

Supplementary Table S1. Summary of studies included in the review and their reported evidence of microplastic ingestion, bioaccumulation, trophic transfer, and biomagnification in aquatic invertebrates

Study (Author, Year)	Invertebrate Group	Species/Taxa	Functional Group	Habitat Type	Ecosystem	Study Design	Exposure Type	Evidence of Ingestion	Evidence of Bioaccumulation	Evidence of Trophic Transfer	Evidence of Biomagnification	Main Findings
Haque et al. (2025)	Aquatic Insects	Multiple species	Collector-gatherers	Freshwater	River	Field	Environmental	Yes	No	No - only potential trophic transfer discussed; no predator-prey transfer demonstrated	No	Aquatic insects act as mediators of microplastic pollution in river ecosystems
Khedre et al. (2023)	Aquatic Insects	Insect Families: <i>Chironomidae</i> , <i>Hydrophilidae</i> , <i>Aeshnidae</i>	Collector-gatherers	Freshwater	Wastewater	Field	Environmental	Yes	Yes	No (potential transfer discussed but not demonstrated)	No	Accumulation assessed among feeding guilds
Khedre et al. (2024)	Aquatic Insects	Multiple Insect Families	Collector-gatherers	Freshwater	Nile River	Field	Environmental	Yes	No	No (potential transfer discussed but not	No	Aquatic insect taxa are trustworthy tool for

										demonstrated)		monitoring MPs.
Amponsah et al. (2024)	Crustaceans	Blue-swimming crab (<i>Callinectes aminicola</i>) and shrimps (<i>Penaeus notialis</i>)	Predators/collector-gatherers	Estuarine	Estuary	Field	Environmental	Yes	Yes - MPs present in internal soft tissues.	No	No	MPs detected in seafood species
Hara et al. (2020)	Crustaceans	<i>Nephrops norvegicus</i>	Predators/collector-gatherers	Marine	Irish Waters	Field	Environmental	Yes	No - MPs measured only in gut, no tissue uptake or retention studied	No	No	Quantified MP ingestion
Welden & Cowie (2016)	Crustaceans	<i>Nephrops norvegicus</i>	Predators/collector-gatherers	Marine	Marine	Experimental	Environmental	Yes	Yes	No - ingestion and retention only, no prey-to-predator transfer tested	No	Gut morphology influenced MP retention
Akindele et al. (2020)	Aquatic Insects	<i>Chironomus</i> sp., <i>Siphonurus</i> sp., and	Collector-gatherers	Freshwater	Tributaries	Field	Environmental	Yes	No	No	No	Different feeding guilds

		<i>Lestes viridis</i>										ingested MPs
Devriese et al. (2017)	Crustaceans	<i>Nephrops norvegicus</i>	Predators	Marine	Marine	Experimental	Laboratory	Yes	No (no significant PCB bioaccumulation from MPs)	No	No	PCB bioaccumulation associated with MPs
Drummond et al. (2025)	Aquatic Insects	<i>Bromeliagrion rehni</i> (Odonata larvae)	Predators	Freshwater	Freshwater microcosm	Experimental	Laboratory	Yes	Yes	Yes	No	Bioaccumulation demonstrated in larvae
Wang et al. (2021)	Crustaceans	<i>Charybdis japonica</i> (predatory marine crab)	Predators	Marine	Marine	Experimental	Laboratory	Yes	Yes	Yes - MPs transferred through contaminated mussel prey.	No	Demonstrated trophic transfer of MPs
Silva et al. (2021)	Aquatic Insects	<i>Chironomus riparius</i>	Collector-gatherers	Freshwater	Freshwater	Experimental	Laboratory	Yes	Yes	No	No	<i>Chironomus riparius</i> larvae ingested and retained PE-MPs in their guts.
Maneechan & Prommi (2022)	Aquatic Insects	<i>Pantala sp.</i>	Predators	Freshwater rice fields	Rice fields	Field	Environmental	Yes	Yes	No	No	MPs detected in edible

