UNIVERSIDAD DE OVIEDO

MÁSTER UNIVERSITARIO EN CONSERVACIÓN MARINA
Master of Science in Marine Conservation

PERCEPCIÓN SOCIAL DE LA POLUCIÓN MARINA BIOTICA Y ABIÓTICA EN LA COSTA CANTÁBRICA: UNA APROXIMACIÓN SOCIOAMBIENTAL

Social Perception Of Biotic And Abiotic Marine Pollution In The Cantabrian Coast: A socioenvironmental Approach

TRABAJO FIN DE MÁSTER
Master Thesis

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JULIO 2016

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Abstract

The state of marine litter in the coast of Asturias (North Spain) is largely unknown. A study of the marine debris and its social awareness on the region was performed. Marine debris was sampled and classified from 21 beaches along the coast of Asturias to know the quantity and type of materials polluting the zone. Questionnaires (N=214) were performed in 9 beaches to understand the local social perception of this litter and its effect on the environment. The data showed that all beaches had some level of littering but the quantity and materials were different. The questionnaire revealed that marine litter was commonly perceived as a problem for the beaches. However, some differences in the perception of its harmful effect were detected between zones and types of beach. The relationship between litter and invasive species was rarely known by the general population. This knowledge will allow to design sound awareness campaigns to increase citizen's knowledge about coastal pollution, to diminish litter generation from its source, and hopefully to reduce littering, which is crucial to rid this problem away.

Keywords: Marine debris, Social Awareness, Plastic litter, Fishing gear

Index

Introduction

The Marine Debris problem

Contamination by marine debris has been considered a major issue among several kinds of marine pollution (Goldberg, 1995; Santos et al., 2005). Marine debris can be defined as solid materials (litter) of human origin that are discarded at sea or reach the sea. This debris has a hazardous effect on the environments, as aesthetic degradation, hazards to wildlife, economic losses, or human health hazards (Ribic et al., 1992; Rees and Pond, 1995). This marine debris has experienced an increase, specially the plastics residues (Laist, 1987). Three can be the main causes of this increase in marine debris: an increment of use of synthetic materials detrimental to the use of natural fibers, the lower production cost of synthetic materials versus natural or recycled ones; and an expansion of maritime traffic and coastal residents that can rise this marine debris production (Ribic et al., 1992).

Marine debris has two main origins: the mainland sources and the ships spills -including wastes dumped at sea from commercial vessels and from fishing vessels- (Gregory, 2009; Sarafraz et al., 2016). Since the enforcement of the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL) and specially with the Annex V (1988) that prevents pollution by garbage from ships in-sea discharges, this source of debris has became the minor contributor to marine debris (Ryan et al., 2009; Dias and Lovejoy, 2012). This leaves mainland sources as the main contributors to sea debris. Of these debris, four main sources have been identified: recreational and tourism-related litter, fishing gear litter, sewage-related debris and shipping waste (Somerville et al., 2003).

The main component of the marine debris are plastics, which are also the most dangerous litter due to its low cost, multiple uses, lightweight and long life (Derraik, 2002; Gregory, 2009; Ryan et al., 2009; Dias and Lovejoy, 2012; Pham et al., 2014). Worldwide the production of plastics has increased every year, reaching 311 million metric tons (MT) in 2014, with the 39% generated in the North Atlantic region (NAFTA & Europe) (PlasticsEurope, 2015). In 2010, about 4.8 to 12.7 MT of plastic entered to the ocean from the 275 MT that were generated (Jambeck et al., 2015) and this proportion of marine litter tend to increase with the total plastic production.

Also, the increase of marine debris is being considered one of the most important problems to the marine environments. Many studies had related these solid wastes with multiple negative effects both to the environment and to humans. One big problem is animal suffocation and smothering. Many marine animals, especially mammals and birds, die after eating debris by error (Laist, 1987; Somerville et al., 2003; Gregory, 2009). Also, when animals eat some litter items (especially plastics and microplastics) that generate toxic reactants or stay in the digestive tract, their food intake capability diminishes and causes development problems (Derraik, 2002; Browne et al., 2008; Gregory, 2009; Williams et al., 2011). Another problem is entanglement. Discharged fishing gears and/or plastics can get entangled in animals bodies (tortoises e.g.) diminishing their swimming ability or impairing them for locomotion and proper development (Gregory, 2009; Williams et al., 2011; Paleczny et al., 2015; Sarafraz et al., 2016). Another environmental problem of great magnitude is the contribution of marine litter to invasive species dispersal. Marine litter has a long life and can be transported with the currents for many kilometers. It is a vector for hitch-hiking species that can be potential invaders (Barnes, 2002; Barnes and Milner, 2004; Gregory, 2009; Dias and Lovejoy, 2012; Gil and Pfaller, 2016).

From the social point of view there are many problems too. First is landscape degradation. The littering of the beaches and the debris accumulation on the coastal zones cause a negative aesthetic impact (Somerville et al., 2003; Roca and Villares, 2008; Gregory, 2009; Sarafraz et al., 2016). Linked with the aesthetic degradation is the tourism decrease, as tourists prefer to visit well-conditioned and unpolluted beaches (Ribic et al., 1992; Uneputty and Evans, 1997; Nijkamp et al., 2008; Roca and Villares, 2008). For fishing sectors, the presence of floating and sink debris has a negative effect on the fisheries due to its direct effect on the biota (as described before) and also because of the damage that inflicts to the fishing gears (Gregory, 2009; Gil and Pfaller, 2016). Finally, authors have also related marine debris on beaches with human diseases and health affections (Dixon, 1981; Ribic et al., 1992; Madzena and Lasiak, 1997).

For the treatment of marine debris there are two main approaches, Preventive measures and Palliative efforts (Rees and Pond, 1995). In the preventive group there are all measures that avoid the litter to reach the sea; from laws to their enforcement, such as the MARPOL Annex V or different European and National directives. These measures have a limited efficacy because, as commented before, the marine litter can be transported many kilometers and it does not responds to national jurisdictions (Barnes, 2002; Barnes and Milner, 2004). Even though, this is the most recommended approach because its high effectiveness and because it is the measure that prevents the damage before it is generated, increasing the forcefulness (Velander and Mocogni, 1998; Coastal Cleanup España, 2015). The palliative methods are focused on removing or diminishing this litter from the oceans, either by cleanings made by the administrations or organized by volunteer groups. These methods, even being the most used by local administrations, are the less effective ones. They are not a solution to the problem but a way to diminish its negative effect.

Because of all the problems listed above, some studies have suggested the implementation of Integrated Coastal Zone Management procedures, as a best tool to manage coastal debris (Storrier and McGlashan, 2006; Chaniotis and Stead, 2007; García-Llorente et al., 2008; Remoundou et al., 2009; Hastings and Potts, 2013). The European Commission has defined the ICZM as "*coordinated application of the different policies affecting the coastal zone and related to activities*" and it needs "*involve all stakeholders across the different sectors to ensure broad support for the implementation of management strategies*" (Environment - European Commission, 2013). To ensure that these ICZM programs could be really effective they must include both preventive measures as laws and directives and palliative such as cleanings (Rees and Pond, 1995; Storrier and

McGlashan, 2006; García-Llorente et al., 2008; Roca and Villares, 2008). As the human population near the coastal zones seems to be directly related with the marine debris problem, a social approach to this problematic has been considered as a better approach instead of only legislation or scientific research, trying to link marine debris with social awareness (Santos et al., 2002, Santos et al., 2005; Marin et al., 2009; Slavin et al., 2012). Because of that, integration of the socioeconomic status of the coastal zones and its environmental status is crucial for a proper implementation of ICZM protocols (van Asselt Marjolein and Rijkens-Klomp, 2002; Santos et al., 2005).

The effectiveness of the measures proposed by ICZM programs depends on the acceptance of the population, and for that the perception and awareness of the citizens about the problematic of litter has to be explained (Chaniotis and Stead, 2007). The general knowledge about the marine debris problematic can be improved as people participate more in cleanings (palliative efforts) and also demand for more legislation and enforcement (preventive efforts). For example, awareness campaigns aimed at children on the importance of debris collection and the effects of marine debris can show them the problem and how they can be part of the solution, both cleaning beaches in the future and also not generating so much litter (Rees and Pond, 1995; Kapoor, 2001; Jefferson et al., 2014; Hartley et al., 2015).

After a literature review for information on this topic in Asturias, no studies of marine and coastal litter and corresponding social awareness have been conducted yet. However, while there are no official studies of marine litter and its social implications in Spain, NGOs and volunteer associations like Oceans Conservancy or Coge3 have alarmed about its importance and detrimental effects both to environmental and socio-economical activities. Also, Spain, as signer of the OSPAR Convention, has agreed to work to protect the North-East Atlantic marine environment, in which the Cantabrian Sea is included. The 2010 OSPAR Commission Report contemplates the marine debris as one of the factors of marine environments damages and insists in more research as well as more efforts to avoid marine littering.

A precise knowledge of the state of marine debris on beaches is necessary for the proper management and for future measures or investigations. Also, to determine the degree of knowledge and awareness of citizens and beachgoers will be crucial to implement management, control and remediation measures that are effective and accepted by the population.

For all that reasons, in this study a descriptive analysis of the state of the beaches in Asturias was performed, besides with a social awareness study to know the current state of the marine debris accumulation in the beaches and the population awareness about it.

Objectives

1. Descriptive analysis of the status of marine debris in the coast of Asturias
2. Relationship between marine debris present and environmental variables of the beaches sampled
3. Citizen perception and awareness analysis of the beachgoers and stakeholders
4. Relationship analysis between citizen awareness with socioeconomic factors and debris on beaches

This study can be used also as a pilot study of the state of the art in the region for future and further studies of this issue and also as a reference to the administration to improve management.

Material & Methods

Environmental Context

The coast of Asturias (43°20′00″ N 6°00′00″ W) is a rugged coastline with many cliffs, estuaries and bays located in the North-West coast of Spain (Figure 1). Several beaches with great variability in physical characteristics are present all along the region. These beaches are generally small and narrow, usually less than 1500m long, with notable exceptions as Playón de Bayas (2.800 m), Playa de Salinas (2.100 m) or Playa de Xagó (1.500 m). In general, those beaches are formed in sheltered creeks and coves in the cliffs occupied by sand or near river mouths from sediments.

There are no high flow rivers in the region, the most important being the Nalón-Narcea basin, which generates about 3.375 hm^3/y and in which valleys lives almost half of the Asturias population (Asturias.es, 2016). The coastline is penetrated by a series of estuaries which receive river contributions upstream, with special mention the main five, called rias in the region (from West to East): Ría del Eo, Ría de Navia, Ría de Pravia, Ría de Villaviciosa and Ría de Tina Mayor.

