Supplementary information

Search method and the hit score system

The research articles included in this review were identified through an extensive literature search utilizing multiple databases, including Web of Science, Google Scholar, PubMed, and Scopus. The search was conducted using specific keywords, namely "transcriptomics + nanoplastics," "proteomics + nanoplastics," and "metabolomics + nanoplastics." The search results were subsequently and manually filtered based on species and publication year, with a specific focus on research articles on aquatic species published between 2013 and 2023. Following this, the search results underwent individual scrutiny to select studies that align with the scope of this review. Data extraction was carried out for each of the 37 Omics studies solely on aquatic species, comprising 22 transcriptomic studies, six proteomic studies, and nine metabolomic studies. Detailed data were systematically tabulated to provide an analytical summary of the species investigated, the type, size, and concentration of nanoplastics utilized, the primary toxicity pathways examined, as well as the underlying mechanisms of toxicity (Tables S2, S4, and S6). The hit score system operates akin to a counting metric. Each time a disrupted pathway is identified, it is tallied as the first hit and subsequently for all reported pathways under a specific nanoplastic treatment condition (Tables S1, S3, S5, and S7).

Table S1 Omics hit score system for affected pathways of aquatic nanoplastics toxicity.

Affected pathways	**Transcriptomics**	**Metabolomics**	**Proteomics**	**Total**
Common				
Oxidative stress	5		4	**9**
Lipid metabolism	4	4	1	**9**
Energy metabolism	2	1	4	**7**
Carbon metabolism	2	1	3	**6**
Metabolism	5			**5**
Metabolism of xenobiotics by cytochrome P450	5			**5**
amino acid metabolisms	2	3		**5**
Photosynthesis	2		3	**5**
Citrate cycle (TCA cycle).	1	3	1	**5**
Fatty acid metabolism	1	4		**5**
Oxidative phosphorylation	2		2	**4**
Purine metabolism	1	3		**4**
ABC transporters	3			**3**
Amino acid synthesis & proline metabolism	3			**3**
Lysosome pathway	3			**3**
Cardiac Development & Hypertrophy	2		1	**3**
Glutathione metabolism	2		1	**3**
Aminoacyl-tRNA biosynthesis	2			**2**
Aminoacyl-tRNA ligases	2			**2**
antioxidant activity	2			**2**
Cell cycle dysfunction	2			**2**
DNA repair and growth arrest	2			**2**
Drug metabolism	2			**2**
Iron ion binding	2			**2**
Nervous system development	2			**2**
NOD-like receptor signaling pathway	2			**2**
Ppara regulation	2			**2**
Starch and sucrose metabolism	2			**2**
Translation process	2			**2**
Protein synthesis	1	1		**2**
Omics specific				
Transcriptomics				
Apoptosis	1			**1**
Cancer-related pathways	1			**1**
Carnitine biosynthetic pathway.	1			**1**
DNA synthesis	1			**1**
Glycerolipids metabolism	1			**1**
Glycolipid metabolism	1			**1**

Glycolysis/gluconeogenesis	1			**1**
Glyoxylate and dicarboxylate metabolism	1			**1**
Gonad development	1			**1**
Heme binding	1			**1**
Hippo and wnt signaling pathways.	1			**1**
Homologous recombination	1			**1**
Lipid storage	1			**1**
Lipid synthesis	1			**1**
MAPK signaling pathway	1			**1**
neuroactive ligand-receptor interaction	1			**1**
Primary bile acid biosynthesis	1			**1**
Proteolysis	1			**1**
Pyruvate metabolism	1			**1**
Saccharide metabolism	1			**1**
Serotonergic synapse	1			**1**
Sphingolipid signaling	1			**1**
Steroid biosynthesis	1			**1**
Sugar metabolism and synthesis	1			**1**
Sulfur compound metabolism	1			**1**
Transcription	1			**1**
Unsaturated fatty acid biosynthesis	1			**1**
Vitellogenesis	1			**1**
Voltage-gated potassium channel complexes	1			**1**
Metabolomics				
Folate biosynthesis		1		**1**
Pentose phosphate metabolism		1		**1**
Taurine hypotaurine metabolism		1		**1**
Nicotinate nicotinamide metabolism		1		**1**
Proteomics				
Signal transduction			1	**1**
Protein metabolism			1	**1**
Carbohydrate metabolism			1	**1**
Nucleic acid metabolism			1	**1**
Calcium metabolism			1	**1**

Table S2 Summary of transcriptomic studies of nanoplastic toxicity in different aquatic species.

