produced and launched in digital channels.
These artistic interventions and audio-visual products had the purpose of approaching art to daily life.

3 Results

Regarding the clean-up actions in riverbanks and on a sandy beach, participants collected 4.300 plastics. The main plastic categories of plastic collect were organized in a TOP 5 of predominance: Fragments (< 2,5 cm) =29%; Cigarette butts = 24%; Fragments (> 2,5 cm) = 17%; Cotton buds = 8%; Bio filters pieces (associated to WWTP) =5% as depicted in Figure 1.

Microplastics, including plastic resin pellets, and plastic pieces most likely associated with WWTP filters were frequently noticed in the riverbanks and in the sand (Figure 2).

During these actions, participants were very motivated, which allowed the removal of more than 150 Kg of litter from (re)entering the aquatic environment.

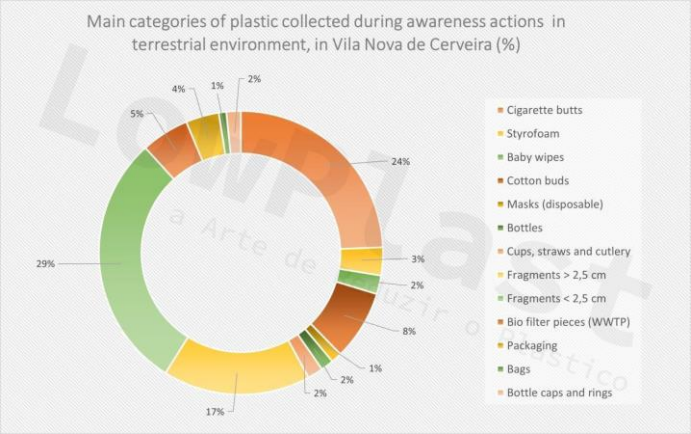

Figure 1: Main categories of plastics collected in awareness actions in the terrestrial environment, in Vila Nova de Cerveira, (%), extracted from LowPlast final report.

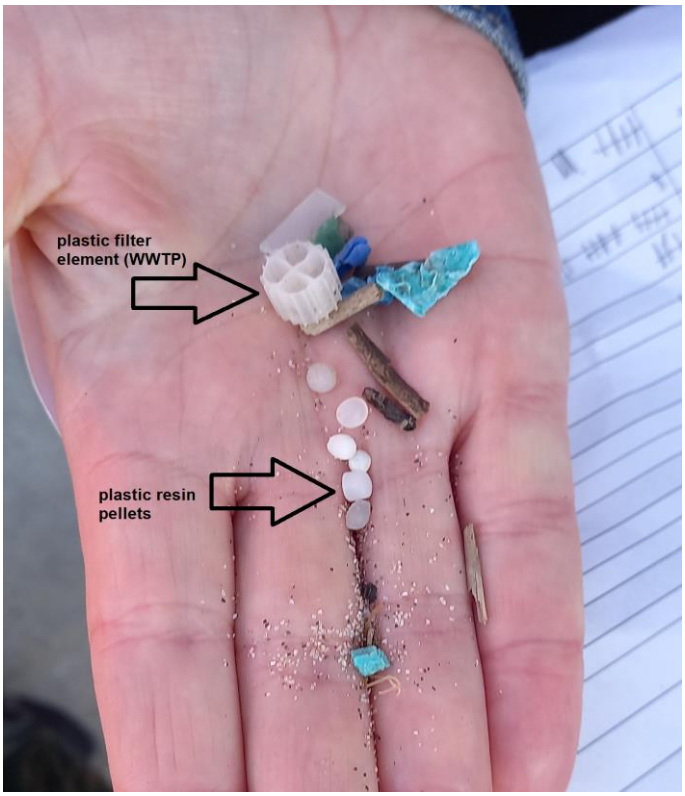

Figure 2: Microplastics, including plastic resin pellets, and plastic elements associated with WWTP filters, collected during clean-up actions in riverbanks and a sandy beach.

Boat trips were also much participated, and it was gratifying to observe the engagement of the public, willing to receive information about the land-based sources of plastic pollution on aquatic environments (Figure 3).
It clearly served as a hook for further actions planned for the representatives of HORECA network establishments with the scope of reducing plastic use and increasing plastic separation for recycling.

Figure 3. Participants receiving information about the impacts of plastic pollution during boat trips in Minho River.