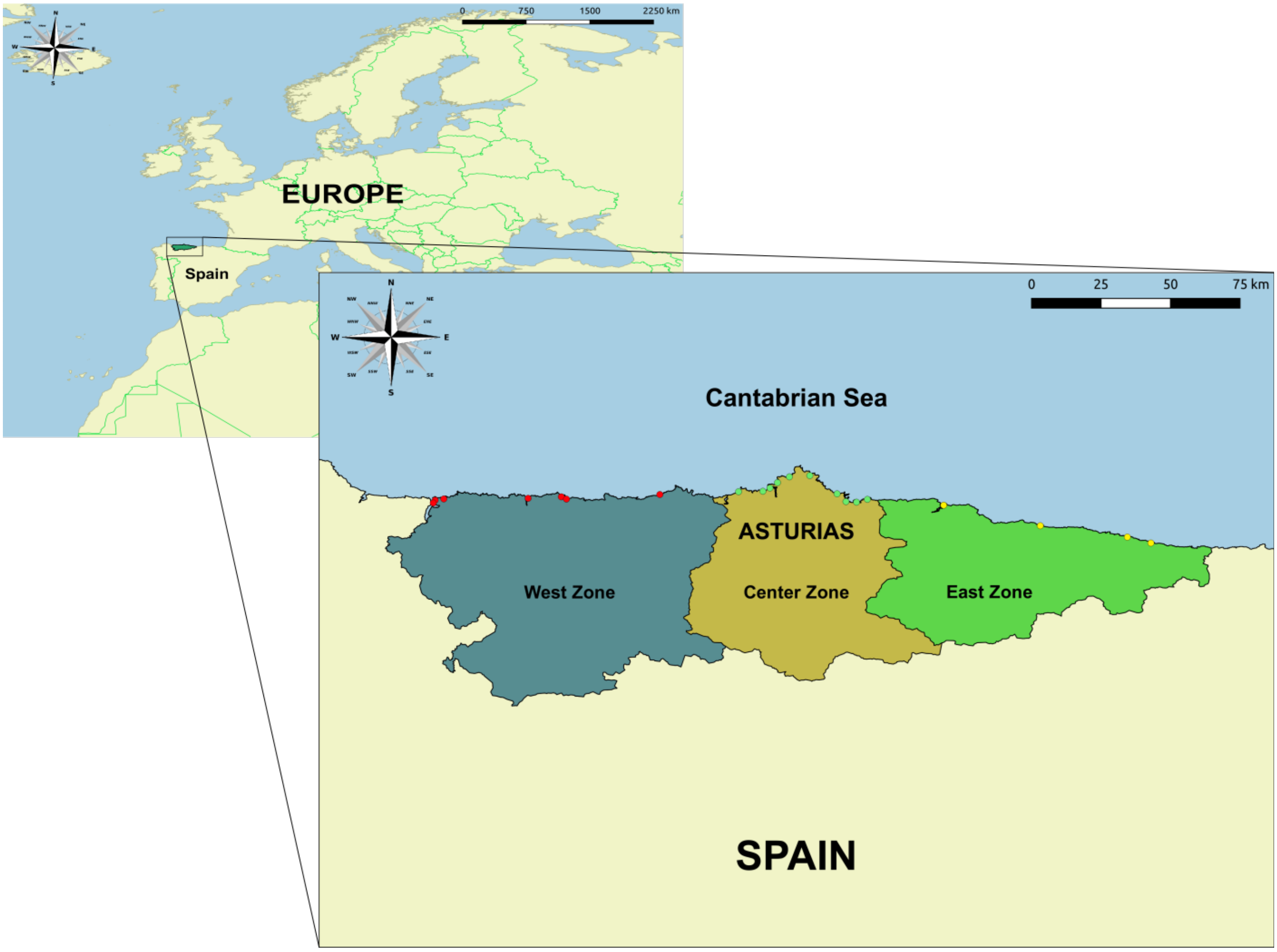


Figure 1. Location of Asturias and general view of the target beaches onto the three different zones of Asturias

Asturias region is unofficially but commonly divided in three zones: East from the Ría de Tina Mayor and the Cantabria frontier (43°23′36″N 4°30′45″W) to the Ría de Villaviciosa (43°31′00″N 5°20′00″W), Center from there to the Nalón River (43°33'51.8"N 6°04'37.5"W), and West from there to the Eo River and the Galicia frontier (43°33'08.8"N 7°01'52.7"W). Even not being recognized as an official territorial division, there are clear socioeconomic differences in each zone (SADEI, 2016) with differences in the focus production of each one: the West zone has main focus on primary production, particularly agricultural production; the Center zone is focused in fisheries production and secondary production; and the West zone is focused mainly in tourism (Table 6).

In this study 21 beaches were sampled along the coast of Asturias and of those beaches, 9 beaches (3 per zone) were selected for perform the questionnaire to have a representation of all shoreline opinion (Table 3).

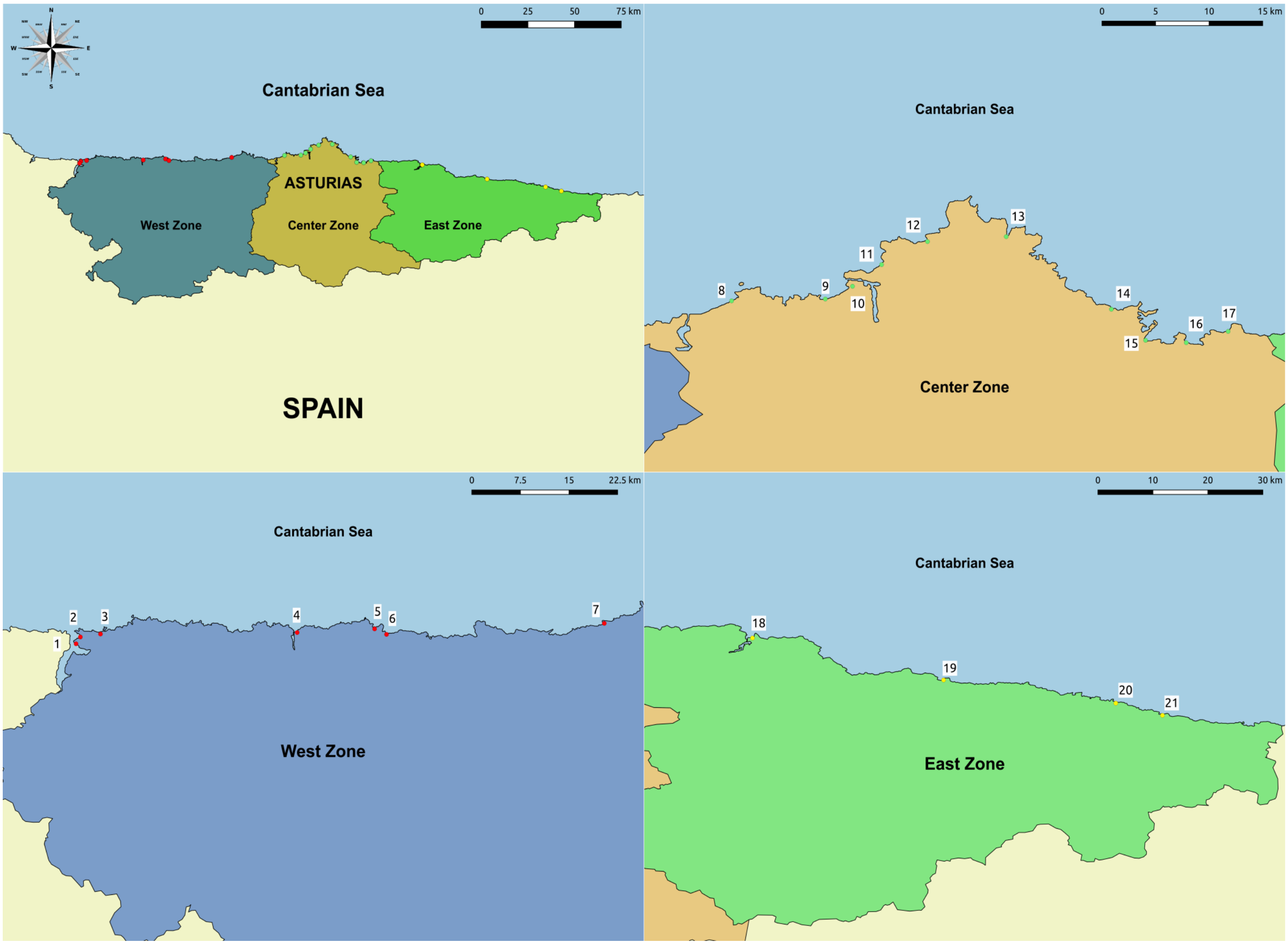


Figure 2. Detail of the zones of Asturias with the names of the target beaches. In numbered order and from West to East: 1. Figueras, 2. Arnao, 3. Peñarronda, 4. Navia, 5. Barayo, 6. Otur, 7. El Silencio; 8. Bayas, 9. Salinas, 10. San Juan/El Espartal, 11. Xagó, 12. Verdicio, 13. Bañugues, 14. Xivares, 15. Arbeyal, 16. San Lorenzo, 17. Peñarrubia; 18. Rodiles, 19. Santa Marina, 20. Poo & 21. Andrín.

Beach debris sampling

The debris quantification was done following the '1m wide belt transect' method proposed by Velander and Mocogni (1999) and modified by Hong et al. (2014). To standardize the data across beaches one sampling transect per 250m was done from the waterline to the vegetation line with 1m width. All the debris sampling was carried out around the low tide (starting 2 hours before and ending 2 hours after) in order to increase the surface available to sample.

The selection of transects was performed in blind in the laboratory to avoid selection bias, using cartography software (Google Maps). Then, the coordinates of sampling points were located in the field with GPS and the transect was delimited with a tripod and a 5mW (3R Class) laser. Finally, the sampling belt was traveled with a 1m ruler to quantify and measure all debris.

The sampling was done once in each beach between the third week of February to the third week of March 2016 (Table 3). All litter items found were classified in the field according to their composition and size, and recorded for further analysis.

