Microplastic pollution of freshwater fishes - uptake, residence time and level of burden

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### Overview

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Introduction: Microplastics in fishes

1

Introduction

Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel

A.L. Lusher, M. McHugh, R.C. Thompson

Microplastics in freshwater fishes: Occurrence, impacts and future perspectives

Ben Parker, Demetra Andreou, Iain D. Green, J. Robert Britton

No increase in marine microplastic concentration over the last three decades – A case study from the Baltic Sea

Sabrina Beer, Anders Garm, Bastian Huwer, Jan Dierking, Torkel Gissel Nielsen

Microplastic in riverine fish is connected to species traits

R.E. McNeilin, L. H. Kim, H. A. Barrett, S. A. Mason, J. J. Kelly, T. J. Hoellein

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Introduction

Potential effects on fish

- **Translocation**: Crossing the gut barrier and reaching tissues and organs.
- **Physical harm**: Damage to the gills or the gastrointestinal tract.
- **Chemical transfer**: Transfer of toxic chemicals in the gastrointestinal tract.
- **Excretion**: Excretion with the chyme over time.
- **Blockage**: Obstruction of the gastrointestinal tract in juvenile fish.
- **Accumulation**: Increased retention time due to adhesion.
- **Reduced hunger**: Filling of the stomach with non-digestible items.
2 Microplastic uptake

### Uptake pathways

**Active uptake**

- Confusion with food

**Passive uptake**

- Accidental ingestion (while feeding/drinking)
- Transfer with the Food chain
Microplastic uptake


**Laboratory exposure experiment I**

- **Common carp**
- **Crucian carp**
- **Rainbow trout**
- **Grayling**

**chemosensory foraging**

**visual foraging**

- Experiments with and without simultaneous feeding
- Determination of particle concentration after 0 h, 6 h and 24 h
Microplastic uptake


Which factors influence an uptake?

- Visually oriented fish ingest microplastics more frequently
- Accidental ingestion during foraging
- Active ingestion of microplastics when food is not present
- Food-like particles were ingested more frequently
3 Residence time
Residence time


**Laboratory exposure experiment II**

- **Common carp**
  - no stomach

- **Rainbow trout**
  - true stomach

- **Exposure to three particle concentrations**
  - low (356/373 particles per g feed)
  - medium (891/933 particles per g feed)
  - high (1782/1886 particles per g feed)

- **Sampling times**
  - carp: 8, 24, 48, 64 h after exposure
  - trout: 8, 24, 48, 56, 72 h after exposure
Which factors influence residence time?

- No accumulation, excretion of the particles over time
- Particle concentration has no influence on the particle retention

T₉₉ = 72 h

T₉₉ = 64 h

Size dependent residence time?

- **Fish with real stomach**
  - active transport of large particles
  - passive transport of small particles

- **Fish without stomach**
  - passive transport of large and small particles

4 Level of burden
State-wide study

- 16 sampling site in 11 rivers
- 6 lakes (incl. Lake Constance)
- 2 different fish species with diverse habitat preference
- More detailed investigation in Lake Constance
- 1167 fishes were sampled (22 fish species)

Level of burden in Baden-Württemberg

- Around 19% of examined fishes were burdened with microplastics
- Microplastic intensity: 1 – 4 particles per fish (mean: 1.2 ± 0.5)
- Fragments and fibers were the dominant plastic types

Level of burden


Lake Constance
### Level of burden

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</table>

Level of burden


**Do size restrictions impede a realistic picture?**

- Particle size distribution analysis was performed
- Only particles > 40 µm were used (detection limit)
- Hyperbolic power law increase with lower particle size

Particle size distribution analysis

- Around 23 particles

Graphs show the distribution of particles by size class and the frequency of particle occurrence with volume equivalent diameter. The graph illustrates a hyperbolic power law increase in particle frequency with lower particle size.
5 Conclusion

- Active and passive ingestion of microplastics in visually oriented fish
- Passive uptake in chemosensory oriented fish

- Generally passive excretion of microplastic particles in fish
- Active transport of large particles in fish with real stomach
- No accumulation, residence time independent from microplastic concentration

- Overall level of burden is low in south-western Germany / Lake Constance
- Current detection limits might impede a realistic picture of the burden
- Comparability of studies difficult, as there are no harmonized protocols
Thank you for your attention!