

DISTRIBUTION OF MICROPLASTICS IN WATER AND SEDIMENT IN A BIOSPHERE RESERVE

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INTRODUCTION

Microplastics in water bodies are a global concern due to the potential threat to biota. Once in the sediment at the bottom they are almost impossible to be safely removed. Among water bodies, the ones belonging to biosphere reserves are critical habitats, with high biodiversity, usually rich in endemic or endangered species. Despite their ecological relevance, the microplastics distribution and the transport mechanisms in coastal lagoons are rarely studied. This investigation presents the abundance of microplastic particles, both in sediment and water, of Río Lagartos coastal lagoon. Moreover, the measured exchanges of water and floating microplastics between this system and the ocean during a complete tidal cycle are presented.

Río Lagartos is located within the homologous Biosphere Reserve, which is the most important nesting site for flamingos (*Phoenicopterus ruber*) in Mexico. The lagoon is a choked system with three consecutive basins communicated through narrow channels. The western basin is the only one communicated with the sea, through three inlets. Due to high evaporation in the zone, and poor water exchange with the sea, the lagoon is hiperhaline, with salinity values up to 147.3

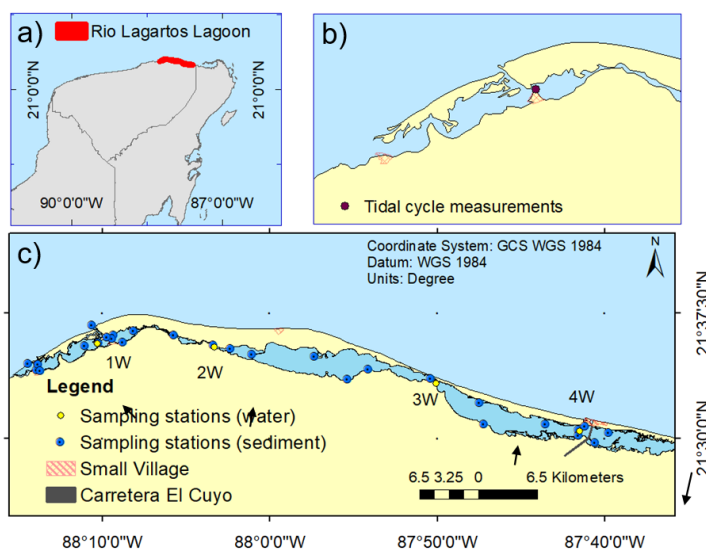


Figure 1. a) Location of Río Lagartos Lagoon in the Yucatan Peninsula, Mexico; b) Temporal monitoring: mouth of the lagoon, showing the location of moored instruments during tidal cycle (25 h) measurements; c) Spatial monitoring: sampling stations in sediment (blue dots) and water (yellow dots pointed with black arrows).

MATERIALS AND METHODS

An intensive field campaign was carried in February 2018 to gather information of the spatial microplastics distribution within the lagoon. Water and sediment samples were collected at 4 and 27 stations respectively within the whole lagoon (Figure 1c). Additionally, exchanges of microplastics between the lagoon and the ocean were measured during a tidal cycle (February 26th to February 27th); current velocities were measured with a towed currentmeter at the main channel and advected microplastics were collected during ebb and flood at the site showed in figure 1b. Current velocities were measured using a Valeport impeller currentmeter. Microplastics were collected with a 30 cm diameter net of 200 μm mesh size, which was placed against the (flood/ebb) current to collect the integrated amount of plastics transported in the water column (in/out) at the lagoon mouth.

At the laboratory, microplastic extraction from both water and sediment was performed by flotation, using a CaCl_2 solution (1.4 g/mL). To eliminate carbonated shells and organic matter that difficult microplastic identification, an acidic digestion with diluted HCl, followed by a wet peroxidation treatment (with hydrogen peroxide and FeSO_4)

were performed. After the digestions, microplastics were visually counted using a stereo microscope. Particles were classified by their shape in fibers, fragments and films.

RESULTS AND DISCUSSION

The highest abundances of microplastic particles in sediments were found near to human activities (Figure 2a). To test if distance to human activities is a significant factor in microplastic distribution, we split the sediment stations in two groups: stations located near to human activities (Group 1), and stations far away from human activities (Group 2) according to a variable distance criteria (R). R was changed from 500 m to 5 km (increasing 100 m each time). By applying a Wilcoxon test for independent samples (confidence interval of 95 %), we found statistical differences between both groups up to a distance of 2.1 km.

In addition to human activities, a second relatively high concentration of microplastics in sediment was found between the central and eastern basins. This location (3A in Figure 1) had the highest concentration of microplastics in water. The high amount of microplastics in water and sediment in this zone located far from human activities may be attributed to the funnel shape of this region that favour accumulation of particles in water (see Table 1).

