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Seasonal variation of waste as an effect of tourism

D4.3.2: Assessment of pilot activities through marine litter surveys

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I- Introduction

In 2017, marine litter surveys were conducted during both the low and high touristic season in order to evaluate the impact of tourism on the generation of waste on sandy beaches of Mediterranean islands. The results can be found in the deliverable D3.4.4 (*"Seasonal concentration and characterization of marine litter in selected beaches of 8 Mediterranean islands"*). Briefly, the accumulation rates of marine litter are clearly higher during the high season, no matter the type of beach considered. During the high season, the touristic beaches are the most impacted with more than 300 items accumulating every day per 1000 m² of beach, followed by the beaches mainly used by locals and the remote beaches.

In 2019, 6 islands involved in the project (Mallorca, Sicily, Malta, Crete, Rhodes and Cyprus) carried out pilot actions in order to reduce the amount of waste that enters the environment through beaches. These activities were implemented during the summer 2019 and consisted in, amongst other, awareness campaigns directly on sites (i.e., on beaches, **Figure 1**) or through social media or radio, installation of new trash bins for mixed or recyclable waste, or the installation of new signs on existing bins. A summary of the different pilot actions performed by the partners is given in **Table 1**, while a complete description of the pilot actions can be found in the deliverable D4.2.2 (*"Pilot activities implementation"*). Most of the pilot actions were implemented directly on the beaches were the marine litter surveys were conducted in 2017.



Figure 1: awareness campaigns conducted on the touristic beaches of a) Mallorca, b) Rhodes, c) Malta, d) Cyprus and e) Crete.

In order to assess the effectiveness of the pilot actions on the reduction of marine litter associated to tourism, marine litter surveys were conducted on the implementation sites. The methodology used is exactly the same as for the surveys of 2017 (please refer to D3.4.4). Moreover the same fixed 100m portions of beach were monitored. Briefly, on the selected portion of beach, all the items with an anthropogenic origin were collected,



characterized and disposed of properly. The small pieces of plastic (i.e., the micro- and the mesoplastics) were collected separately and sent to the UAB for further analysis.

Island:	Mallorca	Sicily		Malta		Crete		Rhodes		Cyprus	
Type of beach:	Touristic	Touristic	Locals	Touristic	Locals	Touristic	Locals	Touristic	Locals	Touristic	Locals
Awareness campaign (leaflets, poster, speaker)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Awareness campaign (merchandising)				Beach ashtrays and reusable bottles						Recyclable bags, reusable bamboo straws and cups, beach ashtrays	
Awareness campaign (social media)		Yes	Yes	Yes	Yes					Yes	Yes
Awareness campaign (radio advertising)				Yes	Yes						
Involvement of HORECA	Yes	Yes	Yes					Yes	Yes		
Involvement of local authorities	Consell de Mallorca	Municipalities and local public waste management service		MESDEC, Nature Trust Malta and MTA		Region of Crete		Municipality of Rhodes		DOE	
Involvement of flight companies				advertising in the Air Malta monthly magazine							
New trash bins for recyclable waste			Yes – with bilingual indications			Yes - with bilingual indications and clay ashtrays				Yes - with bilingual indications	
New trash bins for mixed waste			Yes – with bilingual indications			Yes - with bilingual indications and clay ashtrays				Yes - with bilingual indications	
New signs on existing bins						Yes - stickers with bilingual indications				Yes - stickers with bilingual indications	

Table 1: Summary of the pilot actions carried out on the 6 participating islands in summer 2019.

The marine litter found on the beaches may have different possible sources (Vlachogianni et al., 2017¹) such as tourism and recreational activities, fisheries and aquaculture, shipping, agriculture, etc. In this study, only the items belonging to the ST category are taken into account in

¹ Vlachogianni, Th., Anastasopoulou, A., Fortibuoni, T., Ronchi, F., Zeri, Ch., 2017. Marine Litter Assessment in the Adriatic and Ionian Seas. IPA-Adriatic DeFishGear Project, MIO-ECSDE, HCMR and ISPRA. pp. 168 (ISBN: 978-960-6793-25-7)



order to assess the effectiveness of the pilot actions. The items belonging to this category can be defined as follow: "Shoreline, including poor waste management practices, tourism and recreational activities. Litter items that are attributed to this source include those generated by land-based activities, such as tourism and recreation (beachgoers, sports and recreation businesses, beach bars, hotels, festivals, mismanaged waste at the beaches, etc.) as well as litter produced inland and carried by winds, storms and rivers as a result of poor waste management by municipalities. Indicative items are shopping bags, drink bottles, food containers, straws and stirrers, etc."

