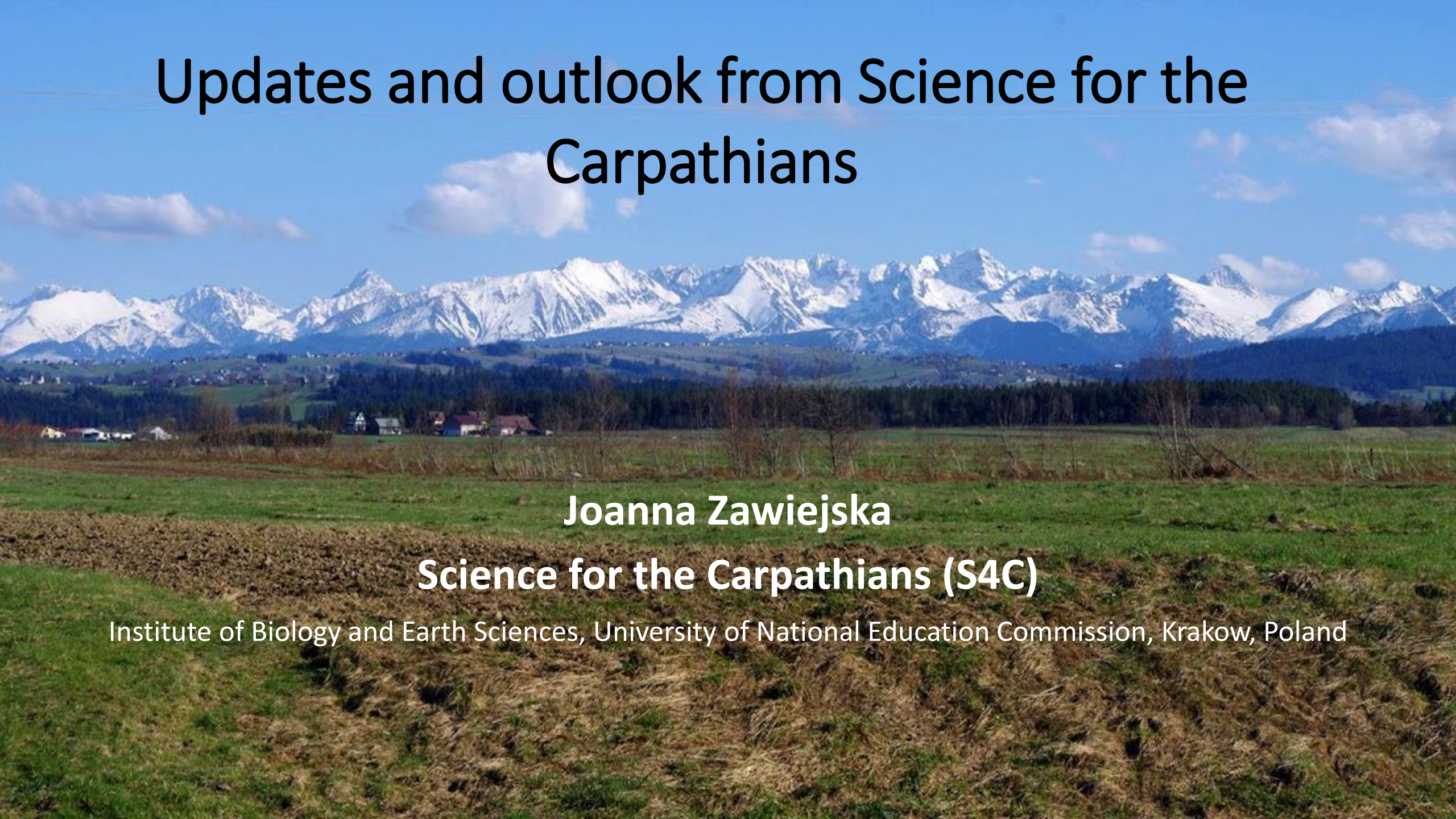
Updates and outlook from Science for the Carpathians



Joanna Zawiejska

Science for the Carpathians (S4C)

Institute of Biology and Earth Sciences, University of National Education Commission, Krakow, Poland

Science for the Carpathians

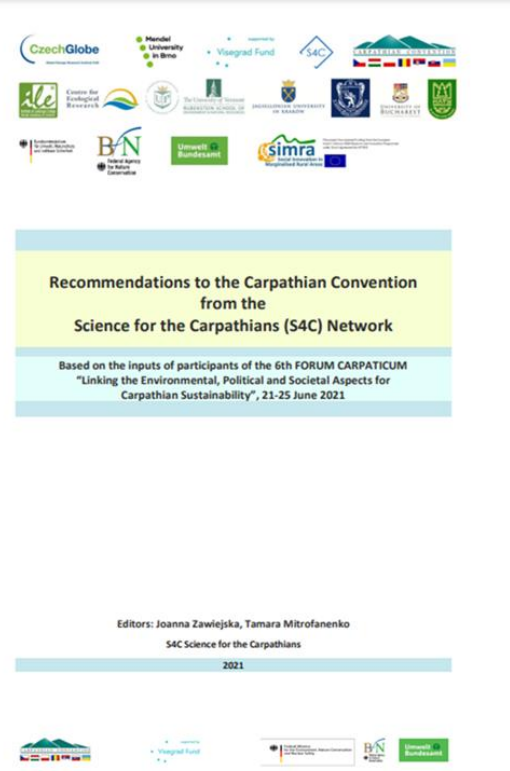
- Interdisciplinary network of scientists working in the Carpathians
- Links and collaboration with the Alpine and the Caucasus scientific networks

https://carpathianscience.uj.edu.pl

Science for the Carpathians

- Develop and implement *the Research Agenda for the Carpathians*
- Identify research needs and emerging topics
- **Foster dialogue between research, policy and practice**

