Le micro e nanoplastiche come contaminanti emergenti: problematiche e casi di studio

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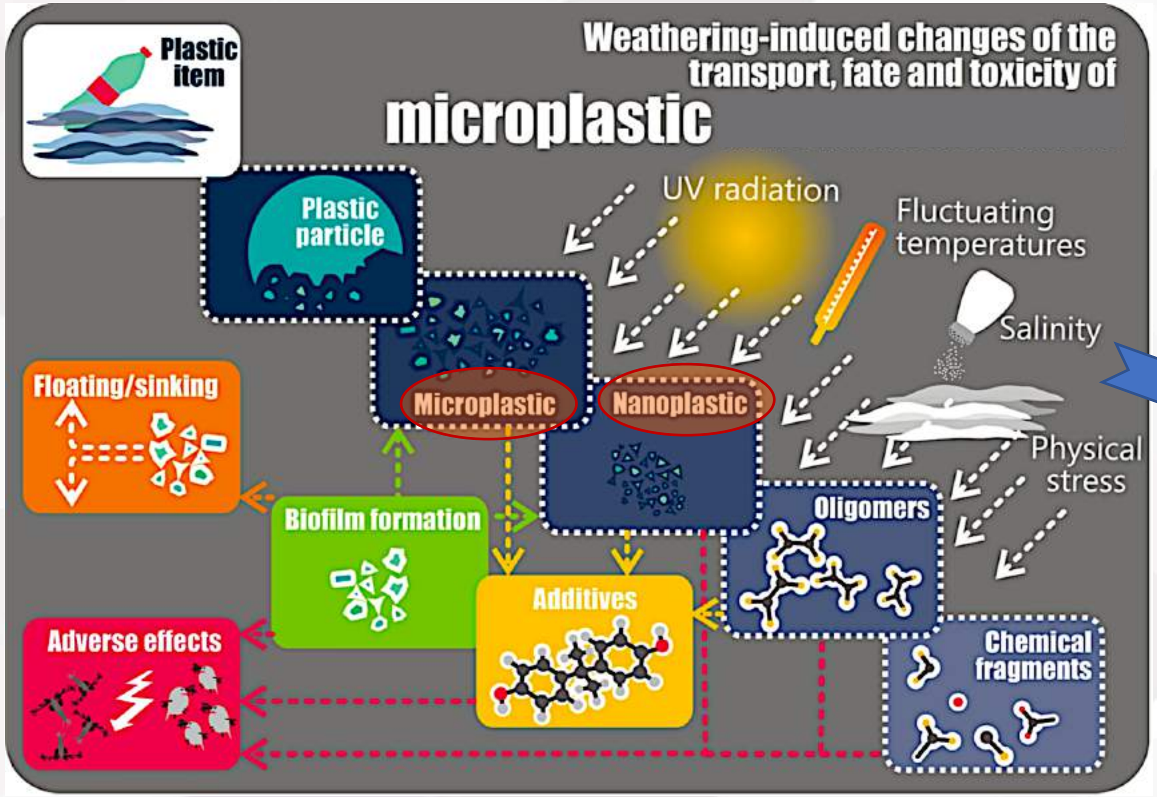
CENTRO ITALIANO PER LA RIQUALIFICAZIONE FLUVIALE
6 maggio 2022

LE MICRO E NANOPLASTICHE

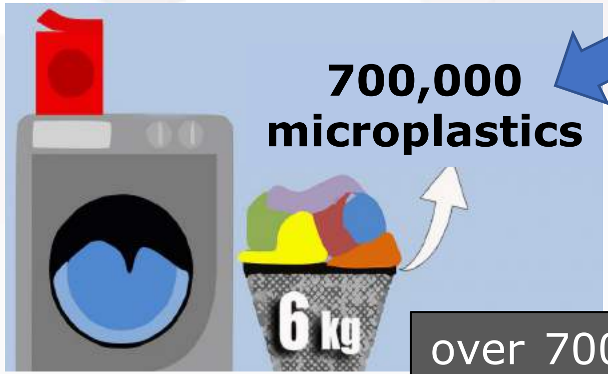


ORIGINE PRIMARIA

SCRUBS, DENTIFRICI, COSMETICI

ORIGINE SECONDARIA

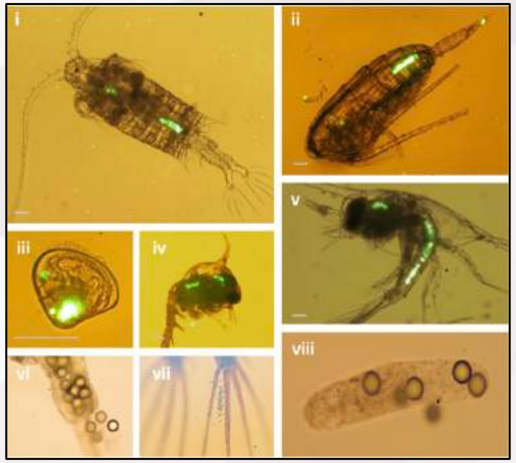
BOTTIGLIE IN PLASTICA, POSATE, PIATTI, BICCHIERI, RETI DA PESCA, PELLETS, BORSE DELLA SPESA, PRODOTTI PER LA CASA, LAVAGGI D'INDUMENTI SINTETICI



over 700,000 fibers could be released from an average 6 kg wash load of acrylic fabric

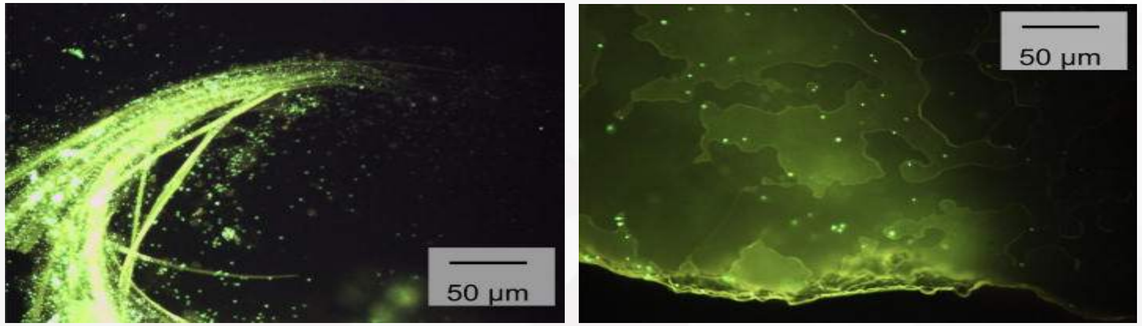
Napper and Thompson 2016

COSA CONOSCIAMO DELLE MICRO- E NANOPLASTICHE?

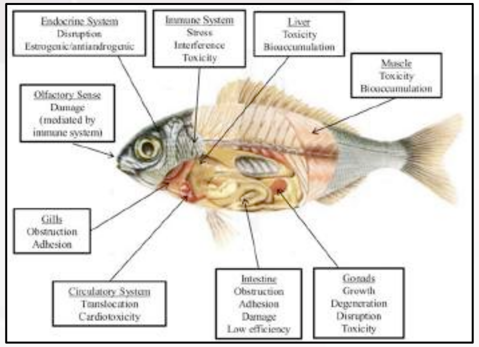


Sono in grado di entrare negli organismi

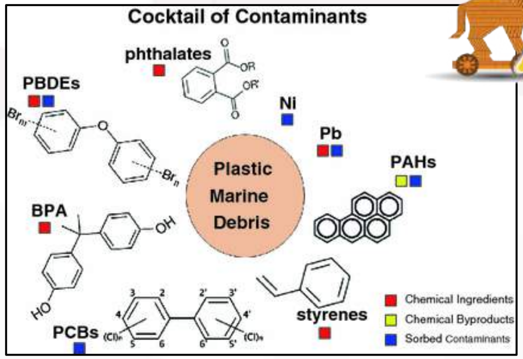
from mussels to crabs (Farrell and Nelson, 2013)



Possono essere trasportate lungo la catena alimentare



Posseggono una tossicita' intrinseca



Trojan horse effect

Possono adsorbire contaminanti chimici e microrganismi (patogeni?)

