Preliminary Risk Assessment of Microplastics in Major Rivers in the Kruger National Park

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Introduction

Microplastic (MPs)

- Plastic particles < 5000 µm.
- Primary and secondary MPs.
- Fibre, fragments, and beads
- Environmental and human health effects.

Major MP Sources

- Solid waste mismanagement
- Tyre wear or traffic related activities
- Stormwater runoff
- Wastewater Treatment Plants (WWTPs) effluent

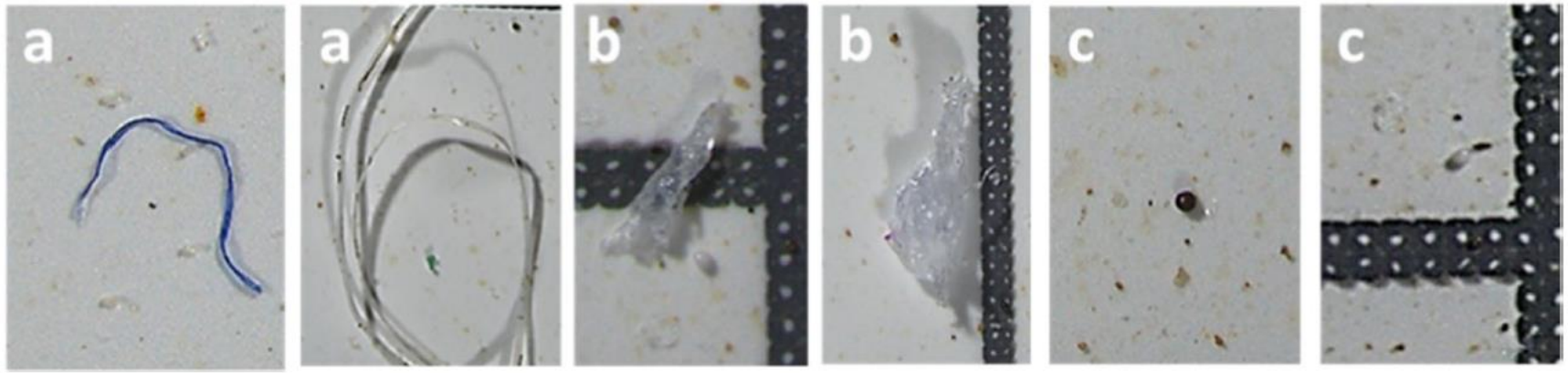

Fig. 1 Microscope images of different microplastic shapes: **a** fibres, **b** fragments, and **c** beads