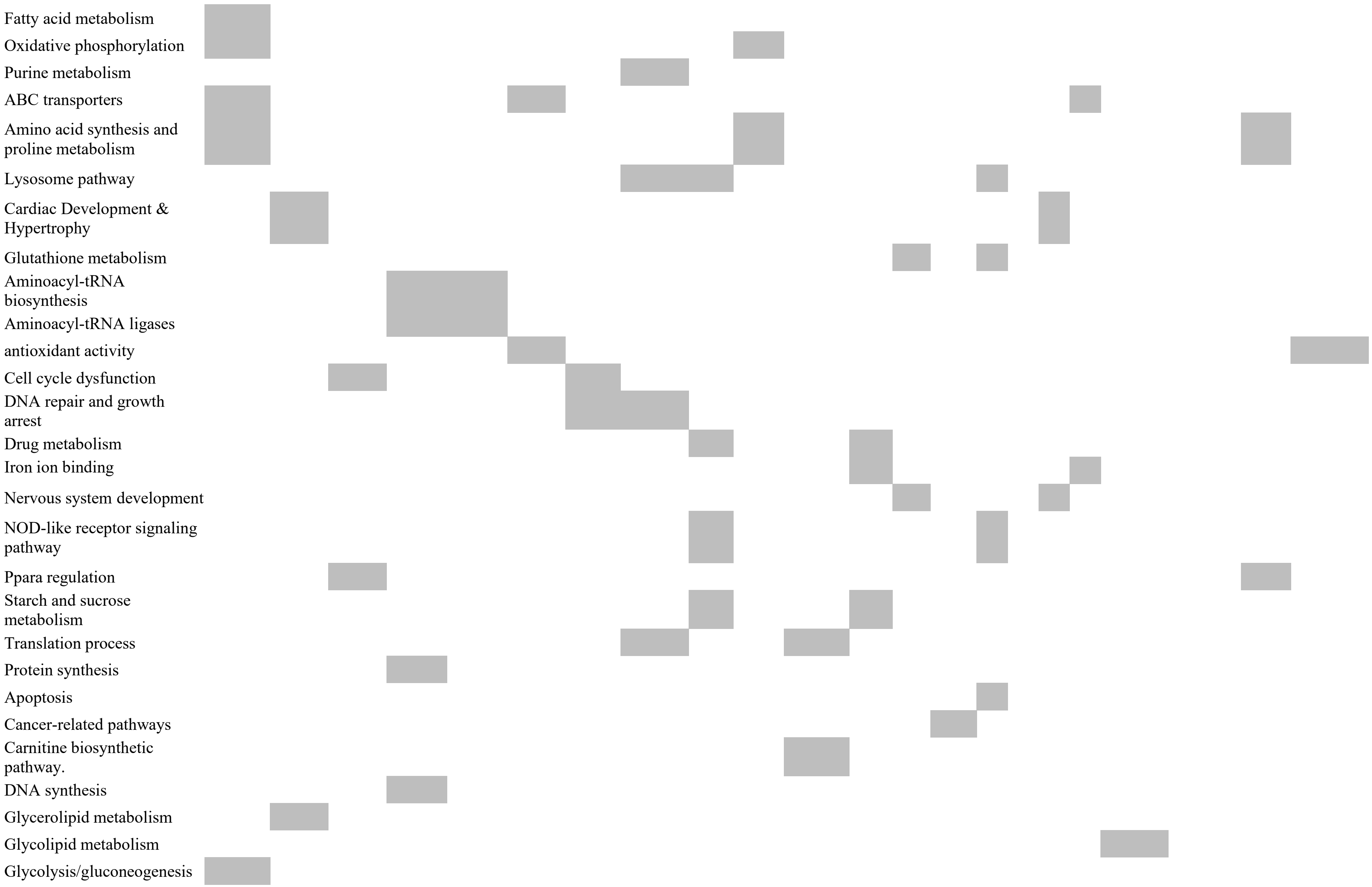
Animal	Sequencing technology	Type & dose	Exposure regime	Toxicological response	Reference
Brachionus plicatilis	Illumina sequencing	Polystyrene microbeads 10 mg/L with diameters of 0.05 and 6 µm.	Rotifer - 24 hrs	Metabolism deficiency and oxidative stress	(Shin and Jeong, 2022)
Cherax quadricarinatus	Illumina sequencing	Polystyrene, 0.025, 0.25, and 2.5 mg/L of NPs on red crayfish	Adult crayfish - 14 days	Antioxidant activity, metabolism, and immune defects	(Cheng et al., 2022)
Danio rerio	Illumina sequencing	0.02, 0.2 mg/L, 100 nm polystyrene nanoplastics (PS-NPs) on zebrafish intestinal cells	Adult zebrafish-21 days	Change in macrophages immunological recognition and apoptosis processes. Affects enterocytes & and alters oxidative stress and abnormality of lipid metabolism.	(Yu et al., 2022)
Isognomon alatus	Illumina sequencing	0.0075 and 0.015 mg/L NP-PS and NP-G (naturally collected marine NPs). NP-G is a mix of plastics, mainly polyethylene and polypropylene. Sizes are 260 nm for NP-PS and 280 nm for NP-G	Oyster - 7 days	Nanoplastics impaired mitochondrial metabolism, oxidative stress, and apoptotic response in oysters.	(Arini et al., 2022)
Streptomyces coelicolor	Illumina sequencing	Polystyrene (PS), M145 was treated with 20 nm, 100 nm, and 1 µm particles at the concentration of 10 mg/L	Gram +ve bacteria, 30 °C for 24 hrs.	Inhibit the transport capacity, primary metabolism, and oxidative phosphorylation of M145; the inhibition extension was negatively related to the particle size. The toxicity of microplastics to M145 was significantly less than that of nanoplastics.	(Liu et al., 2021a)
Chlorella pyrenoidosa	Illumina sequencing	Polystyrene nanoplastics (80 nm in size) 0, 5, 10, 20, 30, 40, and 50 mg/L	Freshwater green algae, 96 hrs	Blockage of the gene expression of aminoacyl tRNA synthetase and the synthesis of related enzymes and proteins. Affected DNA damage repair and hindered photosynthesis.	(Yang et al., 2021a)
Procambarus clarkii	Illumina sequencing	100 nm carboxylated polystyrene nanoparticles (PS NPs). 100 µg PS NPs in food supplement.	Adult red swamp crayfish. through diet in a 72 hrs acute toxicity test	Altered immune response, oxidative stress, gene transcription and translation, protein degradation, lipid metabolism, oxygen demand, and reproduction.	(Capanni et al., 2021)
Karenia mikimotoi	Illumina sequencing	micro/nanoplastics (MPs/NPs; polystyrene and polymethyl methacrylate), 10 mg/L, 65 nm, 100 nm, and 1 µm	Marine dinoflagellates, for 72 hrs	Toxicity response and metabolism	(Zhao et al., 2022)
Oreochromis mossambicus	Illumina sequencing	Polystyrene nanoparticles 100 nm, 20 mg/L.	larval tilapia, for seven days and then returned to freshwater	Abnormal metabolism of glycolipids, energy, and amino acids.	(Pang et al., 2021)