COME SI STUDIANO GLI EFFETTI DOVUTI ALLE MICRO- E NANOPLASTICHE?

Studi di laboratorio

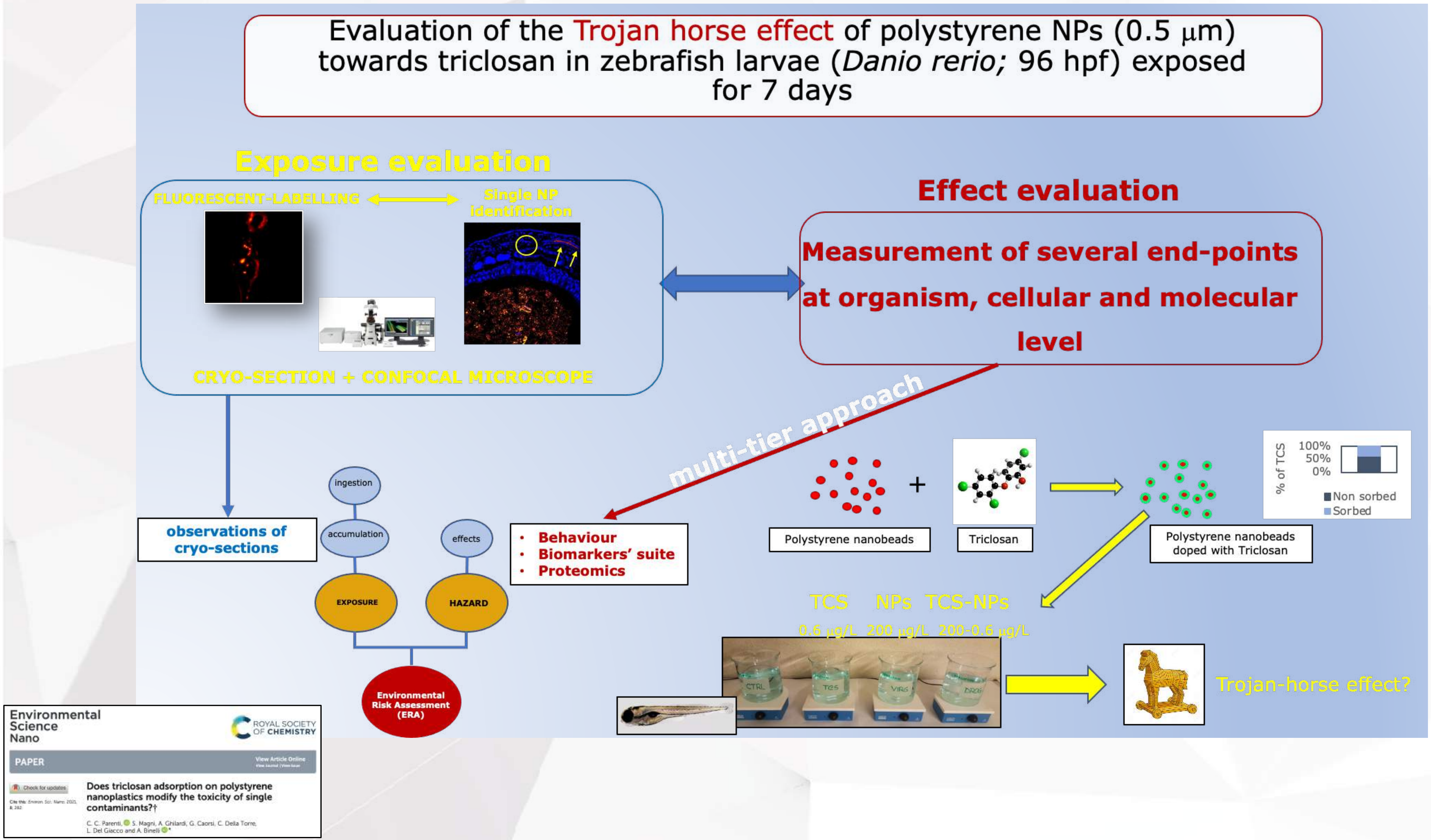
Studi di campo

Gli studi in laboratorio sono indispensabili per valutare le diverse condizioni di assunzione delle plastiche, la loro capacità di infiltrazione nei tessuti, il bioaccumulo e i meccanismi d'azione della loro eventuale tossicità, ma hanno una bassa relazione con i potenziali effetti dovuti alle miscele plastiche presenti in ambiente.

Negli esperimenti di laboratorio si utilizzano generalmente particelle plastiche di **un solo polimero** e con **una sola dimensione e forma**

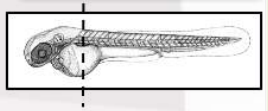
Solo il **17%** degli studi in laboratorio sono condotti con concentrazioni ambientali di plastiche. Generalmente le concentrazioni saggiate in laboratorio sono maggiori anche di alcuni ordini di grandezza.

Bucci et al., 2020


Evaluation of the Trojan horse effect of polystyrene NPs (0.5 μm) towards triclosan in zebrafish larvae (Danio rerio; 96 hpf) exposed for 7 days
Exposure evaluation
FLUORESCENT-LABELLING
Single NP identification
CRYO-SECTION + CONFOCAL MICROSCOPE
Effect evaluation
Measurement of several end-points at organism, cellular and molecular level
multi-tier approach
observations of cryo-sections
ingestion
accumulation
effects
EXPOSURE
HAZARD
Environmental Risk Assessment (ERA)
Behaviour
Biomarkers' suite
Proteomics
Polystyrene nanobeads
+
Triclosan
Polystyrene nanobeads doped with Triclosan
% of TCS
100%
50%
0%
Non sorbed
Sorbed
TCS
NPs
TCS-NPs
0.6 μg/L
200 μg/L
200-0.6 μg/L
CTRL
TCS
VIRG
DROG
Trojan-horse effect?
Environmental Science Nano
ROYAL SOCIETY OF CHEMISTRY
PAPER
View Article Online
Check for updates
Cite this: Environ. Sci.: Nano, 2021, 8, 282
Does triclosan adsorption on polystyrene nanoplastics modify the toxicity of single contaminants?†
C. C. Parenti, S. Magni, A. Ghilardi, G. Caorsi, C. Della Torre, L. Del Giacco and A. Binelli*