For each beach, the effectiveness of the pilot actions are assessed by comparing the number of items collected, the accumulation rates and the accumulation index of the marine litter obtained during the monitoring of 2019 to the results obtained in 2017 for the same month.

Note that the number of items collected presented in this report are the number corrected for the distance (see D3.4.4 for more details).



II- Mallorca

1- The touristic beach of Torà

In September 2017, a total of 2200 items were collected on the fixed 100m portion of the touristic beach of Torà while 1415 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 1214 and 892 respectively, representing 55.2% and 63.1% of the total number of items collected. A decrease of 26.5% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 771.8 items/1000m²/day in September 2017 to 425.3 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 44.9% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items remains the same between 2017 and 2019, as they represent 85.4% of the marine litter.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (668.8 items/1000m²/day), followed by the crisps and sweet packets (24.8 items/1000m²/day), the foil wrappers (21.1 items/1000m²/day), the plastic caps and lids (14.9 items/1000m²/day) and the cutlery (12.4 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 42.3% (386.2 cigarette butts/1000m²/day), 36.3% (15.8 crisps and sweet packets/1000m²/day), 82.4% (3.7 foil wrappers/1000m²/day), 84.4% (2.3 plastic caps and lids/1000m²/day) and 88.8% (1.4 cutlery/1000m²/day).

The awareness campaign implemented on the touristic beach of Torá seems to be effective as we observe a reduction of almost 45% of the accumulation rates of the items from the ST category.



Figure 2: *Number of items vs. accumulation rates:* the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between September 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (yellow sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (yellow bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



III- Sicily

1- The touristic beach of Giardini Naxos

In August 2017, a total of 66 items were collected on the fixed 100m portion of the touristic beach of Giardini Naxos while 44 were collected in August 2019 after the implementation of the pilot actions. The number of items from the ST category was of 46 and 22 respectively, representing 69.4% and 49.1% of the total number of items collected. A decrease of 52.7% of the items from the ST category is observed after the implementation of the pilot actions compared to 2017.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 12.4 items/ $1000m^2$ /day in August 2017 to 7.7 items/ $1000m^2$ /day in August 2019 after the implementation of the pilot activities. This represent a decrease of 37.4% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly increases between 2017 and 2019, from 83.9% to 92.7%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (9.5 items/1000m²/day), followed by the crisps and sweet packets (1.2 items/1000m²/day), the small plastic bags (0.3 items/1000m²/day), the plastic caps and lids (0.3 items/1000m²/day) and the ice lolly sticks (0.3 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 36.5% (6.0 cigarette butts/1000m²/day) and 50.1% (15.8 crisps and sweet packets/1000m²/day). The small plastic bags and the ice lolly sticks were not found on the beach while the accumulation rates of the plastic caps and lids almost doubled (0.6 items/1000m²/day).

The awareness campaign implemented on the touristic beach of Giardini Naxos seems to be effective as we observe a reduction of 37.4% of the accumulation rates of the items from the ST category.



Figure 3: Number of items vs. accumulation rates: the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between August 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (yellow sections) to the other types of items between August 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in August 2017 (grey bars) and August 2019 (yellow bars). The associated blue/orange percentages show the decrease/increase of the accumulation rates after the implementation of the pilot actions.



2- Beach mainly used by locals of Letojanni

In August 2017, a total of 69 items were collected on the fixed 100m portion of the beach mainly used by locals of Letojanni while 183 were collected in August 2019 after the implementation of the pilot actions. The number of items from the ST category was of 43 and 140 respectively, representing 62.7% and 76.6% of the total number of items collected. An increase of 223% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers increased from 11.7 items/ $1000m^2$ /day in August 2017 to 74.6 items/ $1000m^2$ /day in August 2019 after the implementation of the pilot activities. This represent an increase of 538% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly decreases between 2017 and 2019, from 80.6% to 76.6%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (8.1 items/1000m²/day), followed by the plastic bottles and containers (1.1 items/1000m²/day), the plastic caps and lids (1.1 items/1000m²/day), the glass bottles (1.1 items/1000m²/day) and the shopping bags (0.3 items/1000m²/day). After the implementation of the pilot activities, all these items were not found with the exception of the cigarette butts. Their accumulation rates was multiplied by 8 reaching 64.4 items/1000m²/day.

