DEVELOPMENT OF BEACH LITTER MONITORING ON THE LATVIAN COASTLINE: THE CITIZEN SCIENCE PERSPECTIVE

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ABSTRACT

The research analyses the beach litter monitoring programme in Latvia and provides suggestions for its improvement seeking to provide necessary information for effective marine litter management on the Latvian coastline of the Baltic Sea. The beach litter monitoring programme has been enacted since 2012 by NGO "FEE Latvia" and current research has been focused on the situation assessment and particularly provides analyses on a number and distribution of the surveyed beaches, the frequency and timing of the monitoring, litter classification and counting methodology, as well as the possible programme development using the NGO work based on the citizen science approach. The results allow to elaborate several suggestions on how to improve the programme in order to provide lacking information in Latvia on the implementation of the Marine Strategy Framework directive of European Union, and to advise local municipalities in their coastal waste management practices. The suggestions include the increasing number of monitoring sites, a prioritization of the EU Master list classification protocol and an increase of sites with higher frequency of monitoring (3 times per year). Moreover, in the conducted public survey, the beach visitors demonstrated good understanding of marine litter and highly prioritized the issue. The increased interest can add public participation to further development of this applied here citizen science approach.

KEYWORDS: *Baltic Sea, beach litter, monitoring program, citizen science, coastal management.*

JEL CODES: Q52, Q57, Q58.

Introduction

Following the accelerated growth in the amount of waste generated by human activities, there have been a number of environmental consequences emerging as part of the waste is not properly collected and managed. One of the most significant issues is the growth of marine litter, as the solid waste enters marine environment and accumulates in beaches, seabed or in the water column (Ryan, 2015). Marine litter is associated with a number of negative economic, social and ecological consequences, especially concerning plastic waste (Green et al., 2015, Cozar et al., 2014, Cole, 2011) and the reduction of marine litter is one of the objectives of EU Marine Strategy Framework directive (Galgani et al., 2010). In order to evaluate the progress of achieving

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marine litter reduction, there is a need for initial assessment of the European seas and long term monitoring programmes. However, any monitoring of the marine litter has to overcome the complications created by high mobility of plastic litter in marine environment (Pham et al., 2014). It is one of the main reasons why litter on beaches has been used as the main indicator to assess the situation of marine litter – beach litter is relatively immobile and easily accessible for monitoring activities and it is the cheapest of the available monitoring methods (Galgani et al., 2010). Further reductions in costs can be achieved by using volunteers as detecting beach litter does not require expert knowledge and even the classification of litter can sometimes be done by volunteers (OSPAR, 2009). Involvement of volunteers in scientific research has been known as citizen science approach and when properly managed it has proven to be a reliable tool for gathering high quality data (Chandler et al., 2016) and the use of citizen science has been also encouraged when monitoring litter in the European seas (Galgani et al., 2010). Additional benefit of the citizen science approach is that it has raised awareness of the specific issue among volunteers and motivated them to engage (Runnel et al., 2016). Since, the promoting co-responsibility of the marine litter issue in the public is to be considered as one of the main solutions to achieve improvements (Veiga, 2016; UNEP, 2009), the use of the citizen science approach and engagement of local communities is crucial for the marine/beach litter management.

The marine/beach litter monitoring in Latvia started in 2012, when the environmental NGO "Foundation for Environmental Education Latvia" (FEE Latvia) established a public campaign "My Sea" with the aim to raise public awareness on the issue of marine litter, to fill gaps in knowledge about the situation of marine litter on the Latvian coast and to promote partnership, as well as solutions, at the local and national level. Since then, annually, under this campaign in summer time there has been conducted beach litter monitoring on the Latvian coast of the Baltic Sea in 38 locations, complemented by seasonal surveys on so called indicator beaches. The number of indicator beaches have increased from 5 in 2012 to 12 in 2016. Since 2012, each year the central public event of the campaign is the Green Expedition along the 500 km of the Latvian Baltic Sea coast, complemented with workshops and a range of public activities. This expedition gathers from 500 to 800 volunteers, who participate in beach surveys and environmental education activities, including training on marine litter issues and methodology of the beach surveys.

The campaign has proved to be an efficient instrument in raising of public awareness, data gathering, and the coastal policy development work. The campaign has been awarded with several national governmental awards, including the Environmental Science Award for FEE Latvia in 2012 and the Annual Health Award in 2016. Moreover, data obtained during the campaign has become a backbone of the emerging national policies regarding marine litter in the context of implementation of the EU Marine Strategy Framework Directive, Descriptor 10, regarding the ambition to ensure Good Environmental Status for marine litter. On the basis of the campaign data, there was made quantitative analysis of the national situation and set targets for 2020. Also, the campaign data are used in the national Coastal Spatial planning for the next programming period, and also as qualification criteria for the Blue Flag certifications of the beaches.

For the further national developments in the field and particularly for the supporting of the necessary additional impact on the integrated coastal governance development at the local municipal level, this citizen science based methodology of the beach litter monitoring programme on the Latvian coastline needs to be evaluated and assessed in relation to potential improvements in the beach litter management at the national and municipal level (Ulme, 2016). Consequently, this study has been initiated within the BONUS programme project "A Systems Approach Framework for Coastal Research and Management in the Baltic" (BaltCoast). The current and potential marine litter management overview has been prepared in the project's case territory – Salacgriva municipality (Ernsteins, 2016). The purpose of the study is thus to facilitate the existing monitoring programme and its potential in the efforts to improve the municipal and national marine litter policies. Therefore, the objectives of the study are the following: to evaluate the spatial distribution of monitoring sites and the frequency of data collection; to compare the UNEP beach litter protocol currently in use to that of the EU Master List protocol; to study the views of the beach visitors; to provide an overview of beach litter management in the Salacgriva municipality; to provide suggestions for improving the

monitoring programme using the citizen science approach; to address the needs of beach litter management in municipalities.