Chapter: Mitrofanenko, T. et al., 2023: Science-policy-practice collaborations towards sustainable development in the Carpathian Region



JAGIELLONIAN UNIVERSITY IN KRAKÓW

S4C Science for the Carpathians

HUMAN-ENVIRONMENTAL SYSTEM RESEARCH CENTRE

7th Forum Carpaticum Conference
Carpathian Futures - Critical Transitions

25-28 September 2023, Cracow, Poland

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

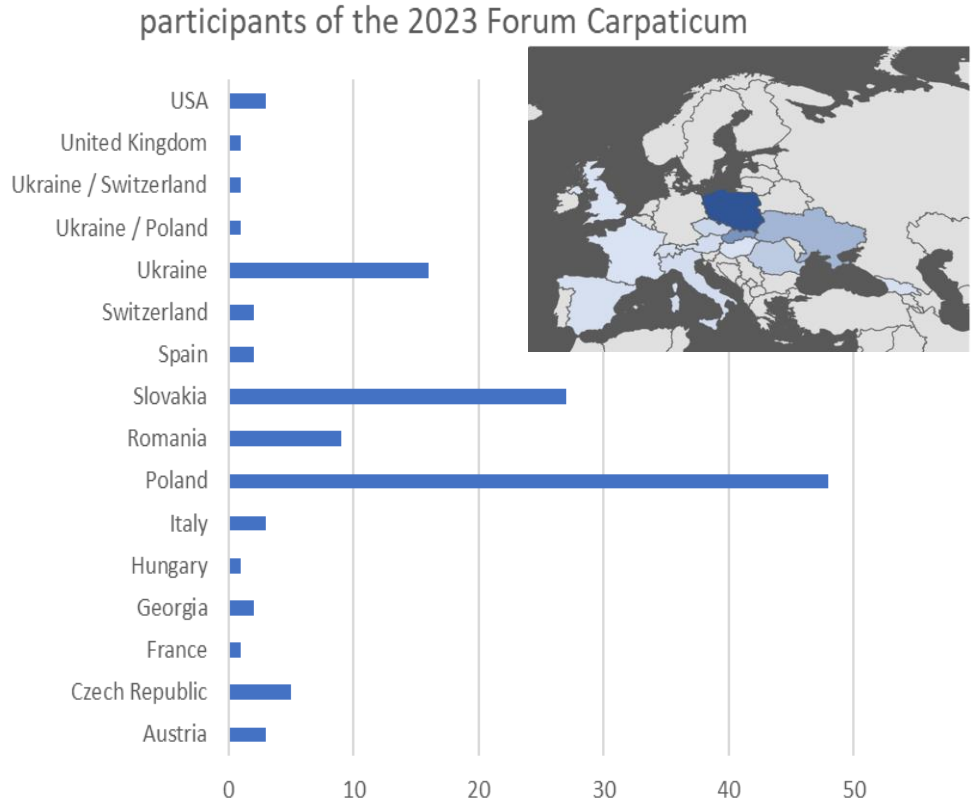
Umwelt Bundesamt

BfN Federal Agency for Nature Conservation

Kraków

7th Forum Carpaticum Conference
Carpathian Futures – Critical Transitions

125 participants from 15 countries



- 3 keynote talks
- **special plenary hybrid session on Ukraine**
- 17 thematic sessions
- mini-symposium on Carpathian endemic species
- 4 side events and workshops

FACULTY OF SOCIAL AND ECONOMIC SCIENCES
Comenius University Bratislava

S4C Science for the Carpathians

serigo

RESDI

Forum Carpaticum 2025: "Taking stock and building partnership for sustainable development of the mountain and rural areas"

Date: 9th-11th September 2025

Venue and hosted by: Faculty of Social and Economic Sciences, Comenius University in Bratislava, Slovakia

Funded by the European Union

Federal Ministry for Economic Affairs and Climate Action

European Climate Initiative EUKI

European Climate Foundation

Building capabilities and facilitating the participation of vulnerable groups in rural and mountain regions through SSE in multi-level sustainable development policy

Bridging natural and social sciences for sustainable development and impact-driven research through transdisciplinary approaches

Thematic sessions at FC 2025

- Innovative Methods and Tools for Integrating Economic, Social and Environmental Aspects to Bridge Science-Policy Interface for Better Decisions in Forestry
- Importance of Nature-based Solutions (NbS) in Sustainable Development of Mountain Areas: a Transdisciplinary Approach
- Historical Ecology and Geography: New Perspectives for Conservation and Management
- Building Capabilities and Facilitating the Participation of Vulnerable Groups in Rural and Mountain Regions through SSE in Multi-Level Sustainable Development Policy
- Bridging Natural and Social Sciences for Sustainable Development and Impact-Driven Research through Transdisciplinary Approaches
- Collaborative Environmental Justice Initiatives in Central and Eastern Europe across Urban and Rural Divides

Thematic sessions at FC 2025

- Carpathian Waters
- Plastic in the mountains
- Safeguarding Carpathian Pastoralism
- Education for Sustainable Development
- Empowering Local Communities to Act for Change
- Transboundary Strategies for Strengthening Carpathian Integrated Landscape Management Governance
- Accessibility, Development Paths and Windows of Opportunities in Core-Periphery Systems: Challenges of Local and Regional Development in the Carpathians
- Special Sessions on Ukraine and on Caucasus/Eurasian Region