			without Polystyrene nanoparticles for another seven days	Induction of inflammation.	
Sinonovacula constricta	Illumina sequencing	0.005, 0.05, 0.5 and 50 mg/L) of 75 nm polystyrene nanoplastics (PS-NPs).	Razor clam, 48 hrs		(Jiang and Zhang, 2021)
Daphnia pulex	Illumina sequencing	Polystyrene nanoplastic, 71 nm, 1 mg/L	96 hrs	Oxidative stress, immune defense, and glycometabolism.	(Liu et al., 2021b)
Brachionus koreanus	Illumina sequencing	Nano-sized microplastic (0.05 µm), 0.0001 mg/L and 0.001 mg/L	7 days, transgenerational effect	Cell cycle dysfunction, and ppara regulation	(Jeong et al., 2021)
Symphysodon aequifasciatus	Illumina sequencing	900 µm, fiber, MFs) or nanoplastics (~88 nm, bead, NPs) with three concentrations (0, 0.02 and 0.2 mg/L).	Juvenile discus fish, 96 hrs	Neuroactive ligand-receptor interaction and serotonergic synapse. Dopaminergic synapse pathway.	(Huang et al., 2022)
Ietalurus punetaus	Illumina sequencing	(0, 5, 10, 25, and 50 mg/L) of 75-nm polystyrene nanoplastics.	larval channel catfish, 24 hrs or 48 hrs	Protein digestion and absorption pathway. PPAR signaling pathway. Biosynthesis of unsaturated fatty acid. Glycolysis pathway Altered arachidonic acid metabolism pathway. Altered proteasome pathway. The pathway to synthesize acetoacetate from tyrosine was affected. Inhibition of xenobiotics metabolism.	(Jiang et al., 2022)
Danio rerio	Illumina sequencing	700 nm, polystyrene	Inject zebrafish larvae. Based on the biodistribution data, injection at the long-pec stage (2 dpf) was chosen for RNAseq.	Altered immune complement pathway.	(Veneman et al., 2017)
Mytilus coruscus	Illumina sequencing	100 nm, 20 mg/L, polystyrene	Adult mussel, 48 hrs.	Xenobiotics: cytochrome P450 exercised detoxification. Lysosome mediated phagocytosis and autophagy Immune signaling pathways represented innate defense mechanisms.	(Qi et al., 2023)
Microcystis aeruginosa	Illumina sequencing	50 nm, polystyrene nanoplastics	freshwater algae, 15-day exposure	Antioxidant defense system Photosynthesis	(Zhang et al., 2022)
Danio rerio	Illumina sequencing	Polystyrene, 200 nm. 100, and 1000 ppb concentrations were analyzed for transcriptomic effects	Zebrafish larvae, 120 dpf	Skeletal/muscular and nervous system development and function pathways. Dysregulated metabolic, cardiac, and hepatic pathways. Metabolic dysfunction. Epigenetic modification.	(Pedersen et al., 2020)

