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Evidence of Plastics and Microplastics in the Fresh Water of the Garda Lake. 12 Months of SEABIN Monitoring.

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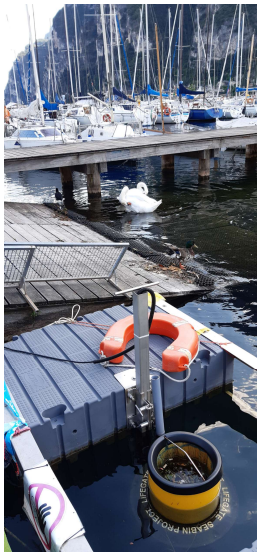


Figure 1. View of SEABIN position in Riva del Garda

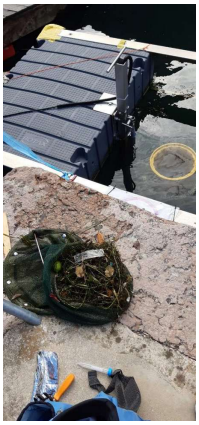


Figure 3. Example of Batch collection (July 2021).

SUMMARY

A Seabin unit has been installed in Fraglia Vela Riva (TN) to capture various floating debris, including plastics (P) and microplastics (MP).

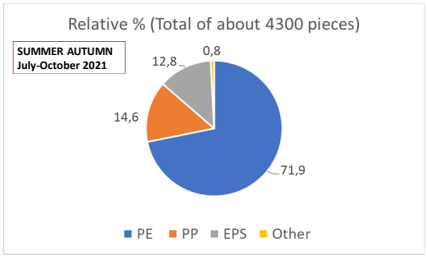
Object of this study is the collection and characterization of plastics (P) and microplastics (MP) floating in the north side of Garda lake, and simultaneously the evaluation of the functionality of the Seabin [1, 2]. Seabin is a basket capable of capturing various debris floating in surface water to clean and remove plastic waste from environment [3], and today more than 900 units have been installed worldwide. The chosen site for Garda Lake (June 17th, 2021) is the northern Fraglia Vela harbour in Riva del Garda, at a strategic confluence of winds and water currents, which favour the local concentration of floating debris [4].
From June 2021 to date, several collection campaigns have been carried out, also with the contribution of two local high schools involved in Plastic Environment Project for specific monthly collection and sampling for 5 or 12 months.
Quantitative and qualitative results of the collected products will be presented (FTIR, specific density, calorimetry, pycnometry, and SEM analysis). Specific attention was paid to EPS products with the comparative analysis of new and aged polymers. More than 4300 pieces of P and MP were separated and catalogued in the summer season 2021, mainly PE (72%), PP(15%) and EPS (12% EPS).

The positioned Seabin in Fraglia Vela of Riva is shown in Figure 1. Each set of collection (between usually 4 and 48 hours, as shown in Tables) requires the separation of plastics from the total waste (Figures 3-5), resulting about 2-15 wt.% of P and 0.5-2 wt. % of MP.

Figure 4. Details of network (L) and appearance of the inner part of the basket before cleaning (R).

Table 1. Results of MP collection between July and October 2021 (* wet Batch).

		Working time	Total Weight	Microplastics (MP)			
Batch #	Date 2021	hours	[g]	[g]	[%]	pieces (per hour)	Average weight[mg]
1a	10/07 ore 10:00	5	16,01	0,093	0,58	25 (5)	3,7
1b	10/07 ore 12:15	2	30,39	0,162	0,53	31 (16)	5,2
2	11/07 ore 16:00	4	10,2	0,103	1,01	19 (5)	5,4
3	17/07 ore 10:30	12	486,66*	1,757	0,36	187 (16)	9,4
4	24/07 ore 15:00	5	584,1*	1,248	0,21	184 (37)	6,8
5a	31/07 ore 10:30	5	9,29	0,072	0,77	59 (12)	1,2
5b	31/07 ore 16:30	6	1163,48*	0,598	0,05	113 (19)	5,3
6	07/08 ore 15:30	6	1382,95*	1,667	0,12	273 (46)	6,1
7a	28/08 ore 9:15	24	58,63	0,211	0,36	73 (3)	2,9
7b**	28/08 ore 14:00	48	1350,91*	2,306	0,17	316 (7)	7,3
8	29/08 ore 14:00	24	131	0,548	0,42	100 (4)	5,5
9	03/09 ore 11:30	48	179,3	1,792	1	290 (6)	6,2
10a	11/09 ore 10:30	24	1511,44*	1,329	0,088	281 (12)	4,7
10b	11/09 ore 16:30	6	687,76*	0,656	0,095	122 (20)	5,4
11	24/09 ore 17:00	24	93,46	0,597	0,638	177 (7)	3,4
12	14/10 ore 11:00	24	121,53	1,598	1,31	500 (21)	3,2
13	28/10 ore 15:00	72	493,85	6,856	1,39	1732 (24)	4,0