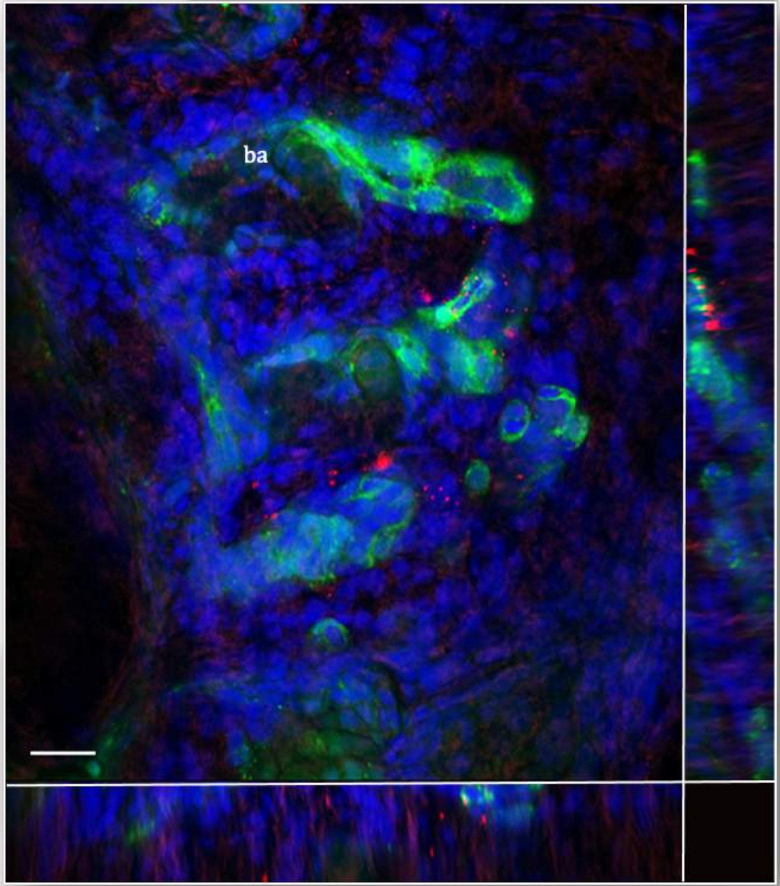
Confocal observations

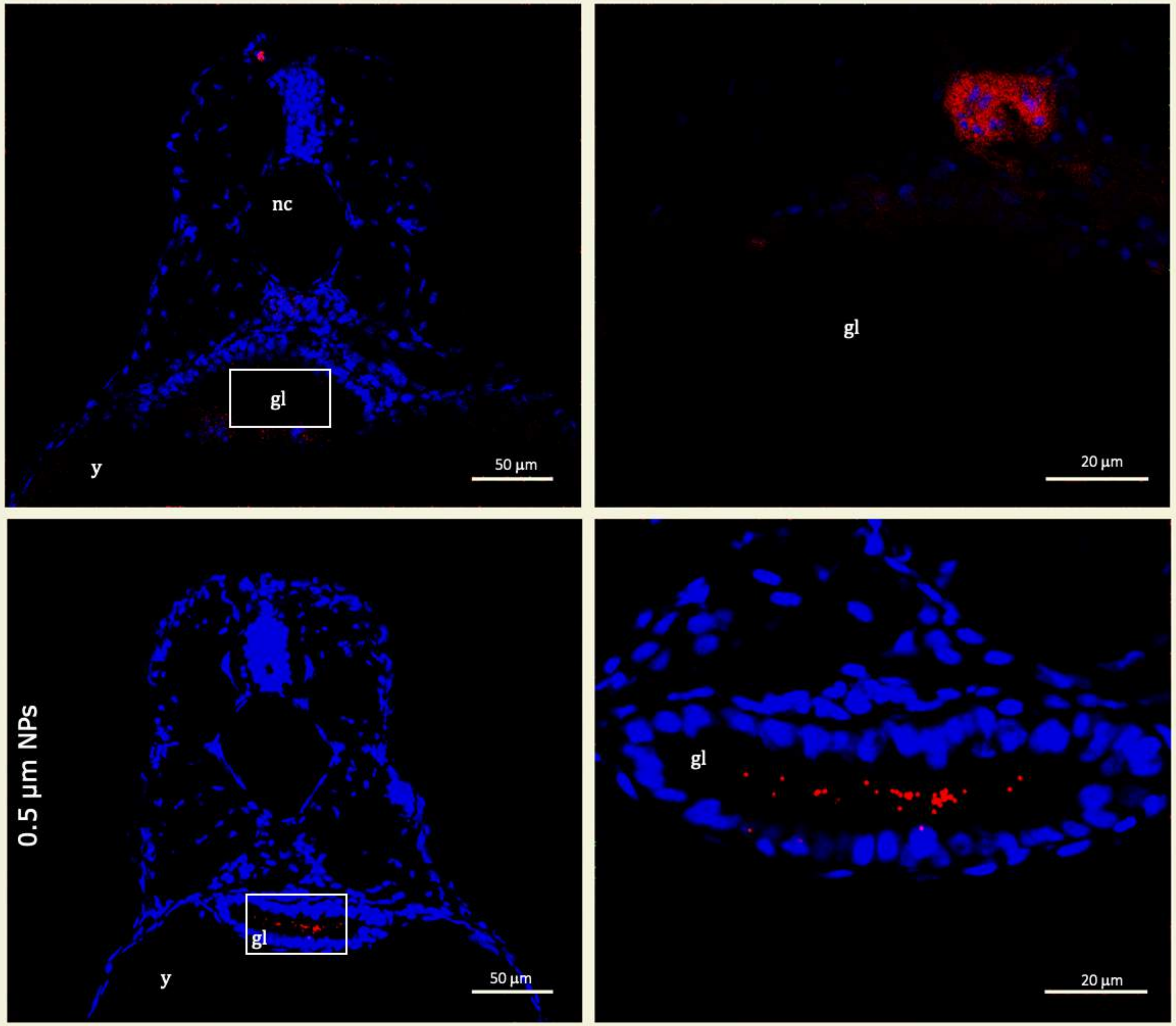
15 μm transversal sections

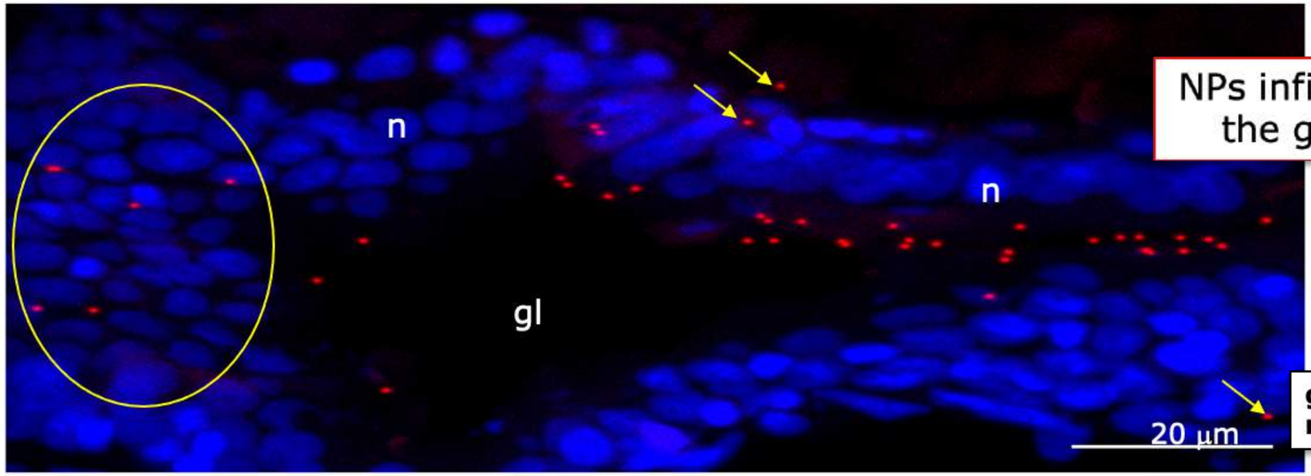


Intake routes:
gut, gills

ba: branchial arches; **gl**: gut lumen; **y**: yolk; **nc**: notochord



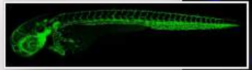




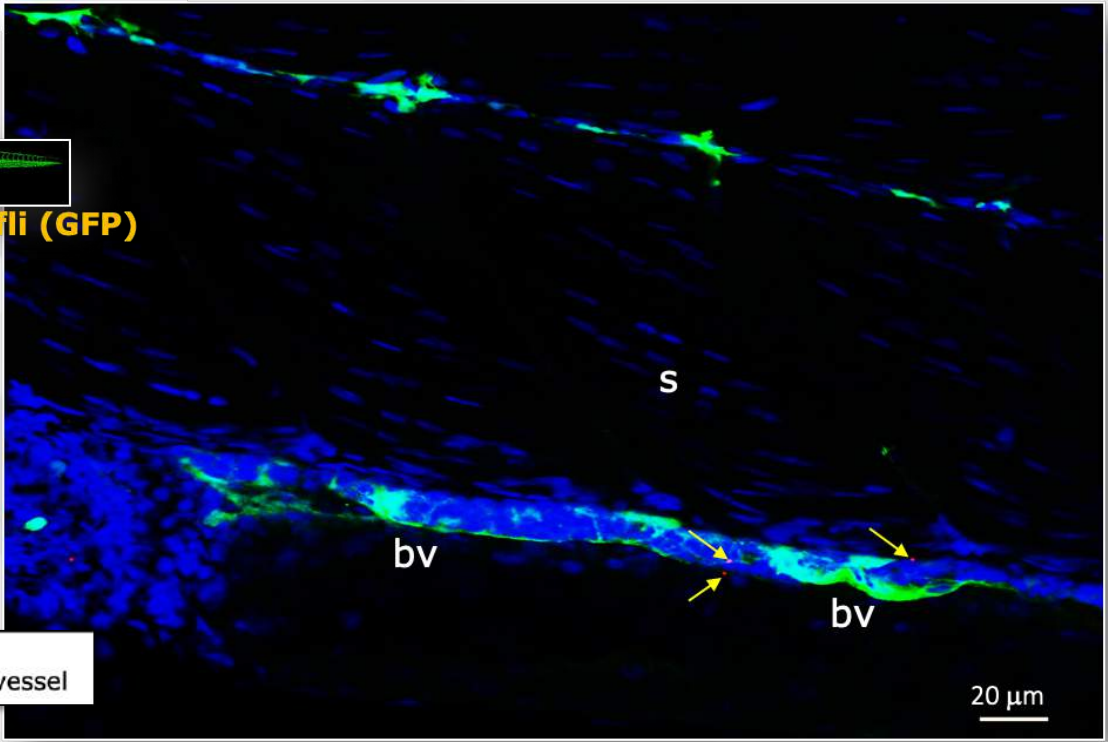
NPs infiltration through the gut epithelium