The exchange of microplastics between the lagoon and the sea during a tidal cycle is shown in Fig 2b. More plastic particles were collected during outflow than during the inflow. Most of the particles consisted in fibers, and a smaller fraction of fragments and films. At this time of the year (February) a dominant outflow of microplastics in the water can be attributed either to the Easterly winds, or to an ebb dominated tidal asymmetry like the one observed during this tidal cycle. Eitherway, in the light of our results, Río Lagartos Lagoon could be acting as a source of microplastics to the ocean.

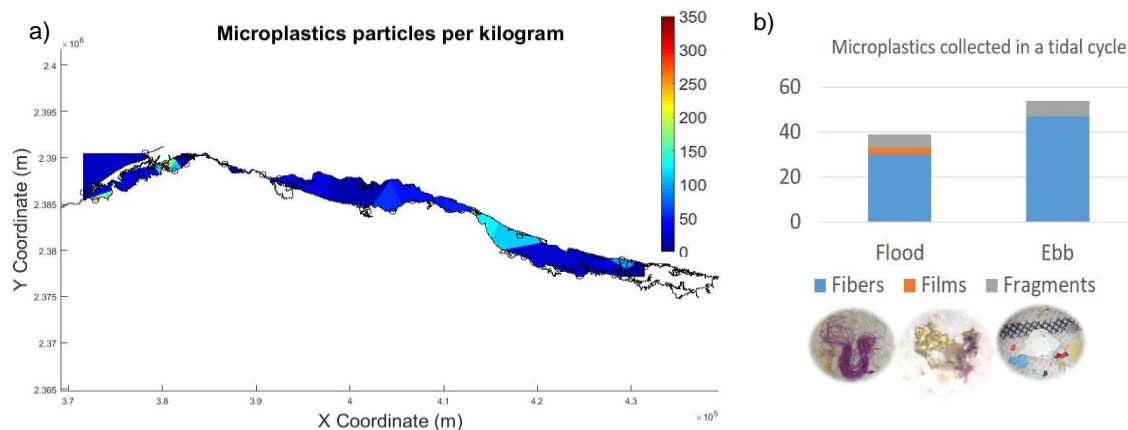


Figure 2. a) Spatial distribution of microplastics in sediment; b) Total amount of collected microplastics during a tidal cycle, including pictures of collected fibres, films and fragments.

Table 1. Microplastic particles in water (units: number of particles $\times 10^{-2}/m^3$).

Station	Fibers	Films	Fragments	Station	Fibers	Films	Fragments
1A	22	0.00	9	2A	9	0.00	5
3A	146	0.00	5	4A	38	0.00	6

REFERENCES

Pool-Stanvliet, Stoll-Kleemann, Giliomee (2018): Criteria for selection and evaluation of biosphere reserves in support of the UNESCO MAB programme in South Africa. *Land Use Policy*, Science Direct, vol. 75, pp 654-663.

UNEP (2016). *Marine plastic debris and microplastics - Global lessons and research to inspire action and guide policy change*. United Nations Environment Programme, Nairobi.

Valdés, Real (2004): Nitrogen and phosphorus in water and sediments at Ria Lagartos coastal lagoon, Yucatan, Gulf of Mexico. *Indian Journal of Marine Sciences*, NISCAIR, vol. 33, no. 4, pp 338-3457.

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EXCEED - SWINDON Conference 2019

THE FUTURE OF WATER RESOURCES

October 13th - 16th, Mérida, Mexico



Programme and Book of Abstracts

PROGRAMME

Sunday, 13 th		Arrival	
19:00	-	21:00	Welcome cocktail

Monday, 14 th		Conference Day 1	
08:30	-	09:00	Registration
09:00	-	09:30	Opening Ceremony <ul style="list-style-type: none"> • Norbert Dichtl • Andreas Haarstrick • Rodolfo Silva • Local authority
09:30	-	10:00	Keynote speech <ul style="list-style-type: none"> • Norbert Dichtl
10:00	-	10:10	Break
Session 1: The impact/performance/role of SDGs Chairman: Valeria Chávez			
10:10	-	10:30	Exploring some ocean energy possibilities in Latin America (Jassiel Hernández)
10:30	-	10:50	Water energy nexus in the MENA region (Abbas Al-Omari)
10:50	-	11:10	Ocean energy and marine biodiversity affectations: a life cycle assessment review (Dora Ruiz-Méndez)
11:10	-	11:40	Coffee Break
Session 2: Water-Energy-Nexus (I) Chairman: Dwi Andreas Santosa			
11:40	-	12:00	Wastewater/waste to energy in MENA region: A review for opportunities (Zeinab Abou Elnaga)
12:00	-	12:20	Water-energy nexus in a wastewater treatment plant: Energy efficiency and recovery (Wang Hongtao)
12:20	-	12:40	From wastewater treatment plants to a resources recovery facility (Marcelo Nolasco)
12:40	-	13:00	Seasonal assessment of the energetic potential associated with salinity gradient: Champoton River, Mexico (Gregorio Posada Vanegas)
13:00	-	14:30	Lunch
Session 3: Water, ecosystem and socio-economic integrating aspects (I) Chairman: Germán Rivillas			
14:30	-	14:50	Decolourization and mineralization of acid green 25 dye through single and catalytic ozonation (Liliana Amaral Féris)