Land use changes and biodiversity
Wildland-urban interface and carnivores

Land use changes in the Carpathians

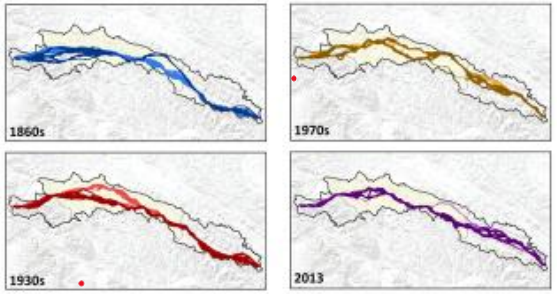
- Forest cover increase
- Settlement development

→ Agricultural land decrease (grasslands+-)

Wildland-urban interface (WUI) increase

Grasslands are among the most biodiversity rich habitats in the EU

Large carnivores habitats and connectivity



Szwagierczak et al., in review

Dr Dominik Kaim, Jagiellonian University

The global wildland–urban interface

Franz Schug, Avi Bar-Massada, Amanda R. Carlson, Heather Cox, Todd J. Hawbaker, David Helmers, Patrick Hostert, Dominik Kaim, Neda K. Kasraee, Sebastián Martinuzzi, Miranda H. Mockrin, Kira A. Pfoch & Volker C. Radeloff — Show fewer authors

Nature **621**, 94–99 (2023) | Cite this article

Conservation Letters
Open Access
A Journal of the Society for Conservation Biology

LETTER | Open Access

Historical maps improve the identification of forests with potentially high conservation value

Ewa Grabska-Szwagrzyk, Michał Jakiel, William Keeton, Jacek Kozak, Tobias Kuemmerle, Kamil Onoszko, Krzysztof Ostafin, Mahsa Shahbandeh, Piotr Szubert ... See all authors

First published: 11 July 2024 | https://doi.org/10.1111/conl.13043 | Citations: 1

ELSEVIER

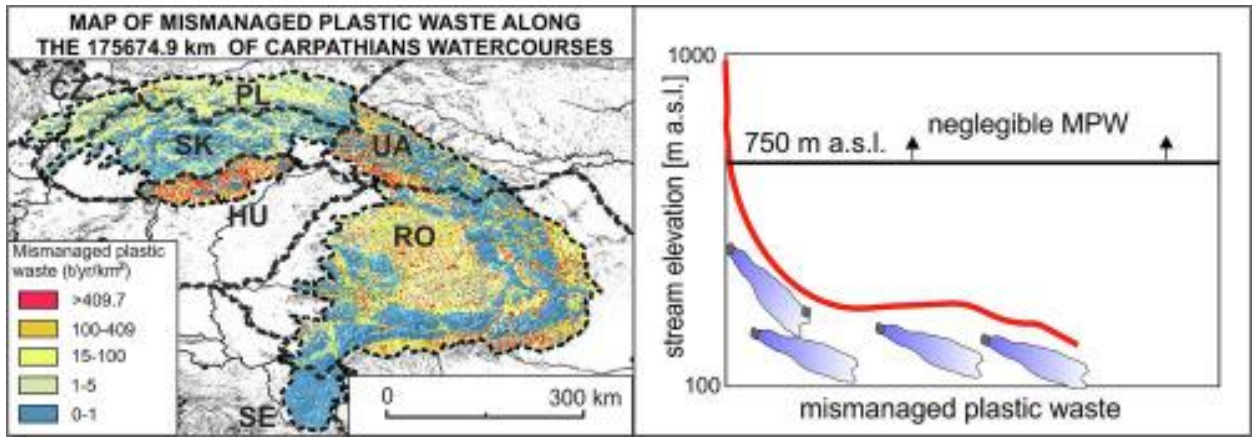
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Mountains of plastic: Mismanaged plastic waste along the Carpathian watercourses

Maciej Liro [a,*], Anna Zielonka [b,c], Tim H.M. van Emmerik [d], Małgorzata Grodzińska-Jurczak [e], Justyna Liro [b], Tímea Kiss [f], Florin-Constantin Mihai [g]

[a] Institute of Nature Conservation, Polish Academy of Sciences, al. Adama Mickiewicza 33, 31–120 Kraków, Poland
[b] Faculty of Geography and Geology, Institute of Geography and Spatial Management, Jagiellonian University, Gronostajowa 7, 30-387 Kraków, Poland
[c] Department of Forest Resources Management, Faculty of Forestry, University of Agriculture in Krakow, al. 29 Listopada 46, 31-425 Kraków, Poland
[d] Hydrology and Quantitative Water Management Group, Wageningen University, Droevendaalsesteeg 3, 6708 PB Wageningen, the Netherlands
[e] Institute of Environmental Sciences, Jagiellonian University, Gronostajowa 7, 30–387 Kraków, Poland
[f] Department of Geoinformatics, Physical and Environmental Geography, University of Szeged, 6722 Szeged, Hungary
[g] CERNESIM Center, Department of Exact Sciences and Natural Sciences, Institute of Interdisciplinary Research, "Alexandru Ioan Cuza" University