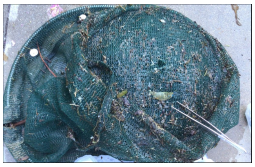


Figure 5. Example of Batch separation of microplastics (MP) and macroplastic (P) 2021.

Figure 6. Example of MP particles for FTIR analysis (PerkinElmer Spectrum One).

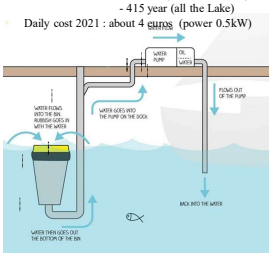
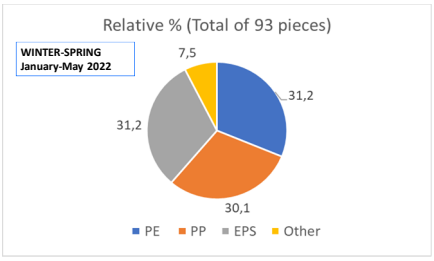


Figure 2. Scheme of SEABIN and technical data

Table 2. Results of P and MP collection between December and May 2022.

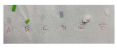
			Total Weight	macro plastics (P)				microplastics (MP)				type of Micro and MacroPlastics [number]					
Batch #	Date 2022	hours	[g]	[g]	%	pieces	average weigth [g]	[g]	%	pieces	average weight [mg]	EPS	PP	LDPE	HDPE	PS	PET
1	17/12/2021	24	51,34	0,649	1,26	6	0,11	0,185	0,36	12	15,4	1	2		3		1
2	21/01/2022	48	383	2,024	0,53	6	0,34	0,171	0,04	12	14,3	2		2		1	
3	17/02/2022	24	38,8	0,301	0,78	4	0,08	0,081	0,21	15	5,4	5	2	3			
4	24/02/2022	24	7,6	0,200	2,63	1	0,20	0,001	0,01	3	0,3	1	2				
5	07/04/2022	48	132	2,650	2,01	16	0,17	0,02	0,02	4	5,0	3	1				
6	22/04/2022	48	810,2	10,700	1,32	29	0,37	0,2	0,02	7	28,6		3	2	2		
7	29/04/2022	48	600	61,360	10,23	15	4,09	0,096	0,02	21	4,6	1	4	1	1		1
8	06/05/2022	24	383	24,681	6,44	33	0,75	1,16	0,30	28	41,4	5	5	2	2	1	
9	19/05/2022	24	764,11	15,000	1,96	20	0,75	0,03	0,00	16	1,9	6	4	1	3		1
10	01/06/2022	24	510,38	18,710	3,67	6	3,12	0,13	0,03	12	10,8	5	3	2	2		



Identification of polymers by immersion in specific density solution (RCS Education Program)

Liquid	Density g/cm3	Composition of solution
1	0.79	Ethanol 100% 10g
2	0.91	4.71g Ethanol 4.39g H_2O
3	0.94	3.54g Ethanol 5.86g H_2O
4	1	H_2O 100% 10g
5	1.15	1.84g K_2CO_3 9.65g H_2O
6	1.38	5.13g K_2CO_3 8.66g H_2O

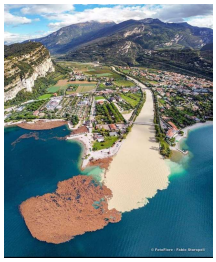
RESULTS: these were the 6 pieces of plastic we had to identify and on the table our results