14:50	-	15:10	Adsorption of naphtholate-as dye in wastewater of batik industry using green synthesized zn layered hydroxyl salts (Sri Juari Santosa)
15:10	-	15:30	Adsorption of hexavalent chromium in coal beneficiation tailing in fixed bed column (Liliana Amaral Féris)
15:30	-	15:50	Kinetics of the adsorption of anionic and cationic dyes in aqueous solution by low-cost activated carbons prepared from sea cake and cotton cake (Ibrahim Tchakala)
15:50	-	16:10	Distribution of microplastics in water and sediment in a Biosphere Reserve (Cecilia Enriquez)
16:10	-	16:30	Evaluation of microplastics contamination in the margins of the Patos Lagoon in south of Brazil (Eduardo Saldanha Vogelmann)
16:30	-	17:00	Coffee Break
Session 4: Water, ecosystem and socio-economic integrating aspects (II) Chairman: Rodolfo Silva			
17:00	-	17:20	Hydrodynamic modelling of the Huave Lagoon System, Oaxaca (María Fernanda González Amador)
17:20	-	17:40	Impact effects of hard infrastructure in Salamanca Natural Park (Juan Carlos Caez-Perez)
17:40	-	18:00	The decision-making in face to coastal squeeze, analysis between social and economic impacts: Case study of Campeche, Mexico (Debora L. Ramírez-Vargas)
18:00	-	18:30	Keynote speech • Elvis Carissimi
20:00			Dinner

Tuesday, 15th		Conference Day 2	
Session 5: Water, ecosystem and socio-economic integrating aspects (III) Chairman: Arwa Naser Damen Hamaideh			
09:00	-	09:20	Dispersion of submarine groundwater discharges in reef lagoons and associated environmental effects (Arlett Rosado Torres)
09:20	-	09:40	Salt intrusions into a freshwater spring in a tropical coastal lagoon, Yucatán, Mexico (Xaní Malagón)
09:40	-	10:00	Variability of the saline gradient in a hypersaline coastal lagoon (Brenda Natalia Fitch Geymonat)
10:00	-	10:20	Sedimentation and water quality status of lake Tana, the headwaters of the Blue Nile, Ethiopia (Seifu A Tilahun)
10:20	-	10:40	An innovative approach to mitigate risks on the existing iron tailings dams in Brazil (Jose Araruna)

10:40	-	11:00	Urban sustainable water management and water efficiency improvement for buildings – a case study for Istanbul (Ahmet Baban)
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11:00	-	11:30	Coffee Break
Session 6: Water-Energy-Nexus (II) Chairman: Eduardo Saldanha Vogelmann			
11:30	-	11:50	Reverse electrodialysis for energy and water: coupled systems based in salinity gradients (Mateo Roldan-Carvajal)
11:50	-	12:10	Development of graphene oxide membranes for its use in reverse electrodialysis systems (Eddie López Honorato)
12:10	-	12:30	Development of graphene oxide based materials for water treatment (Ana Cecilia Reynosa Martinez)
12:30	-	12:50	Laboratory experiences on marine energy conversion devices for supplying electricity demand of remote coastal communities (Jassiel Hernández)
12:50	-	13:10	Plate type obstacles used for coastal protection and power generation (Luis Eduardo Pérez Paez)
13:10	-	14:40	Lunch
Session 7: Water, ecosystem and socio-economic integrating aspects (IV) Chairman: Thi Thanh Van Ngo			
14:40	-	15:00	Evaluating combinatorial water treatment by locally available materials (Chrispin Kowenje)
15:00	-	15:20	Desalination by capacitive deionization as a tool to provide drinkable water to small communities in the Brazilian semiarid (Luis Augusto Martins Ruotolo)
15:20	-	15:40	Fluoride ions removal from groundwater by alumina adsorption (Elvis Carissimi)
15:40	-	16:00	Bio-refineries: A new concept towards green energy production from agroindustrial wastewater (Víctor Alcaraz)
16:00	-	16:20	The importance of water and nutrients management in paddy fields as an effort to increase crop yields and producing an electrical energy through microbial fuel cells (Dwi Andreas Santosa)
16:20	-	16:50	Coffee Break
16:50	-	17:20	Keynote speech • Klaus Fricke
16:50	-	18:00	Panel discussion Moderators: Edmilson Santos de Lima and Norbert Dichtl
20:00			Gala dinner