Study Objectives

1. Environmental Risk Assessment for the Olifants and Sabie rivers (Quantified MPs).

2. Estimate microplastic quantities transported by KNP major rivers.

3. Determine if microplastic quantities decrease from the western to the eastern border of the KNP.

Materials and Methods

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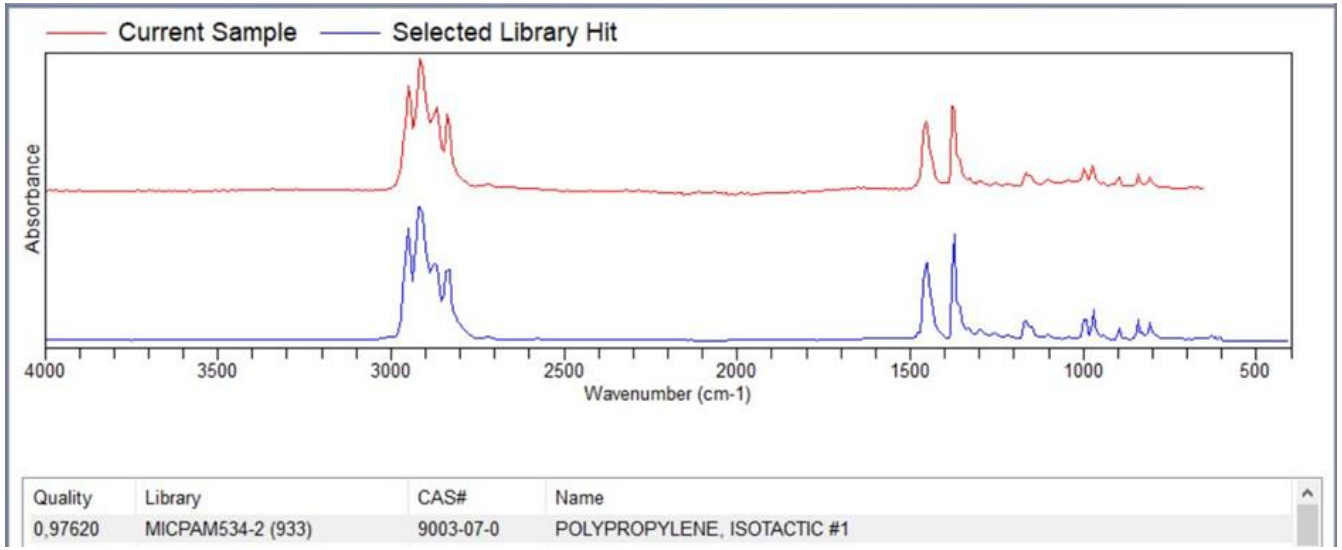
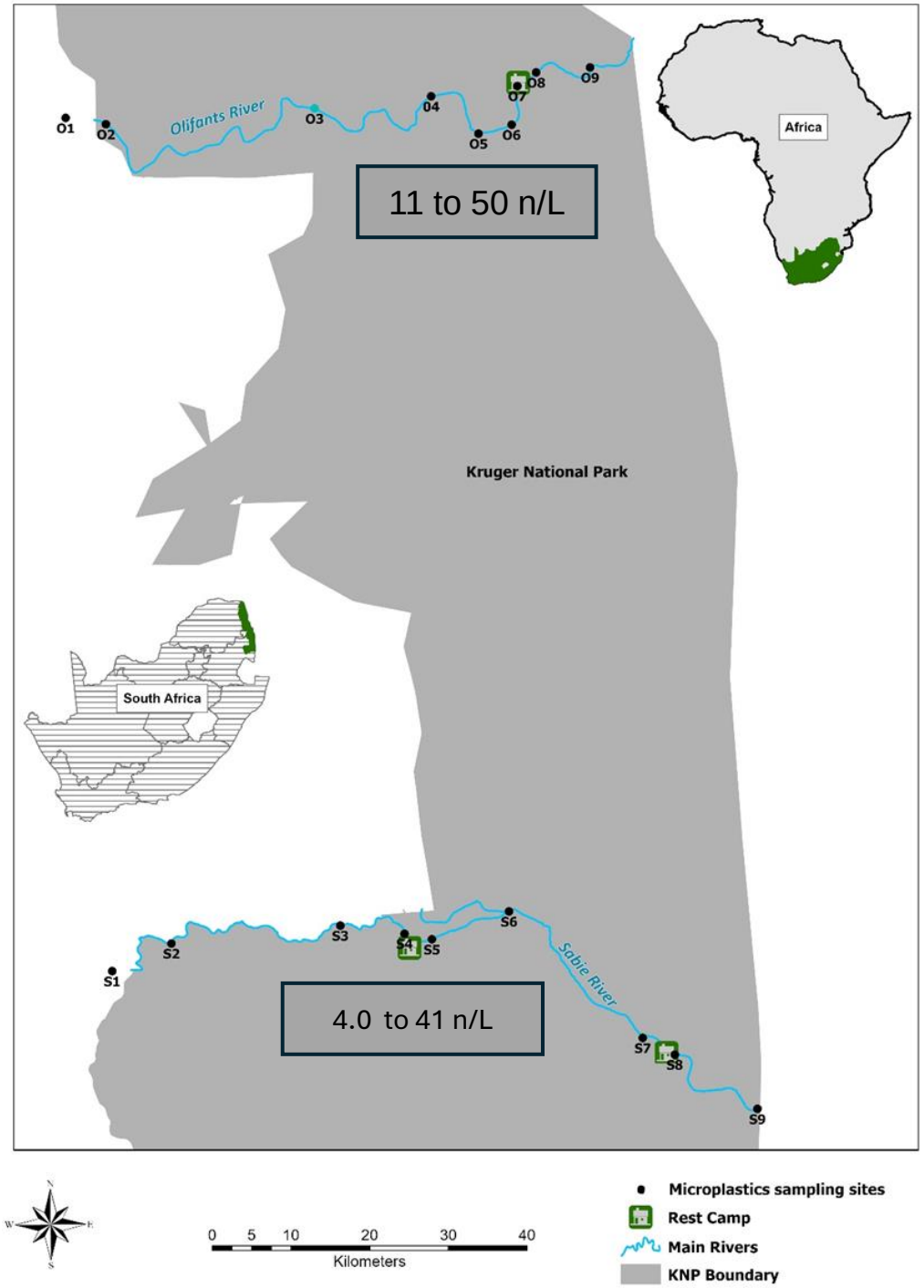
Microplastic Concentrations in Sediments and Waters Do Not Decrease in Two Rivers Flowing Through the Kruger National Park, South Africa