Social Awareness Study

In order to know the debris perception of beachgoers and users of the beach, a general knowledge survey was developed, so it was designed an ad-hoc semi-structured questionnaire adapted from Santos et al. (2005. The survey (Encuesta Social de Observancia Activa p.31) was divided in an anonymous general description of each surveyed individual where the sex, age, occupation, and visit frequency was written down and eight free answer questions where the general opinion about the state of the beach in accordance with the debris was asked:

1. **¿Percibe usted la presencia de basuras en esta zona?** (Do you perceive the presence of litter in this zone?)
2. **¿Cómo cree usted que llega la basura hasta aquí?** (How do you think litter arrives here?)
3. ¿**Cómo podríamos evitar la presencia de basuras en la zona?** (How could be avoid litter to be present in the zone?)
4. **¿Hace usted personalmente algo para evitar la presencia de basuras en esta zona? ¿Llevan bolsas para recoger sus basuras?** (Do you do something personally to avoid litter presence in this zone? Do you bring plastic bags with you to take the litter?)
5. **¿Piensa usted que pueda haber una relación entre la presencia de basuras en esta zona y la aparición de especies invasoras?** (Do you think is there any relationship between the litter presence and the alien invasive species occurrence?)
6. **¿En su opinión, cuál diría usted que es el problema más importante para la biodiversidad en esta zona?** (In your opinion, which do you consider is the main problem to biodiversity in this zone?)
7. **¿Cuál cree usted que es el producto/basura más común en esta zona?** (Which, do you think, is the most common litter in this zone?)
8. **En su opinión, ¿Qué tipo de desecho es el más dañino para el medio ambiente?** (In your opinion, which is the most harmful product for the environment?)

The questions 1, 2, 4 and 7 were asked to know perception of debris on the beach and the public behavior towards this issue; the question 3 was asked to know the suggestions to avoid/fix this problem; the question 5 was asked to know the citizens knowledge about the relationship between marine debris and invasive species; and the questions 6 and 8 were asked to know the level of awareness about the effects of the marine debris on the environment.

A pilot survey was made to see if the questionnaire was clear and had internal validity, in order to improve it in case of problems. This tool was tested for that validation in the faculty and with acquaintances and colleagues to check its comprehensibility and ease of answer. Pertinent modifications where done in order to polish the questionnaire and to avoid misconceptions for the future surveyed individuals.

The surveying was conducted from the 24th of March to the 2nd of April in 9 selected beaches from the 21 debris sampled divided into 3 beaches in the West, 3 in the Center and 3 in the East (Table 3).

For our objectives we selected five questions from the total:

- ***1. Do you perceive the presence of litter in this zone?***, to have a general idea of the public perception of the state of the beaches.
- ***3. How could be avoid litter to be present in the zone?***, to know the users solutions proposed to this item.
- ***5. Do you think is there any relationship between the litter presence and the alien invasive species occurrence?***, to know the level of knowledge about this relationship.
- ***7. Which, do you think, is the most common litter in this zone?***, to compare the general perception of the litter with the litter sampled on these beaches.
- ***8. In your opinion, which is the most harmful product for the environment?***, to compare those answers with the ones of the last question.

The answers of the questionnaire were transformed to rank the score so we have objective results using Likert scales following the methodology of the University of St Andrews CAPOD (2016) as done by Sharp et al. (2011). The categories of the scale were generated from the range of answers, in general: (1) No, (2) Maybe, (3) Yes/sure and (4) No Answer. The answers to the questions 2, 3, 6, 7 and 8 were classified depending on the general answers and the specific ones were placed according to that classification.

Environmental and socioeconomic variables

In the beach debris sampling, 18 different types of litter were recorded, such as plastics from 2,5 to 5cm, plastics from 5 to 10 cm, plastic bags, shorter than 1m fishing gears, etc.. Due to the skewed data and with the purpose to increase the strength of the statistical analysis all these data was summarized in four different categories. Depending on its composition, namely: Plastics, Fishing Gears, Other Debris, and Total Debris; and also all data was weighted by area covered in each beach.

Also 15 different environmental variables of each transect were recorded from the field observations and from “Ministerio de Agricultura, Alimentación y Medio Ambiente” (MAGRAMA) databases that can be found in (Ministerio de Agricultura, 2016): Substrate composition (percentage of sand), Distance to the river (if present), Distance to outfalls (if present), orientation, urbanization observed, urbanization declared from the MAGRAMA, distance to trash bins, distance to the road, cleanings, protection level, occupation observed, occupation declared from the MAGRAMA and Blue Flag certification (FEE certificate water quality, safety, environmental education and information given to beaches from all over the world (Foundation for Environmental Education, 2014)). All these variables were supposed to be related, directly or indirectly, with both the presence and quantity of debris and the social perception of the debris in the beaches.

Furthermore, 6 socioeconomic scoreboards from each zone were obtained from the “Sociedad Asturiana de Estudios Económicos e Industriales” (SADEI, 2016) database: agricultural production (Tons), cattle rising farms (Number) and Fisheries production (Tons) for the **primary production**; Industrial jobs (Number) for the **secondary sector production**; and accommodation places (Number) and restaurants (Number) of the **tertiary sector production** (services)**.**

Data Analysis

The debris database was analyzed using one-way ANOVA or Kruskal-Wallis test (Slavin et al., 2012), depending on the homoscedasticity and the normality, to determine significant differences in total debris between beaches and zones. Homoscedasticity was checked from Levene's test, and data normality with Shapiro-Wilk test. In the significant ANOVAs or Kruskal-Wallis global tests, comparisons between partial subsets were done using the Dunn's *post hoc* test to identify the drivers of these differences (Oigman-Pszczol and Creed, 2007).

The environmental data was analyzed using the Primer-E Primer 6 software. The environmental variables were imported to the software and transformed with square roots transformations to homogenize the values. The weighted debris quantity of each beach was analyzed by a cluster analysis of a resemblance matrix and later those results were analyzed along with the environmental values with a PCA analysis. Finally, the correlation level between environmental data with the debris sampled was also analyzed with SPSS by a Pearson's correlation test in search of any driver of differences in quantity or litter material composition between beaches.

Finally, the answers to the social awareness study were analyzed with a Chi-Square test based on the sex, age range and frequency of visits of the surveyed people and based on those results a descriptive study of the selected questions was done for the three zones of Asturias.

Results

Debris Sampling Study

The descriptive statistics for the litter in the beaches shows that there was no one clean beach (without littering) from the 21 studied beaches. Also the recorded debris has great differences among beaches and per types of litter. In total, 1457 litter items where sampled in 7354 m^2; approximately 0.1981 items per m^2. Three beaches seem to be the main focuses of litter in Asturias: Navia, Bayas and Xagó; and also Figueras has a great amount of litter classified as “Other” (nor plastics or fishing gear litter) (Figure 3)

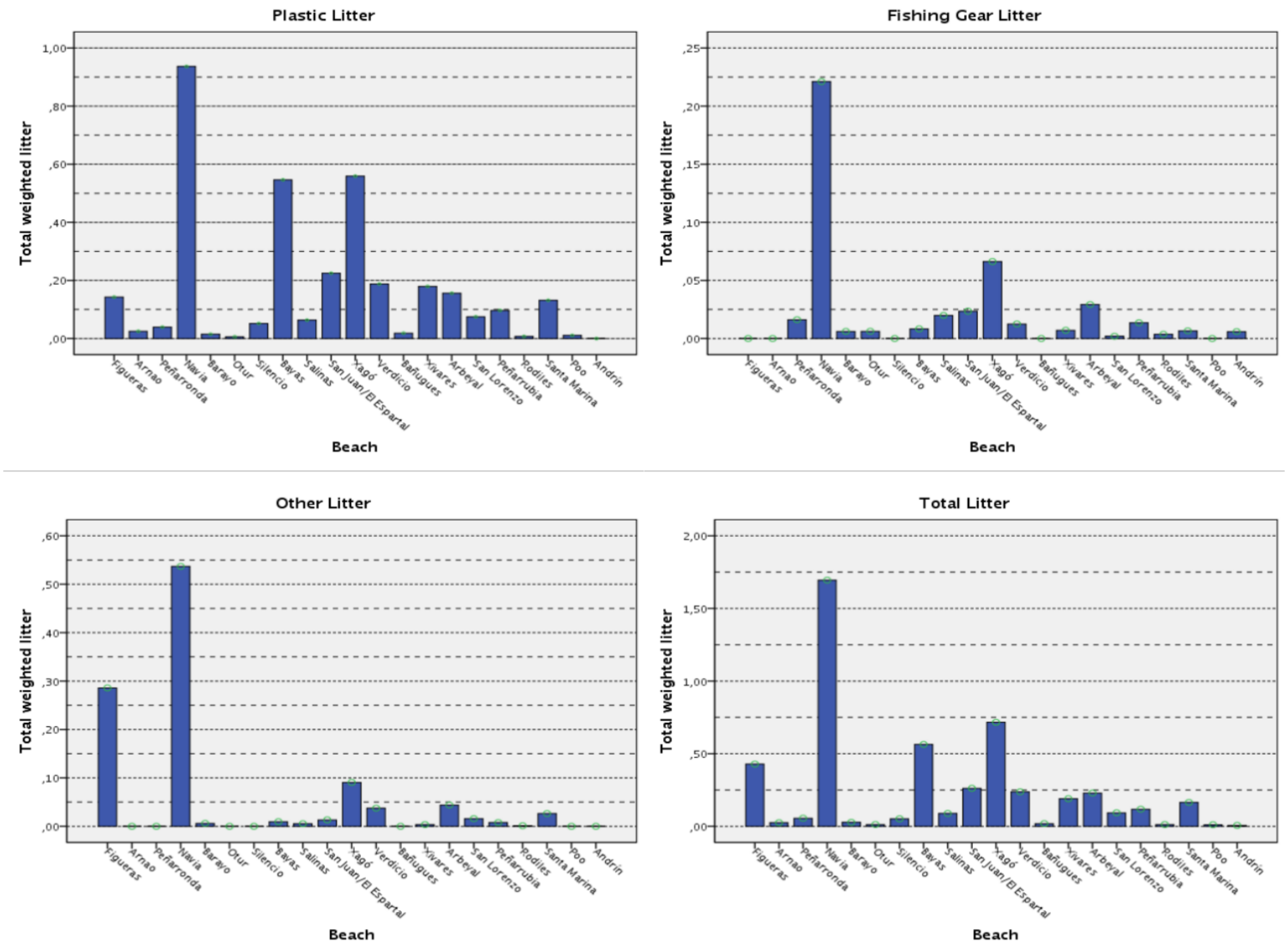


Figure 3: Total weighted debris per tipe and total for the different beaches sampled

The statistical analysis by zones showed important differences in all data, with three important outliers in Navia, Bayas and Xagó beaches. These three were the most littered beaches from each of the considered zones and of all Asturias too. This reveals a geographical variability in litter accumulation, the western and the central zones being the most polluted ones. More plastics and fishing gear were found in the Center and more litter out of those two groups in the West (Figure 4). Finally, as a whole, there was a decreasing gradient of total litter from the West to the East. Even so, the western zone had a great variability, being Navia, the most polluted beach, an outlier in every analysis.