In order to achieve these objectives, the further presented methods were employed. For the assessment of the programme methodology the existing literature and guidelines on the beach litter monitoring programmes were reviewed. It was supplemented with analyses of the collected data for each aspect of the monitoring programme, i.e., the spatial distribution of the survey sites in relation to potential litter sources, the frequency of monitoring in relation to data variability and the litter classification systems used. Furthermore, locations of the survey sites were analysed from the perspective of the municipality borders to achieve better data density in each of them. Assessing the public perception of marine litter, a questionnaire was distributed to 400 beach visitors met on the spot. It contained 8 multiple choice questions about the perceived cleanliness of the beach, the importance of beach cleanliness relative to other factors, and a number of questions about the marine litter issue in general. In addition, there was collected data about the age and education level. All respondents were grouped according to their relation to the beach, namely, local inhabitants, local or foreign tourists, and representatives from municipalities.

1. Spatial distribution of monitoring survey locations

There is relatively good agreement on the basic principles of selecting the sites for beach litter. Most of these principles follow from international monitoring guidelines developed by UNEP in 2009 (Cheshire et al., 2009). As shown on Table 1, most of the principles regarding the site selection have been followed in the analysed beach litter monitoring along the Latvian coastline.

Table 1. Criteria of selecting the sites for the survey in Latvian monitoring programme compared to the guidelines of UNEP and EU

Criteria	**Implementation in the monitoring programme**	**Compatibility**	
		UNEP	**EU**
Beach type	Consisting of sand or gravel, with a slope of 15 to 45 degrees	yes	yes
Number of sites	38 (on average every 14 km of the coastline)	not specified	not specified
Frequency of monitoring	annual	yes	yes
Total time for surveying all the sites	40 days	partially	no
Width of the survey site	100 m	yes	yes
Boundaries of the survey site	From the coast to the first permanent vegetation	yes	yes
Collection of the surveyed litter	All litter is collected and removed from the beach	yes	yes
Information about local waste collection activities	No information is collected	partially	partially
Representation of different dominant sources of waste	Sites are diverse, but mostly selected at beaches used in recreation	partially	partially

Source: MARLIN, 2013; Cheshire et al., 2013; MSFD GES Technical Subgroup on Marine Litter, 2013.

As the guidelines of UNEP and EU are made to be similar and comparable, the main deviations from them in the Latvian monitoring programme are the same – there is little reliable information available about the waste collection activities performed by municipalities and local actors (due to lack of such information in most municipalities), as well as the problem with representation as there are relatively few beaches surveyed that would have almost no impacts from visitors, although, there are many beaches on the Latvian coastline with very few visitors. Another difference from the both protocols is a relatively long period of investigation of all the sites. Yet the possibilities to adjust the selected survey sites are discussed in the following subsections.

1.1. Assessing the relevant conditions for representation

The amount of litter on the beach can provide useful information about the total flows of litter in the marine environment (Ryan et al., 2009). The solid waste enters the sea from different sources – mostly from shipping, cities and leftovers from beach visitors (Barnes et al., 2009). Another significant source of litter on beaches are large rivers (Rech et al., 2014; Gasperi et al., 2014). Because adjacent beaches can give information about the relative impacts of these sources, the survey sites of the monitoring programme were assessed based on the main sources.

All 38 survey sites were assessed using the data about cities, towns and mouths of large rivers in direct vicinities, as well as a number of visitors (Grupa 93, 2015) on each beach. The data was used to create subgroups of the survey sites, namely: beaches with low, average or high number of visitors, and beaches within towns and cities with a population larger than 10 000 inhabitants (Liepaja, Ventspils, Jurmala, and Riga). Next, these groups were evaluated based on the results of litter items and types found within each of them during a four-year period of marine litter monitoring on the Latvian coastline of the Baltic Sea. Since the grouping was performed according to different criteria, the same beach might appear in three different groups. This resulted in overlapping, as most visited beaches were located near the cities, and all, except one, was near the mouth of the river, i.e., also in a vicinity of a city. Therefore, it was not easy to evaluate the impact of the factors of cities and rivers on litter input.

The validity of differentiating such groups was assessed using the data of litter items found in each of them during the beach litter monitoring during the period 2012–2015. It was noted that there is a large heterogeneity of all variables among all the groups, but there were still noticeable differences among the groups created.

By analysing the total number of litter items found along the 100 m stretch of the beach, it was predictably found that the beaches with the least number of visitors had the least amount of litter found on them; the average in the group of beaches with a low number of visitors was 10% lower than the average of all beaches, but in the frequently visited beaches it was 27% above the average (Figure 1).