The awareness campaign implemented on the beach mainly used by locals of Letojanni did not meet our expectation as we observed an increase of 538% of the accumulation rates of the items from the ST category. This increase seems to be driven by the higher amount of cigarette butts found in August 2019.



Figure 4: *Number of items vs. accumulation rates:* the blue bars represent the items belonging to the ST category, while the grey bars represent all the other items. The orange arrows and the associated percentages represent the increase observed between August 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (blue sections) to the other types of items between August 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in August 2017 (grey bars) and August 2019 (blue bars). The associated blue/orange percentages show the decrease/increase of the accumulation rates after the implementation of the pilot actions.



IV- Malta

1- The touristic beach of Golden Bay

In September 2017, a total of 261 items were collected on the fixed 100m portion of the touristic beach of Golden Bay while 1928 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 182 and 803 respectively, representing 69.9% and 41.6% of the total number of items collected. An increase of 340% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 935.0 items/1000m²/day in September 2017 to 411.8 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 56% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly decreases between 2017 and 2019, from 95.4% to 91.3%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (749.2 items/1000m²/day), followed by the cutlery (74.3 items/1000m²/day), the plastic caps and lids (31.0 items/1000m²/day), the crisps and sweet packets (24.8 items/1000m²/day) and the bottle caps (18.6 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 53.5% (348.6 cigarette butts/1000m²/day), 90.0% (7.4 cutlery/1000m²/day), 56.0% (13.6 plastic caps and lids/1000m²/day), 82.5% (4.3 crisps and sweet packets/1000m²/day) and 56.7% (8.0 bottle caps/1000m²/day).

The awareness campaign implemented on the touristic beach of Golden Bay seems to be effective as we observe a reduction of 56% of the accumulation rates of the items from the ST category.



Figure 5: *Number of items vs. accumulation rates:* the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue/orange arrows and the associated percentages represent the decrease/increase observed between September 2017 and 2019. Plastic content: comparison of the proportion of plastic items (yellow sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (yellow bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



2- The beach mainly used by locals of Gnejna

In September 2017, a total of 153 items were collected on the fixed 100m portion of the beach mainly used by locals of Gnejna while 1152 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 99 and 339 respectively, representing 64.9% and 29.4% of the total number of items collected. An increase of 242% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 200.8 items/1000m²/day in September 2017 to 102.9 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 48.8% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly decreases between 2017 and 2019, from 96.6% to 93.5%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (148.5 items/1000m²/day), followed by the plastic caps and lids (14.6 items/1000m²/day), the cutlery (12.6 items/1000m²/day), the small plastic bags (6.3 items/1000m²/day) and the toys and party poppers (4.2 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 47.8% (77.5 cigarette butts/1000m²/day), 46.1% (7.8 plastic caps and lids/1000m²/day), 65.0% (4.4 cutlery/1000m²/day) and 85.0% (0.6 toys and party poppers/1000m²/day). The small plastic bag were not found.

The awareness campaign implemented on the beach mainly used by locals of Gnejna seems to be effective as we observe a reduction of 48.8% of the accumulation rates of the items from the ST category.



Figure 6: *Number of items vs. accumulation rates:* the blue bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue/orange arrows and the associated percentages represent the decrease/increase observed between September 2017 and 2019. Plastic content: comparison of the proportion of plastic items (blue sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (blue bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



V- Crete

1- The touristic beach of Rethymno

In September 2017, a total of 1743 items were collected on the fixed 100m portion of the touristic beach of Rethymno while 1306 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 1244 and 422 respectively, representing 71.3% and 32.3% of the total number of items collected. A decrease of 66.1% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 69.9 items/1000m²/day in September 2017 to 23.7 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 66.1% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly increases between 2017 and 2019, from 94.0% to 97.5%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (48.0 items/1000m²/day), followed by the crisps and sweet packets (9.4 items/1000m²/day), the cutlery (5.0 items/1000m²/day), the plastic caps and lids (3.1 items/1000m²/day) and the newspapers and magazines (0.9 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 66.4% (16.1 cigarette butts/1000m²/day), 75.3% (2.3 crisps and sweet packets/1000m²/day), 65.2% (1.7 cutlery/1000m²/day and 43.6% (1.7 plastic caps and lids/1000m²/day). The newspapers and magazine were not found.