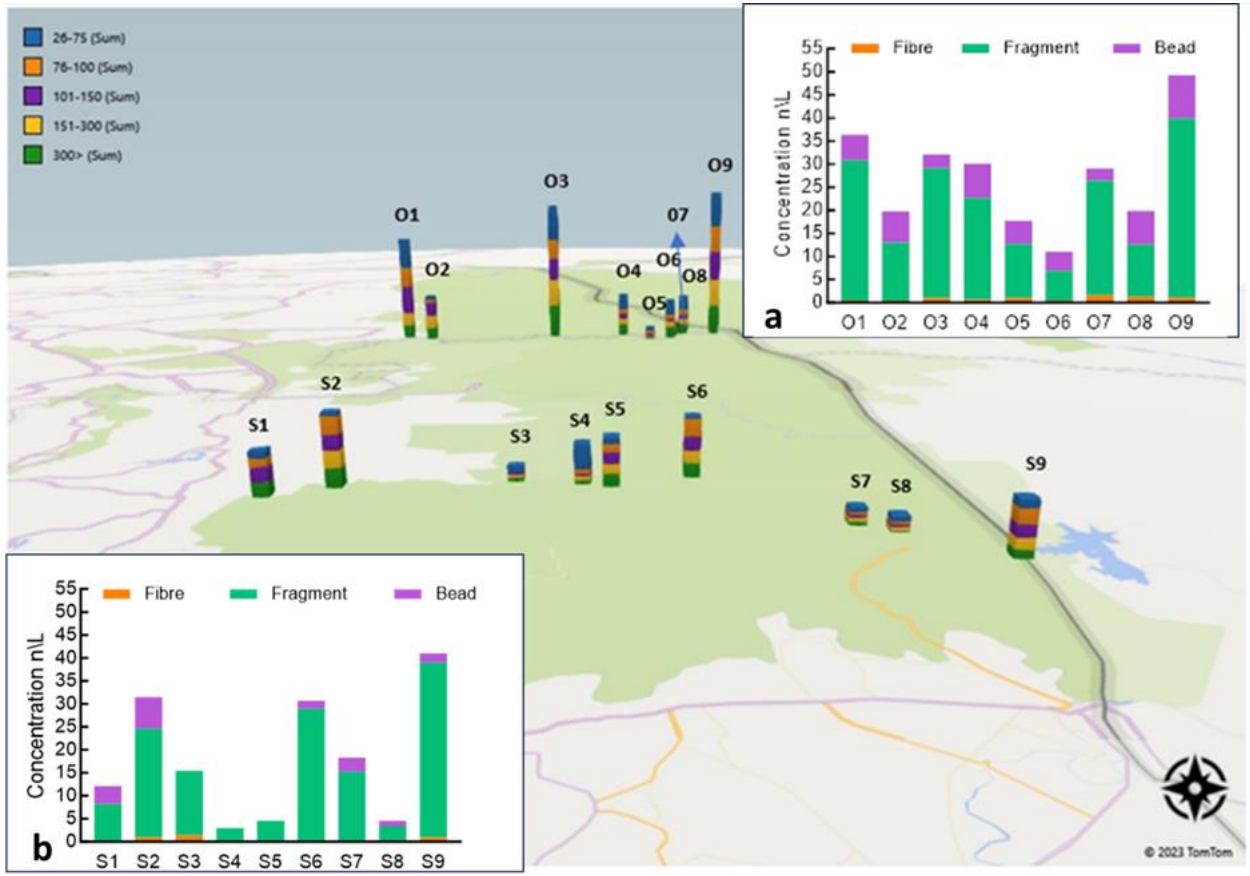
Purvance Shikwambana · Llewellyn C. Foxcroft · Jonathan C. Taylor · Hindrik Bouwman