gl: gut lumen
n: cell nuclei (DAPI)

15 μm longitudinal section



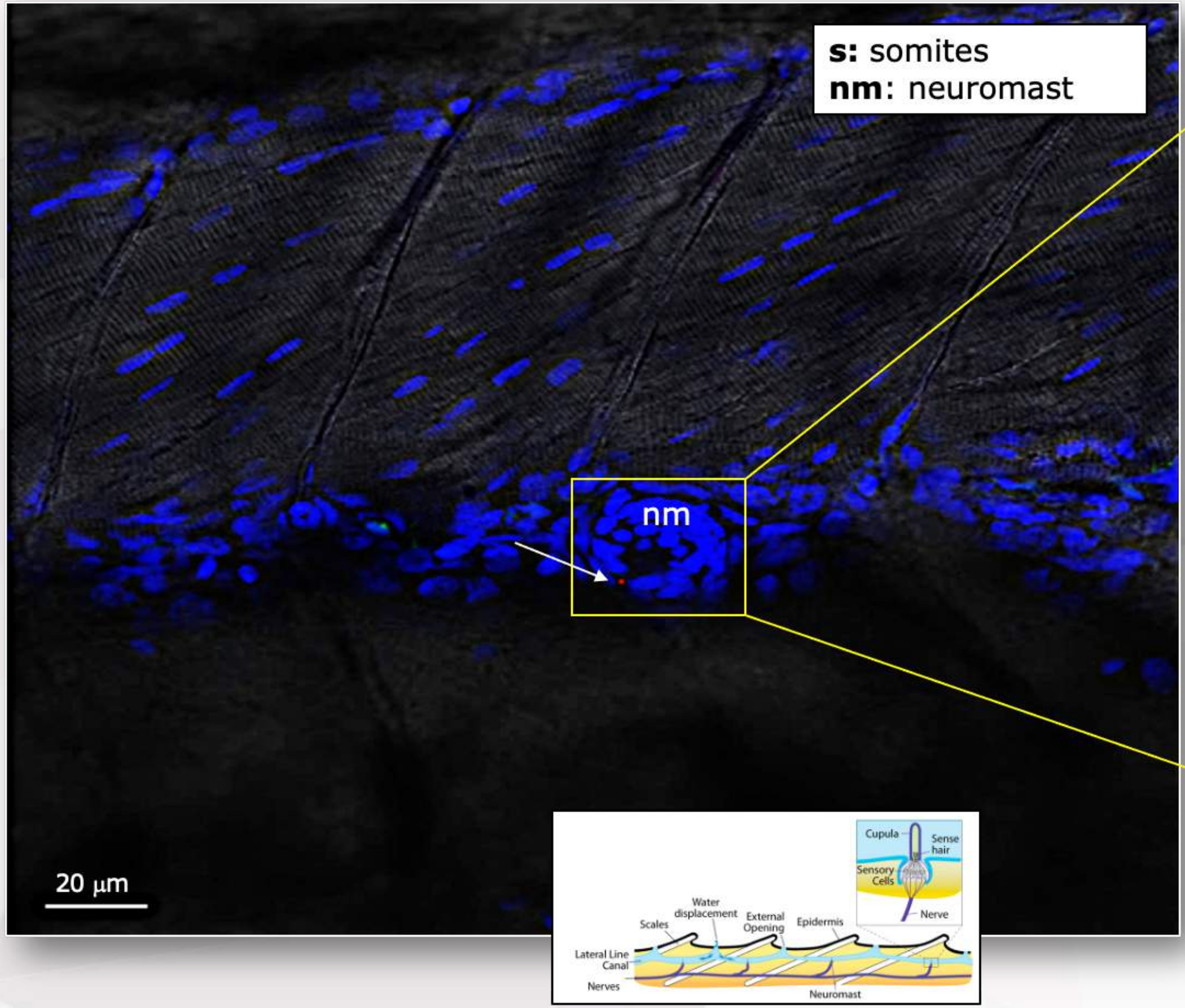
transgenic fli (GFP)