The awareness campaign implemented on the touristic beach of Rethymno seems to be effective as we observe a reduction of 66.1% of the accumulation rates of the items from the ST category.



Figure 7: *Number of items vs. accumulation rates:* the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between September 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (yellow sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (yellow bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



2- The beach mainly used by locals of Arina

In September 2017, a total of 3305 items were collected on the fixed 100m portion of the beach mainly used by locals of Arina while 3251 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 1250 and 428 respectively, representing 37.8% and 13.2% of the total number of items collected. A decrease of 65.8% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 10.9 items/1000m²/day in September 2017 to 4.3 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 60.3% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly increases between 2017 and 2019, from 95.8% to 99.5%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (7.0 items/1000m²/day), followed by the plastic caps and lids (1.1 items/1000m²/day), the small plastic bags (1.1 items/1000m²/day), the cutlery (0.9 items/1000m²/day) and the food containers (0.2 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 60.9% (2.7 cigarette butts/1000m²/day), 87.5% (0.1 plastic caps and lids/1000m²/day), 64.2% (0.4 small bags/1000m²/day and 72.7% (0.2 cutlery/1000m²/day). The food containers were not found.

The awareness campaign implemented on the beach mainly used by locals of Arina seems to be effective as we observe a reduction of 60.3% of the accumulation rates of the items from the ST category.



Figure 8: *Number of items vs. accumulation rates:* the blue bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between September 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (blue sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (blue bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



VI- Rhodes

1- The touristic beach of Tsampika

In September 2017, a total of 205 items were collected on the fixed 100m portion of the touristic beach of Tsampika while 703 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 144 and 81 respectively, representing 70.1% and 11.6% of the total number of items collected. A decrease of 43.4% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 1.6 items/1000m²/day in September 2017 to 0.9 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 39.5% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items increases between 2017 and 2019, from 84.6% to 97.4%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (0.7 items/1000m²/day), followed by the plastic caps and lids (0.2 items/1000m²/day), the food containers (0.2 items/1000m²/day), the plastic bottles and containers (0.1 items/1000m²/day) and the cigarette lighters (0.1 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 53.8% (0.3 cigarette butts/1000m²/day), 41.8% (0.1 plastic caps and lids/1000m²/day), 57.3% (0.1 food containers/1000m²/day, 23.8% (0.1 plastic bottles and containers/1000m²/day) and 54.3% (0.04 cigarette lighters/1000m²/day).

The awareness campaign implemented on the touristic beach of Tsampika seems to be effective as we observe a reduction of 39.5% of the accumulation rates of the items from the ST category.



Figure 9: *Number of items vs. accumulation rates:* the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between September 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (yellow sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (yellow bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



2- The beach mainly used by locals of Afandou

In September 2017, a total of 141 items were collected on the fixed 100m portion of the beach mainly used by locals of Afandou while 464 were collected in September 2019 after the implementation of the pilot actions. The number of items from the ST category was of 105 and 50 respectively, representing 74.6% and 10.7% of the total number of items collected. A decrease of 52.8% of the items from the ST category is observed after the implementation of the pilot actions compared to 2017.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 1.5 items/1000m²/day in September 2017 to 0.02 items/1000m²/day in September 2019 after the implementation of the pilot activities. This represent a decrease of 98.8% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items increases between 2017 and 2019, from 76.8% to 97.9%.

In 2017, the five most abundant items from the ST category collected were: the plastic caps and lids (0.3 items/1000m²/day), followed by the cigarette butts (0.3 items/1000m²/day), the plastic bottles and containers (0.1 items/1000m²/day), the food containers (0.1 items/1000m²/day) and the drink cans (0.1 items/1000m²/day). After the implementation of the pilot activities, the accumulation rates of these specific items decreased respectively by 99.1% (0.003 plastic caps and lids/1000m²/day), 98.7% (0.004 cigarette butts/1000m²/day), 98.8% (0.002 plastic bottles and containers/1000m²/day, 98.3% (0.002 food containers/1000m²/day) and 98.6% (0.002 drink cans/1000m²/day).