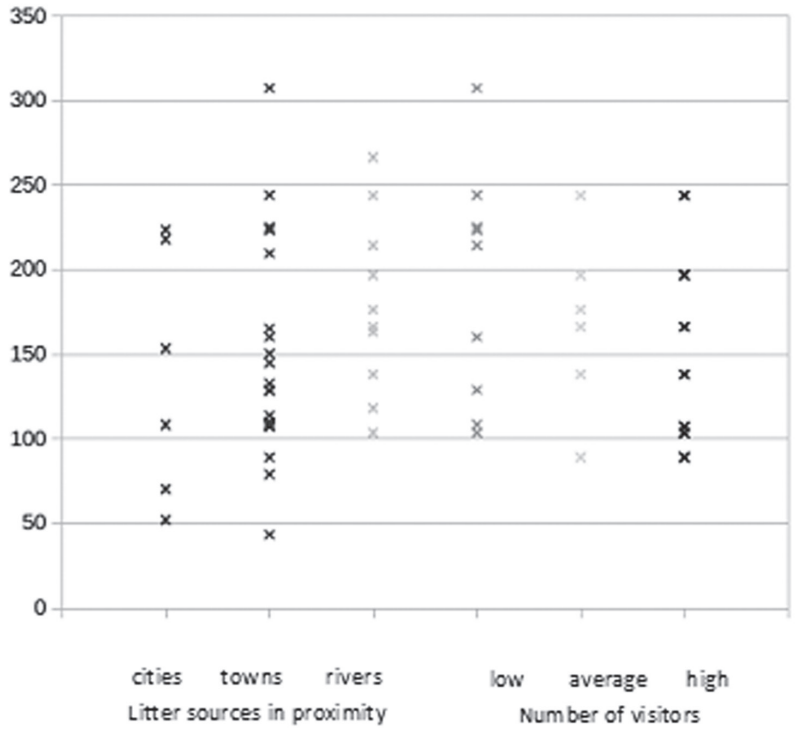

Figure 1. Average number of litter items found within 100 m of each group of the beaches during 2012–2015 period

Source: FEE Latvia, 2016a.

As it can be seen, there is very high variability of data among all the groups. This is mostly due to the general variability of the amount of litter found on beaches (Ryan, 2014, Schulz et al., 2015) and most of the monitored beaches show very different amounts of items found every year. As the goal of this article is just to detect the differences of the classes, but not to determine statistical significance of these differences, most of the analyses are presented visually by the graphs.

To get a denser data set, all the data entries about the beaches with different visitor pressures were selected for each year of the 2012–2015 period. At the same time, this also increased the role of extreme values caused by a few extreme events of litter monitoring that did not allow for objective comparison. To avoid this, the extreme values of litter items were dropped using the following three criteria: (1) the recorded amount of litter units was larger than 400; (2) the amount of litter recorded was many times larger than the previous records; (3) units were from a class of waste that is immobile (steel, concrete, glass) and were unlikely to disperse along all the length of a beach. These criteria were set in order to exclude cases of extreme values of litter items being recorded due to some unique condition (such as many small items in one place, etc.) rather than consistent trend. The results before and after the exclusion of extreme values are presented in Figure 2.

What is obvious from the graphs that although the data points are largely overlapping with all of the groups, the intervals they are covering are slightly different – this does indicate that the division into these groups is meaningful as the specific coastline tends to show different values of litter items depending on the amount of visitors it receives. Because of that, it would be important to include into analysis beaches from different categories of this indicator in order to more accurately assess the total litter loads on the specific coastline, at the national or municipal level.

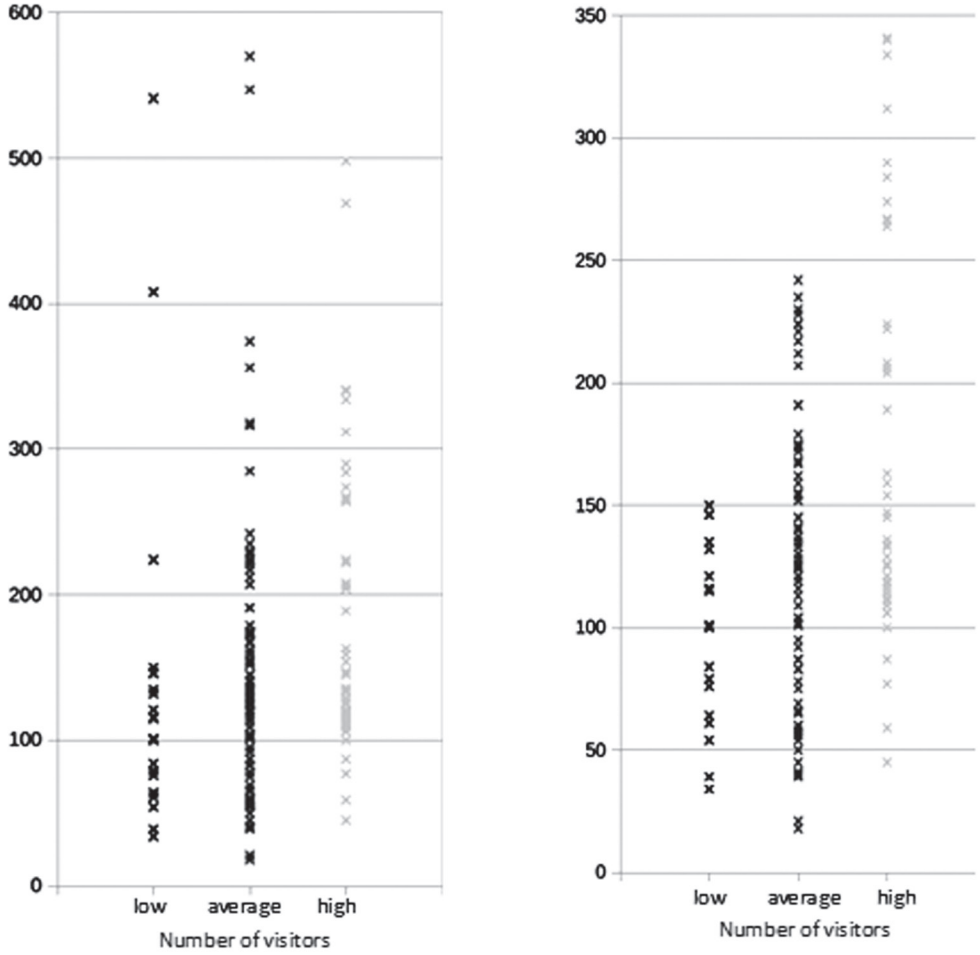

Figure 2. All annual records of litter items found within 100 m of each group of beaches during 2012–2015. On the left – all records, on the right – records excluding extreme values

Source: FEE Latvia, 2016a.