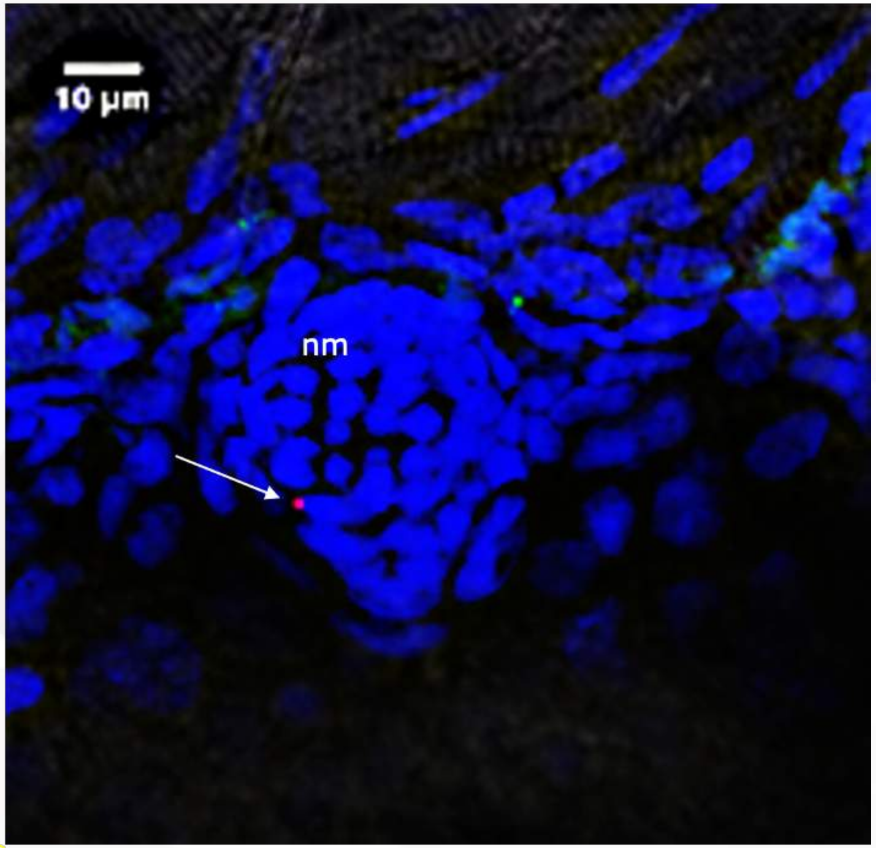


NPs are transported by blood vessels

s: somites
bv: blood vessel

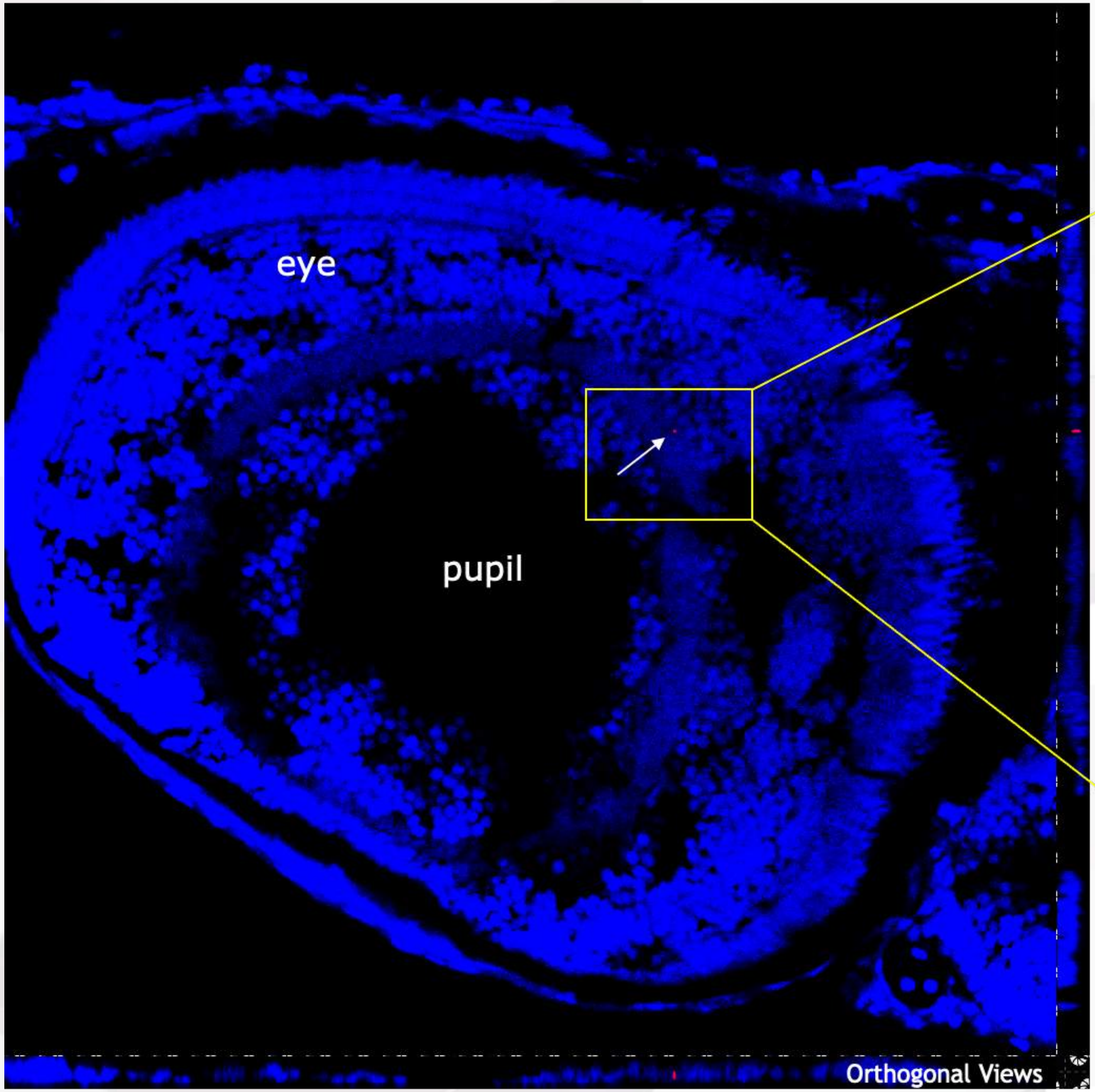
OBSERVATION OF A SINGLE NP IN THE NEUROMAST

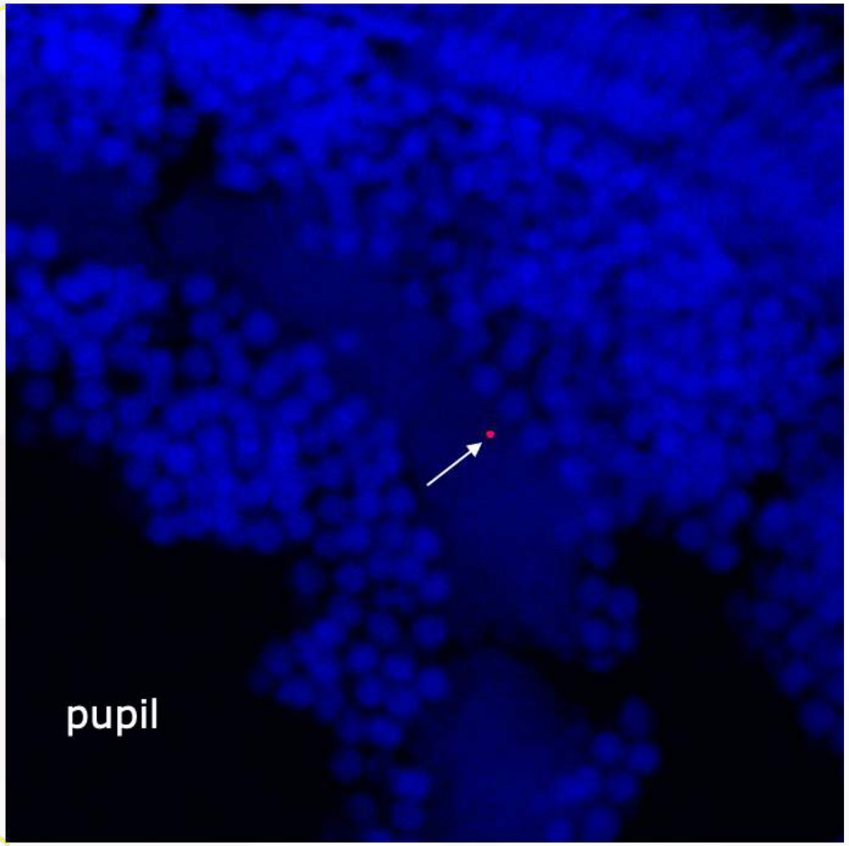




ALTERNATIVE INTAKE ROUTE OR TARGET FOR NPs?