The awareness campaign implemented on the beach mainly used by locals of Afandou seems to be effective as we observe a reduction of 98.8% of the accumulation rates of the items from the ST category.



Figure 10: *Number of items vs. accumulation rates:* the blue bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between September 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (blue sections) to the other types of items between September 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in September 2017 (grey bars) and September 2019 (blue bars). The associated blue percentages show the decrease of the accumulation rates after the implementation of the pilot actions.



VII- Cyprus

1- The touristic beach of Sunrise

In August 2017, a total of 913 items were collected on the fixed 100m portion of the touristic beach of Sunrise while 807 were collected in August 2019 after the implementation of the pilot actions. The number of items from the ST category was of 550 and 436 respectively, representing 60.3% and 54.0% of the total number of items collected. A decrease of 20.8% of the items from the ST category is observed after the implementation of the pilot actions compared to 2017.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 251.3 items/1000m²/day in August 2017 to 198.9 items/1000m²/day in August 2019 after the implementation of the pilot activities. This represent a decrease of 20.8% of the accumulation rates of the items belonging to the ST category. The proportion of plastic items remains the same between 2017 and 2019, as they represent about 96% of the marine litter.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (223.9 items/1000m²/day), followed by the plastic caps and lids (6.0 items/1000m²/day), the cutlery (6.0 items/1000m²/day), the crisps and sweet packets (3.7 items/1000m²/day) and the plastic bottles and containers (3.2 items/1000m²/day). After the implementation of the pilot activities, only the accumulation rates of the cigarette butts (147.0 items/1000m²/day) and the crisps and sweet packets (2.8 items/1000m²/day) decreased respectively by 34.4% and 25.0%; while the accumulation rates of the plastic and caps lids (8.3 items/1000m²/day), the cutlery (14.8 items/1000m²/day) and the plastic bottles and containers (3.2 items/1000m²/day) and the plastic and caps lids (8.3 items/1000m²/day), the cutlery (14.8 items/1000m²/day) and the plastic bottles and containers (6.5 items/1000m²/day) increased respectively by 38.5%, 146.2% and 100%.

Despite the increase of the accumulation rates of some items, the awareness campaign implemented on the touristic beach of Sunrise seems to be effective as we observe a reduction of 20.8% of the accumulation rates of the items from the ST category.



Figure 11: *Number of items vs. accumulation rates:* the yellow bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between August 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (yellow sections) to the other types of items between August 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in August 2017 (grey bars) and August 2019 (yellow bars). The associated blue/orange percentages show the decrease/increase of the accumulation rates after the implementation of the pilot actions.



2- The beach mainly used by locals of Faros

In August 2017, a total of 466 items were collected on the fixed 100m portion of the beach mainly used by locals of Faros while 512 were collected in August 2019 after the implementation of the pilot actions. The number of items from the ST category was of 259 and 122 respectively, representing 55.5% and 23.8% of the total number of items collected. A decrease of 52.9% of the items from the ST category is observed after the implementation of the pilot actions.

The accumulation rates of the items most likely left on beach by the beachgoers decreased from 29.8 items/ $1000m^2$ /day in August 2017 to 14.0 items/ $1000m^2$ /day in August 2019 after the implementation of the pilot activities. This represent a decrease of 52.9% of the accumulation rates of the items belonging to the ST category.

The proportion of plastic items slightly increases between 2017 and 2019, from 91.8% to 93.1%.

In 2017, the five most abundant items from the ST category collected were: the cigarette butts (12.5 items/1000m²/day), followed by the plastic caps and lids (1.0 items/1000m²/day), the cutlery (0.6 items/1000m²/day), the plastic bottles and containers (0.3 items/1000m²/day) and foil wrappers (0.3 items/1000m²/day). After the implementation of the pilot activities, only the accumulation rates of the cigarette butts (8.2 items/1000m²/day) and the plastic caps and lids (0.3 items/1000m²/day) decreased respectively by 34.3% and 66.7%; while the accumulation rates of the cutlery (1.0 items/1000m²/day), the plastic bottles and containers (0.5 items/1000m²/day) and the foil wrappers (0.7 items/1000m²/day) increased respectively by 80.0%, 33.3% and 100.0%.