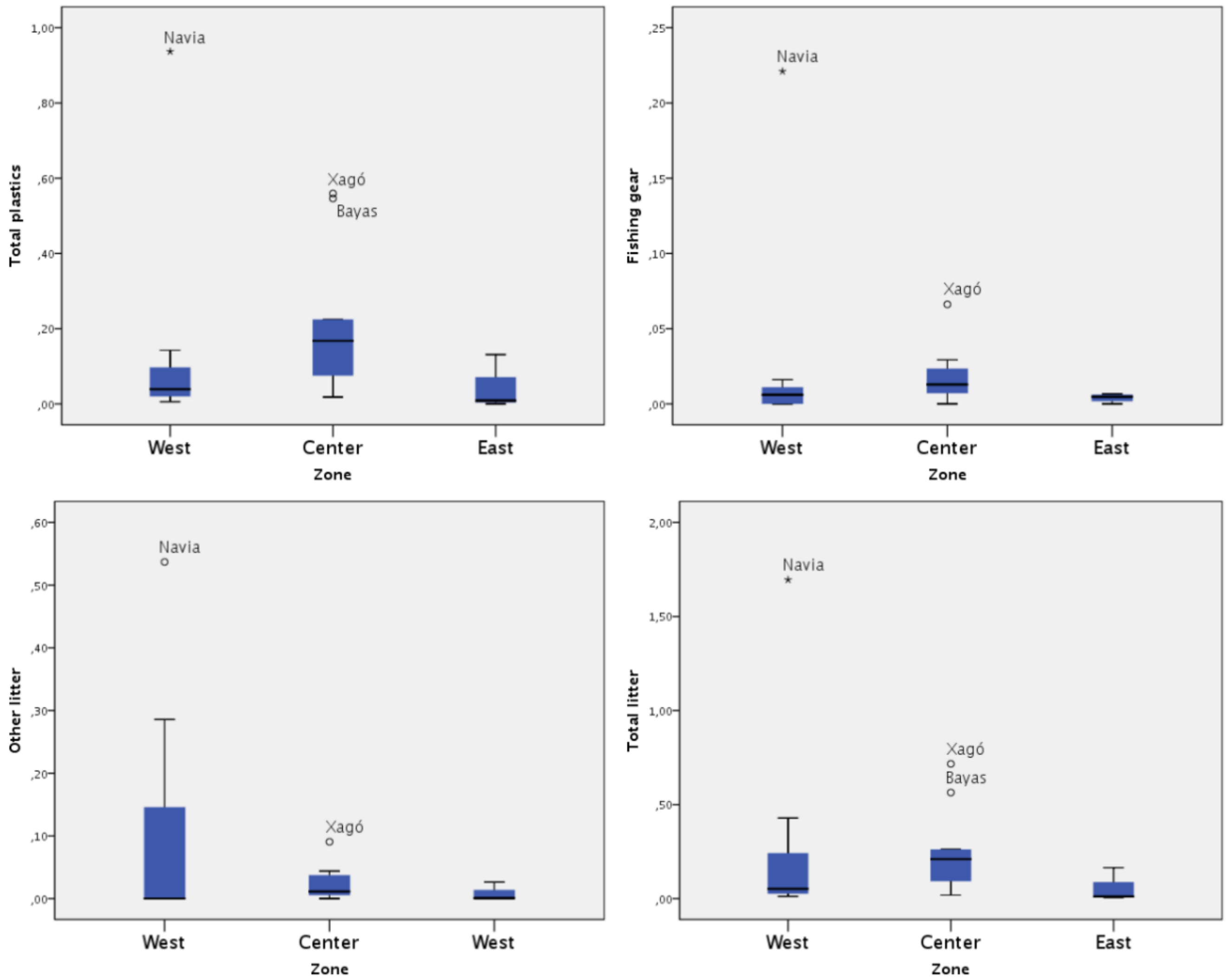


Figure 4. Box plot graphics of plastic litter (top left), fishing gear (top right), other litter (bottom left) and total litter (bottom right) sampled per zone

The data significantly deviated from normality and homoscedasticity. Hence the variance was analyzed with a Kruskal-Wallis test (Table 1). The test shows differences between zones for the plastic litter and for the total litter; but those values, even being correct, are really close to the 0.05 limit of acceptance.

Table 1. Kruskal-Wallis test for the litter sampled per zone

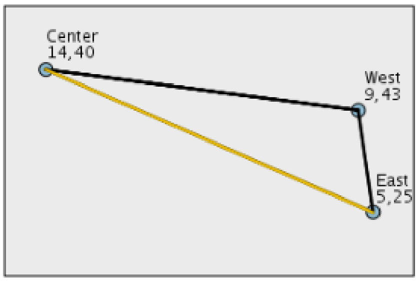
Test Statistics[a,b]

	Plastic	Fishing Gear	Other litter	Total Litter
Chi-Square	6,887	3,940	2,471	6,302
df	2	2	2	2
Asymp. Sig.	,032	,139	,291	,043

a. Kruskal Wallis Test

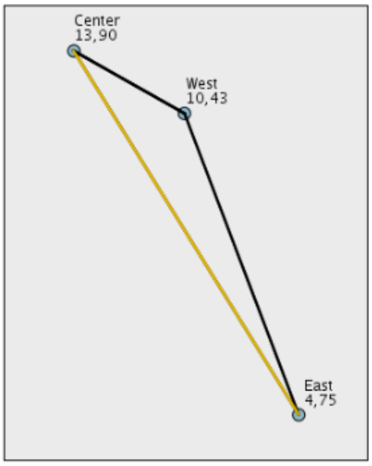
b. Grouping Variable: Zone

Finally, the *post hoc* Dunn's test was carried out to discern the drivers of these dissimilarities in the plastic litter and in the total litter sampled (Figure 5 & Figure 6).



Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
East-Center	9,150	3,671	2,493	,013	,038
West-Center	-4,971	3,058	-1,626	,104	,312
East-West	4,179	3,889	1,074	,283	,848

Figure 5. Post hoc Dunn's test of dissimilarities for the plastic litter sampled per zone



Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
East-Center	9,150	3,671	2,493	,013	,038
East-West	5,679	3,889	1,460	,144	,433
West-Center	-3,471	3,058	-1,135	,256	,769

Figure 6. Post hoc Dunn's test of dissimilarities for the total litter sampled per zone

The test showed that the East was significantly different from the other two zones both for the plastics and the total litter; their amount being lower in the East in both cases.

Social Awareness Study

From 20 to 25 random voluntarily and anonymous surveys were performed in each beach. In total 214 individual questionnaires were completed from the 9 beaches selected. The surveys were evenly distributed along the three zones (64 in the West, 76 in the Center and 74 in the East).

In the three zones studied both the age range and space of visits of the surveyed people seemed to be different, as it can be seen in Figure 12 and Figure 13 and the Pearson's Chi-squared test confirmed that although the gender was similar between zones, neither the age range nor the frequency of visits are so (Table 2).

Table 2: Pearson's Chi-squared test for the gender, age range and frequency of visits of the surveyed individuals

Test Statistics

	Gender	Age range	Frequency of visits to the beach
Chi-Square	,673	80,019	10,271
df	1	3	2
Asymp. Sig.	,412	,000	,006

The answers to the first question (Figure 7) suggest that in all zones, in general, most people do not perceive litter on the beaches. This percentage has its peak on the East (61.04%) and its lowest value on the Center (29.80%).

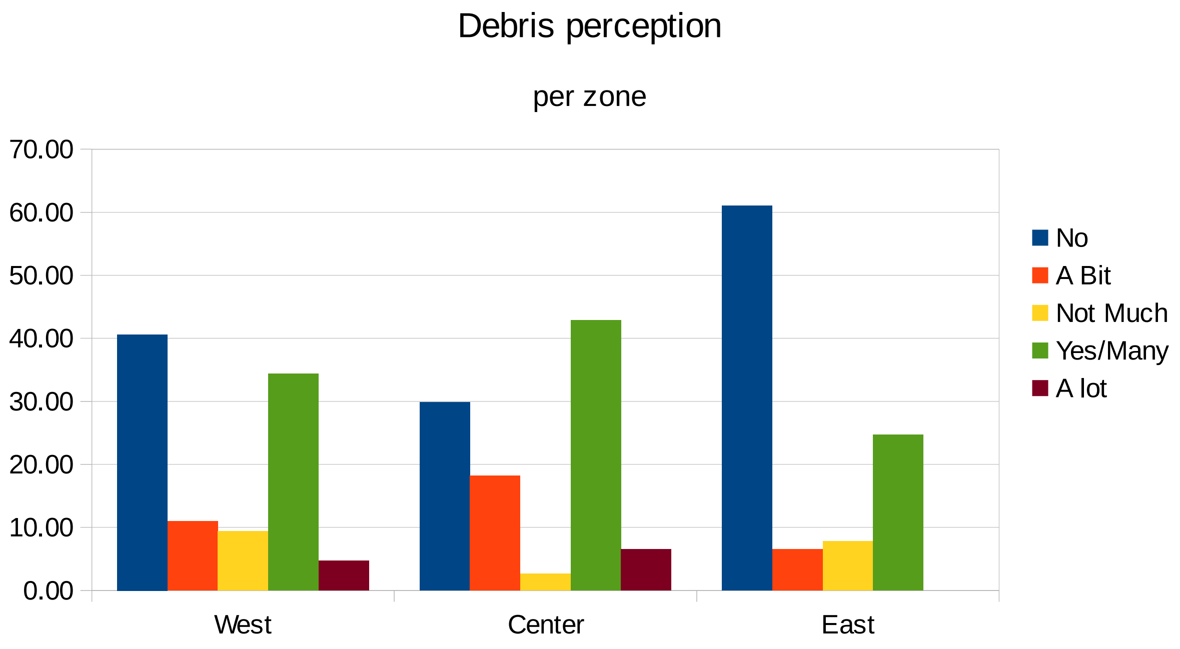


Figure 7. Weighted percentage answers to the question "1. Do you perceive the presence of litter in this zone?"

The analysis of these answers based on the frequentation (Table 7) shows that this perception is quite complex. In the West zone the negative perception ("No" answer) was more frequent in the occasional beachgoers versus the perception of the regular users, who detected debris on the beaches more frequently ("Yes" answer). Also, the frequent visitors tended to detect some debris but not too much ("A bit" answer), instead of perceiving enough debris to state the beach was littered. The central zone had more dispersed responses; the lower perception of debris was from the frequent visitors, while the most intense perception of litter corresponded to the regular users.