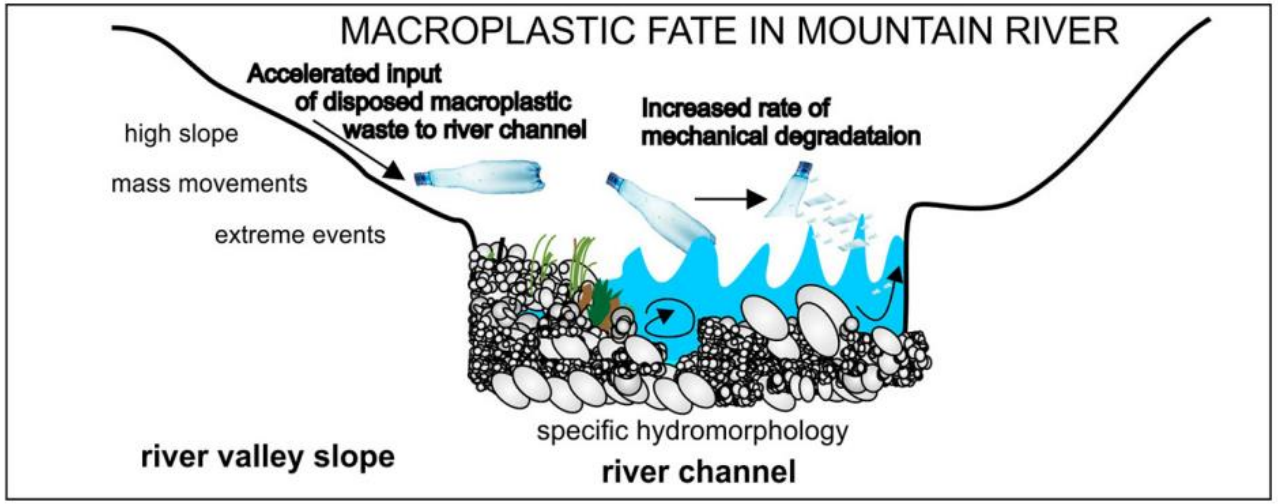


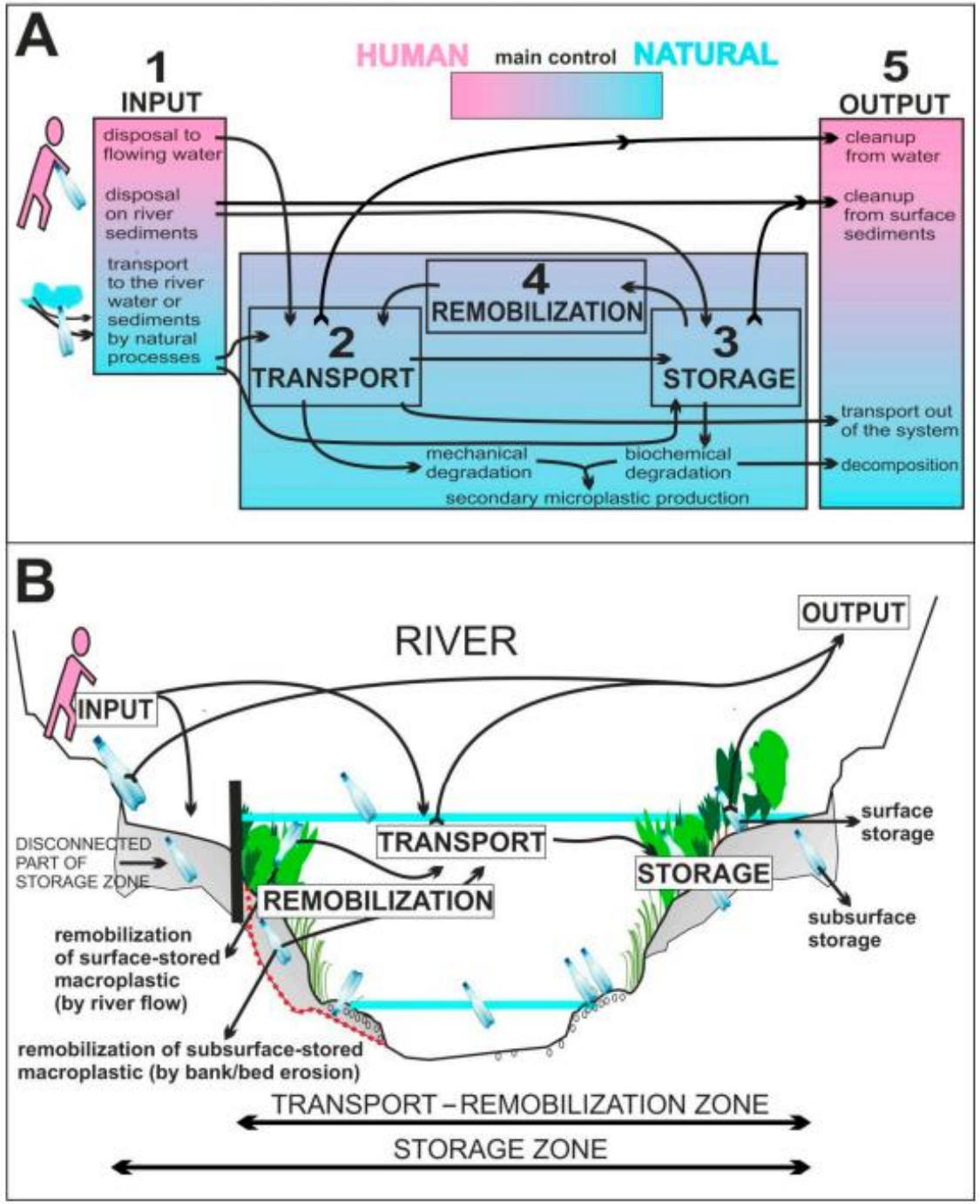
#dtptidyup #interregtidyup

Plastic in mountain rivers

- nano- (>100 nm) micro- (<5mm) and **macroplastic** (>5 mm) categories
- different in form and size
- threat to fauna (through entanglement or ingestion etc.)
- decrease in aesthetic value
- biochemical degradation?
- fragmentation
- burial in sediments
- mineral, organic and …new, artificial/synthetic sediment in fluvial system