Chlorella pyrenoidosa	Illumina sequencing	Polystyrene, 80 nm, 0mg/L and 10 mg/L	Algae, 9 days.	Cell cycle dysregulation Ion balance and transport Protein synthesis aminoacyl-tRNA biosynthesis	(Yang et al., 2021b)
Ciona robusta	Illumina sequencing	Polystyrene–NH2 NPs, 50 nm, 10, 15 mg/L	About 1000 embryos were exposed to two different concentrations of polystyrene-NH2 until they reached the late tailbud I stage (~13 hpf).	Glutathione metabolism Immune defense. Nervous system Energy metabolism. Oxidative stress. Morphological defects. Impaired swimming behavior. Sulfur compound metabolic and biosynthetic processes.	(Eliso et al., 2023)
Danio rerio	Illumina sequencing	Polystyrene, 300, 50 nm, 0.1 mg/L	30-day exposure, adult zebrafish.	Steroid biosynthesis, primary bile acid biosynthesis, amino acid metabolisms and saccharide metabolisms, and defense pathways such as ABC transporters Fatty acid metabolism, glycolysis/gluconeogenesis, insulin signaling pathway and Tight junction	(Yu et al., 2023)
Sepia esculenta	Illumina sequencing	Polystyrene-NPs (50 nm, 50 mg/L) short-term exposure (4 and 24 h)	Larvae, short-term exposure (4 and 24 hrs).	Altered cancer related pathways	(Liu et al., 2023)

Table S3 Transcriptome hit score system for dysregulated pathways of nanoplastics toxicity in different aquatic species.

Altered pathways	***Streptomyces coelicolor***	***Brachionus plicatilis***	***Brachionus koreanus***	***Chlorella pyrenoidosa***	***Chlorella pyrenoidosa***	***Microcystis aeruginosa***	***Isognomon alatus***	***Sinonovacula constricta***	***Mytilus coruscus***	***Karenia mikimotoi***	***Procambarus clarkii***	***Daphnia pulex***	***Ciona robusta***	***Sepia esculenta***	***Danio rerio***	***Danio rerio***	***Danio rerio***	***Danio rerio***	***Oreochromis mossambicus***	***Symphysodon aequifasciatus***	***Ictalurus punctatus***	***Cherax quadricarinatus***
Oxidative stress		■					■		■							■		■				
Lipid metabolism								■			■					■			■			
Energy metabolism								■											■			
Carbon metabolism										■									■			
Metabolism		■			■					■			■									■
Metabolism of xenobiotics by cytochrome P450									■		■	■			■						■	
amino acid metabolism																		■	■			
Photosynthesis				■		■																
Citrate cycle (TCA cycle).	■																					