OBSERVATION OF A SINGLE NP IN THE EYE

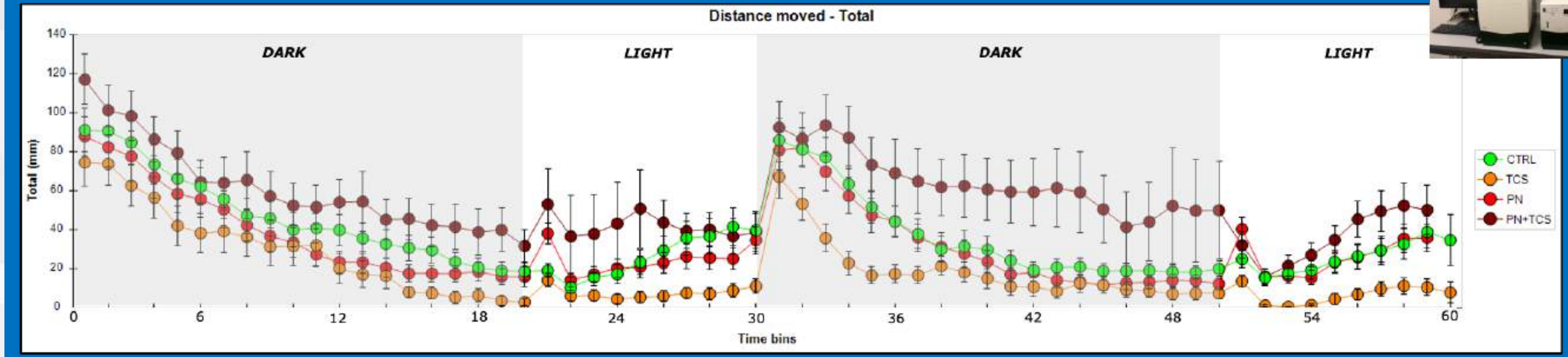


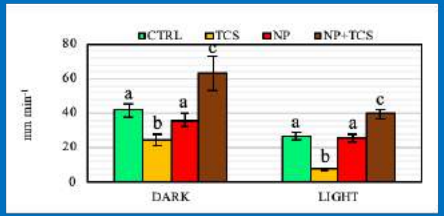


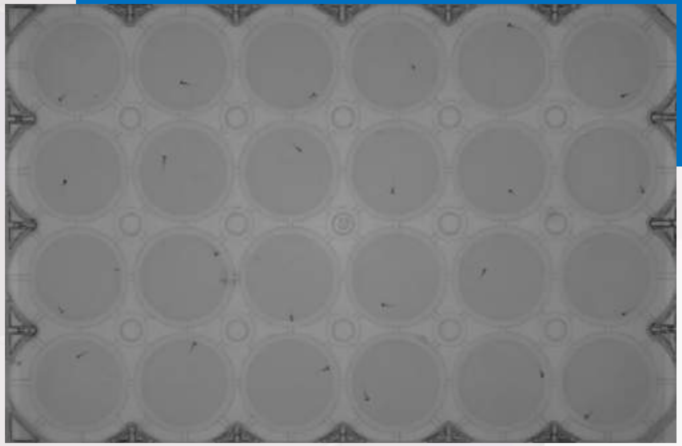
EVALUATION OF THE TROJAN-HORSE EFFECT

Swimming behaviour

Endpoints: total distance moved, mean velocity, absolute turn angle and angular velocity, for each embryo during 60 min dark/light cycle

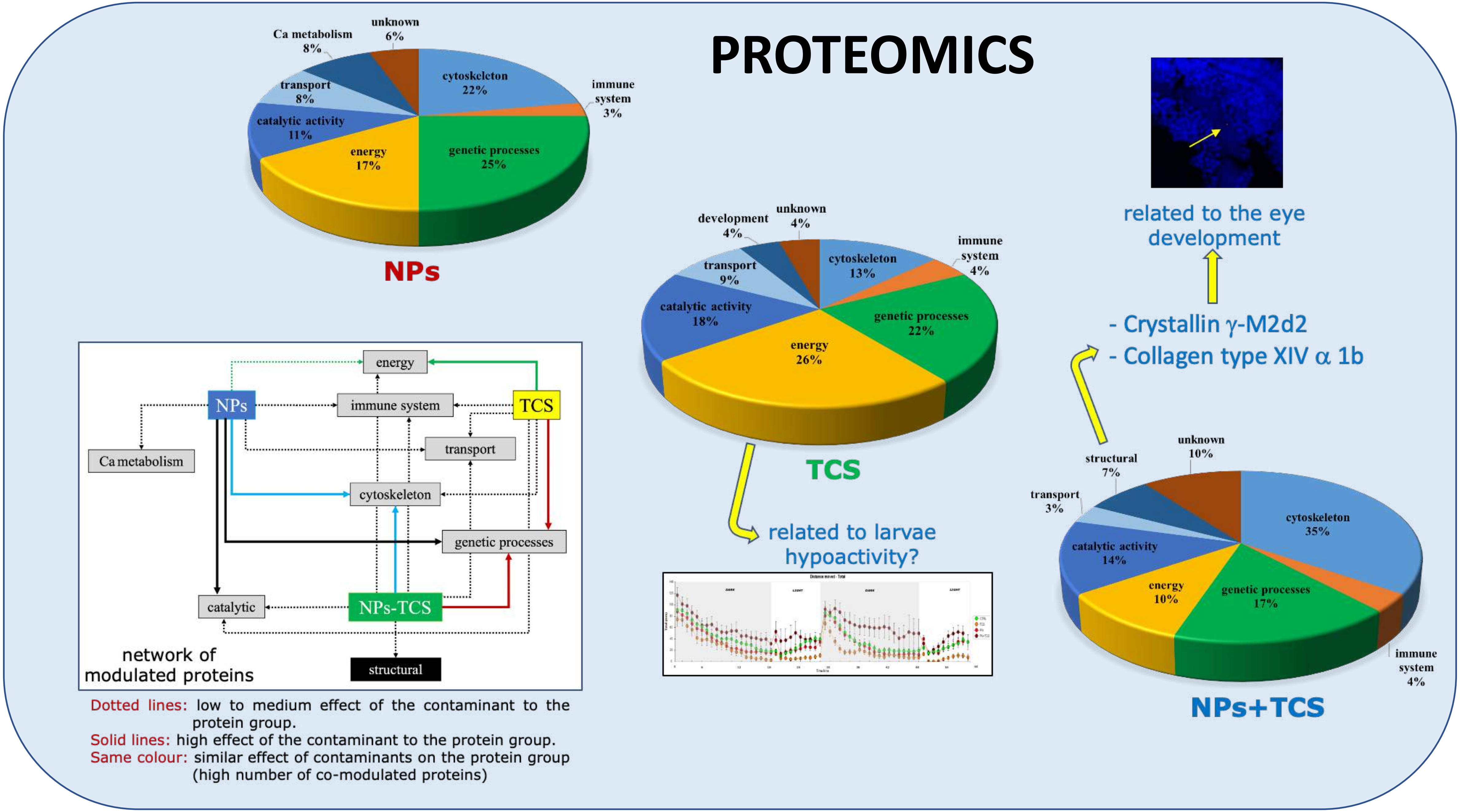




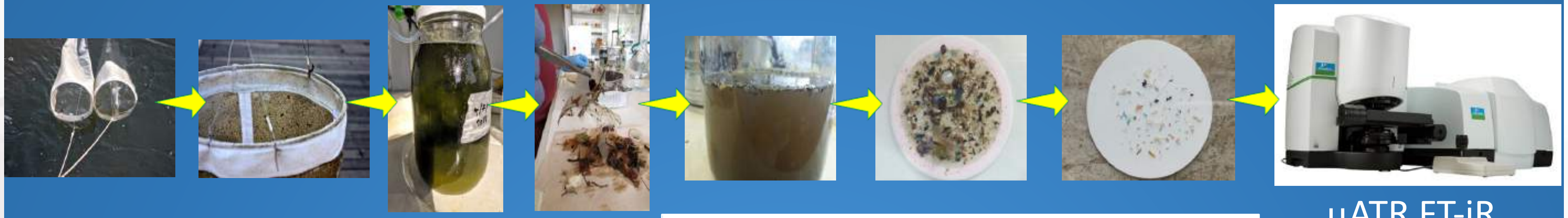


36 zebrafish larvae each treatment after 7 days of exposure

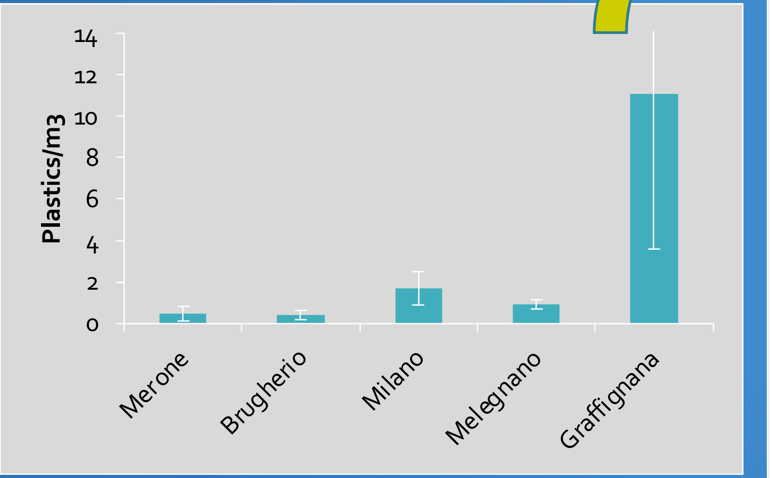
decrease of individual survival?