												aquatic insects
Woods et al. (2018)	Molluscs	<i>Mytilus edulis</i>	Filter feeders	Marine	Marine	Experimental	Laboratory	Yes	Yes	No	No	Mussels ingest, retain, egest MPs
Kumari et al. (2023)	Molluscs	<i>Physa acuta</i>	Grazers	Freshwater	Freshwater	Laboratory experimental study	Dietary exposure	Yes	Yes	No -Snail identified as a potential vehicle of MP transfer	No	MPs reduce locomotion, reproduction
Rahman et al. (2025)	Molluscs	<i>Littorina littorea</i> (common periwinkle)	Grazers	Intertidal Marine	Coastal	Field	Environmental	Yes	Yes	No	No	Universal ingestion with high fibre dominance
Gong et al. (2021)	Molluscs	<i>Dosidicus gigas</i> (Jumbo squid)	Predators	Marine	Humboldt Current	Field	Environmental	Yes	Yes	No (no predator-prey transfer assessed)	No	Tissue-specific distribution of microplastics
Expósito et al. (2022)	Molluscs	Various molluscs	Filter feeders/grazers	Marine	Mediterranean Sea	Field	Environmental	Yes	Yes	No (no food-chain or predator transfer assessed)	No	Oysters/mussels highest MPs; molluscs key

												exposure route.
Weinstein et al. (2022)	Molluscs	<i>Crassostrea virginica</i> (Eastern oyster)	Filter feeders	Marine	Marine	Experimental	Laboratory	Yes	Yes	No	No	Oysters accumulate MPs; depuration partial
Naji et al. (2018)	Molluscs	Various molluscs species	Filter feeders/Grazers	Marine	Persian Gulf	Field	Environmental	Yes	Yes	No – potential trophic transfer suggested, not experimentally demonstrated	No	Molluscs ingest and accumulate MPs across feeding guilds.
Hurley et al. (2017)	Annelids	<i>Tubifex tubifex</i>	Deposit feeders	Freshwater	Freshwater	Experimental	Laboratory	Yes	Yes	No - potential trophic transfer discussed, not experimentally demonstrated	No	Tubifex worms ingest and retain sediment microplastics
Silva et al. (2023)	Platyhelminthes	<i>Girardia tigrine</i> (Planarians)	Predators	Freshwater	Freshwater	Laboratory experiment	Dietary	Yes (limited intake)	No -MPs detected only near pharynx,	Yes (via predation on	No	MPs altered physiology, behaviour

						ntal study		near pharyn x)	no systemic retention or accumulati on reported	contaminat ed prey)		and regeneratio n
Keerthika et. (2024)	Annelids	<i>Capitella capitata</i>	Deposit feeders	Marine benthic	Coastal marine ecosyste m	Field	Environm ental exposure	Yes	No- occurrence only; no evidence of long-term retention	No	No	Non- selective feeders ingested MPs
Porter et al. (2023)	Annelids	<i>Hediste diversicolor</i>	Deposit feeders	Marine	Benthic sediment and overlying water column	Experim ental	Laborator y	Yes	Yes	No evidence reported.	No	Feeding mode influences microplasti c uptake
Vecchi et al. (2021)	Annelids	<i>Sabella spallanzani i, Hermodice carunculat a</i>	Suspension/s elective feeders	Marine	Mediterra nean Sea	Field	Environm ental	Yes	No	No	No	Microplasti c ingestion varies by feeding strategy
Hamzah et al. (2021)	Annelids	<i>Namalycas tis sp.</i>	Deposit feeders	Estuarin e wetland sedimen t	Estuarine ecosyste m	Field	Environm ental	Yes	No	No	No	MPs detected in estuarine polychaetes
James et al. (2023)	Annelids	<i>Diopatra sp., Prionospio</i>	Deposit feeders	Nearsho re benthic	Coastal marine	Field	Environm ental	Yes	No	No	No	High ingestion in carnivorou

