MarILCA
MARINE IMPACTS IN LCA

November 4th, 2022

Learnings from MarILCA and case study applications integrating microplastics impacts into LCA

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POLYTECHNIQUE MONTRÉAL

The process – MarILCA (Marine Impacts in LCA)

- International scientific committee founded in 2018
- Coordinates harmonized research efforts among organizations across the globe
- Goal: Integrating impacts of marine litter, especially plastic, into LCA

MarILCA
MARINE IMPACTS IN LCA

Life Cycle Initiative

FSLCI
Forum for Sustainability through Life Cycle Innovation

CIRAIG™

PUCP

NTNU

Prof. Anne-Marie Boulay

Prof. Ian Vázquez-Rowe

Prof. Francesca Verones

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Work plan

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Phase 1
2019

- Framework paper developing and illustrating the different impact pathways associated with (plastic) marine litter and identification of gaps and building blocks
- Paper submission planned for Summer/Fall 2019

Phase 2
2020-2022

- Coordination and launch of different research projects filling identified gaps
- Act as central reference aiming to avoid scientific overlap
- Members welcome who are working and contributing on the topic.
- Findings and updates will be regularly discussed with stakeholders vi an online platform, as well as digital and physical workshops.

Phase 3
2022-2025

- Consensus building process: Delivery of a harmonized and consensus-based impact pathway framework and methods addressing plastic litter impacts (and potentially other complementary marine impacts) in LCA
- Joint participation with GLAM (Global Guidance for Life Cycle Impact Assessment Indicators and Methods) project of Un Environment Life Cycle Initiative

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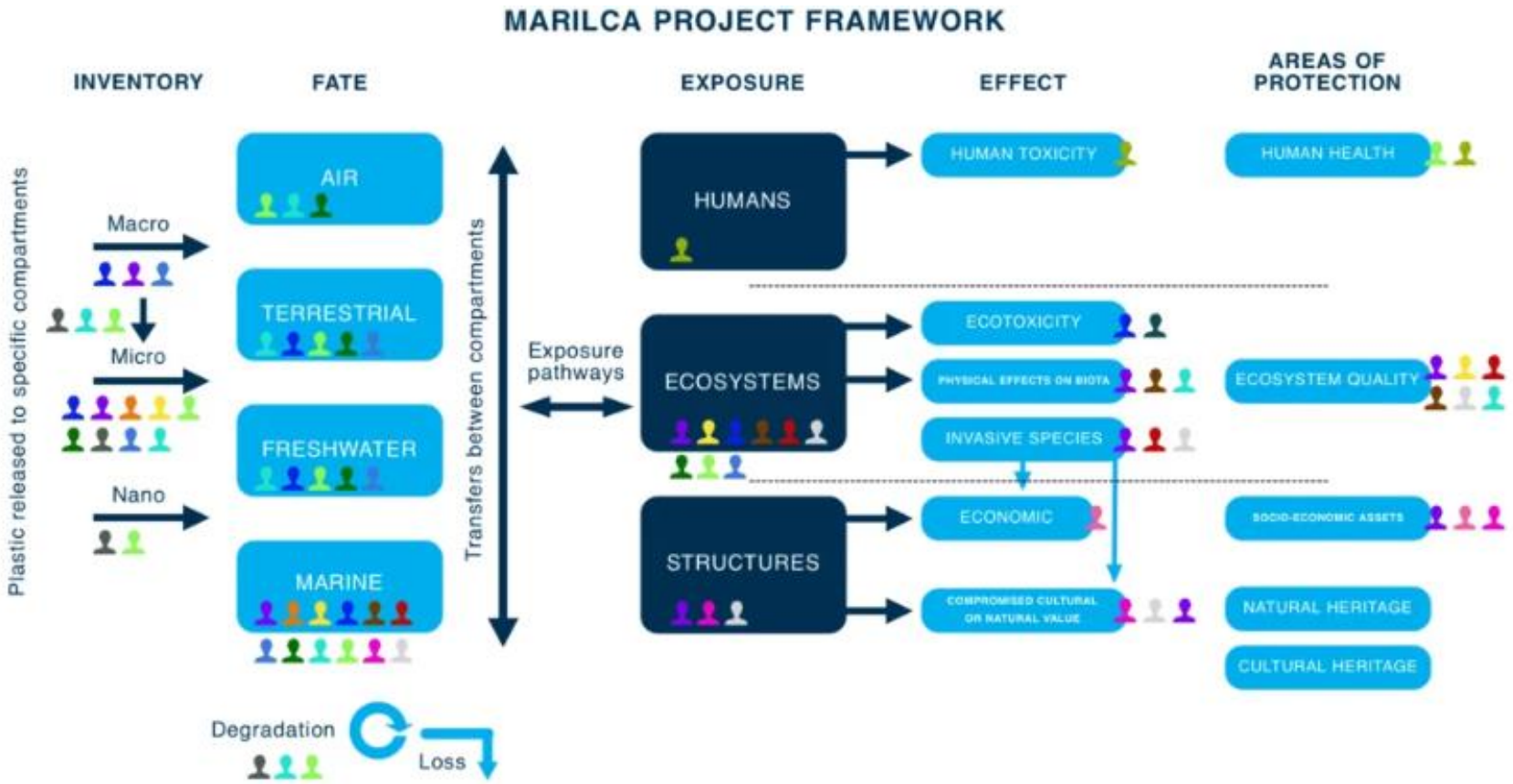
MarILCA framework and contributors