This skew of the data seemed to respond to moderate perceptions of debris ("A bit" and "Not much" answers). Finally, the East zone had the most frequent non-perception of litter with no clear trend from the frequentation. In this case the frequent visitors perceived more debris, but the differences between users were less marked than in the case of the center zone.

The analysis of this answers from the age range of the surveyed sample (Table 7) did not exhibit a clear pattern or trend on the answers. The West zone contained quite even answers across age classes, with a slight increase in the non-perception of litter with ageing. The central and the eastern zone showed no pattern at all, showing great differences between age ranges.

The answers to the second question about the relationship between marine debris and alien invasive species dispersal (Figure 8) showed a general ignorance about this topic. The percentage of negative answers ("No" answers) was in general high in all zones, from a 36.84% in the Center zone to the 50.77% in the West zone. Similarly, the level of unknown answers ("I don't know") was quite big, being the West zone the one with the highest percentage of affirmative answers.

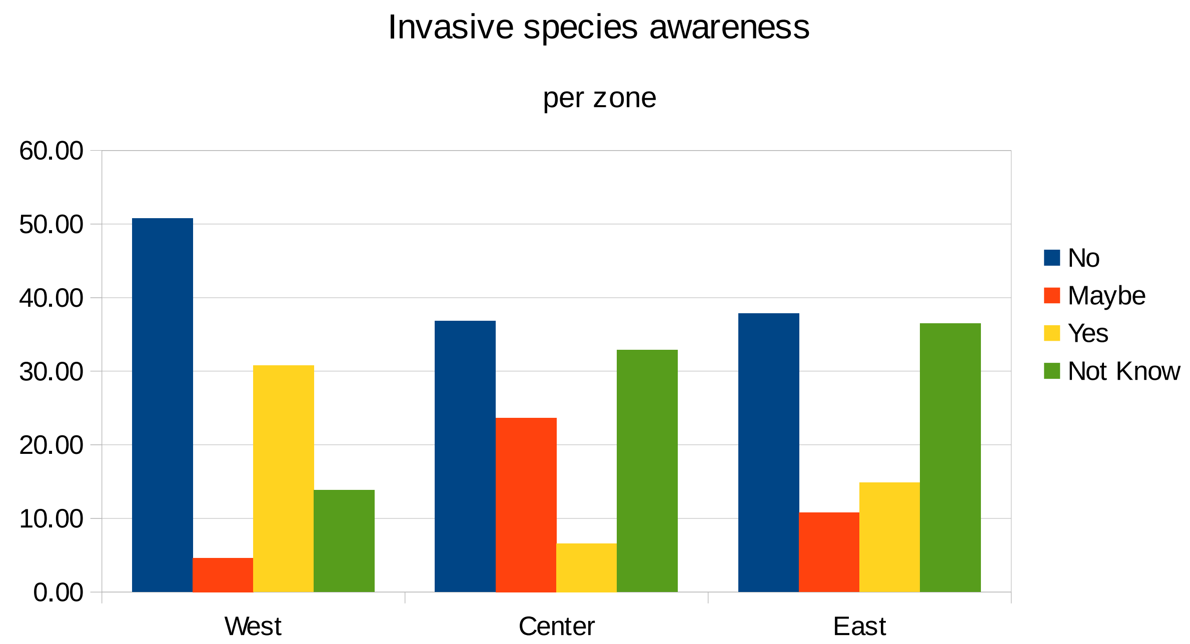


Figure 8. Weighted percentage answers to the question 5. "Do you think is there any relationship between the litter presence and the alien invasive species occurrence?"

The analysis based on the frequency of visiting (Table 7) revealed that in the three zones the most frequent negative responses came from the frequent beachgoers, especially in the West zone. The same happened with the "I don't know" answers, in the three zones the majority of these answers were from the occasional and habitual users. The data showed no clear patterns or trends.

Depending on the age range (Table 7) the analysis showed also skewed results with no clear patterns. In general in all zones the level of negative answers or "I don't know" answers was the higher one, answering only affirmatively the surveyed people older than 50 years from the West who showed some high level (44.44%).

The answers to the third question (Figure 9) show a great variability in proposals between zones. While in the West zone a big percentage of the surveyed people suggest more cleanings by the administrations, this percentage diminishes while we move to the East as it increases the percentage of suggestions for more awareness campaigns. Also, the request for more infrastructures to throw trash increases from West to the East.

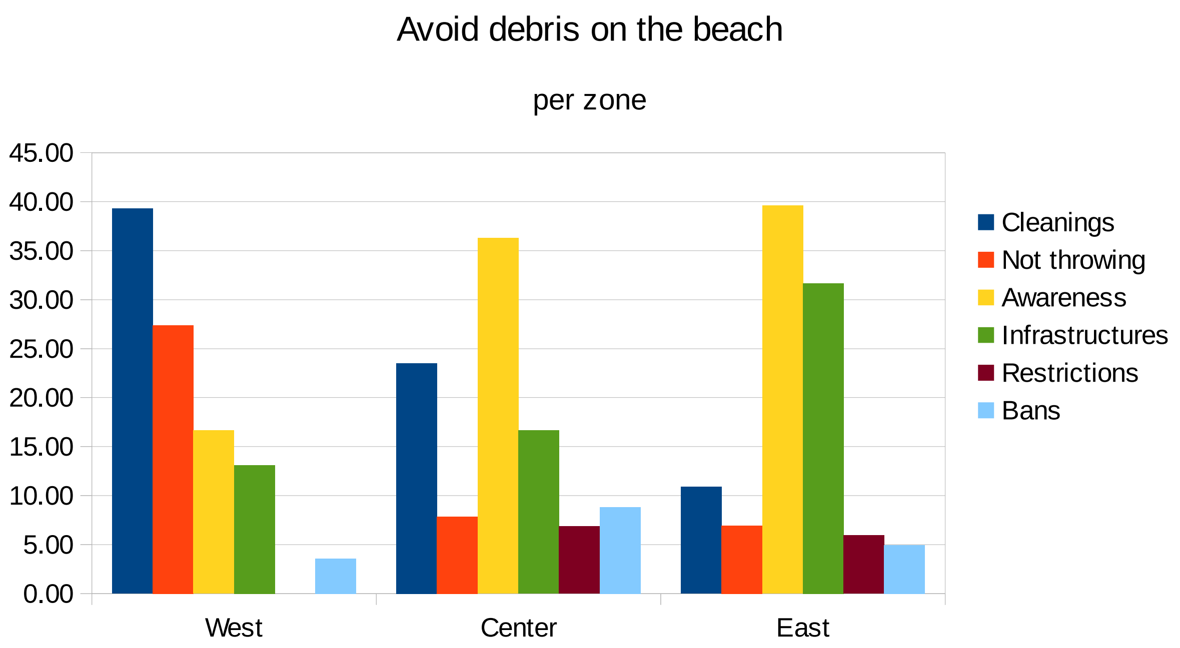


Figure 9. Weighted percentage answers to the question *3. How could be avoid litter to be present in the zone?*

From frequency of visiting of the participants (Table 8) it can be seen that in the Center and the East the occasional beachgoers request more awareness campaigns, while those measures are asked more for the frequent visitors on the West zone.

Also, in the case of the age ranges (Table 8), the answers are roughly similar, principally on the West zone, which has no special outliers. In the central zone is remarkable that all the youngsters asked more awareness campaigns and in the East zone were the 50%, being the other 50% more infrastructures.

Finally, the last two questions about the most common debrsis (Question 7) and the most harmful one (Question 8) (Figure 10), showed concordance in the answers and few differences between zones. In general people perceived plastic litter as the most common material of the debris, as well as considered it most harmful for the environment. After plastic litter, people were more concerned about chemical residues over the rest of litter types.

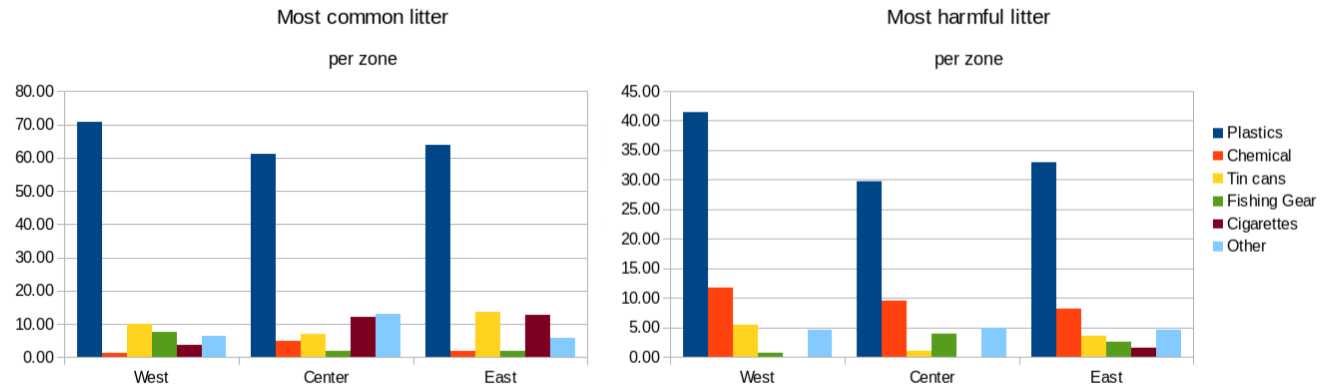


Figure 10. Weighted percentage answers to the questions 7. “Which, do you think, is the most common litter in this zone?” and 8. “In your opinion, which is the most harmful product for the environment?”

Depending on the frequency of visiting (Table 7 & Table 8), the plastic litter is considered the most common and harmful debris material. After it, in the West fishing gears are considered most common for the frequent visitors (20.00%), being less aware about presence of other materials. Nevertheless, the biggest concern about harm to the environment in the West comes from the tin cans for the frequent visitors and to the chemicals to the habitual ones. This awareness about hazardousness of chemical residues for the environment is more or less constant in all the zones, while in the East zones those residues seem not to be so perceived by the surveyed people. In the Center however the opinions are more diverse; the occasional visitors perceive cigarettes, the frequent visitors more chemical residues and the habitual beachgoers detect most other kinds of litter.

For the age range of the visitors (Table 7 & Table 8), the perception of the most common litter was significant anomalous to the youngsters (aged from 8 to 18 years old) from the central zone, that perceive “other” litter as the second most common (as common as plastic litter) and from the West zone, who perceive tin cans as the only debris on the beach. Equally, those age range surveyed people on those zones perceived plastic litter as the only harmful residues to the environment. Besides, on the central zone the answers to the Question 8 gave disperse answers for all age ranges.