To assess the usefulness of the other groups, more indicators were evaluated. The percentage of the plastic waste in the total amount of beach litter was assessed, as the plastic waste at the same time has the most devastating environmental impacts (Cole, 2011; ARCADIS, 2013; UNEP, 2016) and a different pattern of distribution due to its durability and low weight (Pham et al., 2014; Jambeck et al., 2015).

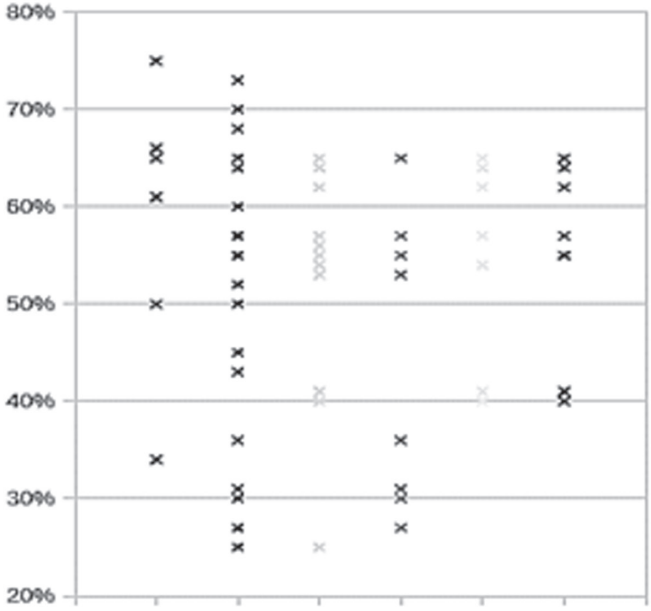

Figure 3. Average percentage of plastic in all litter recorded in beaches during 2012–2015

Source: FEE Latvia, 2016a.

Similarly, the percentage of litter from different sources was assessed. The main sources of marine litter that can be distinguished after the classification of litter items are land based litter and sea based litter (OSPAR, 2009; MSFD GES Technical Subgroup on Marine Litter, 2013). The third group consists of items of unidentifiable source, i.e., it could belong to each of the two previous groups.

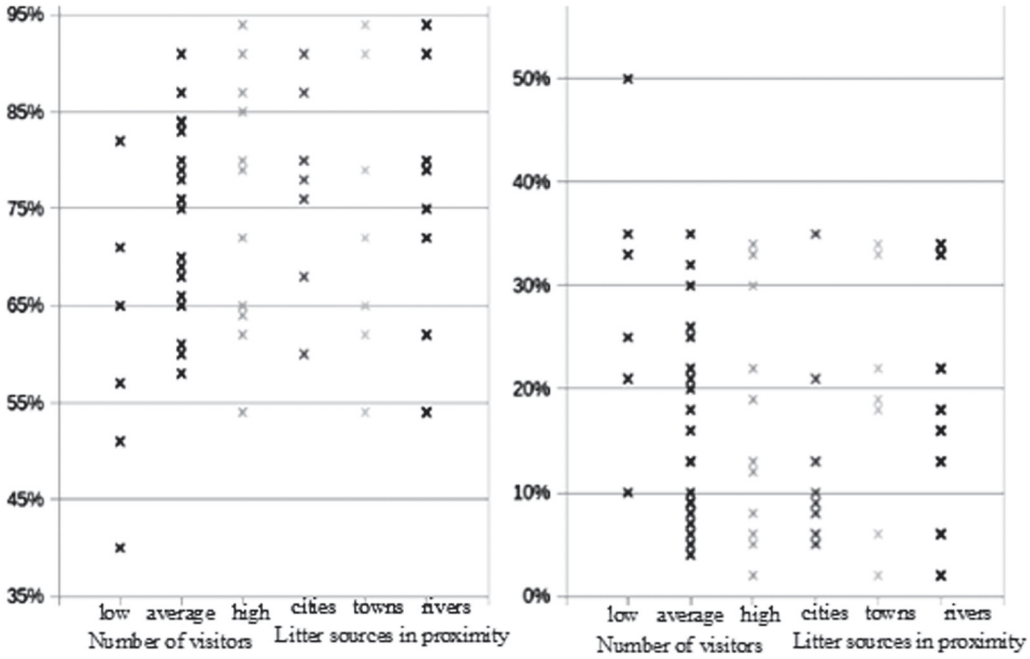

Figure 4. Average percentage of land based litter (on the left) and sea based litter (on the right) in all litter recorded on beaches during 2012–2015

Source: FEE Latvia, 2016a.

In the Baltic Sea, the land based sources dominate the composition of marine litter (MARLIN, 2012). This is explained largely by the generally better management system developed in the Baltic Sea region regarding the shipping waste, as most ports are well equipped to receive litter loads from ships when they arrive.

Analysing the results of the land based sources and the sea based sources in Figure 4, the created groups were assessed by the percentage of each of them (percentage of items from unidentifiable source is not presented). As expected, the percentage of the land based litter – mostly from tourism – increases with the number of visitors the beach receives. However, due to heterogeneity of data any differences among the groups are smaller than those within the groups.