		sp., and related genera		sediments and polychaete tubes	ecosystem							s polychaetes
Schuab et al. (2023)	Annelids	<i>Phragmatopoma caudata</i>	Suspension/selective feeders	Coastal reef and intertidal sediments	Coastal marine ecosystem	Field	Environmental	Yes	No	No	No	Filaments dominant; colonies act as MP reservoirs
Kang et al. (2021)	Nematodes	<i>Enoplolaimus</i> spp.	Deposit feeder	Intertidal sandy sediments	Marine coastal ecosystem	Laboratory exposure experiment	Synthetic microplastics of different sizes (0.5–10 µm) in sediment exposure	Yes	No	No	No	Smaller MPs ingested more; egestion partial
Fueser et al. (2019)	Nematodes	Multiple species	Deposit feeder	Freshwater	Freshwater	Experimental	Laboratory	Yes	No	No	No	Ingestion depended on feeding strategy
Fueser et al. (2020)	Nematodes	Bacteria-feeding nematodes	Deposit feeder	Freshwater	Freshwater	Experimental	Laboratory	Yes	No	No	No	Rapid ingestion and egestion observed
Fueser et al. (2020)	Nematodes	Meiobenthic community	Deposit feeder	Freshwater sediment	Freshwater benthic ecosystem	Experimental	Laboratory	Yes	No	No	No	Ingestion size- and feeding-type dependent;

				(microcosms)								sediment reduced uptake
Huang et al. (2024)	Platyhelminthes	<i>Dugesia japonica</i> (Planarians)	Predator	Freshwater	Freshwater	Experimental	Laboratory	Yes	No (no measurement of internal accumulation or tissue concentrations)	No	No	MPs disrupted homeostasis and regeneration
Xie et al. (2024)	Platyhelminthes	<i>Dugesia japonica</i>	Predator	Freshwater	Freshwater	Experimental	Laboratory	Yes (controlled exposure)	No	No	No	MPs enhanced Pb toxicity
Mueller et al. (2020)	Nematodes	<i>Caenorhabditis elegans</i> , <i>Acrobeloides nanus</i> , <i>Plectus acuminatus</i>	Deposit feeder	Freshwater	Freshwater	Experimental	Laboratory	Yes	No	No	No	Long-term exposure affected population growth
Mueller et al. (2020)	Nematodes	<i>Caenorhabditis elegans</i>	Deposit feeder	Freshwater	Freshwater	Experimental	Laboratory	Yes	No	No	No	Polystyrene (PS) bead surface area drives reproductive toxicity

Gao et al. (2022)	Platyhelminthes	<i>Dugesia japonica</i>	Predator	Freshwater	Freshwater	Experimental	Laboratory	Yes	No (no measurement of internal MP concentration or retention)	No	No	Reduced regeneration and growth
Gambino et al. (2020)	Platyhelminthes	<i>Dugesia japonica</i>	Predator	Freshwater	Freshwater aquatic ecosystem	Experimental	Laboratory chronic dietary exposure experiment	Yes	No - experimental exposure only; persistence noted but no quantified long-term environmental accumulation	No	No	MPs altered tissue regeneration and homeostasis
Samudra et al. (2024)	Poriferans	<i>Oncosclera asiatica</i> , <i>Eunapius carteri</i> (sponges)	Suspension feeders	Freshwater	River	Field	Environmental	Yes	Yes	No	No	Freshwater sponges accumulate microplastics
Savage et al. (2022)	Cnidarians	<i>Anemonia viridis</i>	Suspension/selective feeder	Coastal rocky shore	Marine ecosystem	Laboratory exposure and field survey	Environmental and experimental	Yes	No - There was no quantification of long-term retention, internal	No	No	Uptake occurred across environmental conditions