Socioeconomic features and environmental associations

The PCA cluster analysis and the resemblance matrix showed no significant similarities for the beaches based on the environmental measures gathered (Figure 11).

Also, the Pearson's correlation matrix (Table 9) showed no clear correlation between environmental an debris values impedes also to find a clear driver of litter on these beaches. Even though it can be seen a slight increase in the correlation level while using our own measures versus the ones taken from the MAGRAMA.

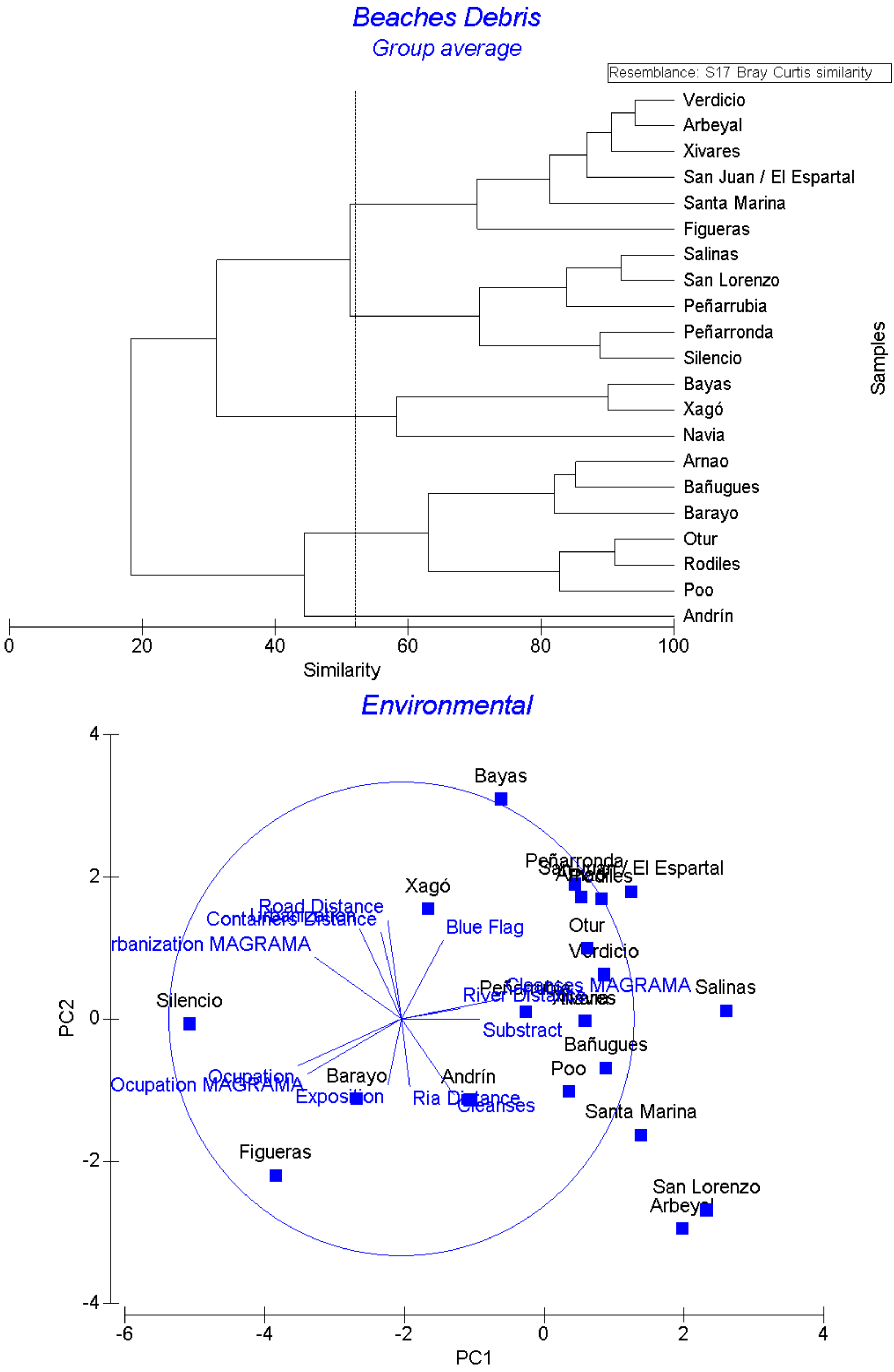


Figure 11. Similarity tree from the Primer6 analysis of the debris by beaches (left) and their relationship with the environmental values gathered with a PCA analysis (right).

Discussion

Marine debris is a global problem and no region seems to be free of it. Even with only one sampling, in this study it was clear that marine debris was present in all the studied beaches, what shows the delicate state of this issue on the Asturian region. However, in comparison with other studies this first analysis suggests a relatively clean state in the coast of Asturias. Although the central zone and some beaches of the East zone had high densities of debris, it was relatively low compared with other studies in other regions such as Transkei Coast (South Africa), Armação dos Búzios (Brazil) or Bandar Abbas (Iran) (Lastra and Mclachlan, 1996; Oigman-Pszczol and Creed, 2007; Sarafraz et al., 2016). These data have to be taken as preliminary information and further samplings are needed around the year in order to have a more objective view of the state of the beaches and also to identify any possible trend in this littering, if occurring. Anyway, as explained above, the state of the coast of Asturias is not in optimal conditions, but is not heavily degraded – at least due to the marine debris. Measures to diminish this problem could be performed easily, and good results could be expected.

Unfortunately, the MAGRAMA database proved inefficient to make a good environmental analysis of the beaches, not allowing researchers to ascertaining the source of these variations. This was mainly because the data contained in it was inaccurate or incomplete. Many of the variables that appear in the Ministry official webpage were apparently more addressed to tourists than useful for an environmental description of the beaches. This could be explained as a sort of intended positive publicity of the region as a "natural paradise" because the touristic sector is very important in the regional economy (Fernández, 2016). A more complete and accurate database containing proper environmental data could be more useful for works as this one or other related. Variables as dominant currents in each beach, daily tides variations along the year, frequency of visits along the year, protection level, cleanings done along the year, could be more informative. Here some association seemed to occur between the debris quantities and the distance to the big estuaries and the exposure of the beaches of Navia (Ría de Navia), Bayas (Ría del Nalón) and Xagó (Ría de Avilés); but this relationship was not proven by statistical analysis. The main currents that affect these beaches and transport debris could explain this apparent relationship.

Strong differences between beaches and regional zones were found. Taking into account the socioeconomic data from (SADEI, 2016)(Table 6) some connections can be suggested:

- The central zone is the most polluted, especially in plastics and fishing gear litter and it has also the greater population urban centers (Avilés and Gijón) with the highest population densities and industrial and fisheries productions. It can be suggested that this high population and industrial use has a reflection on the inland debris production that finally reaches the sea and can be found on the beaches.
- The western zone, which is the one with less debris on the beaches, is mainly focused on tourism, which valued much the cleanliness of the beaches, so it is not unreasonable to

think that investment in cleaning these beaches may be greater than in other areas. But also it is the less populated zone, so its low human density may not generate so much debris as in the other zones.

- The eastern zone has the higher quantities of litter classified as “Other” and a great variability in the data. This, *a priori*, cannot be explained with the information available.

In general, people's concern about the marine debris issue is quite good. Their level of awareness about the state of the beaches and effect of marine and coastal debris seem to be accurate. Even so, the level of unknown or confusion rises with more technical topics, such as invasive species. Because of that, an improvement in popular science, which conveys scientific knowledge to the general public should be done. Some studies showed that a well informed population supports and values campaigns against invasive species or marine litter (Bremner and Park, 2007; Sharp et al., 2011), which increases its effectiveness.

It may be relevant that the measures taken by the administrations (restrict the use or access to the beach and ban for littering) do not coincide with the recommendations done by the beachgoers, who advocate for more awareness measures and infrastructure investments. Management measures should be informed and have a consensus with citizens in order to facilitate their implementation (Marin et al., 2009); which in this case has good precedents.

It was shown that the knowledge of regular users about the problematic and level of awareness was quite good and many people (specially in the Center and West zones) advocate for more awareness campaigns. Obviously, taking into account the frequentation of each zone, different approaches to this awareness campaigns have to be done. For example, the touristic zones, as the West, could focus on poster signs and green tourism initiatives; while where there are more resident visitors school awareness courses, speeches and volunteering initiatives could be performed (Hartley et al., 2015). These measures have to be implemented along with investment in infrastructures and more cleanings, as it was suggested by the great majority of the surveyed people.

The implementation of an Integrated Coastal Zone Management (ICZM) protocol to improve the state of the beaches could be a good alternative to the current measures. However, beach cleanings in Spain are competence of the municipalities (El Comercio, 2015) which produce wide differences in the state of beaches due to the differences in the investment by those municipalities (Chaniotis and Stead, 2007). This has been suggested in other zones as a problem to the implementation of good measures to reduce coastal debris (Hastings and Potts, 2013). Also, in order to this measure could be effective, it was suggested that that labor must be coordinated at least regional or autonomic level. This could allow a proper coordination between zones and added to the volunteer debris collection that are currently developing such activities (Europa Press, 2014; La Nueva España, 2014; Redacción EFE Verde, 2014) could result in a better and cheaper approach to this issue. This should leave a scenario of a medium-high scale coordination with local actions on the beaches performed by the volunteer associations and local administration.

Obviously, this faces some problems such as the amount of landfilled plastic litter in Spain is around 50% of the total plastic used, only being recycled about 25% (PlasticsEurope, 2015). Moreover, the possible reluctance of municipalities to the transfer of its dependencies or the skepticism of some stakeholders could be also a problem to face.

These results suggest a delicate status of the coast of Asturias in an early stage of degradation. The conservation of the beaches of Asturias and the Cantabric Sea is important for the ecosystem of the region as well as to maintain the livelihood of many people that make a living from it. For the conservation of the environment in order to avoid further ecological and socio-economical degradation, this could be an inflection point to evolve into an environment recovery. All this will be possible by delving into the causes and unification of efforts.

Conclusions

After this study about the state of marine debris in Asturias and its perception by the beachgoers, it can be concluded that:

1. The beaches of Asturias, even not being pristine, present a good state of littering compared with other regions of the world. Even though there is a need for a reduction in the production of marine debris.
2. The national database of Spain beaches results insufficient to know the factors driving the marine debris. For further analysis a database with good measures of environmental factors that can influence marine debris appearance must be built.
3. General knowledge about marine debris problematic is good both for residents and visitors. More technical knowledge tend to be more unknown.
4. The awareness level and knowledge was slightly different between the zones studied, showing little differences in perception based on the zone studied. This should be taken into account for the implementation of measures to prevent marine debris, such as IZCMs protocols.