1.2. Assessment of representativeness of the survey sites

It was concluded from this analysis that the number of visitors is an important variable to take into account for the representation of the beaches in the specific area, as the adjacency to rivers or large rivers also appeared to be important; although, it could not be sufficiently confirmed due to overlapping of categories and data variability. The group of beaches in smaller towns was not assumed to be important as its impact seemed to be mostly related to the number of visitors.

Since the groups of beaches with a different number of visitors showed differing amounts and compositions of waste found in the survey sites, therefore, it was analysed if various levels of visitor numbers were represented well enough in the survey sites selection. It was concluded that nationally there was a need for more sites, which are less popular among visitors, as this group was underrepresented. There is also a need to monitor less visited beaches in cities and beaches adjacent to rivers, because such beaches exist (Grupa 93, 2015) and can give valuable information about specific impacts of these additional sources.

There are 17 municipalities, both rural and urban, sharing the Latvian coastline within their territories. These municipalities were evaluated based on the number of the survey sites and the groups of beaches with a different number of visitors included. The municipal evaluation was carried out acknowledging the significance of the local policies in combating the problem of marine litter (Oosterhuis et al., 2014; MARLIN, 2013).

Five of 17 municipalities were marked as having insufficient representation and in need for improvements due to lack of the survey sites or lack of representation of the different beache types within the coastline of the municipality; nine were marked as having sufficient representation and only three were evaluated as having good representation according to the conditions found on the beaches within the municipality areas. The most common problem was a lack of rarely visited beaches to be included in the monitoring programme, yet the municipality had a large number of such beaches.

Only one of all 17 municipalities, had a problem with monitoring density – Grobina parish – that did not have a single survey site included in the monitoring programme within its 5 km of the coastline. The lack of rarely visited beaches was found to be a problem on a national scale as well.

Moreover, the Eco-Schools network was included in the research as a potential supporting network for citizen science activities. The educational institutions within 10 km of the coast that are part of the Eco-Schools programme have been mapped in Figure 5 together with the survey sites. There are 18 such institutions, mainly in the cities of Riga, Liepāja and Ventspils. Sixteen schools are located in close proximity of the existing monitoring sites, while two are near the coastline further from the existing sites.

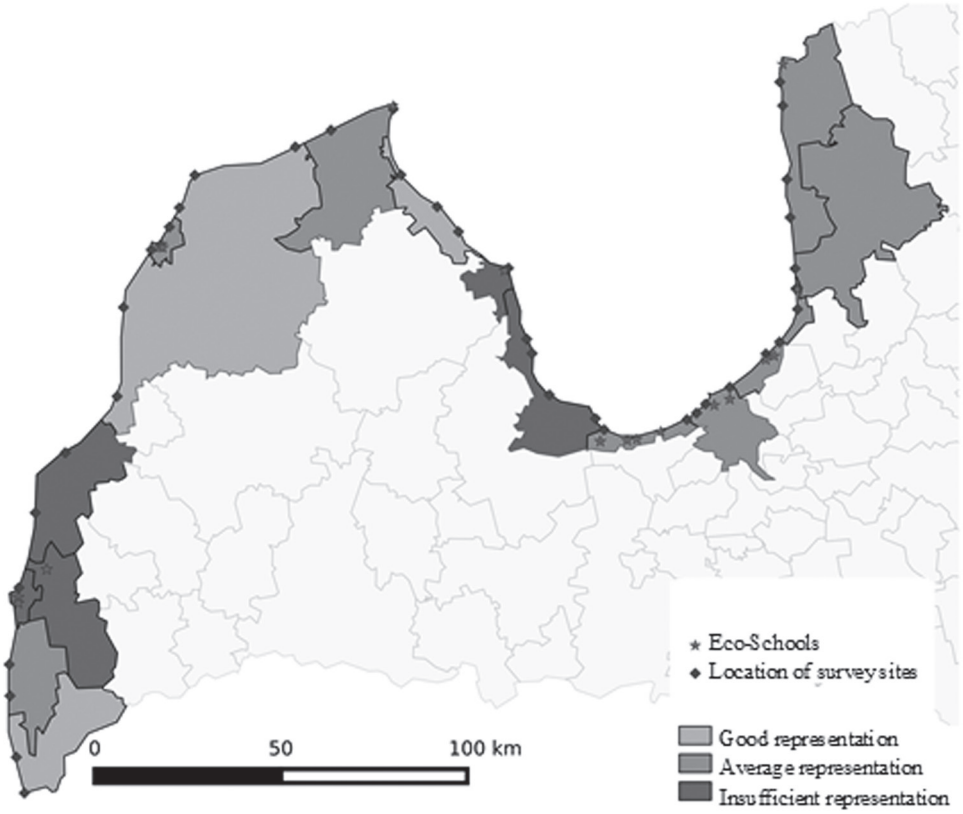

Figure 5. Number and distribution of monitoring sites within the municipalities along 500 km coastline in Latvia

Source: FEE Latvia, 2016a; FEE Latvia, 2016b.

The prospect of educational value of engaging schools in these activities (Veiga, 2016) and the possible improvements in the monitoring frequency suggest to set the possible additional survey sites in the proximity of these schools.

2. Frequency of the monitoring

One of the most significant problems of the current monitoring programme is that the surveys are performed every year but only in the summer. This contradicts to the suggestions of the EU guidelines that recommend monitoring the sites three times per year, i.e., every season except winter (MSFD GES Technical Subgroup on Marine Litter, 2013). There were 5 locations along the Latvian coastline where additional monitoring was performed in the spring and autumn season, and in 2016 the number of seasonal monitoring increased to 12 sites. However, to evaluate the possible loss of information because of concentrating only on the summer season, the yearly trend of litter amount was analysed in these locations using the normalized litter data from 2012 to 2015 in each season as the percentage of the total recorded annual litter amount (Figure 6).