Despite the increase of the accumulation rates of some items, the awareness campaign implemented on the beach mainly used by locals of Faros seems to be effective as we observe a reduction of 52.9% of the accumulation rates of the items from the ST category.



Figure 12: *Number of items vs. accumulation rates:* the blue bars represent the items belonging to the ST category, while the grey bars represent all the other items. The blue arrows and the associated percentages represent the decrease observed between August 2017 and 2019. *Plastic content:* comparison of the proportion of plastic items (blue sections) to the other types of items between August 2017 and 2019. *The five most abundant items:* accumulation rates of the five most abundant items of the ST category collected in August 2017 (grey bars) and August 2019 (blue bars). The associated blue/orange percentages show the decrease/increase of the accumulation rates after the implementation of the pilot actions.



VIII- Conclusions

During the high touristic season of 2019, the partners from Mallorca, Sicily, Malta, Crete, Rhodes and Cyprus conducted various pilot actions (see Table 1 and deliverable D4.2.2) in order to reduce the amount of marine litter found on the beaches as an effect of tourism. The pilot actions were implemented on 11 beaches and their effectiveness was assessed by conducting marine litter surveys. As already mentioned, only the items belonging to the ST category (i.e., most likely abandoned on the beaches by the beachgoers) were taken into account in order to evaluate the effectiveness.

Awareness campaigns have been implemented on the 11 selected beaches, consisting in the installation of posters at the main entrances of the beaches, the distribution of flyers or the intervention of representatives informing the visitors of marine litter and its prevention.

It is interesting to note that when nobody was present physically on the beach to conduct the awareness campaign the amount of marine litter related to tourism did not change much compared to 2017 (see the results for the touristic beach of Sicily, Fig. 3) or even increased (see the results from the beach mainly used by locals in Sicily, Fig. 4).

On 6 beaches (Malta, Crete and Cyprus), ashtrays were made available for the visitors. The average accumulation rates of cigarette butts for these 6 beaches decreased by 49.5% (\pm 13.3%) after the implementation of the pilot actions compared to the results of 2017. For the beaches where no ashtrays were made available, we observed a decrease of 44.2% (\pm 8.8%) after the implementation of the pilot actions compared to the results of 2017. No significant difference between the two groups of beaches is observed (*p-value*>0.05), suggesting that the distribution of ashtrays does not have a significant impact when it is implemented in parallel of an awareness campaign. Note that for the beaches where no ashtrays were taken into account for the calculation, as the beaches mainly used by locals of Sicily and Rhodes presented values much higher/lower compared to the other ones.

On 4 beaches (Crete and Cyprus), new trash bins for mixed and recyclable waste were installed. The average accumulation rates of the marine litter for the ST category for these 4 beaches decreased by 50.0% (\pm 20.2%) after the implementation of the pilot actions compared to the results of 2017. For the beaches where no new trash bins for mixed and recyclable waste were installed, we observed a decrease of 45.3% (\pm 7.5%) after the implementation of the pilot actions compared to the results of 2017. No significant difference between the two groups of beaches is observed (*p*-value>0.05), suggesting that the installation of new trash bins does not have a significant impact when it is implemented in parallel of an awareness campaign. Note that for the beaches where no new trash bins were excluded from the analysis as they presented values much higher/lower compared to the other ones.

Finally, the accumulation index of the items belonging to the ST category were calculated for 2017 and 2019, right after the implementation of the pilot activities (Fig. 13). The very encouraging point is that for all the beaches with the exception of the beach mainly used by locals of Sicily, the AI of the items belonging to the ST category decreased between the two considered periods. However and with the exception of the touristic beach of Sicily and the two beaches of Rhodes, the AI of the marine litter from the ST category are still categorized as "high" to "very high". Then the pilot actions did not achieve a drastic reduction of the



marine litter generated by tourism on the beaches as expected. However, the results are really encouraging as they show an average reduction of 47.4% (±13.7%) of the marine litter related to tourism after the implementation of the pilot actions (the beaches mainly used by locals of Sicily and Rhodes were not used in this analysis for the same reasons provided above).



Figure 13: accumulation index calculated for the 11 selected beaches in 2017 (yellow) and 2019 (green). The green/red symbols of the right side show the effectiveness/ineffectiveness of the pilot actions.