In what concerns the actions directed to the functioning of HORECA network, it is important to recognize that this sector had been strongly affected by many lockdown periods and restrictions caused by COVID-19 pandemics, and this project was contemporary to those constraints.
Nonetheless, 42 establishments were surveyed, from which 7 establishments met all *indicators* from the beginning, so they received the Best Practice Seal (Figure 4), as a good example to similar local establishments. From the other 35 establishments, there were 3 that didn't have enough time or resources to implement all the changes, so they didn't receive the Seal. However, it is noteworthy to mention their improvements (Table 1 red color*). Each establishment was able to develop, on average, 2 indicators.

Figure 4. Best Practice Seal towards reduction of single-use plastics and improvement of plastic recycling designed for HORECA network establishments.

The divulgation of the improvements adopted by the establishments adherent to the Seal of Best Practices to reduce disposable plastic in Vila Nova de Cerveira, was promoted on social media and remained available at the project webpage:
https://aquamuseu.cm-vncerveira.pt/pages/927
The resume of best practices implemented in the establishments of Vila Nova de Cerveira is displayed on Table 1.

Table 1. Resume of the implementation of the Best Practice Seal to reduce disposable plastic, in HORECA network establishments, in Vila Nova de Cerveira. In red color the establishments that did not achieve the Seal, however worked towards plastic reduction and improvement of plastic waste management.

Establishment	Typology	Improvements achieved with the implementation of the Best Practice Seal of LowPlast project
Restaurante Luso-Galaico	Restaurant	Eliminated in the summer approx. 900 plastic straws, 750 plastic bags with handles for take-away service. Keep plastic water bottles because clients demand but are evaluating prices to introduce glass water bottles in table service.
Vila 'artes	Restaurant / Pizzeria	Started from zero and reached 90% plastic separation for recycling. In the summer, eliminated approx. 900 plastic cutlery (fork and knife), 2250 plastic cups e 2500 plastic straws.
Quinta de S. Roque	Local Accommodation	Eliminated in the summer 600 plastic water bottles, 600 plastics to wrap the glass in the WC of the room, and 450 tetra pack packaging of chocolate-milk drink.
Abrigo das Andorinhas	Restaurant	Replaced 80 % of plastic water bottles of 1.5 L and 50% of plastic water bottles of 0.5 L, for glass water bottles.
Colher de Pau	Restaurant	Eliminated plastic straws. Use new glass water bottles of 0,5L and 1,5L, filled with filtered water, thus reducing (280 and 350 plastic bottles/month), respectively.
Hotel Minho	Hotel	Eliminated in the summer 600 plastic cutlery (fork, knife), 500 plastic cups, 500 plastic spoons and plastic 800 straws.

Table 1. Continued.

Establishment	Typology	Improvements achieved with the implementation of the Best Practice Seal of LowPlast project
Foral D. Dinis	Restaurant	Eliminated plastic bags with handles, communicating with clients to bring their own shopping bags. Improved plastic waste separation (70%).
O Cervo	Restaurant	Eliminated plastic straws. Reduced plastic water bottles (50%). Taxed plastic bags with handles to motivated clients to bring their own shopping bags.
Paladartes	Bar	Eliminated lightweight plastic bags and plastic stirrers. Couldn't invest in replacement of plastic water bottles for glass water bottles, due to financial difficulties.
Poço Bar	Café / Bar	Substituted in the summer 200 plastic straws for paper straws.
Cerva Bar	Café / Bar	Eliminated in the summer 500 plastic straws.
***Hotel Minho Belo**	Hotel	Eliminated plastic straws; Substituted plastic cups for paper cups and are searching for solutions for plastic water bottles and plastic *amenities* (soap in the WC of the room).
***Central**	Restaurant	Eliminated lightweight plastic bags. Need to use up all the plastic water bottles in stock, but then will invest in glass.
Pastelaria S. Pedro	Café / Pastry	Eliminated plastic cups and straws. Taxed plastic bags with handles to motivate clients to bring their own shopping bags and offer card boxes. Replaced plastic water bottles, for glass water bottles (20%). Separate 100% plastic waste for recycling.
Restaurante Adega do Real	Restaurant	Replacement in the summer of plastic water bottles for glass water bottles in esplanade service (1400 bottles). Eliminated plastic straws; substituted plastic bags with handle for paper bags for take-away service, but they break. Will test other bags because clients hardly bring their bags.
***Creperia Entre Sabores**	Creperie / Ice-creams	Have a lot of merchandise in stock. Keep plastic water bottles because clients demand and for the esplanade. Have new "biodegradable" plastic spoons for ice creams and asked the provider for information to be sure about it. Had a low plastic collecting rate and achieved 100%.