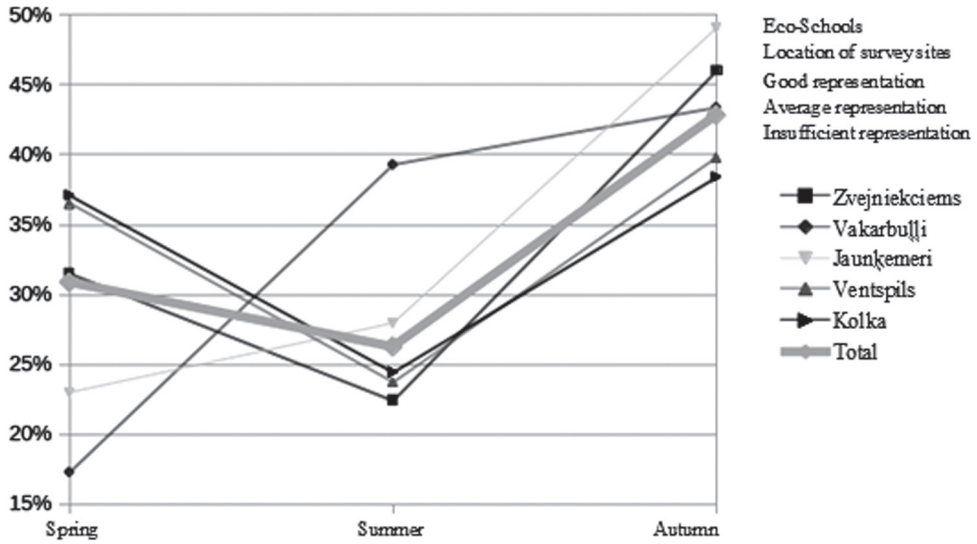

Figure 6. Seasonal litter distribution in five monitoring locations in Latvia as percentage of annual litter amount recorded in each location during 2012–2015

Source: FEE Latvia, 2016a.

It can be seen that in the summer season the amount of litter on average is the lowest showing almost half of the amount of litter found in the autumn. This has been proposed to be a consequence of more clean-up activities that take place at the same time as there are much more tourism activities in the summer season. However, the selected survey sites do not include beaches with a lower number of visitors, therefore the trends cannot be generalized across the country.

3. Litter classification system

The current monitoring programme is based on UNEP guidelines developed in 2009 (Cheshire et al., 2009) and is only partially compatible with the guidelines developed by the EU (MSFD GES Technical Subgroup on Marine Litter, 2013). In order to decide which litter classification system to use, both guidelines were compared and evaluated based on the data gathered on each litter class during the last four years.

Both classification systems were developed to make it easy to compare the data classified using the other system. Fortunately, there has been much effort to make all international litter monitoring classifications comparable since the system was developed in the North Atlantic region in 2007 (OSPAR, 2007). The EU Master List is the most recent international classification system and there are 20 classes of litter that overlap with the classes used by UNEP, separating them in smaller sections. To evaluate if such separation is useful, the number of items found in these classes had been counted for the Latvian coastline since 2012 (Table 2).

The analysis of the new reclassification provided by the EU Master List suggests that it is a more sophisticated system, which concentrates on the most often found items to further clarify their type, and it can be helpful in the more precise sourcing of items without too many obscure classes with rarely found items.

Furthermore, some classes of litter items present on the UNEP list have been excluded as they have never been found on the Latvian coastline and there have added 44 new classes many of which seem to be necessary (especially plastic pieces as a separate category, as it is the most often found item in the Baltic Sea), whereas some of them are not relevant to the Latvian coastline as well (e.g., specific aquaculture).

Table 2. The comparison of UNEP and EU Master List litter classification in the overlapping classes

Part of all items, %	Total number of items found	UNEP		EU Master List	
		code	item	item	code
8.4%	2094	PL07	Plastic bags (opaque and clear)	Small plastic bags incl. pieces	G4
				Shopping Bags incl. pieces	G3
6.5%	1624	PC03	Cups, food trays, food wrappers, cigarette packs, drink containers	Cups, food trays, food wrappers, drink containers	G153
				Cigarette packets	G152
				Cartons/Tetra pack (others)	G151
				Cartons/Tetra pack (Milk)	G150
6.1%	1536	PL19	Rope	String and cord (diameter < 1cm)	G50
				Rope (diameter > 1cm)	G49
5%	1253	PL01	Bottle caps and lids	Plastic rings from bottle caps/lids	G24
				Plastic caps/lids unidentified	G23
				Plastic caps/lids chemicals, detergents (non-food)	G22
				Plastic caps/lids drinks	G21
1.9%	465	PL06	Food containers (fast food, cups, lunch boxes and similar)	Cups and cup lids	G33
				Food containers incl. fast food containers	G10
1.8%	462	ME10	Other (specify), including appliances	Other metal pieces > 50 cm	G199
				Other metal pieces < 50 cm	G198
				Industrial scrap	G186
1.2%	308	PL04	Knives, forks, spoons, straws, stirrers, (cutlery)	Straws and stirrers	G35
				Cutlery and trays	G34

Source: FEE Latvia, 2016a; Cheshire et al., 2009; MSFD GES Technical Subgroup on Marine Litter, 2013.