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Supplementary Information

Table 3. Target beaches for the study, analysis performed (debris Sampling and/or Social Awareness Study) and dates of the surveys

Zone	Beach	Coordinates	Debris Sampling Study	Social Awareness Study	Debris Sampling Study Date	Social Awareness Study Date
West	Figueras	43° 32' 22,926'' N 07° 01' 38,622'' W	✓	✗	1st March	-
	Arnao	43° 32' 55,968'' N 07° 01' 16,779'' W	✓	✗	1st March	-
	Peñarronda	43° 33' 10,401'' N 06° 59' 36,564'' W	✓	✓	1st March	28th March
	Navia	43° 33' 17,290'' N 06° 43' 15,119'' W	✓	✓	15th March	29th March
	Barayo	43° 33' 35,036'' N 06° 36' 48,403'' W	✓	✗	15th March	-
	Otur	43° 33' 08,382'' N 06° 35' 49,156'' W	✓	✓	15th March	29th March
	Silencio	43° 34' 01,678''N 06° 17' 42,004'' W	✓	✗	22nd February	-
Center	Bayas	43° 34' 34,326'' N 06° 02' 25,877'' W	✓	✗	2nd March	-
	Salinas	43° 34' 39,760'' N 05° 57' 43,070'' W	✓	✓	16th March	2nd April
	San Juan	43° 35' 17,138'' N 05° 56' 20,765'' W	✓	✗	16th March	-
	Xagó	43° 36' 20,161'' N 05° 54' 53,017'' W	✓	✓	20th February	1st April
	Verdicio	43° 37' 27,525'' N 05° 52' 34,517'' W	✓	✗	20th February	-
	Bañugues	43° 37' 41,897'' N 05° 48' 36,918'' W	✓	✗	21st February	-
	Xivares	43° 34' 9,852'' N 05° 43' 19,497'' W	✓	✗	21st February	-
	Arbeyal	43° 32' 39,468'' N 05° 41' 36,190'' W	✓	✗	16th February	-
	San Lorenzo	43° 32' 32,594'' N 05° 39' 33,169'' W	✓	✓	16th February	2nd April
	Peñarrubia	43° 33' 05,140'' N 05° 37' 26,920'' W	✓	✗	12th March	-
East	Rodiles	43° 31' 56,869'' N 05° 22' 38,697'' W	✓	✓	23th February	24th March
	Santa Marina	43° 27' 57,804'' N	✓	✓	24th	24th March

	05° 03' 54,579'' W			February	
Poo	43° 25' 45,712'' N 04° 47' 1,552'' W	✓	✗	24th February	-
Andrín	43° 24' 36,476'' N 04° 42' 27,311'' W	✓	✓	24th February	24th March

Table 4. Normality test table for the debris sampled on the beaches

	Zone	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Plastics	West	,394	7	,002	,560	7	,000
	Center	,271	10	,036	,801	10	,015
	East	,414	4	.	,697	4	,011
Fishing Gear	West	,451	7	,000	,511	7	,000
	Center	,197	10	,200	,811	10	,020
	East	,237	4	.	,908	4	,470
Other Litter	West	,415	7	,001	,655	7	,001
	Center	,298	10	,012	,767	10	,006
	East	,419	4	.	,663	4	,004
Total Litter	West	,384	7	,002	,597	7	,000
	Center	,282	10	,023	,839	10	,043
	East	,430	4	.	,662	4	,004

Table 5. Homogenity (Levene) test table for the sampled debris on the beaches

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Plastics	1,375	2	18	,278
Fishing Gear	3,615	2	18	,048
Other Litter	12,041	2	18	,000
Total Litter	2,967	2	18	,077

Table 6: Socioeconomical data from the target zones

	Pop. Density	Primary production			Industrial	Tourism				
		Agriculture Production (Tn)	Cattle Rising Farms	Fishery Production (Tn)	Jobs	Hotels	Rural acc.	Other acc.	Total Acc.	Restaurants
West	61.52	**348,352**	4,932	4,138,363.93	2,040	1,678	1,617	5,177	8,472	8,475
Center	**942.14**	94,414	**7,142**	**51,150,909.10**	**26,537**	**6,643**	316	4,240	11,199	**44,917**
East	59.32	72,281	2,712	3,535,000.29	1,116	4,216	**4,092**	**12,938**	**21,246**	14,102

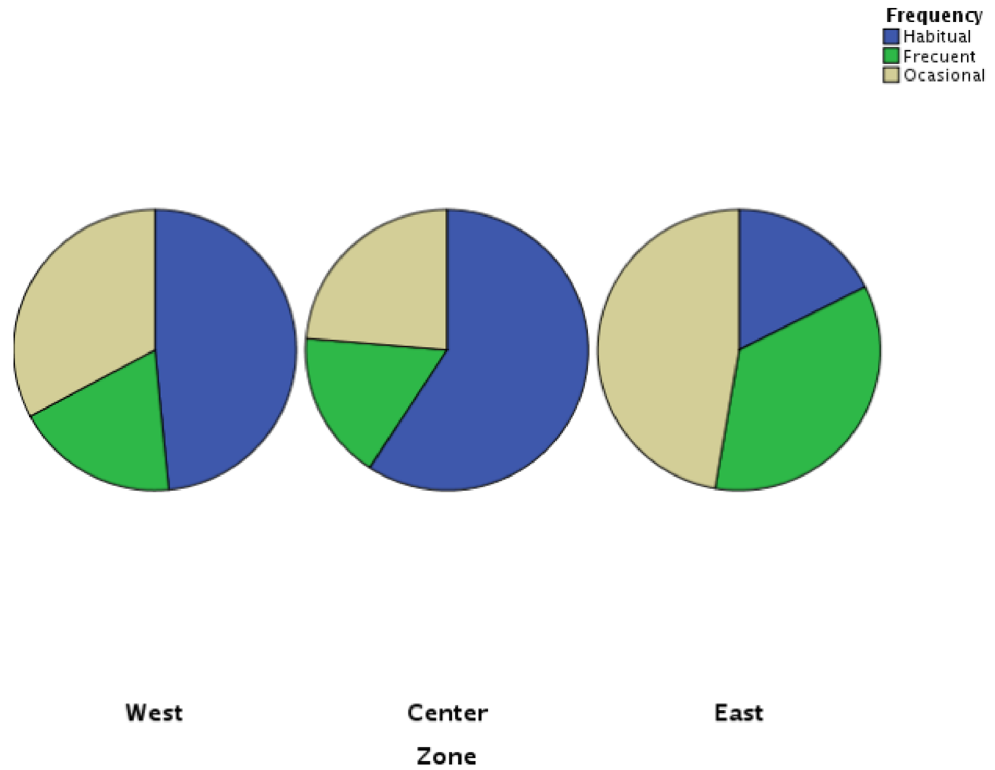

Figure 12. Pie charts of the frequency of visiting of the surveyed individuals during the social awareness study per zones

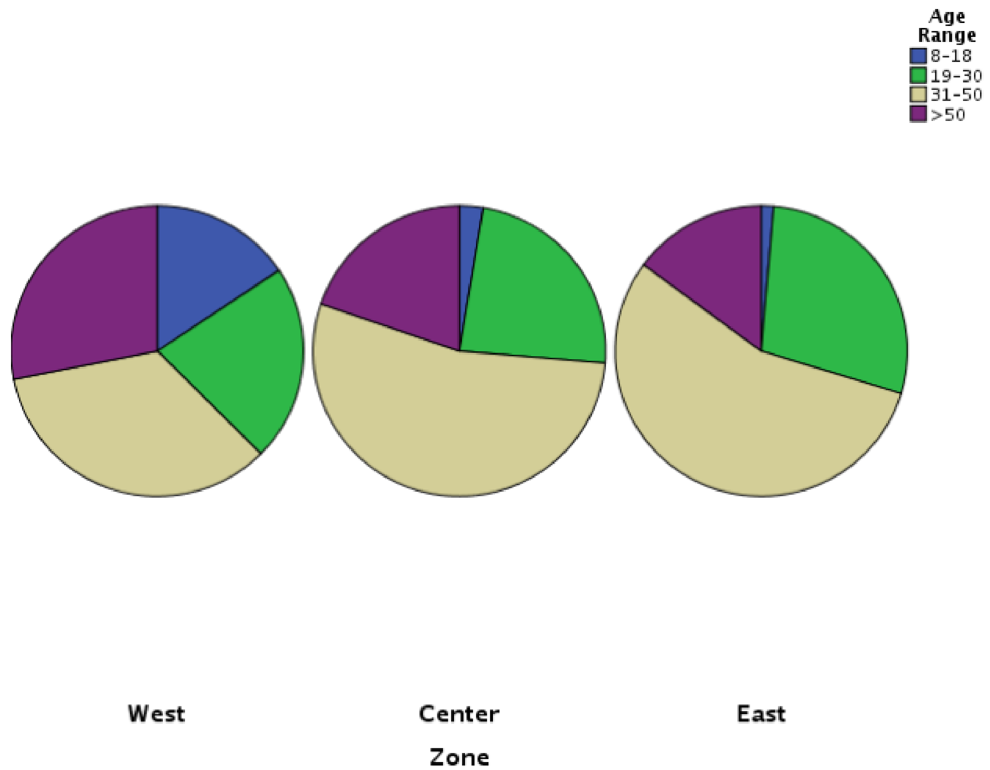

Figure 13. Pie charts of the age range of the surveyed individuals during the social awareness study per zones

Encuesta Social de Observancia Activa

Contexto / Localización / Geoposicionamiento **Fecha:**

Encuesta social

Datos personales
Ocupación:

Presencia personal en la zona

Habitual	
Frecuente	
Ocasional	

♂	♀
8 a 18	18 a 30
30 a 50	+ de 50

Observación activa

Datos científicos

1. ¿Percibe usted la presencia de basuras en esta zona?
(Do you perceive the presence of litter in this zone?)

2. ¿Cómo cree usted que llega la basura hasta aquí?
(How do you think litter arrives here?)

3. ¿Cómo podríamos evitar la presencia de basuras en la zona?
(How could be avoid litter to be present in the zone?)

4. ¿Hace usted personalmente algo para evitar la presencia de basuras en esta zona? ¿Llevan bolsas para recoger sus basuras?
(Do you do something personally to avoid litter presence in this zone? Do you bring plastic bags with you to take the litter?)

5. ¿Piensa usted que pueda haber una relación entre la presencia de basuras en esta zona y la aparición de especies invasoras?
(Do you think is there any relationship between the litter presence and the alien invasive species occurrence?)