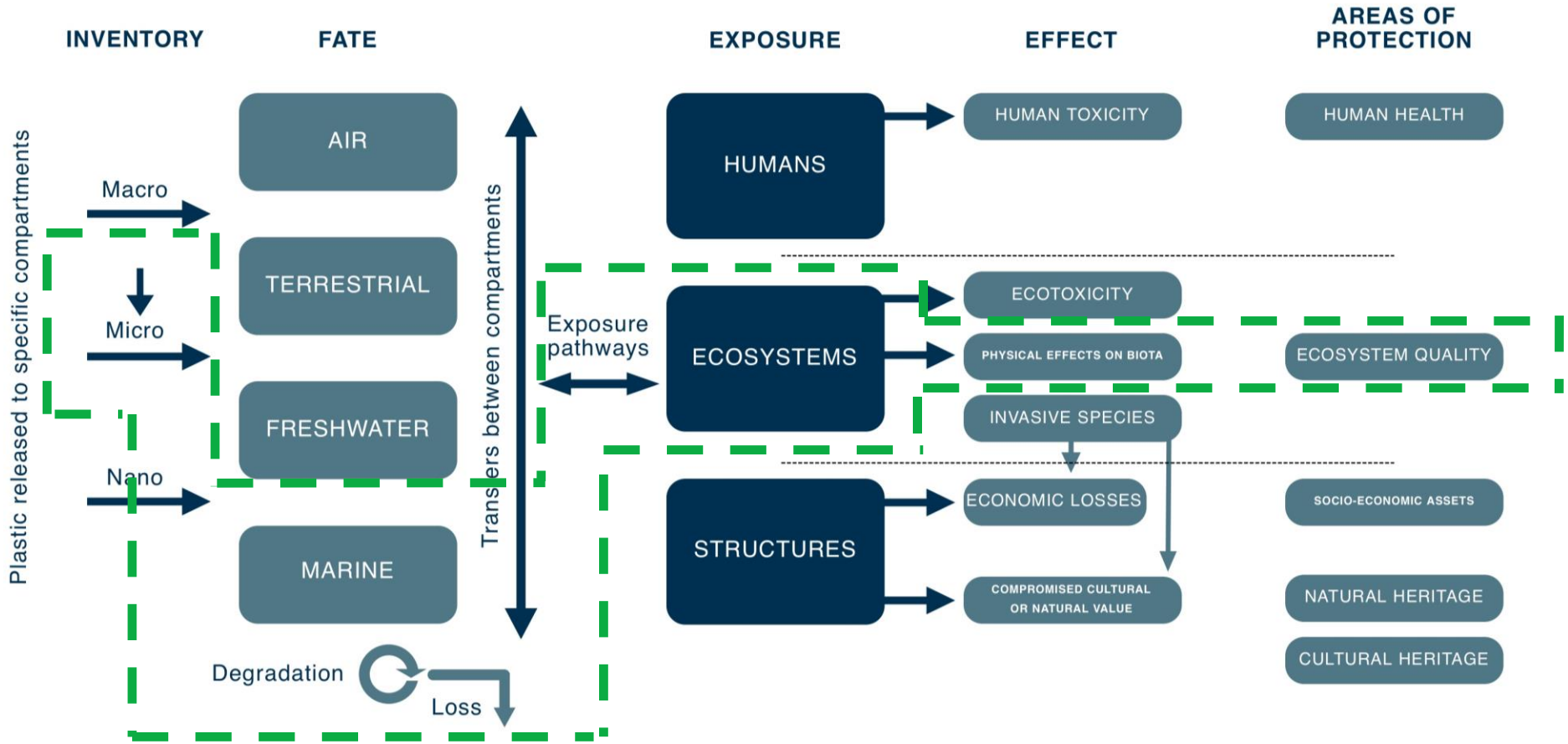


ACTIVE PROJECTS BY MARILCA PARTNERS WITHIN THE PROJECT FRAMEWORK

- CIRAIG | A. Boulay
- CIRAIG | Y. Tang
- NTNU | P. Gjedde
- NORSUS | C. Askham
- CIRAIG | E. Corella Puertas
- DTU | O. Jolliet
- NTNU | M. A. Høiberg
- NTNU | V. Pauna
- CIRAIG | C. Hajjar
- NTNU | F. Verones
- NTNU | A. Marhoon
- NOVA | Naiara
- CIRAIG | L. Ospital
- NTNU | M. Dorber