4. Public perception of beach litter

The results of the on-spot survey indicate that half of the respondents, i.e., beach visitors met on the coast, do perceive the Latvian coastline and beaches as clean or very clean. The analysis showed that these rankings do not have a direct connection to the results of the beach litter surveys on the local level, which leads to the conclusion that evaluation of beach cleanliness is based on the range of other factors. Nevertheless, the cleanliness of a beach is among the leading factors for people choosing their coastal destinations, together with beach accessibility and its location. Visitors of the Latvian beaches give the beach infrastructure (restaurants, children playground, beach patrol) much lower priority when choosing their recreation destination.

When asked to identify, which marine litter fractions are the most problematic, respondents identified plastic items mainly, together with glass and cigarette butts. Plastic was mentioned twice as much as the next following fraction. Accordingly, it corresponds to the data about the beach litter situation in Latvia, where plastic litter constitutes more than half of litter found on the beaches. As for potential sources of litter on the beaches overwhelming the majority, the respondents identified tourists / beach visitors (the main source), then followed illegal waste dumping on the coastal zone and the impact of sea transportation. It indicates a very good understanding on the topic, as visitors are clearly responsible for majority of littering as the monitoring data indicate.

Most of the respondents ranked the marine litter impact on the sea ecosystem as the main concern for them. Furthermore, the impacts on human safety, health and water quality were identified, pointing out marine litter also as an aesthetical problem. However, economic impact as an important one was mentioned very rarely, indicating that people do not understand the connection between marine litter and increasing costs for

coastal and waste management, as well as with other economic impacts like decreasing tourism value of the coastal destination.

The main responsibility according to the survey results lies on the beach visitors themselves, then on the municipalities and their failures in beach management. Most of the respondents do not link the state or international policy with everyday situation on the beach. Similarly, regarding the possible tools necessary to enhance the situation, the most frequent and the highest ranked response was raising of public awareness, followed by the improvement of beach infrastructure and beach management.

5. Beach litter case territory: Salacgriva municipality

The Salacgriva municipality (covers 55 km of various type of coastline, which is 10% of the Latvia's whole coastline) was studied in detail seeking to assess the existing monitoring problems and their relation to local level management so that to propose more detailed solutions based on the local conditions. There are four beach litter monitoring sites in Salacgriva municipality. Three of them are highly visited by tourists, and two of them are remote but popular resorts, while the third site is a beach in the vicinity of the capital town and port. The fourth beach has an average number of visitors.

In the long term trend, all Salacgriva municipality's beaches under monitoring, on average indicated, an increase in beach litter amounts (only in one of the four beaches the litter items decreased). The average amount of litter is 205 items per 100 meters of the monitoring site beach, which is higher than the national average of 130 units. Considering the relatively low population density, tourism is assumed to be one of the main reasons for higher levels of litter. However, the comparison among other municipalities cannot be directly made as none of the four monitoring sites is located within the less visited remote beaches. An approximate estimation of litter amounts during the expedition indicates that for the most part of the Salacgriva municipality coastline, the litter loads are far below the national average. Due to the lack of representation, it was suggested to change/add one of the survey sites to a remote beach with appropriate conditions (the municipality's coast consists largely of rocky shores (also coastal meadows) not suitable for litter monitoring). The inclusion of such a particular beach would allow to approximate to beach litter trends in the largest part of the municipality's coastline.

The majority of litter items collected on all of the beaches are related to tourism and household sources – from 60% to 80%, while the dominant item was plastic pieces, similar to all other coastal regions. Overall, the data indicates a generally worse situation in those selected monitoring sites of municipality than on the average Latvian coast despite the relatively low number of seaside towns, villages and other local litter sources present there. However, shall be also noted, that current international beach litter monitoring methodology, as both by limited number/location of monitoring sites and by monitoring done mostly only during annual coastal campaign/marsh occasion, need to be expanded and/or complemented by other forms/types of municipal/public monitoring. Clearly next stages of science-public-municipal projects/partnerships shall be further encouraged. For example, to address the potentially most significant local litter source, namely tourists from other municipalities, a more active engagement of local inhabitants and decision makers in protection of the beach might be beneficial; simple information signs discouraging from littering have proved to be very beneficial in reducing litter amounts in the United Kingdom (Risk and policy analysts Ltd., 2013).

As mentioned before, widening of the citizen science type applications is one of the possible ways not only to engage local people and achieve more monitoring results, but really to have more impact on the municipal coastal management. In Salacgriva municipality, there is only one Eco-School, located in Salacgriva town that could act as a local coordination centre and help gather more regular monitoring data for to uncover seasonal variation in litter amounts. But instead, there are several non-traditional or even pioneering bottom-up governance activities (e.g. local village development NGO's, village elders, youth/NGO based consultation council at the municipality), which can definitely contribute to this and other type of coastal monitoring. Furthermore, the project system *Adopt a Beach* might be implemented, where a certain group of people in a

certain stretch of the beach could take responsibility for clean-up and litter monitoring actions. In dialogue with local activist groups and organizations a more remote beach might be selected as a new monitoring site where data are gathered during the clean-ups. However, the validity of data should be evaluated, to avoid possible misinterpretations of the methodology.

Yet the most important issue for any local public monitoring is to have direct application of data in decision making at the local municipality, which requires not only involvement of various local stakeholders, but also collaboration between them and the municipality itself. This is an issue for the whole Latvian coastline to be further developed.

Conclusions

The comparison of the two waste classification systems showed that the EU Master List is much more adjusted to the situation in the Baltic Sea, as it has more detailed evaluation of 35% of litter items most frequently found on the Latvian coastline than is provided by the UNEP classification system. While some of the waste classes are not relevant to the Baltic Sea and possibly are included because of their prevalence in the other European seas, they can be excluded from the field protocol.