Table 1. Continued.

Establishment	Typology	Improvements achieved with the implementation of the Best Practice Seal of LowPlast project
Casa Lau	Restaurant	Replaced plastic bags with handles for paper bags. Use take-away packaging made from sugar cane.
Churrasqueira do Cruzeiro	Grill	Communicate with clients, and publish information on the door and social media, to motivate clients to bring their own containers and bags which led to a reduction of approx. 200 take-away packaging and plastic bags /month.
Restaurante Galiza	Restaurant	Replaced plastic water bottles for glass water bottles in table service (24 bottles/week). Keep plastic water bottles because clients demand. Improved plastic waste separation (100%).
Rainha do Gusmão	Pastry	Eliminated 90% of plastic straws and reduced 50% of plastic lightweight bags, tax plastic bags. Taxed plastic bags with handles. Improved plastic waste separation (90%).
Casa Matriz	Restaurant	Replaced 100 % of plastic water bottles of 1.5 L and 0.5 L, for glass water bottles.
Cantinho dos Amigos	Restaurant	Contacted the local waste collection and management service (Valorminho) and got positive feedback for the recycling bin. Lack of space for glass water bottles deposit room.
Piazza	Pizzeria	Defined new glass water bottles of 1L, but keep 0,5L plastic water bottles because clients' demand.
Pousada da Juventude	Youth hostel	Created their own recycling bins in common areas. Implemented soap dispensers in WC of the rooms. Communicated a wish list of more best practices to their network Movijovem, related with elimination of glass water bottles and unitary doses of butter and jam.
Flor das Cerejas	Café / Pastry	Reduced 75% take-away packaging and eliminated plastic bags.
Casas da Loureira	Rural Tourism	Fulfill all indicators.
Casas da Vila	Local accommodation	Fulfill all indicators.
Casa do Cais	Local accommodation	Fulfill all indicators.
Casa da Muralha	Local accommodation	Fulfill all indicators.
Casa das Velhas	Restaurant	Fulfill all indicators.

Table 1. Continued.

Establishment	Typology	Improvements achieved with the implementation of the Best Practice Seal of LowPlast project
Coroa de ferro	Bar	Replaced 25% plastic water bottles for glass water bottles. Improved plastic waste separation (100%).
Quinta da Malaposta	Hotel	Improved plastic waste separation (80%). Gradually replacing plastic water bottles for glass water bottles.
Convento SanPayo	Local accommodation	Fulfill all indicators.
Inatel	Hotel	Eliminated plastic water bottles and plastic cups from the rooms. In September eliminated 2400 bottles and 6000 cups. Search alternatives for lightweight plastic bags (WC), like plant base materials (corn, sugar cane, cellulose).
Curt'isso	Bar	Keep plastic water bottles because it is cheaper and due to lack of space to store glass water bottles, but already substituted other plastic drink bottles for glass bottles. Separate plastic waste (100%) collected by Valorminho.
Beat Caffé	Café / bar	Changed manager but kept interest in participating. Eliminated plastic straws (250 und/ month).
Dom Júlio	Restaurant	Adhered to a campaign from Valorminho to improve plastic waste separation. Are trying to reduce the internal consumption of plastic water bottles, planning to install a water container with a pump at the employer's cafeteria.
Moinho do Prado	Local accommodation	Fulfil all indicators.
Glutão	Restaurant	Eliminated plastic cups and straws. Keep plastic water bottles because clients demand, but in table service use glass water bottles.
Toni	Pizzeria	Eliminated plastic straws. Use glass water bottles of 0.5 L and 1L but keep plastic water bottles because clients demand.
O Parente	Café / Snack bar	Substituted plastic cups for paper cups. Motivate clients to bring their own take-away containers.
Variante	Restaurant / Pastry	Eliminated plastic water bottles in table service. keep plastic water bottles because clients demand (specially truck drivers). Separate plastic waste (100%).