- NTNU | F. Song
- PUCP | D. Ita-Nagy

From www.marilca.org

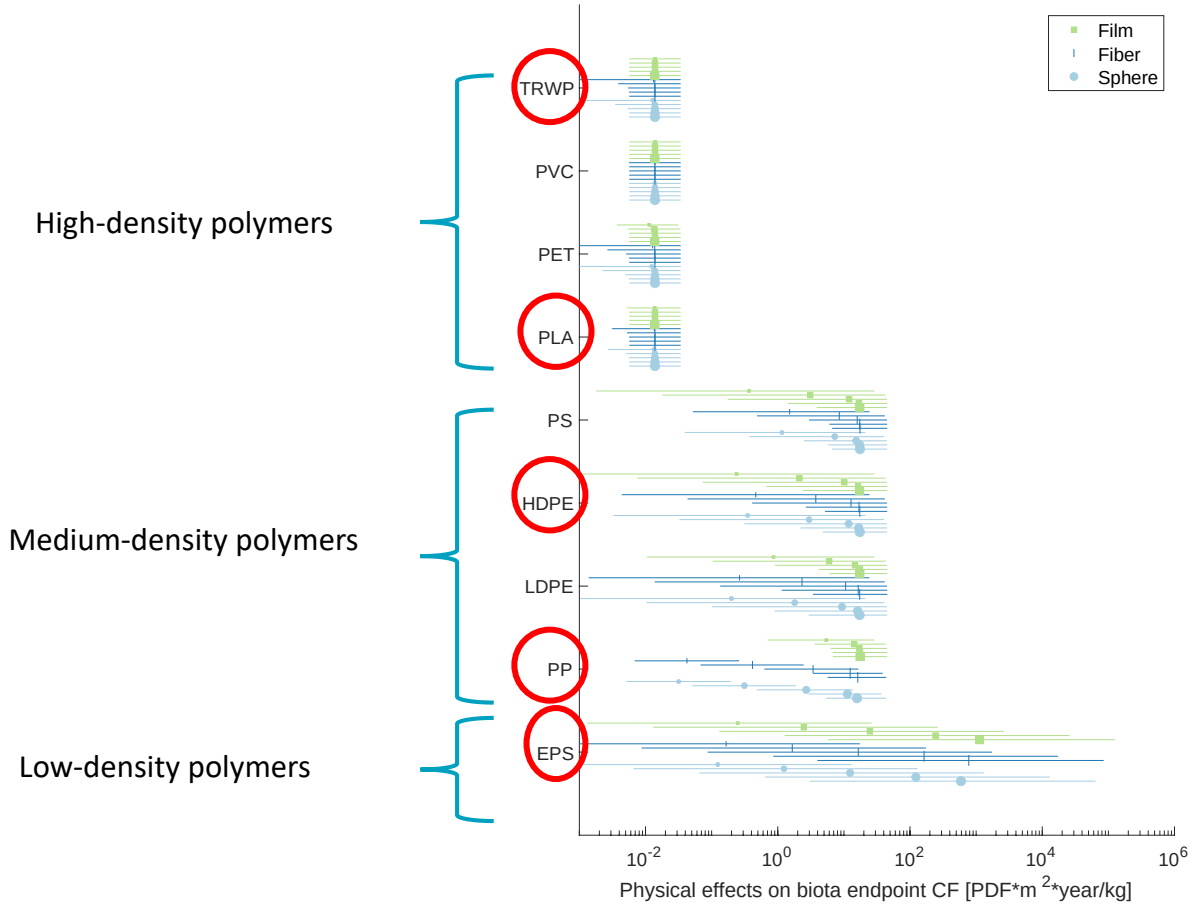
MarILCA framework - application of microplastics CF



Adapted from Woods, J. S., Verones, F., Jolliet, O., Vázquez-Rowe, I., & Boulay, A. (2021). A framework for the assessment of marine litter impacts in life cycle impact assessment. *Ecological Indicators*, *129*, 107918.