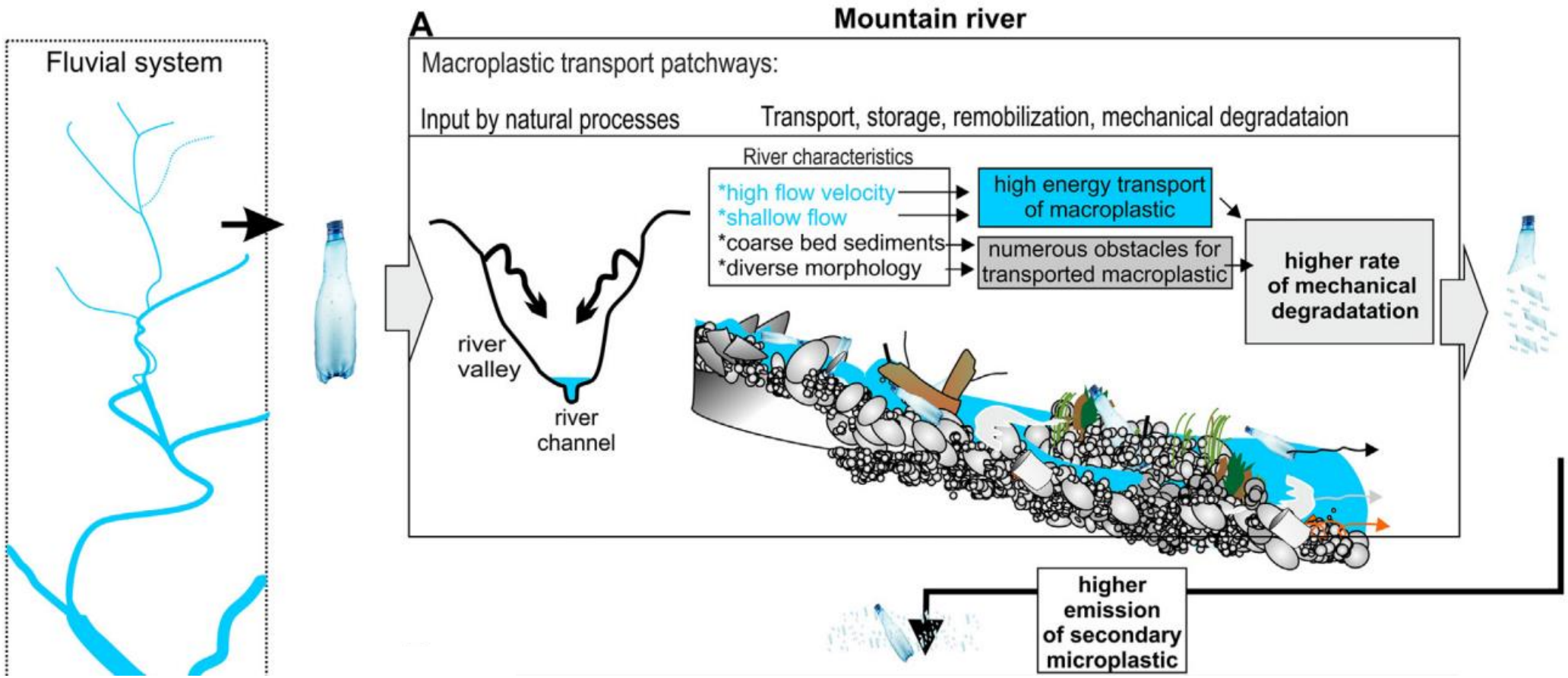
Fate of macroplastic

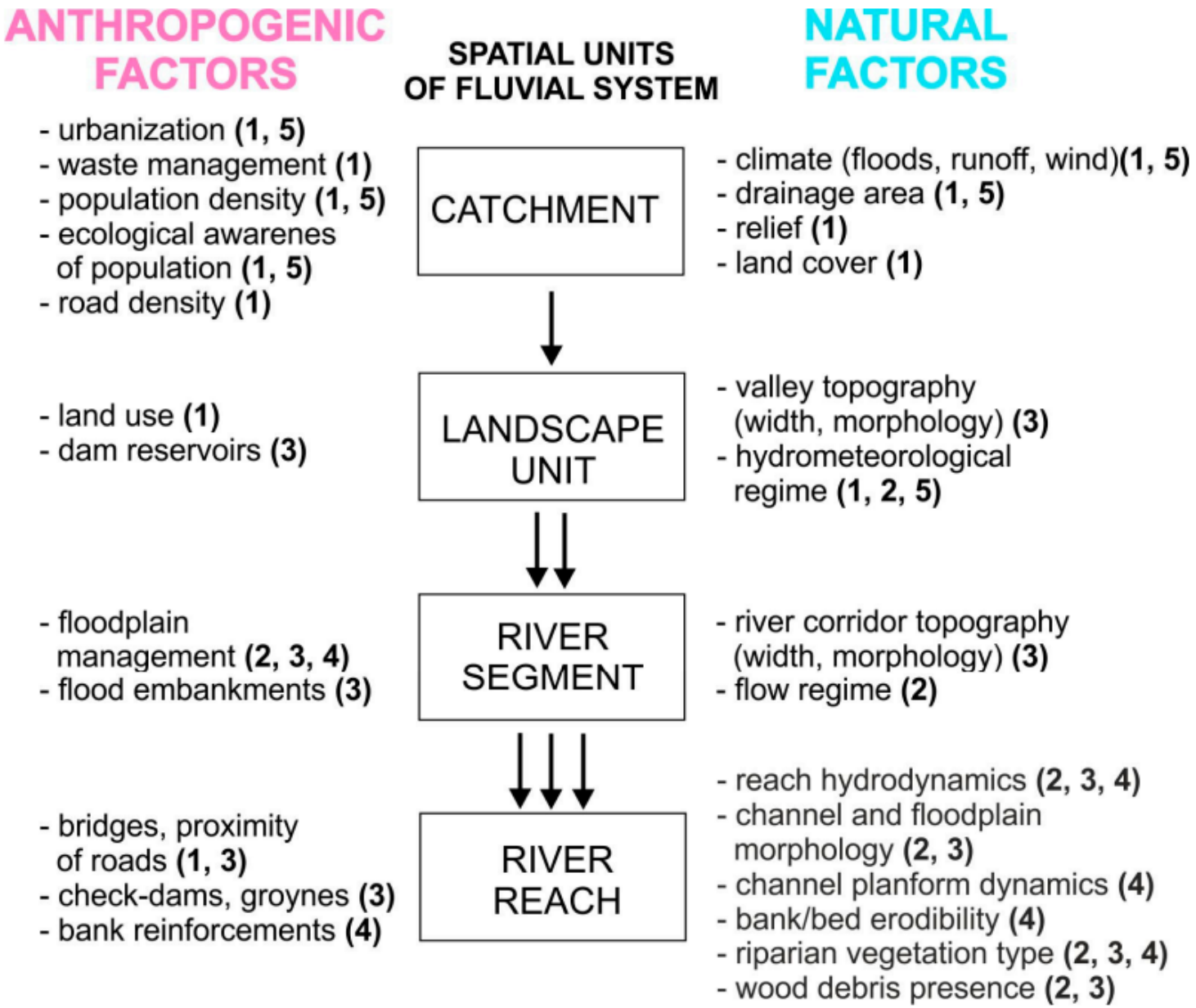




Liro et al. 2020 & 2023

Mountain rivers: microplastic fragmentation machines?