The reduction or elimination of some indicators was more expressive, with emphasis on plastic water bottles (43%), plastic straws (40%) and plastic bags with handles (26%). Also, the choice of improving plastic separation for recycling was relevant (29%), as depicted in Figure 5.

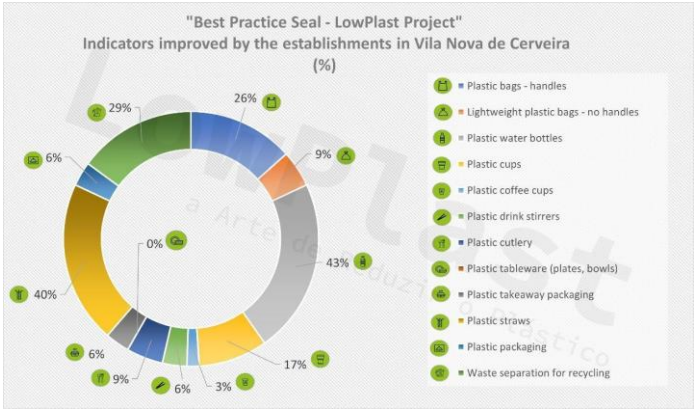

Figure 5. Indicators selected by the establishments that committed with the Best Practice Seal to reduce disposable plastic and improve plastic separation for recycling, in Vila Nova de Cerveira, percent values.

An artistic installation with reused plastic water bottles - Ilhas de Plástico / Plastic Islands, covering an area of approximately 400 m2 was installed in the international Minho river (Figure 6), and presented to the public on World Oceans Day, 8 June.

Figure 6. Bird 's eye view of the artistic installation "Ilhas de Plástico" / Plastic Islands, in Minho river.

Other important artworks created to stimulate the public's interaction with the project scope comprised: drawings inspired on plastic patterns in the water surface "Plastic Fantastic" (Figure 7), one sculpture made of plastic fragments "Like a Crystal of memories in a forgetful mind" (Figure 8) , and handmade bottles from lightweight plastic pieces "Drifted Away"(Figure 9), accompanied by audio-visual elements that contextualized the artwork process, developed by Norwegian art students and presented at the Art Biennale Foundation.

Figure 7. Artworks "Plastic Fantastic" at the Art Biennale Foundation, in Vila Nova de Cerveira.

Figure 8. Artworks "Like a Crystal of memories in a forgetful mind" at the Art Biennale Foundation, in Vila Nova de Cerveira.

Figure 9. Artworks "Drifted Away" at the Art Biennale Foundation, in Vila Nova de Cerveira.

An archive of the audio-visual elements was created, to capitalize the project outcomes, remaining available at https://www.youtube.com/channel/UCE30zoE85F6EXSmPJCABj8Q

4 Discussion

Boat trips and Clean-up actions had very positive feedback from the participants, reflecting the ability of these awareness actions to motivate civic participation and call attention to the plastic pollution issue. The publications about these actions, on social media, also had good audience reach.

These actions allowed as well, the collection of data related to the most frequent litter categories found, and the collection of items for artistic work.

Plastics were indeed the main category of litter found in the riverbanks and beach clean-up actions of LowPlast actions, in Vila Nova de Cerveira. These results match with data from clean up actions all over the Portuguese coast, as reported on Portuguese Environmental Agency Programme of Marine Litter Monitoring, where plastic represents 73% of the marine litter collected at 11 Portuguese beaches (APA, 2017).

Clean-up actions are performed every year, by formal and informal groups of citizens, in small scale, or massive events and thus more covered by media, such as the International Coastal Clean-up Day (ICC), usually occurring by the middle of September, which engages people from around the world to remove waste from the beaches and waterways. According to the Ocean Conservancy, since the start, over 16 million volunteers have collected more than 340 million pounds of trash (OCEAN CONSERVANCY, 2022).

Another internationally recognized initiative is the Blue Flag, promoted by Foundation for Environmental Education (FEE, 2022a), awarded to beach operators in compliance with a number of stringent criteria connected with accessibility, safety, environmental and educational programmes, specifically to avoid the depletion of natural resources, environmental threats, pollution and general environmental degradation. More than 4.500 beaches, marinas and eco-tourism boats are awarded with the Blue Flag, therefore contributing to the sustainable development goals (FEE, 2022a).