Application of CFs

- From Corella et al (in preparation) results
- For microplastic emissions to the marine environment
- Based on existing case studies



- Corella et al, in preparation

Application to case studies

UNEP report on supermarket food packaging:

1. To-go food containers
   - EPS vs bagasse vs wood pulp
   - Cradle-to-grave (Corella-Puertas et al. 2022)

2. Fresh produce (lettuce) bags
   - PP vs PLA
   - Microplastic impacts added to Vigil et al. 2020

3. Reusable fruit crates
   - PP vs HDPE vs cardboard
   - Microplastic impacts added to Abejón et al. 2020

References in: UNEP. (2022). Single-use supermarket food packaging and its alternatives: Recommendations from life cycle assessments.

Plastics inventory (Plastic Leak Project)

Identifying and quantifying sources of marine microplastic emissions:

I. Primary microplastics (pellets) at the **production stage**
   - 70% of emissions to freshwater are transported to marine water

II. Secondary microplastics from macroplastics leaked at the **end-of-life stage**
   - Macroplastics leakage depends on region (HIC, UMC, LMC, LIC)
   - Residual value identified (high for reusable crates, low for lettuce bags and to-go food containers)
   - Different macroplastic fragmentation scenarios tested (10%, 50%, 100%)

III. TRWP from tire abrasion at the **transportation stage**
   - Only quantified for to-go food container study
   - TRWP << other microplastic sources

Quantis and EA. (2020). Plastic Leak Project - Methodological Guidelines, *v1.3*(May).

Microplastics inventory

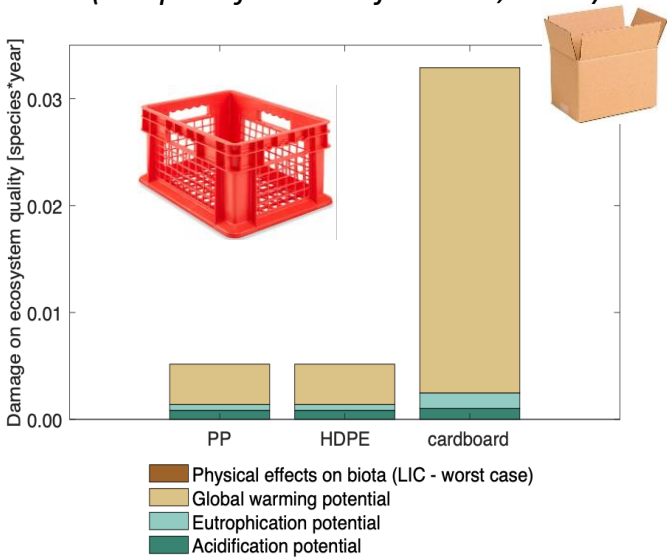
Case study	Polymer	Production stage (pellets)	End-of-life stage (100% macroplastic fragmentation)	Transportation stage (tire abrasion)
		kg emitted/ kg produced	kg emitted/ kg waste	kg emitted/ (kg product*km)
To-go food containers (1 container) *Corella-Puertas et al. 2022*	EPS	1.20E-05	7.45E-03	N/A
	TRWP	N/A	N/A	5.17E-10
Bags for fresh-cut produce (1 bag)* *Vigil et al. 2020*	PLA	1.20E-05	2.49E-01	N/A
	PP	1.20E-05	2.39E-01	N/A
Reusable fruit and vegetable crates* (100668 crates) *Abejon et al. 2020*	HDPE	1.20E-05	9.55E-03	N/A
	PP	1.20E-05	9.55E-03	N/A

*Leakage in low-income countries (worst-case scenario)