1 – input

2 –transport

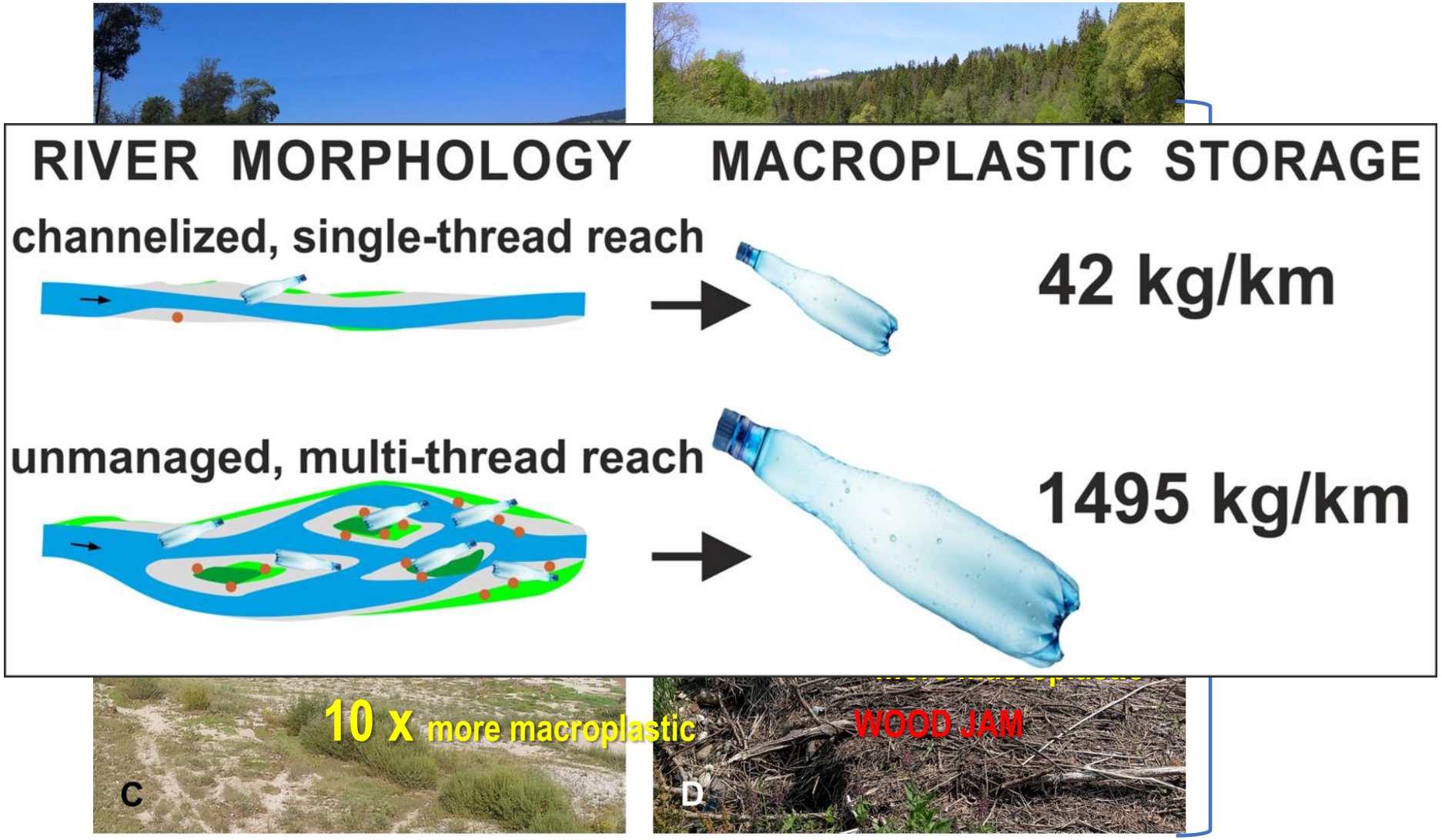
3 – storage

4 – remobilization

5 – output

Liro et al. 2020

Amounts of macroplastic trapped

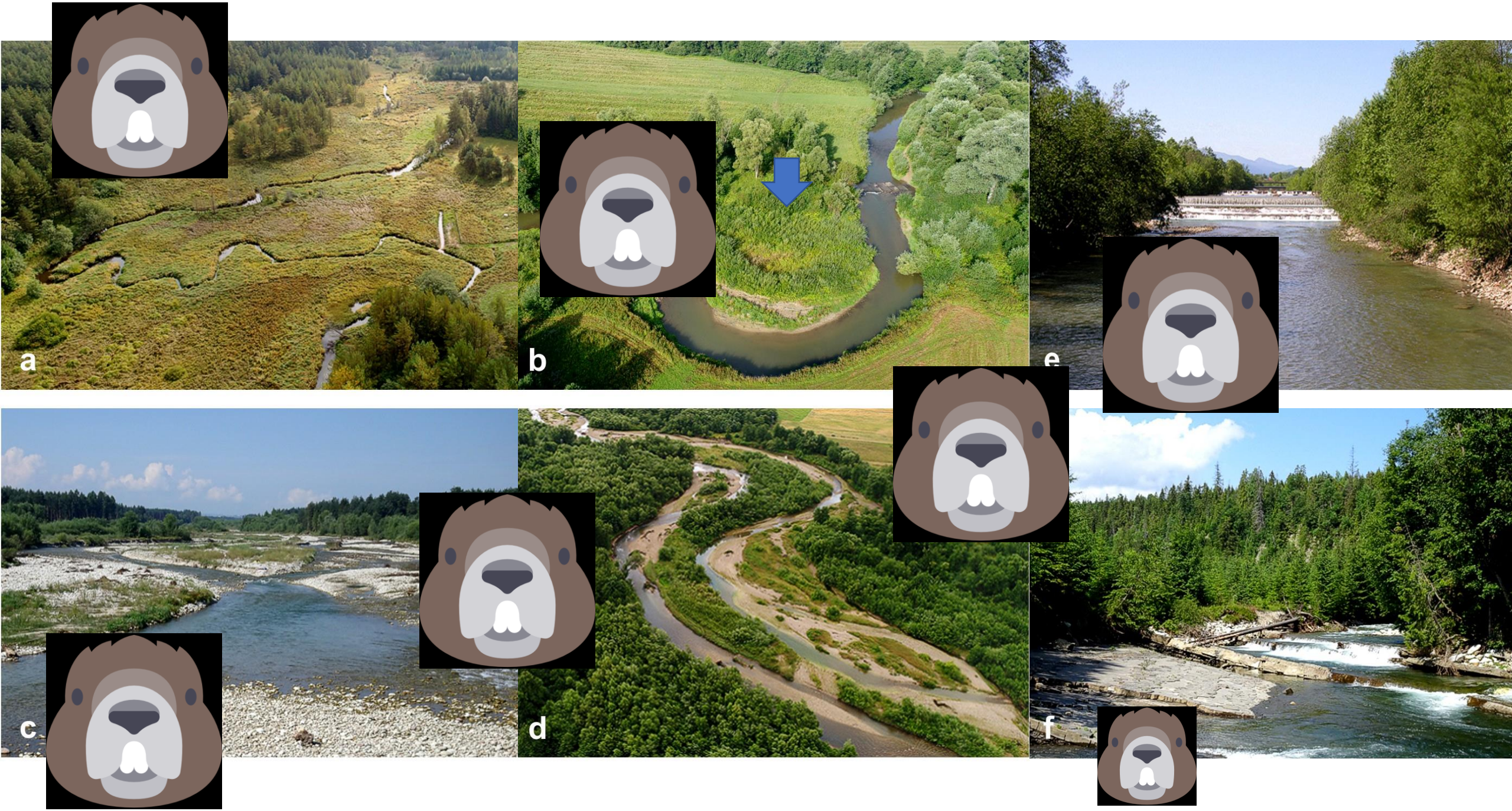


Liro et al., 2022. STOTEN

Towards a geography of plastic fragmentation M Liro, A Zielonka Microplastics and Nanoplastics 5 (1), 1-5		2025
Plastic-wood jams: macroplastic deposition on woody debris in a Mediterranean mountain river and its similarities to temperate ecosystems M Liro, L Gallitelli Hydrobiologia, 1-11		2025
Rivers as microplastic factories M Liro, A Zielonka, H Hajdukiewicz, A Czajka, P Mikuś, J Dzida, C Russell Environmental Research Letters 20 (5), 051005		202
Field experiment confirms high macroplastic trapping efficiency of wood jams in a mountain river channel M Liro, P Mikuś, A Zielonka Scientific Reports 15 (1), 2933		202
From roads to rivers: Field experiments on road-related macroplastic input to mountain river system W Haska		202
Monitoring macroplastics in aquatic and terrestrial ecosystems: Expert survey reveals visual and drone-based census as most effective techniques L Gallitelli, P Girard, U Andriolo, M Liro, G Suaria, C Martin, AL Lusher, ... Science of The Total Environment 955, 176528	10	202
Do river garbage patches exist? L Gallitelli, M Liro Frontiers in Environmental Science 12, 1480391	3	202