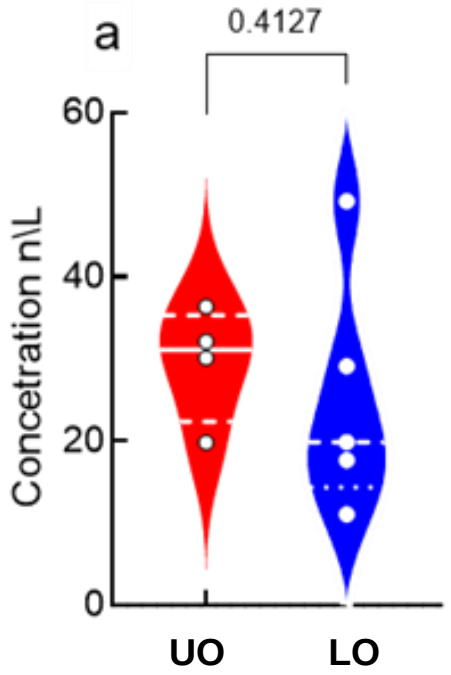


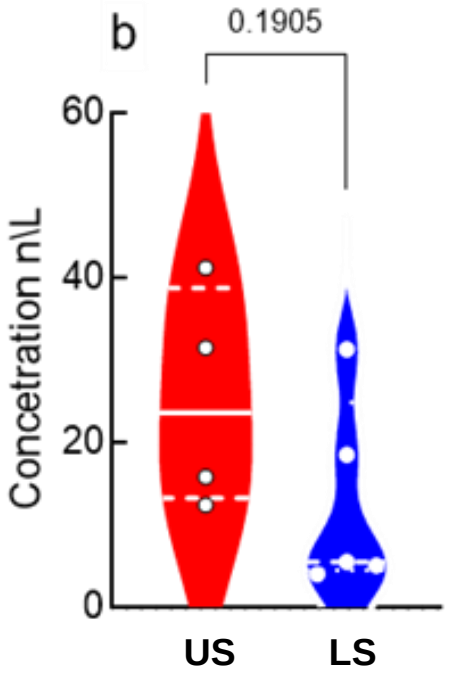
Twelve (12) plastic polymers
PET – 32%, PVA – 14%, and PE – 12%



Materials and Methods







Materials and Methods

Microplastic Risk Assessment

1. $\mathrm{MPCFi} = \left(\frac{\mathrm{Cmicroplastic}}{\mathrm{Cbaseline}}\right)$
2. $\mathrm{MPPLIsite} = \sqrt[2]{\mathrm{MPCFrag\ x\ MPCBead}}$
3. $\mathrm{Hi} = \sum Pn\ X\ Sn$
4. $PRI = \sum Hi\ x\ MPPLIsite$