Regarding the Best Practice Seal implementation in HORECA network establishments, it was a successful challenge, since there were positive changes in every establishment, at such a demanding time.

Owners/managers of these establishments tend to maintain the improvements since it represents a good visiting card for customers, low investment and inclusively many establishments also benefited economically with the changes, for example, Inatel accommodation establishment, just by replacing water bottles, by water in a jar, the establishment saved not only single-use plastic consumption, but also the purchase of 2.400 water bottles in the summer (see Inatel, in Table 1).

In other situations, the changes implicated different strategies of the owners/managers, like talking to the employers and explaining the choices to the clients.
On the other hand, there were some statements of high demand for plastic water bottles in the summer, and on days of local fair, so establishments admitted the need to maintain plastic bottles available, which leads to commercial features. Lack of space to store empty glass bottles, glass bottles being taken intentionally or not, by clients, with loss for the establishment, were other addressed aspects. The frequency of waste collection was also a referred: in some establishments door-to-door collecting of waste seemed to be working well, but in other establishments were stated difficulties in waste collection or in accessing selective waste bins.

In sum, these actions targeted at restaurants, bars, cafes, hotels and local accommodation, were actually good case studies that revealed the diversity of factors that can be related with plastic consumption at HORECA network and with the recycling feasibility.
The Best Practice Seal to reduce disposable plastics in HORECA establishments finds a parallel in worldwide implemented initiatives such as the Green Key, a voluntary eco-label awarded to more than 3.200 hotels and other establishments in 65 countries. It represents the commitment with environmental responsibility and sustainable operation within the tourism industry and also for guests' perception that their choices make a difference at environmental level (FEE, 2022b).

One of the multiple options to mitigate plastic pollution relates to single-use plastic bans, recently supported by the Directive EU 2019/904.
Herberz, Barlow and Finkbeiner (2020) analyzed alternatives like to ban or impose a premium price on every single-use product, thus reducing its consumption and thereby the pollution it may cause; Stop exporting plastic waste from the EU to countries with high rates of mismanaged waste, like China or Malaysia. The authors also suggest awareness raising to avoid inappropriate waste disposal and certification of sustainable forestry sources for paper and wood products.

As for the artworks and artistic interventions there was a permanent contact of residents and tourists with continuous and diverse artistic outputs that promoted awareness on plastic reduction and expansion of the circular economy, especially the art installation “Ilhas de Plástico”/Plastic Islands, in the transboundary waters of Minho river, attracting the attention of both Portuguese and Spanish populations.

The audio-visual products were disseminated in social media and in the webpage, thus expanding the project message beyond the village, to a wider audience.
More projects and actions to increase knowledge and perception of the public about the impacts of plastic on the aquatic environment are blooming. The Portuguese artist Bordalo II, develops his ideas and creations with end-of-life materials, searching for sustainability, ecological and social awareness (WIDE OPEN WALLS, 2022). Ana Pêgo is a Portuguese marine biologist and that embraces the awareness about marine litter, collecting and using items found in Portuguese beaches for artworks, and also created an educational project, with workshops, and artistic expressions, called *Plasticus maritimus* with 10.3 thousand followers on social media Instagram (PLASTICUS MARITIMUS, 2022).

Other approaches suggest that the integration of environmental education in visual arts may lead, for example, to a larger reutilization of material in artistic practices, or more suited options in what concerns the lifecycle of the planned objects, contributing to diminishing the quantities of garbage that are produced (MATOS DA FONSECA, 2019).

In brief conclusion about LowPlast actions, it is a fact that rivers are a transport channel of litter from land- based sources, into the oceans. Therefore, it is fundamental to protect these aquatic environments, avoiding its "silent" littering.

There is a need to promote more extensive and multidimensional environmental projects to stimulate the public perception about this problem and engage local stakeholders into best practices towards the reduction of plastics, mainly the single-use plastics.

It is also necessary to improve the waste management and the recycling of plastics. As well as rethink the products, its packaging design and its marketing.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Patrícia Louro: Investigation, Conceptualization, Data curation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. Carlos Antunes: Investigation, Validation, Project administration, Resources, Supervision, Writing – review & editing.

DECLARATION OF INTEREST

The authors disclose that they have no known competing financial interests or personal relationships that could have appeared to influence the study reported in this manuscript.

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