Fatty acid metabolism
Oxidative phosphorylation
Purine metabolism
ABC transporters
Amino acid synthesis and proline metabolism
Lysosome pathway
Cardiac Development & Hypertrophy
Glutathione metabolism
Aminoacyl-tRNA biosynthesis
Aminoacyl-tRNA ligases
antioxidant activity
Cell cycle dysfunction
DNA repair and growth arrest
Drug metabolism
Iron ion binding
Nervous system development
NOD-like receptor signaling pathway
Ppara regulation
Starch and sucrose metabolism
Translation process
Protein synthesis
Apoptosis
Cancer-related pathways
Carnitine biosynthetic pathway.
DNA synthesis
Glycerolipid metabolism
Glycolipid metabolism
Glycolysis/gluconeogenesis

Glyoxylate and dicarboxylate metabolism
Gonad development
Heme binding
Homologous recombination
Lipid storage
Lipid synthesis
MAPK signaling pathway
neuroactive ligand-receptor interaction
Primary bile acid biosynthesis
Proteolysis
Pyruvate metabolism
Saccharide metabolism
Serotonergic synapse
Sphingolipid signaling
Steroid biosynthesis
Sugar metabolism and synthesis
Sulfur compound metabolism
Transcription
Unsaturated fatty acid biosynthsis
Vitellogenesis
Voltage-gated potassium channel complexes
Hippo and wnt signaling pathways.

Table S4 Summary of proteomic studies of nanoplastic toxicity in different aquatic species.

Animal	Proteomics approach	Particle &dose	Exposure	Toxicological response	Reference
Daphnia pulex	HPLC fractionation and LC-MS/MS analysis	Spherical polystyrene nanoplastic, the average size of polystyrene is 71.18 nm	21 days	Induces oxidative stress, affects signaling transduction, energy production, protein and lipid metabolism, and cuticle and chitinase	(Liu et al., 2021b)
Microcystis aeruginosa	LC-MS/MS	50 nm amino-modified polystyrene nano-spheres (PS-NH_2) particles	Acute (2 days) and long-term (10 days)	Impaired cell membrane integrity and inhibited photosystem efficiency	(Feng et al., 2020)
Emiliania huxleyi	nanoLC-ESI-MS/MS analysis	50 nm polystyrene nanoparticles (PS-NPs), 0.001% w/v	Phytoplankton, 72 hrs	Reduction in photosynthetic efficiency	(Dedman et al., 2022)
Anabaena sp	Pierce High pH Reversed-Phase Peptide Fractionation RP-LC-MS/MS	30 nm polystyrene nanoparticles (PS-NPs), 1 to 200 mg/L	Filamentous cyanobacteria, 72 hrs	Oxidative stress and photosynthetic activity deficiency	(Tamayo-Belda et al., 2021)
Zebrafish	Peptide purification by reversed-phase chromatography. High-resolution mass spectrometry analysis (nLC-MSMS)	500 nm polystyrene nanoparticles, 200 μg/L	Zebrafish larvae, 7 days	Nanoplastics impacted zebrafish behavior and swimming patterns. Dysregulated proteins are associated with genetic processes, immune response, cytoskeleton, and molecule transport.	(Parenti et al., 2021)
Zebrafish	nanoLC-MS/MS	50 nm Amine-functionalized polystyrene nanoplastics (PS-NH_2 NPs), 0.1 mg/L	Zebrafish larvae exposed for 72 hrs	Induction of oxidative stress and the oxidative phosphorylation rate in the mitochondria	(Duan et al., 2023)

Table S5 Proteome hit score system for dysregulated pathways and mechanisms of nanoplastics toxicity in different aquatic species.