First attempt to measure macroplastic fragmentation in rivers M Liro, A Zielonka, P Mikuś Environment International 191, 108935	5	202
Conceptual framework for exploring riverine macroplastic fragmentation M Liro, A Zielonka, THM van Emmerik	1	202
Road-related macrolitter input to mountain river: the case of the Kamienica Gorczańska stream in Polish Carpathians W Haska, M Liro, E Gorczyca EGU General Assembly Conference Abstracts, 14992		2024
Field methods for studying macroplastic pollution in rivers M Liro, A Czajka, H Hajdukiewicz, W Haska, A Zielonka, J Dzida, P Mikuś, ...		2024
Experimental method for quantifying macroplastic fragmentation in rivers M Liro, A Zielonka, P Mikuś EarthArXiv		2024
Macroplastic pollution hotspots across global mountain river catchments A Zielonka, M Liro EGU General Assembly Conference Abstracts, 20411		2024
Macroplastic fragmentation in rivers M Liro, A Zielonka, THM van Emmerik Environment International 180, 108186	33	2023
Litter Selfie: A citizen science guide for photorecording macroplastic deposition along mountain rivers using a smartphone M Liro, A Zielonka, H Hajdukiewicz, P Mikuś, W Haska, M Kieniewicz, ... Water 15 (17), 3116	6	2023
Mountains of plastic: Mismanaged plastic waste along the Carpathian watercourses M Liro, A Zielonka, THM van Emmerik, M Grodzińska-Jurczak, J Liro, ... Science of the Total Environment 888, 164058	10	2023