6. ¿En su opinión, cuál diría usted que es el problema más importante para la biodiversidad en esta zona?
(In your opinion, which do you consider is the main problem to biodiversity in this zone?)

7. ¿Cuál cree usted que es el producto/basura más común en esta zona?
(Which, do you think, is the most common litter in this zone?)

8. En su opinión, ¿Qué tipo de desecho es el más dañino para el medio ambiente?
(In your opinion, which is the most harmful product for the environment?)

Table 7. Weighted anwswers to the target questions 1, 5 & 7 in general (per zones) and depending on the frequency of visiting and on the age range of the surveyed

		Debris Perception					Invasive species relationship with debris				Most common litter					
		No	A Bit	Not Much	Yes/Many	A lot	No	Maybe	Yes	Not Know	Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other
West		40.63	10.94	9.38	34.38	4.69	50.77	4.62	30.77	13.85	70.89	1.27	10.13	7.59	3.80	6.33
Center		29.87	18.18	2.60	42.86	6.49	36.84	23.68	6.58	32.89	61.00	5.00	7.00	2.00	12.00	13.00
East		61.04	6.49	7.79	24.68	0.00	37.84	10.81	14.86	36.49	63.73	1.96	13.73	1.96	12.75	5.88
Zone	Visits Frec.	No	A Bit	Not Much	Yes/Many	A lot	No	Maybe	Yes	Not Know	Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other
West	Ocassional	66.67	0.00	4.76	28.57	0.00	38.10	9.52	38.10	14.29	72.73	0.00	9.09	4.55	4.55	9.09
	Frecuent	41.67	33.33	8.33	16.67	0.00	66.67	0.00	8.33	25.00	66.67	0.00	13.33	20.00	0.00	0.00
	Habitual	22.58	9.68	12.90	45.16	9.68	51.61	3.23	35.48	9.68	71.43	2.38	9.52	4.76	4.76	7.14
Center	Ocassional	33.33	22.22	0.00	38.89	5.56	33.33	16.67	5.56	44.44	56.52	0.00	8.70	0.00	34.78	0.00
	Frecuent	53.85	0.00	0.00	30.77	15.38	38.46	30.77	15.38	15.38	50.00	41.67	0.00	0.00	0.00	8.33
	Habitual	22.22	22.22	4.44	46.67	4.44	37.78	24.44	4.44	33.33	64.62	0.00	7.69	3.08	6.15	18.46
East	Ocassional	68.57	8.57	8.57	14.29	0.00	28.57	11.43	17.14	42.86	60.78	1.96	15.69	0.00	15.69	5.88
	Frecuent	53.85	3.85	3.85	38.46	0.00	50.00	15.38	11.54	23.08	61.54	2.56	12.82	5.13	12.82	5.13
	Habitual	61.54	7.69	0.00	30.77	0.00	38.46	0.00	15.38	46.15	83.33	0.00	8.33	0.00	0.00	8.33
Zone	Age Range	No	A Bit	Not Much	Yes/Many	A lot	No	Maybe	Yes	Not Know	Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other
West	8-18	30.00	0.00	10.00	60.00	0.00	30.00	10.00	30.00	30.00	53.33	6.67	20.00	0.00	6.67	13.33
	19-30	14.29	21.43	21.43	42.86	0.00	64.29	0.00	35.71	0.00	73.68	0.00	15.79	10.53	0.00	0.00
	31-50	45.45	18.18	4.55	22.73	9.09	54.55	4.55	18.18	22.73	72.00	0.00	4.00	16.00	4.00	4.00
	>50	61.11	0.00	5.56	27.78	5.56	44.44	5.56	44.44	5.56	80.00	0.00	5.00	0.00	5.00	10.00
Center	8-18	0.00	100.00	0.00	0.00	0.00	50.00	50.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	50.00
	19-30	5.56	5.56	0.00	66.67	22.22	33.33	33.33	11.11	22.22	75.00	0.00	8.33	0.00	16.67	0.00
	31-50	31.71	21.95	4.88	39.02	2.44	31.71	19.51	4.88	43.90	59.26	9.26	9.26	1.85	7.41	12.96
	>50	60.00	13.33	0.00	26.67	0.00	53.33	20.00	6.67	20.00	50.00	0.00	0.00	5.56	22.22	22.22
East	8-18	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00
	19-30	42.86	4.76	0.00	52.38	0.00	38.10	28.57	4.76	28.57	61.76	0.00	17.65	0.00	14.71	5.88
	31-50	78.57	7.14	2.38	11.90	0.00	45.24	2.38	16.67	33.33	61.11	3.70	12.96	3.70	12.96	5.56
	>50	36.36	9.09	27.27	27.27	0.00	9.09	9.09	27.27	54.55	84.62	0.00	0.00	0.00	7.69	7.69

Table 8. Weighted anwswers to the target questions 8 & 3 in general (per zones) and depending on the frequency of visiting and on the age range of the surveyed

		Most harmful litter						Avoid Litter					
		Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other	Cleanings	Not throwing	Awareness	Infrastructures	Restrictions	Bans
West		41.41	11.72	5.47	0.78	0.00	4.69	54.10	0.00	22.95	18.03	0.00	4.92
Center		29.80	9.60	1.01	4.04	0.00	5.05	25.53	0.00	39.36	18.09	7.45	9.57
East		32.99	8.12	3.55	2.54	1.52	4.57	11.70	0.00	42.55	34.04	6.38	5.32
Zone	Visits Frec.	Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other	Cleanings	Not throwing	Awareness	Infrastructures	Restrictions	Bans
West	Ocassional	60.00	16.67	6.67	3.33	0.00	13.33	43.33	40.00	0.00	16.67	0.00	0.00
	Frecuent	68.75	6.25	25.00	0.00	0.00	0.00	42.86	28.57	14.29	14.29	0.00	0.00
	Habitual	66.67	25.00	2.78	0.00	0.00	5.56	35.00	17.50	30.00	10.00	0.00	7.50
Center	Ocassional	65.00	5.00	10.00	0.00	0.00	20.00	14.29	21.43	25.00	21.43	7.14	10.71
	Frecuent	64.29	35.71	0.00	0.00	0.00	0.00	29.41	0.00	41.18	23.53	0.00	5.88
	Habitual	57.81	20.31	0.00	12.50	0.00	9.38	26.32	3.51	40.35	12.28	8.77	8.77
East	Ocassional	65.91	15.91	4.55	4.55	0.00	9.09	4.17	8.33	41.67	37.50	2.08	6.25
	Frecuent	70.59	11.76	5.88	2.94	0.00	8.82	17.65	5.88	32.35	26.47	11.76	5.88
	Habitual	44.44	18.52	11.11	7.41	11.11	7.41	15.79	5.26	47.37	26.32	5.26	0.00
Zone	Age Range	Plastics	Chemical	Tin cans	Fishing Gear	Cigarettes	Other	Cleanings	Not throwing	Awareness	Infrastructures	Restrictions	Bans
West	8-18	72.73	18.18	0.00	0.00	0.00	9.09	36.84	31.58	0.00	31.58	0.00	0.00
	19-30	60.00	20.00	10.00	5.00	0.00	5.00	36.84	36.84	26.32	0.00	0.00	0.00
	31-50	58.06	19.35	12.90	0.00	0.00	9.68	53.85	7.69	23.08	11.54	0.00	3.85
	>50	75.00	15.00	5.00	0.00	0.00	5.00	25.00	40.00	15.00	10.00	0.00	10.00
Center	8-18	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
	19-30	50.00	7.69	7.69	3.85	0.00	30.77	22.58	6.45	25.81	25.81	6.45	12.90
	31-50	61.54	30.77	0.00	3.85	0.00	3.85	28.57	4.08	42.86	6.12	8.16	10.20
	>50	68.42	5.26	0.00	26.32	0.00	0.00	15.00	20.00	30.00	30.00	5.00	0.00
East	8-18	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	0.00	0.00
	19-30	50.00	21.88	9.38	9.38	0.00	9.38	7.14	10.71	21.43	32.14	17.86	10.71
	31-50	74.00	12.00	4.00	0.00	2.00	8.00	10.71	7.14	42.86	33.93	1.79	3.57
	>50	50.00	13.64	9.09	9.09	9.09	9.09	20.00	0.00	60.00	20.00	0.00	0.00

Table 9. Pearson's correlation matrix for the environmental values (X axis) and the debris materials surveyed on the beaches (Y axis).

		Plastic litter	Fishing Gear Litter	Other Litter	Total Litter
Substratum	Pearson Correlation	.017	.060	-.042	.004
	Sig. (2-tailed)	.941	.796	.856	.986
	N	21	21	21	21
Exposition level	Pearson Correlation	-.327	-.250	-.234	-.309
	Sig. (2-tailed)	.148	.275	.308	.173
	N	21	21	21	21
Rivers distance	Pearson Correlation	-.144	-.068	-.144	-.140
	Sig. (2-tailed)	.638	.825	.639	.648
	N	13	13	13	13
Distance to big rivers/ rias	Pearson Correlation	-.344	-.274	-.326	-.353
	Sig. (2-tailed)	.127	.229	.150	.116
	N	21	21	21	21
Urbanization Level	Pearson Correlation	-.020	-.048	-.266	-.106
	Sig. (2-tailed)	.933	.836	.243	.646
	N	21	21	21	21
Urbanization Level (MAGRAMA)	Pearson Correlation	.154	.013	.025	.104
	Sig. (2-tailed)	.505	.956	.915	.653
	N	21	21	21	21
Distance to trash bins	Pearson Correlation	.317	-.050	-.188	.123
	Sig. (2-tailed)	.200	.842	.455	.627
	N	18	18	18	18
Distance to the road	Pearson Correlation	.345	.205	-.325	.188
	Sig. (2-tailed)	.175	.430	.204	.470
	N	17	17	17	17
Cleanings frequency	Pearson Correlation	-.570	-.190	-.090	-.520
	Sig. (2-tailed)	.181	.684	.849	.232
	N	7	7	7	7
Cleanings frequency (MAGRAMA)	Pearson Correlation	-.056	.034	-.171	-.087
	Sig. (2-tailed)	.808	.885	.458	.707
	N	21	21	21	21
Occupation level	Pearson Correlation	-.193	-.187	.163	-.088
	Sig. (2-tailed)	.402	.417	.481	.705
	N	21	21	21	21
Occupation level (MAGRAMA)	Pearson Correlation	-.186	-.182	.232	-.060
	Sig. (2-tailed)	.419	.429	.312	.796
	N	21	21	21	21
Blue Flag	Pearson Correlation	-.286	-.131	-.245	-.273
	Sig. (2-tailed)	.208	.570	.285	.231
	N	21	21	21	21