PROTEOMICS
unknown 6%
Ca metabolism 8%
transport 8%
catalytic activity 11%
energy 17%
genetic processes 25%
cytoskeleton 22%
immune system 3%
NPs
development 4%
unknown 4%
immune system 4%
transport 9%
cytoskeleton 13%
catalytic activity 18%
genetic processes 22%
energy 26%
TCS
related to larvae hypoactivity?
related to the eye development
- Crystallin γ-M2d2
- Collagen type XIV α 1b
unknown 10%
structural 7%
transport 3%
cytoskeleton 35%
catalytic activity 14%
energy 10%
genetic processes 17%
immune system 4%
NPs+TCS
energy
NPs
immune system
TCS
transport
Ca metabolism
cytoskeleton
genetic processes
catalytic
NPs-TCS
structural
network of modulated proteins
Dotted lines: low to medium effect of the contaminant to the protein group.
Solid lines: high effect of the contaminant to the protein group.
Same colour: similar effect of contaminants on the protein group (high number of co-modulated proteins)

Monitoraggio di plastiche lungo il Fiume Lambro

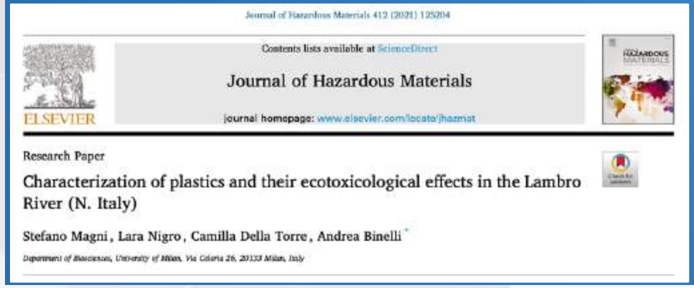


µATR FT-iR



Site	$Q_{average\ dec.}$
Merone	12.35 m3/s
Brugherio	12.35 m3/s
Milano	26.15 m3/s
Melegnano	36.08 m3/s
Graffignana	78.10 m3/s

Stima dell'apporto giornaliero del F. Lambro nel F. Po:
≈ 100 milioni di plastiche/giorno



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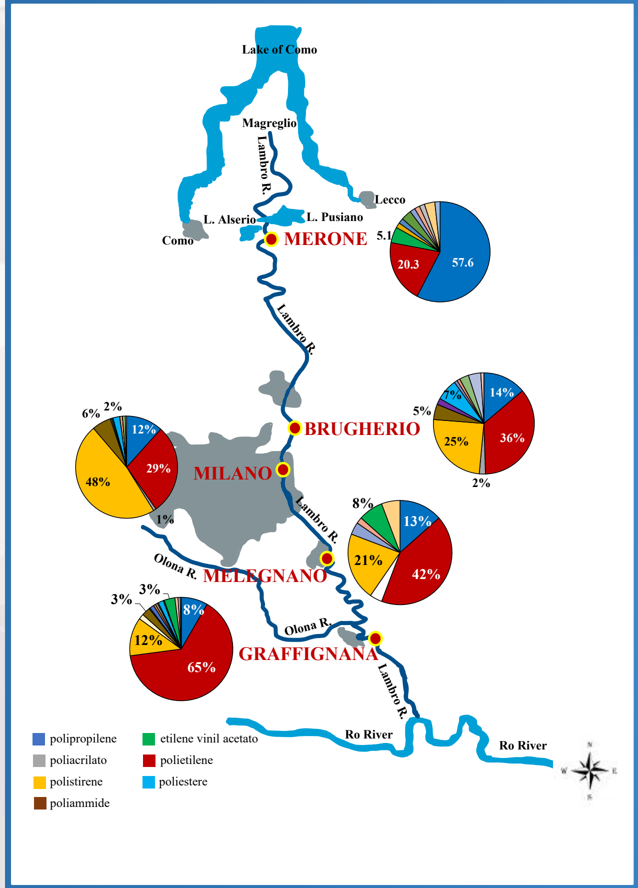
Research Paper

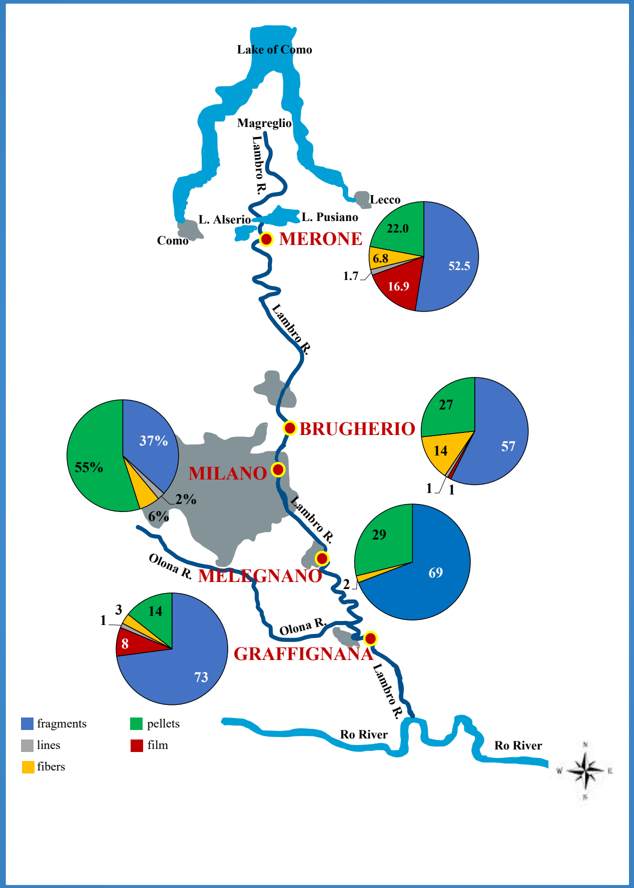
Characterization of plastics and their ecotoxicological effects in the Lambro River (N. Italy)

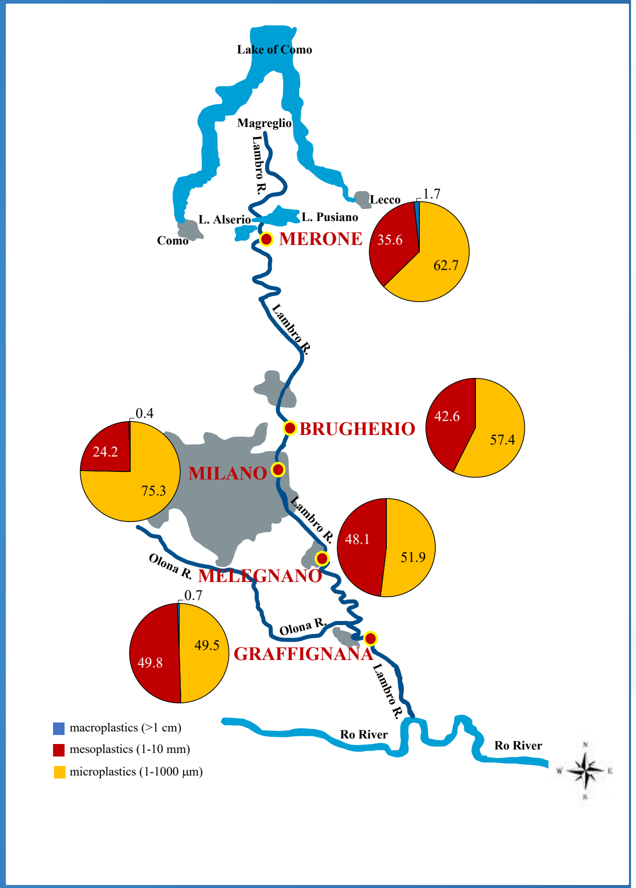
Stefano Magni, Lara Nigro, Camilla Della Torre, Andrea Binelli

Department of Biosciences, University of Milan, Via Celoria 26, 20133 Milan, Italy