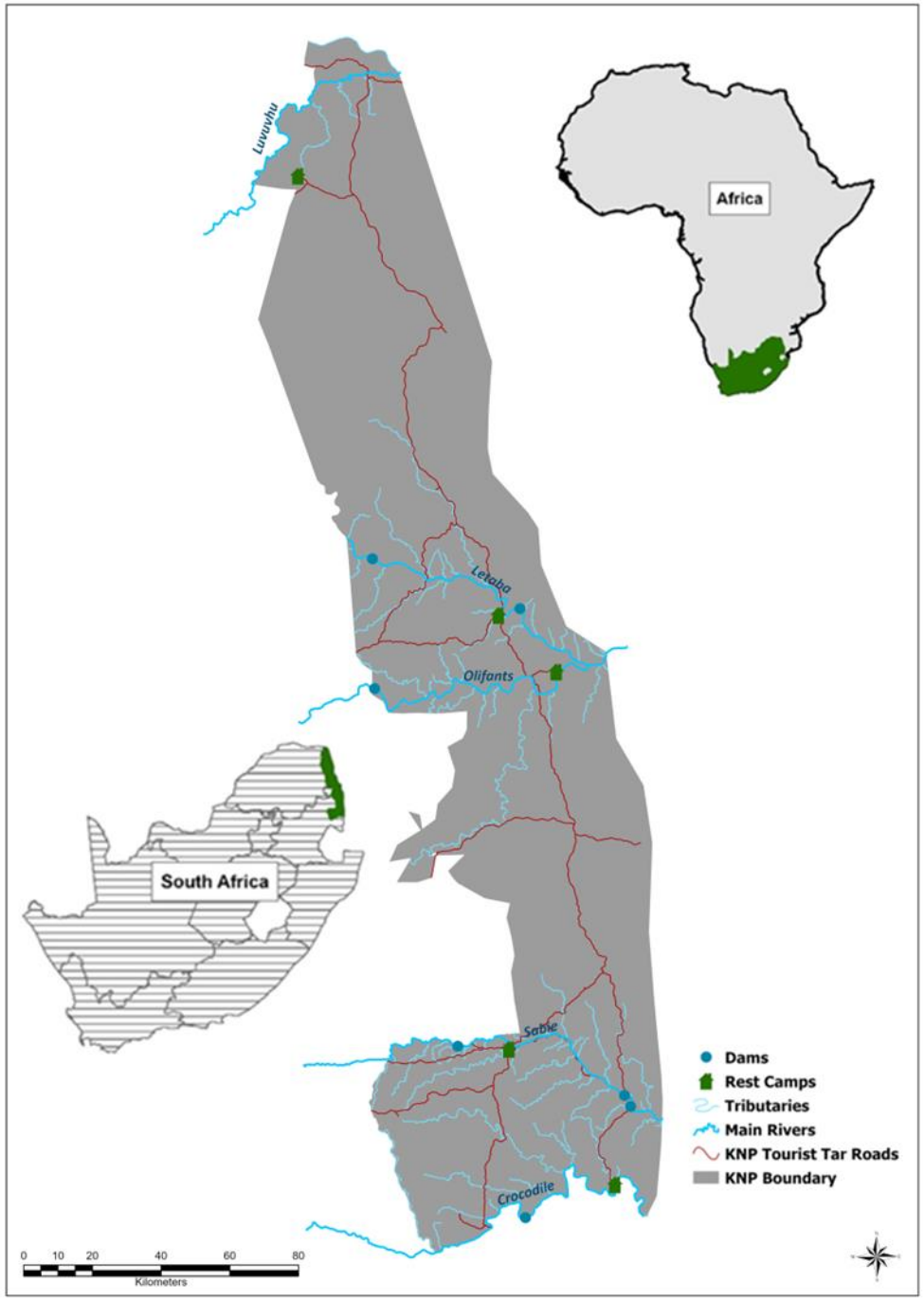
Microplastic Estimates

F = C*Q

F = Microplastic flux,
C = Microplastic concentration, and
Q = River flow

SRS1 Cubic Spline
- Extrapolation

Risk Category	Low (I)	Moderate (II)	High (III)	Very high (IV)	Dangerous (V)
Contamination Factor (CF)	<1	1-3	3-6	>6	
Pollution Flux Index (PLI)	<1	1-3	3-4	4-5	>5
Pollution Risk Index (Hi)	<10	10-100	101-1000	1000-10000	>10000
Pollution Risk Index (PRI)	<150	150-300	300-600	600-1200	>1200