Analysing the conditions of the survey sites and their impact on the litter categories it was found that the groups of different number of visitors were very diverse, while the groups of beaches with nearby rivers, towns or cities did not show visible differences. High heterogeneity of data and different municipal approaches and routines regarding the coastal management was a problem evaluating the impact of these factors as application of statistical methods is complicated with a small number of data; it has been noted in other research too. However, the beaches with different number of visitors have enough important differences to take the number of visitors as one of the factors representing the survey sites as specific locations.

It was also concluded that significant changes were necessary in distributing the monitoring sites so that to represent conditions in each municipality. In most cases no new monitoring sites were required, except for some sites, located on beaches with a higher number of visitors that might be replaced with those of a lower number of people visiting them. This could also help to assess better the conditions on the whole coastline.

The beach visitors' survey demonstrates the generally well-informed perception on beach/marine litter, which is also seen as a significant determinant of beach attractiveness for most people. The dominant opinion is that the main responsibility in solving the issue lies on each individual, rather than on collective actions of the municipality or government. At the same time the rising public awareness was indicated as the main course of action as the majority of people supports campaigns and other communication by the decision-makers.

The overview of the potential support network to be provided by the Eco-Schools programme in Latvia showed that the frequency of monitoring in 10 beach sites could be easily increased as there are Eco-schools near to the sites. Also, in Latvia there is valuable experience in organizing local/regional school networks for public monitoring of nature; the application of the BaltCoast project's science-policy-practice interface proposes to elaborate the necessary programming means for new developments, particularly on coastal monitoring. This could also encourage the formal process of school education through engaging students and teachers in the citizen science practice, providing necessary data about changes in the amount of local coastal waste during different seasons, without much of other resources required.

In a more detailed evaluation of the Salacgriva municipality, many potential synergic benefits were found in relation to improvement in data quality and the reduction of beach litter. However, the actual results of the proposed actions on engaging the local community through Eco-Schools, the local/village NGO's and other organizations need to be further assessed and tested on the next project steps, in order to make conclusions

and particular recommendations about their various impact on the beach litter management and the municipal coastal management in general.

After these methodological and public participatory changes are made, the existing beach litter monitoring system in Latvia, based on the citizen science approach, can provide valuable information for decision making at the municipal, national and the European level even more efficiently and trustworthy. However, still local stakeholders' collaboration enhancement shall be stressed in order to reach mandatory precondition of any monitoring type work success (compare to nature observation approach etc.) – real and regular usage of monitoring data for municipal coastal policy development and management practice.

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PAPLŪDIMIŲ TARŠOS STEBĖJIMAS LATVIJOS PAKRANTĖJE: PILIEČIŲ POŽIŪRIS

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Santrauka

Moksliniame straipsnyje, atlikus tyrimą, pateikiama paplūdimio stebėsenos programa Latvijoje. Autoriai teikia pasiūlymus dėl jos tobulinimo, pateikdami tyrimo duomenis, kurių reikia, siekiant veiksmingai tvarkyti Latvijos pakrantėse, prie Baltijos jūros, iš jūros išmetamas šiukšles.

Paplūdimio taršos stebėsenos programa priimta 2012 metais nevyriausybinės organizacijos „FEE Latvija“, atlikti moksliniai tyrimai buvo nukreipti į situacijos įvertinimą. Ypač daug dėmesio skirta tiriamų paplūdimių analizei: jų skaičiaus, pasiskirstymo, stebėjimų laikotarpio bei dažnumo, taršos klasifikavimo ir skaičiavimo metodikai, galimam piliečių dalyvavimui šiame procese. Tyrimo rezultatai leido parengti keletą pasiūlymų, kaip pagerinti Latvijoje vykdomą programą, siekiant, kad ji atitiktų esamą Jūrų strategijos pagrindu parengtą direktyvą Europos Sąjungoje ir būtų galima patarti pakrančių regionų valdžios institucijoms pakrančių taršos tvarkymo klausimais. Pasiūlymai apima stebėsenos vietų skaičius didinimą, rekomenduojant patobulinti ir ES nustatytus klasifikatorius, siekiant padidinti vietų, kur būtų atliekami tyrimai dėl į jūrą išmetamų šiukšlių, skaičių, pažymima, kad stebėsena turėtų vykti dažniau (3 kartus per metus).

Atlikus viešą apklausą paaiškėjo, kad paplūdimių lankytojai gerai supranta jūros taršos problemas, suvokia jų svarbą. Būtina skatinti aktyvią piliečių paramą, vykdant tokius tyrimus. Detalesnė Salacgriva regiono apžvalga atskleidė potencialią sinergiją: nustatyta, kad kuo daugiau savanoriškai nusiteikę piliečiai surenka

šiukšlių paplūdimiuose ar jų atneša tyrėjams, tuo švaresni tampa paplūdimiai. Tačiau pasiūlytų vietinės bendruomenės įtraukimo būdų (ekologinės mokyklos, vietinės nevyriausybinės organizacijos) ir faktinės naudos tarpusavio ryšį dar būtina tirti kituose projekto etapuose, siekiant konkrečių išvadų ir galimybės pateikti aiškias rekomendacijas dėl paplūdimių taršos valdymo bei vietinių pakrančių savivaldybių įtraukimo į šių problemų sprendimą.

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PAGRINDINIAI ŽODŽIAI: *Baltijos jūra, paplūdimio tarša, stebėjimo programa, nevyriausybinės organizacijos, pakrančių valdymas.*

JEL KODAI: Q52, Q57, Q58