Altered pathways	*Daphnia pulex*	*Daphnia magna*	*Microcystis aeruginosa*	*Danio rerio*	*Danio rerio*	*Anabaena sp*	*Emiliania huxleyi*
Oxidative stress							
Carbohydrate metabolism							
Protein metabolism							
Energy metabolism							
Lipid metabolism							
ABC transporter							
Metabolism							
Photosynthesis							
Signaling transduction							
Genetic processes							
Cytoskeleton							
Organo-nitrogen metabolism							
Nucleic acid metabolism							
Cuticle and chitinase							
Surface location							
phototrophic metabolism							
Catalytic							

Table S6 Summary of metabolomic studies of nanoplastic toxicity in different aquatic species.

Animal	Metabolomics approach	Particle &dose	Exposure	Toxicological response	Reference
Euglena gracili	UHPLC-MS	Polystyrene-nanoplastics, 100 nm, 50 μg/L (1.1 × 1010 particles/L).	Fresh water algae, 96 hrs	Metabolic disruption of purine and carbohydrate	(Cao et al., 2022)
Microcystis aeruginosa	GC−MS	Polystyrene-nanoplastics, 30 nm with and without sulphonic acid modification, 10 mg/L, 50 mg/L, and 100 mg/L.	Fresh water cyanobacteria, 96 hrs	Fatty acid metabolism Oxidative stress.	(Wang et al., 2023)
Phaeodactylum tricornutum	GC−MS	Polystyrene-nanoplastics, 80-100 nm, 0.01─10 mg/L.	Diatom, 120 hrs	Fatty acid, amino acid, energy, and carbohydrate metabolism. Fatty acid biosynthesis Biosynthesis of phenylalanine, tyrosine, and tryptophan Antioxidant system	(Yao et al., 2023)
Sinonovacula constricta	UHPLC-TripleTOF	Polystyrene-nanoplastics, 75 nm, 0.005, 0.05, 0.5 and 50 mg/L.	Adult, 48 hrs	Purine metabolism.	(Jiang and Zhang, 2021)
cyanobacterium Synechocystis	UHPLC-MS	Polystyrene-nanoplastics, 0.05 μm, 50 mg/L.	Cyanobacteria, 96 hrs	Oxidative stress TCA cycle and glycerophospholipids metabolism	(You et al., 2021)
Danio rerio	UHPLC-MRM-MS/MS	Polystyrene-nanoplastics, 44 nm, 1, 10, and 100 μg/L.	Adult, 30 days	Altered neurotransmitter metabolites and gut microbiota.	(Teng et al., 2022)
Oreochromis mossambicus	UPLC-Q-TOF-MS	Polysyrene-nanoplastics, 100 nm, 20 mg/L.	Larvae, 7 days	Metabolism of glycolipids, energy, and amino acids.	(Pang et al., 2021)
Danio rerio	GC-TOF MS	Polystyrene-nanoplastics, 100 nm, 2 × 104 items of n-PS suspended in 50 mL.	Larvae, 72 hrs	Biosynthesis of unsaturated fatty acid and linoleic acid metabolism, glutamate, taurine and hypotaurine Antioxidant system.	(Duan et al., 2020)
Danio rerio	LC-QTOF	Polystyrene-nanoplastics, 20 nm, 3 nL of polystyrene nanoplastic stock solution.	Larvae, 120 hpf	Oxidative stress Lipid accumulation	(Sulukan et al., 2022)
Brachionus plicatilis	UHPLC-Q	Microplastic/Nanoplastic (70 nm, 500 nm, and 2 μm), 0, 20, 200, and 2000 μg/L.	euryhaline rotifer, 48 hrs	Disruptions of purine-pyrimidine metabolism, TCA cycle, and protein synthesis.	(Li et al., 2023)

Table S7 Metabolome hit score system for dysregulated pathways and mechanisms of nanoplastics toxicity in different aquatic species.