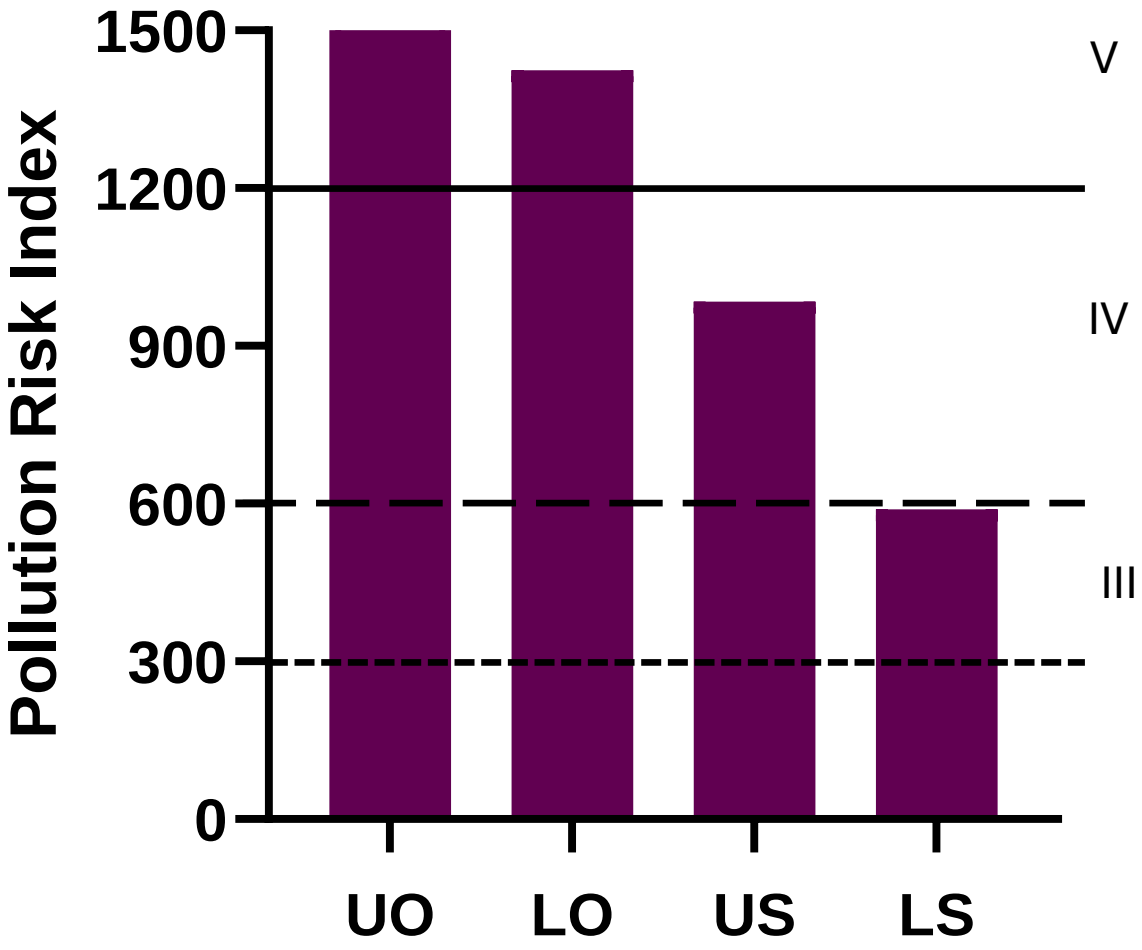
Results and Discussion

Polymer	Acronym	Hi	H	Severity
Butyl	BTL	2	I	Low
Chlorobutyl	CIIR	9	I	Low
Cellulose	CLL	0	I	Low
Ethylene-vinyl acetate	EVA	63	II	Moderate
Polyethylene	PE	132	III	High
Polyethylene Terephthalate (Polyester)	PET	128	III	High
Poly (4-methyl-1-pentene)	PMP	0	I	Low
Polypropylene	PP	10	II	Moderate
Polystyrene	PS	180	III	High
Polytetrafluoroethylene	PTFE	0	I	Low
Poly(vinyl)alcohol	PVA	14	II	Moderate
Thermoplastic Elastomer	TPE	1112	IV	Very high