									accumulation.			
Hu et al. (2023)	Cnidarians	<i>Rhopilema esculentum</i>	Suspension/selective feeder	Coastal marine waters	Marine ecosystem	Experimental	Laboratory	Yes	Yes.	No	No	Visualised ingestion and biological effects
Celis-Hernández et al. (2021)	Poriferans	<i>Haliclona implexiformis</i> , <i>Halichondria melanadocia</i> , <i>Amorphinopsis atlantica</i>	Suspension feeders	Mangrove and coastal benthic habitats	Marine ecosystem	Field	Environmental	Yes	Yes	No	No	Marine sponges bioaccumulate microplastics efficiently
Devereux et al. (2021)	Cnidarian/Ctenophores	Multiple Species	Suspension/selective feeders	Marine	North Sea	Field	Environmental	Yes	No	No (potential only)	No - potential food-web route only	Potential pathway for trophic transfer
Krikech et al. (2023)	Poriferans	Multiple Species	Suspension feeders	Marine	Marine ecosystem (Moroccan Mediterranean coast)	Field	Environmental	Yes	Yes	No	No	Mediterranean sponges bioaccumulate MPs efficiently

Sucharita kul et al. (2021)	Cnidarians	<i>Aurelia coerulea</i> (ephyrae, medusae)	Suspension/s elective feeders	Pelagic coastal waters	Marine	Experimental	Laboratory	Yes	No -MPs ingested but rapidly egested; no long-term retention quantified	Yes	No	Trophic transfer dominates microbead uptake
Sivan et al. (2025)	Poriferans	<i>Clathria</i> sp., <i>Haliclona</i> sp., <i>Callyspongia fibrosa</i>	Suspension feeders	Coastal benthic habitat	Marine	Field	Environmental	Yes	Yes	No	No	<i>Clathria</i> sp. accumulates highest MPs
Hossain et al. (2026)	Poriferans	<i>Mycale grandis</i> , <i>Cinachyrella</i> sp.	Suspension feeders	Coastal benthic habitat	Marine	Field	Environmental	Yes	No	No	No	MPs mainly adhered to sponge surfaces; no internal penetration observed
Corti et al. (2023)	Poriferans	Antarctic sponge species	Suspension feeders	Marine	Antarctic	Field	Environmental	Yes	Yes	No	No	MPs accumulated in Antarctic sponges
Okubo et al. (2020)	Cnidarians	<i>Seriatopora caliendrum</i> , <i>Exaiptasia</i> sp.	Suspension/s elective feeders	Coral reef/coastal benthic	Marine	Experimental	Laboratory	Yes	Yes	No — only prey-mediated uptake within	No	MPs disrupted coral-algae symbiosis

										experiment ; no food- web level transfer		
Costa et al. (2020)	Cnidarians (Jellyfish)	<i>Aurelia sp. (ephyrae)</i>	Suspension/s elective feeders	Marine pelagic habitats	Marine	Experimental	Laboratory	Yes	No	Yes	No	Trophic transfer occurred without toxicity.
Sucharita kul et al. (2020)	Cnidarians	<i>Aurelia aurita</i> (medusae)	Suspension/s elective feeders	Marine pelagic habitats	Marine	Experimental	Laboratory	Yes - Limited ingestion observed	No	No	No	Limited ingestion and rapid egestion
Rapp et al. (2021)	Cnidarians	<i>Pelagia noctiluca</i>	Pelagic predator	Coastal benthic habitat	Marine	Field survey	Environmental exposure	Yes	No	No - potential predator transfer suggested	No	Widespread MP ingestion in jellyfish suggests potential transfer to predator
Messinetti et al. (2019)	Tunicates	<i>Ciona intestinalis</i>	Filter feeders	Coastal benthic habitat	Marine	Experimental	Laboratory	Yes	Yes	No	No	MPs translocate beyond gut tissues.
Pennati et al. (2022)	Tunicates	<i>Ciona intestinalis</i>	Filter feeders	Coastal benthic habitat	Marine	Experimental	Laboratory exposure	Yes	Yes	Yes	No	Feeding enhanced MP