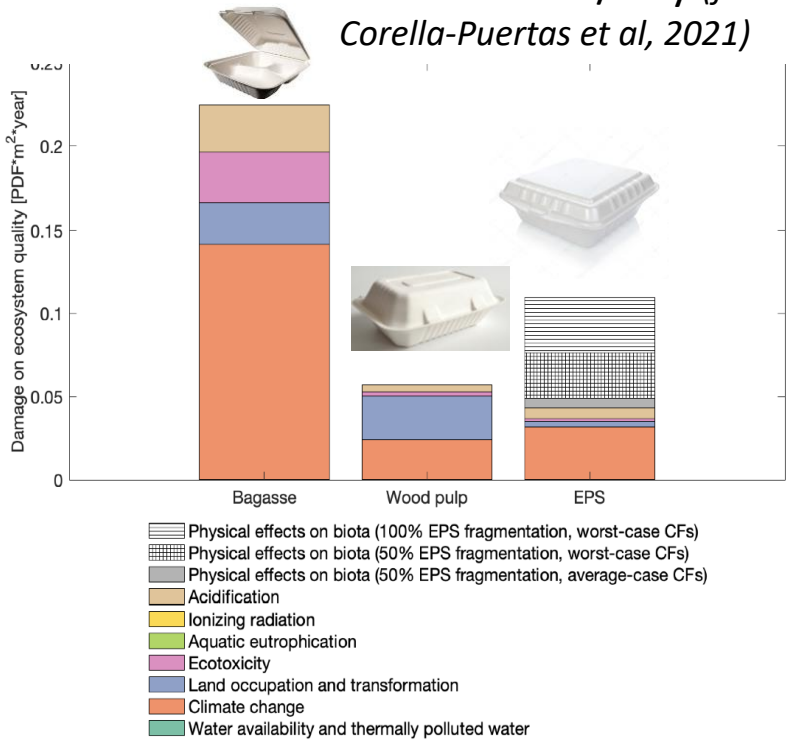
Applications in Case studies – UN Report (October 2022)

- Only “worst case” EPS seem to potentially influence conclusions (low density, slow degradation) → contribution negligible for other case studies so far
- Limits: only microplastics impacts in ocean considered (not macroplastic effect of entanglement/ingestion yet, not additives toxicity)

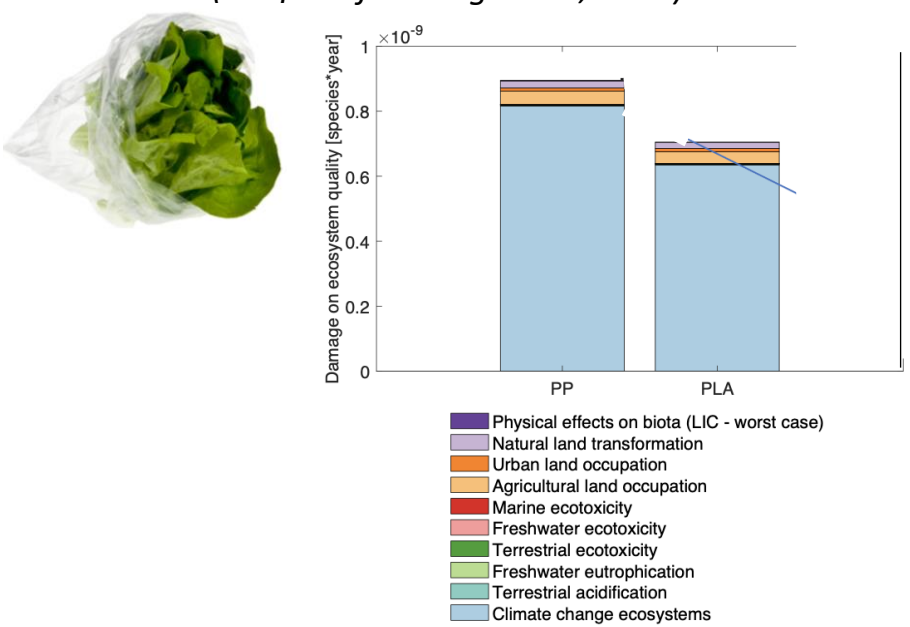
Reusable crates
(adapted from Abejon et al, 2020)



Food container/tray *(from Corella-Puertas et al, 2021)*



Lettuce bags
(adapted from Vigil et al, 2020)



The outcome – preliminary findings

→ For all case studies performed so far, only EPS impacts have the potential to change the outcome of an LCA

→ Impacts from macroplastic entanglement, additives leaching, not included

→ Most (single use) alternatives to single-use plastic perform worse than the single-use plastic item

→ Global warming remains the most important impact category for ecosystem quality damages

Conclusions & outlook

- CF for *physical effects on biota* of microplastic emissions were proposed for 9 polymers, 3 shapes and 5 sizes and applied to case studies
- Ongoing work on sedimentation and fragmentation modelling, human health impacts
- Upcoming work on soil, air and freshwater fate, regionalisation, additives impacts

Merci!
Questions?

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The missing piece of plastic litter