CARATTERIZZAZIONE

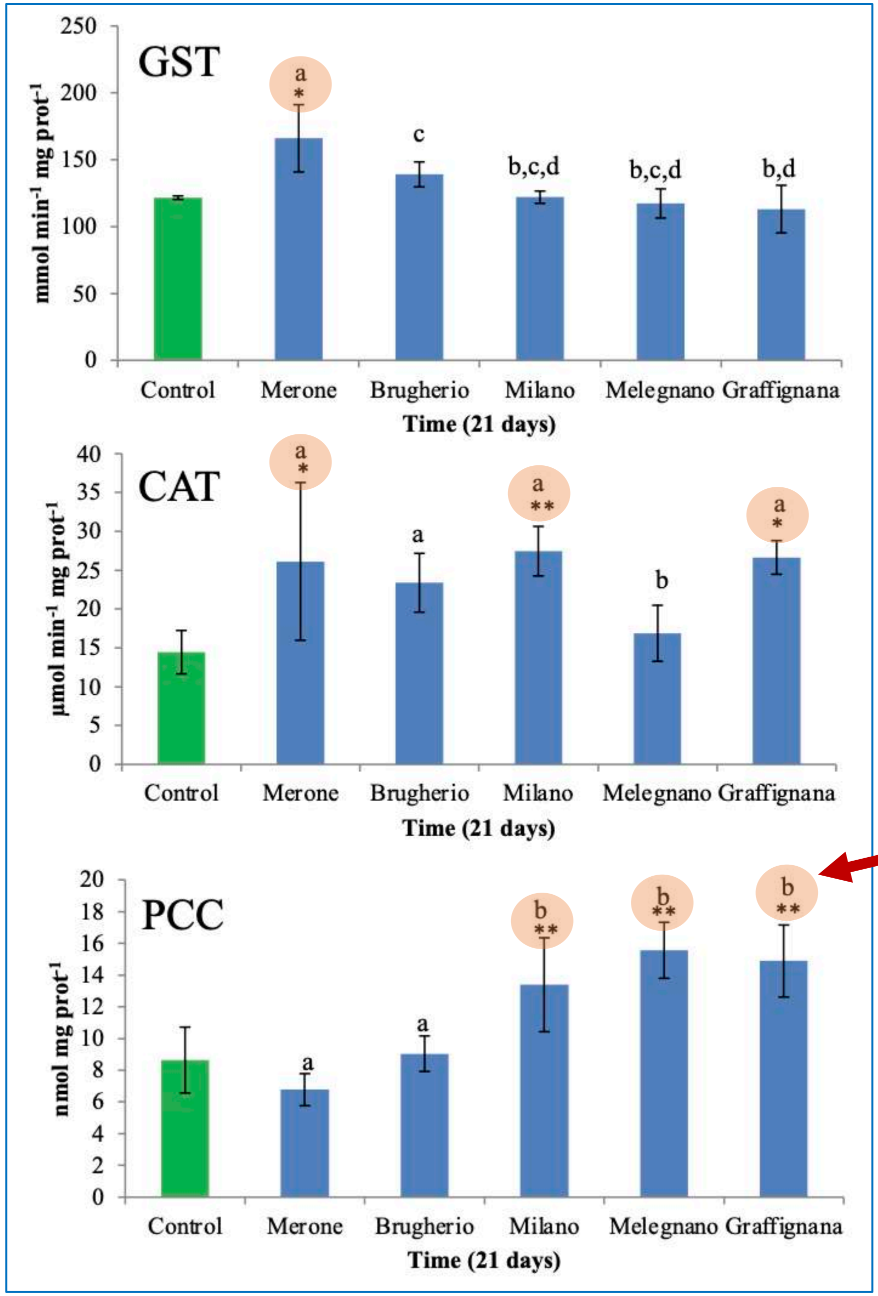






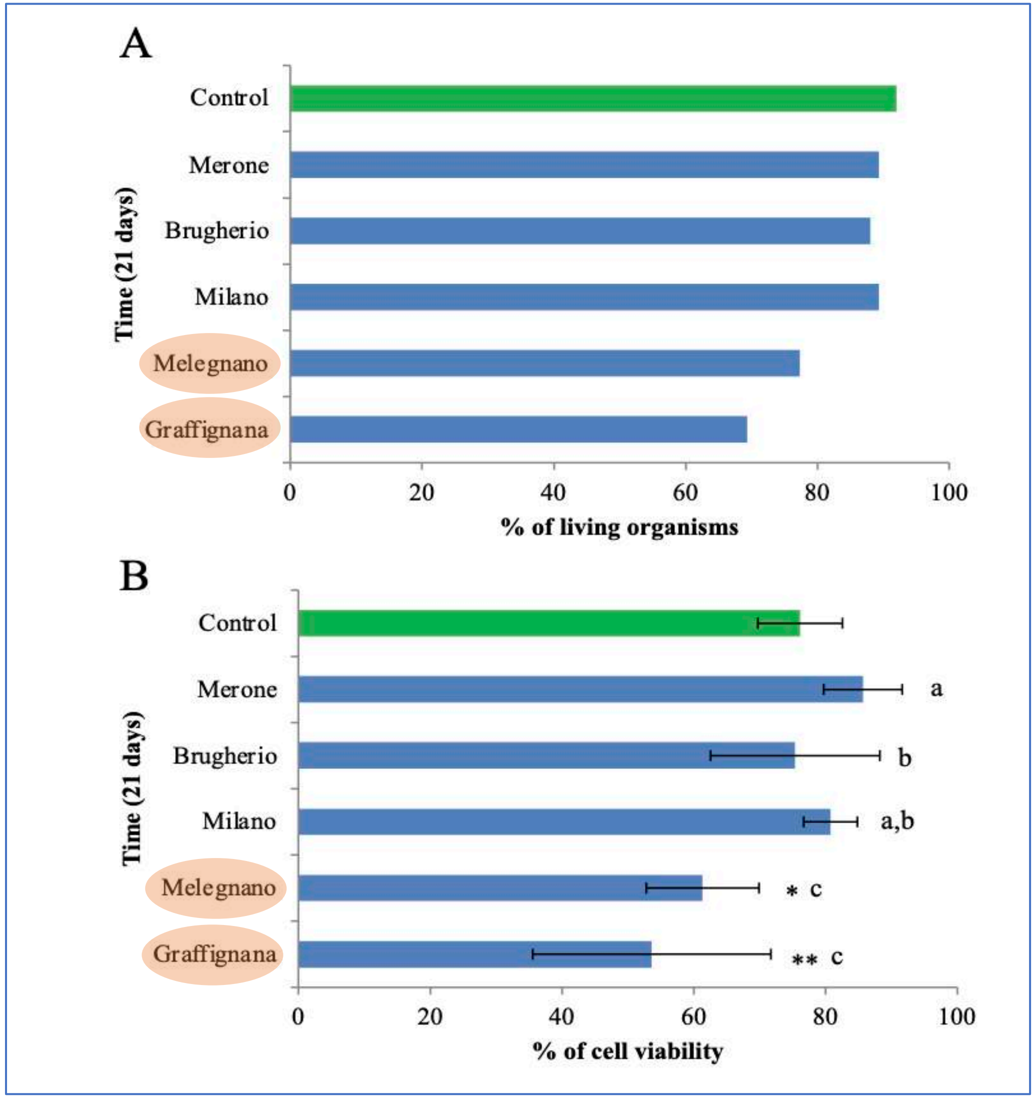
Polipropilene: tappi, cruscotti e parafanghi, bicchierini caffè
Poliacrilato: smalti, pannolini
Polistirene: posate e piatti, materiali isolanti per l'edilizia
Poliammide (nylon): abbigliamento, tendaggi, tappeti
Etilene vinil-acetato (EVA): attrezzature sportive, celle solari, guarnizioni
Polietilene: shoppers, pluriball, pellicole alimentari, giocattoli
Poliestere: abbigliamento, arredamento, pneumatici

EFFETTI DELL'ESPOSIZIONE ALLE MISCELE PLASTICHE



Modello biologico: *Dreissena polymorpha*
Tempo di esposizione: 21 giorni

Carbonilazione proteica
=
danno ossidativo alle proteine
(inattivazione)



OPEN QUESTIONS

- **Definizione definitiva delle dimensioni delle varie categorie di plastiche**
- **Standardizzazione delle tecniche di campionamento, analisi e caratterizzazione**
- **Valutazione del destino ambientale, trasporto e vie di assunzione negli organismi**
- **Valutazione dell'esposizione e degli effetti delle plastiche nei confronti degli organismi e della salute umana**

RISPOSTE

REGOLAMENTAZIONE

GRAZIE DELL'ATTENZIONE