							experiment					accumulation
Paffenhöfer & Köster (2020)	Tunicates	<i>Doliolletta gegenbauri</i>	Filter feeders	Marine pelagic habitats	Marine	Experimental	Laboratory	Yes	No	No	No	MPs reduced feeding, growth and metabolism
Rahmawati et al. (2023)	Echinoderms	Sea urchins (<i>Echinoidea</i>)	Grazers	Benthic, sediment-associated	Marine	Field	Environmental	Yes	No	No	No	Sediment MPs correlated with gut contamination.
Martines et al. (2023)	Echinoderms	<i>Holothuria tubulosa</i>	Grazers	Benthic marine sediment	Mediterranean	Field comparison + laboratory experiment	Environmental	Yes	No	No	No	Ubiquitous ingestion; stable temporal pattern
Lekatompey et al. (2023)	Echinoderms (sea urchin)	<i>Tripneustes gratilla</i>	Deposit feeder (herbivorous grazer/collector-grazer)	Marine benthic	Marine island ecosystem	Field survey	Environmental exposure	Yes	Yes	No	No	MP accumulation in digestive tract and gonads reduced gonad quality.
Bulleri et al. (2021)	Echinoderms	<i>Holothuria tubulosa</i>	Deposit feeders	Marine	Mediterranean Sea	Experimental	Laboratory	Yes	No	No	No	Increased MP resuspension

												n in water column
Renzi et al. (2018)	Echinoderms	Sea cucumbers (Holothurians)	Deposit feeders	Rocky bottom habitats (slides, cliffs, banks)	Mediterranean Sea	Field	Environmental	Yes	No	No - but study highlights holothurians as vectors transferring MPs from sediments into biotic compartments	No	Transfer from sediments to trophic webs
Suckling & Richard (2020)	Echinoderms	<i>Arbacia punctulata</i>	Deposit feeders/grazers	Marine	Coastal marine	Experimental	Laboratory	Yes	No.	No.	No	No short-term physiological impacts observed
Feng et al. (2020)	Echinoderms	Sea urchins (wild spp.)	Deposit feeders/grazers	Marine	Northern China coastlines	Field	Environmental	Yes	Yes	No	No	Widespread tissue-level microplastic contamination
Hennicke et al. (2021)	Echinoderms	<i>Paracentrotus lividus</i>	Deposit feeders/grazers	Coastal benthic sediment	Eastern Aegean Sea, Greece	Field	Environmental	Yes	No - whole urchins analysed, no tissue	No - vectors from	No	MP burden correlates with

									uptake shown	sediment to biota		sediment pollution
Muham mad Husin et al. (2021)	Echinoder ms	<i>Stichopus horrens</i>	Deposit feeders/graze rs	Coastal benthic sedimen t	Marine coastal	Field	Environm ental	Yes	No	No	No	High fibre ingestion in sea cucumbers
Zamani et al. (2023)	Echinoder ms	<i>Diadema sp.</i>	Deposit feeders/graze rs	Marine	Marine coral reef	Field	Environm ental	Yes	No	No - vectors from sediment to biota	No	Sediment linked, fibres predomina nt ingestion
Cossi et al. (2021)	Echinoder ms	<i>Henricia obesa; Odontaster penicillatu s</i>	Deposit feeders/graze rs	Marine benthic asteroids	Marine Protected Area	Field	Environm ental	Yes	Yes -MPs present in internal soft tissues	No	No	Widesprea d tissue microplasti c contaminat ion
Wu et al., 2025	Echinoder ms	<i>Holothuria leucospilot a</i>	Deposit feeders/graze rs	Marine plankton ic (larvae)	Marine	Experim ental.	Laborator y exposure	Yes	Yes	No	No	MPs hinder larval growth, survival, and metamorph osis

Table S1 Note. Studies included in the synthesis were classified according to major aquatic invertebrate groups and functional feeding groups under the Trait–Habitat–Particle (THP) framework. Functional groups were assigned based on the predominant feeding strategy reported in the literature, including filter feeders, deposit feeders, collector-gatherers, grazers, predators, and suspension/selective feeders. Evidence of ingestion, bioaccumulation, trophic transfer, and biomagnification was recorded based on information reported in the original studies. "Yes" indicates evidence reported in the study, whereas "No" indicates that no evidence was reported. Main findings are summarised qualitatively to highlight the principal outcomes relevant to microplastic interactions in aquatic invertebrates.

Abbreviation

PCB = polychlorinated biphenyl

MPs = Microplastics

MP = Microplastic