Altered pathways	***Euglena gracili***	***Microcystis aeruginosa***	***Diatoms***	***Zebrafish***	***Zebrafish***	***Tilapia***	***Razor clam***	***Synechocystis***	***Brachionus plicatilis***
Lipid metabolism	■			■			■	■	
Fatty acid metabolism		■	■		■	■			
Amino acid metabolism	■		■		■				
Tricarboxylic acid cycle (TCA)		■						■	■
Purine-pyrimidine metabolism	■						■		■
Pentose phosphate metabolism				■					
Taurine and hypotaurine metabolism						■			
Nicotinate and nicotinamide metabolism						■			
Protein synthesis pathway									■
Carbohydrate metabolism	■								
Energy metabolism							■		
Folate biosynthesis					■				

References

Arini A, Gigault J, Venel Z, Bertucci A, Baudrimont M (2022). The underestimated toxic effects of nanoplastics coming from marine sources: A demonstration on oysters (Isognomon alatus). Chemosphere, 295: 133824

Cao J, Liao Y, Yang W, Jiang X, Li M (2022). Enhanced microalgal toxicity due to polystyrene nanoplastics and cadmium co-exposure: From the perspective of physiological and metabolomic profiles. Journal of Hazardous Materials, 427: 127937

Capanni F, Greco S, Tomasi N, Giulianini P G, Manfrin C (2021). Orally administered nano-polystyrene caused vitellogenin alteration and oxidative stress in the red swamp crayfish (Procambarus clarkii). Science of the Total Environment, 791: 147984

Cheng H, Dai Y, Ruan X, Duan X, Zhang C, Li L, Huang F, Shan J, Liang K, Jia X, Wang Q, Zhao H (2022). Effects of nanoplastic exposure on the immunity and metabolism of red crayfish (Cherax quadricarinatus) based on high-throughput sequencing. Ecotoxicology and Environmental Safety, 245: 114114

Dedman C J, Christie-Oleza J A, Fernández-Juárez V, Echeveste P (2022). Cell size matters: Nano- and micro-plastics preferentially drive declines of large marine phytoplankton due to co-aggregation. Journal of Hazardous Materials, 424: 127488

Duan Z, Duan X, Zhao S, Wang X, Wang J, Liu Y, Peng Y, Gong Z, Wang L (2020). Barrier function of zebrafish embryonic chorions against microplastics and nanoplastics and its impact on embryo development. Journal of Hazardous Materials, 395: 122621

Duan Z, Wang J, Zhang H, Wang Y, Chen Y, Cong J, Gong Z, Sun H, Wang L (2023). Elevated temperature decreases cardiovascular toxicity of nanoplastics but adds to their lethality: A case study during zebrafish (Danio rerio) development. Journal of Hazardous Materials, 458: 131679

Eliso M C, Bergami E, Bonciani L, Riccio R, Belli G, Belli M, Corsi I, Spagnuolo A (2023). Application of transcriptome profiling to inquire into the mechanism of nanoplastics toxicity during Ciona robusta embryogenesis. Environmental Pollution, 318: 120892

Feng L J, Sun X D, Zhu F P, Feng Y, Duan J L, Xiao F, Li X Y, Shi Y, Wang Q, Sun J W, Liu X Y, Liu J Q, Zhou L L, Wang S G, Ding Z, Tian H, Galloway T S, Yuan X Z (2020). Nanoplastics promote microcystin synthesis and release from cyanobacterial Microcystis aeruginosa. Environmental Science & Technology, 54(6): 3386–3394

Huang J N, Wen B, Xu L, Ma H C, Li X X, Gao J Z, Chen Z Z (2022). Micro/nano-plastics cause neurobehavioral toxicity in discus fish (Symphysodon aequifasciatus): Insight from brain-gut-microbiota axis. Journal of Hazardous Materials, 421: 126830

Jeong C B, Kang H M, Byeon E, Kim M S, Ha S Y, Kim M, Jung J H, Lee J S (2021). Phenotypic and transcriptomic responses of the rotifer Brachionus koreanus by single and combined exposures to nano-sized microplastics and water-accommodated fractions of crude oil. Journal of Hazardous Materials, 416: 125703

Jiang Q, Chen X, Jiang H, Wang M, Zhang T, Zhang W (2022). Effects of acute exposure to polystyrene nanoplastics on the channel catfish larvae: Insights from energy metabolism and transcriptomic analysis. Frontiers in Physiology, 13: 923278

Jiang Q, Zhang W (2021). Gradual effects of gradient concentrations of polystyrene nanoplastics on metabolic processes of the razor clams. Environmental Pollution, 287: 117631