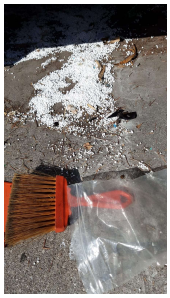
Sample code / colour	Observations for floating / sinking in the 6 different solutions						Probable identity of plastic
	1	2	3	4	5	6	
A	It sinks	It sinks	It sinks	It sinks	It floats	It floats	PS
B	It sinks	It floats	It floats	It floats	It floats	It floats	PP
C	It sinks	It sinks	It floats	It floats	It floats	It floats	LDPE
D	It sinks	It sinks	It sinks	It sinks	It sinks	It sinks	PET
E	It floats	It floats	It floats	It floats	It floats	It floats	EPS
F	It sinks	It sinks	It sinks	It floats	It floats	It floats	HDPE

https://edu.rsc.org/experiments/identifying-polymers-by-density/385.article

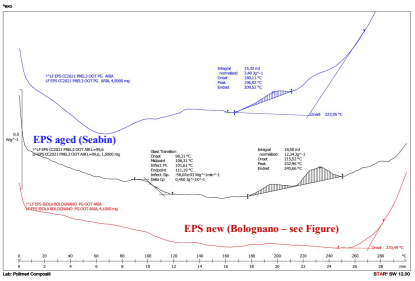
Figures 7. Possible Source of contamination

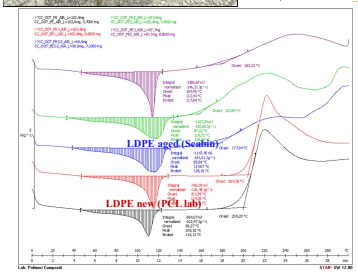


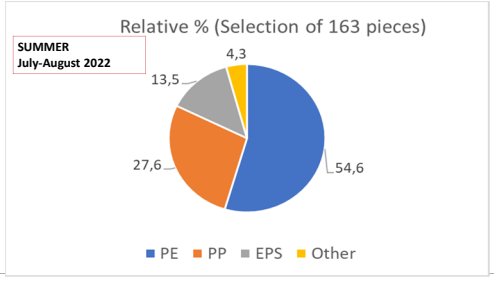
Sarca River (October 4th, 2020)



Bolognano (TN) August 25th, 2022

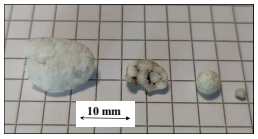


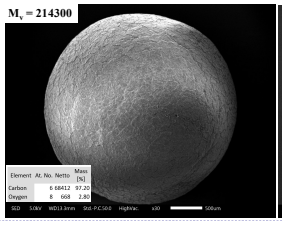


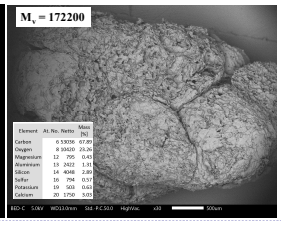


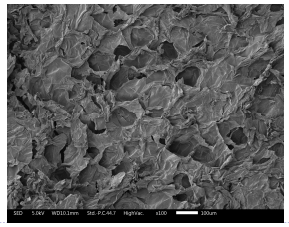
CASE of Foamed products (EPS).

Expanded Polystyrene (EPS) is confirmed to be the third most aboundant plastic residue.
Various PES collected from Seabin were characterized and compared with relative new EPS pieces (EPS beads have found around a municipal waste collector in Bolognano).
-Morphology (SEM) and EDAX analysis
-DSC thermal characterization with OOT determination
-Viscometric molecular weight (M_v) in toluene at 25,0°C
(Mark Houwink constant K=8,48*10^{-5}dl/g and a=0,748)









CONCLUSIONS

•Several collection campaigns were carried out between June 2021 and July 2022. The collected materials were removed from the basket and examined in lab at different levels, number, weight, size, type of polymer (by FTIR, pycnometry, calorimetry, and SEM analysis).
•Local classes of two high schools, namely Liceo Maffei and Gardascuola, have been involved in Plastic Environment Project for specific monthly collection and sampling for 12 or 6 months respectively, identifying the type of plastics by density (bouyancy method or immersion in selected density solution). The collection profile showed a seasons dependence. In summer-autumn more than 4000 pieces of plastics were identified (72% PE; 15% PP; 12% EPS; a minor content of PET, CA, nylon, PMMA). The peak of EPS recorded in July-August 2021. Important data selected are the ratio of plastics to total, and for P and MP, pieces per hour/day, weight per hours/day, type of plastics, and also the seasonal comparison.
•In conclusion, the installed Seabin appears to be an efficient system to monitor the level of plastic contamination. Limitations of maximum continuous use time have been highlighted.
•The various activities confirmed the efficiency of Seabin not only in plastics collections and monitoring, but also in educational promotion and raising awareness
•Local activities have become a valuable tool for educational and awareness-raising.

•Work in progress.
•Artificial ageing of plastic sample (UV-solar box exposition)
•Mechanical testing of foamed samples

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