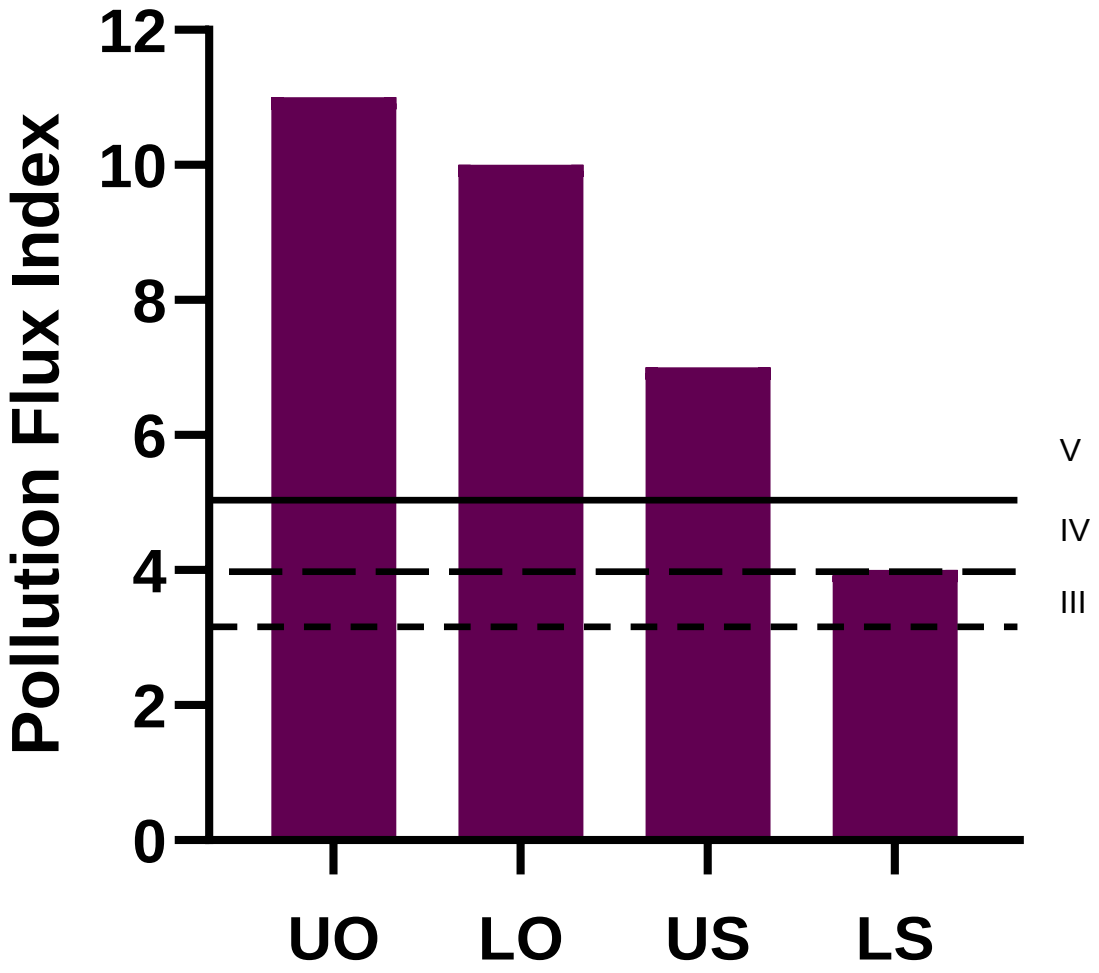
I - Low toxicity

IV - Very toxic to aquatic life with long lasting effects

Results and Discussion



Results and Discussion

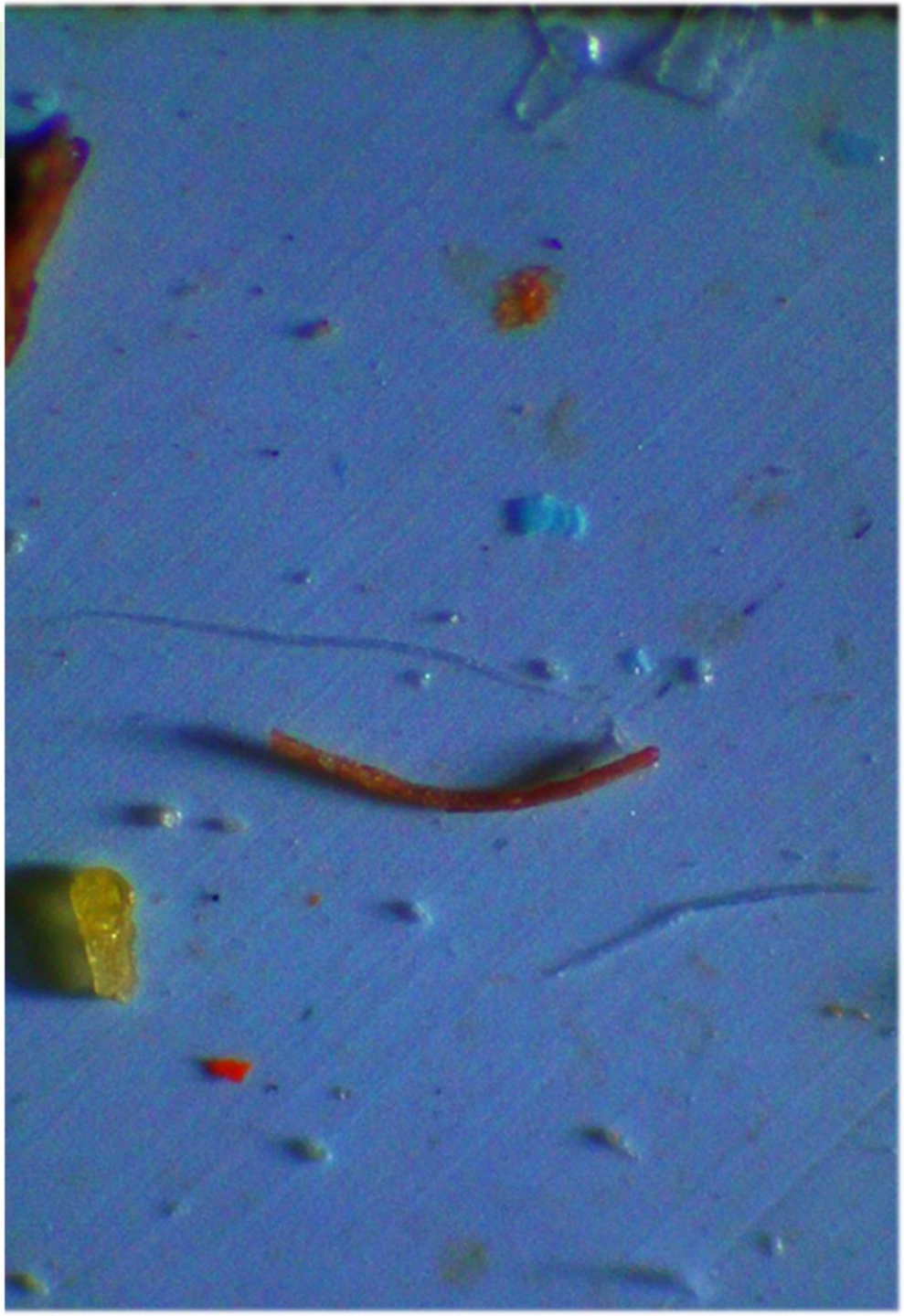


Results and Discussion

River		Monthly Av Flow Rate (m^3/month)	MPS flux (n/month)	MPs Quantities Decrease?
Olifants	Upper Olifants	5.24×10^7	$1{,}55 \times 10^{12}$	
	Lower Olifants	6.10×10^7	$1{,}55 \times 10^{12}$	NO
Sabie	Upper Sabie	1.56×10^7	$3{,}93 \times 10^{11}$	
	Lower Sabie	3.24×10^7	$4{,}17 \times 10^{11}$	NO
Crocodile	Upper Crocodile	3.40×10^7	$1{,}53 \times 10^{12}$	
	Lower Crocodile	2.94×10^7	$1{,}33 \times 10^{12}$	YES
Letaba	Upper Letaba	3.43×10^6	$2{,}05 \times 10^{11}$	
	Lower Letaba	1.80×10^7	$8{,}38 \times 10^{11}$	NO
Luvuvhu	Luvuvhu	3.03×10^6	$1{,}88 \times 10^{11}$	

Conclusion

- Lower Sabie River section reflected high levels (III) for PLI and PRI.
- Upper Sabie River section reflected dangerous levels (V) for PLI and very high levels (IV) for PRI
- The Olifants River reflected dangerous levels (V) in PLI and PRI
- Olifants River transports higher microplastics than the other major rivers.



Recommendations

From Source to Sea?

- Rivers need management from their headwater into the sea.
- Mitigating microplastic pollution requires local and international strategies because river water flow is not restricted to the region of origin.

THANK YOU!