Field experiment on transport and deposition of plastic bottles along mountain river M Liro, P Mikuś, Z Anna, M Kieniewicz EGU General Assembly Conference Abstracts, EGU-11175		2023
Macroplastic fragmentation in rivers L Maciej, Z Anna, HM van Emmerik Tim Environment International 180		2023

Wood-plastic interactions

highly ecologically valuable, wide river sections are also macroplastic ’traps’

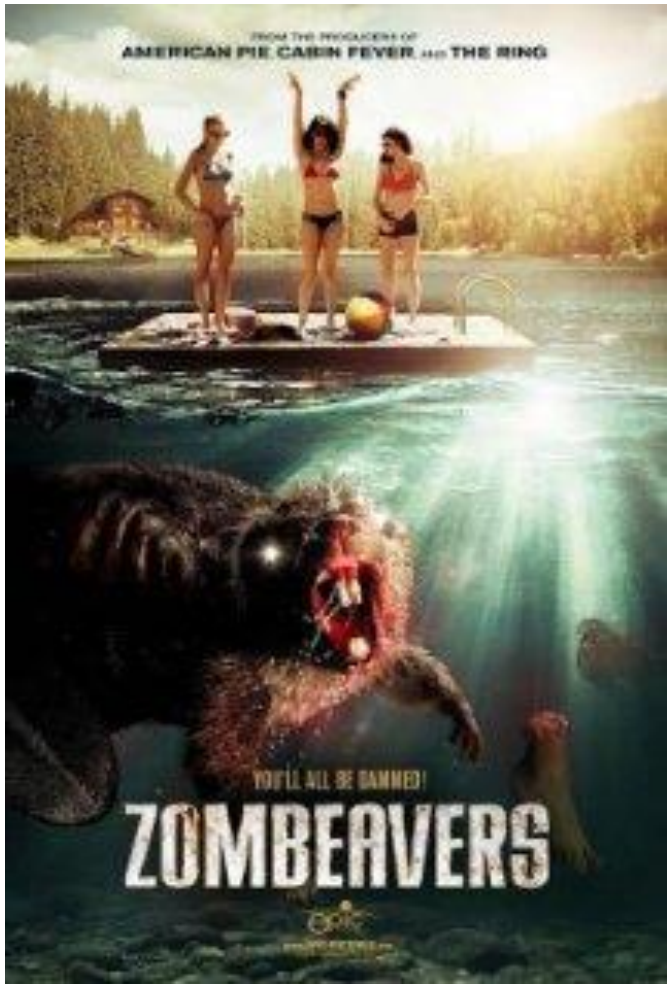

a
b
e
c
d
f

Ecosystem engineers: the return of the beaver

- restoration of lateral connectivity
- maintenance of habitats for other species within previously disconnected and modified floodplains
- restoration of vegetation diversity
- storage of water within floodplain areas
- overall increase in biodiversity
- RAPID restoration of ditches and melioration system in peat covered areas
- re-wetting and restoration of valley floor water storage
- increased rates of deposition of fine material
- facilitating lateral mobility

Ecosystem engineers or zombeavers?

- Changes to woodland and river morphology
- Selective removal of species
- Culvert blockage
- Tunnel digging
- Local flooding
- blamed for destruction of embankments



other initiatives

- ESD involvement - ESD expert network
- Heritage interpretation
- Peace Park initaitive
- Summer/winter schools and courses