Li X, Lu L, Ru S, Eom J, Wang D, Samreen, Wang J (2023). Nanoplastics induce more severe multigenerational life-history trait changes and metabolic responses in marine rotifer Brachionus plicatilis: Comparison with microplastics. Journal of Hazardous Materials, 449: 131070

Liu X, Bao X, Wang X, Li C, Yang J, Li Z (2023). Time-dependent immune injury induced by short-term exposure to nanoplastics in the Sepia esculenta larvae. Fish & Shellfish Immunology, 132: 108477

Liu X, Ma J, Yang C, Wang L, Tang J (2021a). The toxicity effects of nano/microplastics on an antibiotic producing strain - Streptomyces coelicolor M145. Science of the Total Environment, 764: 142804

Liu Z, Li Y, Pérez E, Jiang Q, Chen Q, Jiao Y, Huang Y, Yang Y, Zhao Y (2021b). Polystyrene nanoplastic induces oxidative stress, immune defense, and glycometabolism change in Daphnia pulex: Application of transcriptome profiling in risk assessment of nanoplastics. Journal of Hazardous Materials, 402: 123778

Pang M, Wang Y, Tang Y, Dai J, Tong J, Jin G (2021). Transcriptome sequencing and metabolite analysis reveal the toxic effects of nanoplastics on tilapia after exposure to polystyrene. Environmental Pollution, 277: 116860

Parenti C, Magni S, Ghilardi A, Caorsi G, Della Torre C, Del Giacco L, Binelli A (2021). Does triclosan adsorption on polystyrene nanoplastics modify the toxicity of single contaminants? Environmental Science. Nano, 8(1): 282–296

Pedersen A F, Meyer D N, Petriv A V, Soto A L, Shields J N, Akemann C, Baker B B, Tsou W L, Zhang Y, Baker T R (2020). Nanoplastics impact the zebrafish (Danio rerio) transcriptome: Associated developmental and neurobehavioral consequences. Environmental Pollution, 266(Pt 2): 115090

Qi P, Qiu L, Feng D, Gu Z, Guo B, Yan X (2023). Distinguish the toxic differentiations between acute exposure of micro- and nano-plastics on bivalves: An integrated study based on transcriptomic sequencing. Aquatic Toxicology (Amsterdam, Netherlands), 254: 106367

Shin H, Jeong C B (2022). Metabolism deficiency and oxidative stress induced by plastic particles in the rotifer Brachionus plicatilis: Common and distinct phenotypic and transcriptomic responses to nano- and microplastics. Marine Pollution Bulletin, 182: 113981

Sulukan E, Şenol O, Baran A, Kankaynar M, Yıldırım S, Kızıltan T, Bolat İ, Ceyhun S B (2022). Nano-sized polystyrene plastic particles affect many cancer-related biological processes even in the next generations; zebrafish modeling. Science of the Total Environment, 838: 156391

Tamayo-Belda M, Vargas-Guerrero J J, Martín-Betancor K, Pulido-Reyes G, González-Pleiter M, Leganés F, Rosal R, Fernández-Piñas F (2021). Understanding nanoplastic toxicity and their interaction with engineered cationic nanopolymers in microalgae by physiological and proteomic approaches. Environmental Science. Nano, 8(8): 2277–2296

Teng M, Zhao X, Wang C, Wang C, White J C, Zhao W, Zhou L, Duan M, Wu F (2022). Polystyrene nanoplastics toxicity to zebrafish: dysregulation of the brain–intestine–microbiota axis. ACS Nano, 16(5): 8190–8204

Veneman W J, Spaink H P, Brun N R, Bosker T, Vijver M G (2017). Pathway analysis of systemic transcriptome responses to injected polystyrene particles in zebrafish larvae. Aquatic Toxicology (Amsterdam, Netherlands), 190: 112–120 doi:10.1016/j.aquatox.2017.06.014

Wang Q, Liu W, Zeb A, Lian Y, Shi R, Li J, Zheng Z (2023). Toxicity effects of polystyrene nanoplastics and arsenite on Microcystis aeruginosa. Science of the Total Environment, 874: 162496

Yang W, Gao P, Li H, Huang J, Zhang Y, Ding H, Zhang W (2021a). Mechanism of the inhibition and detoxification effects of the interaction between nanoplastics and microalgae Chlorella pyrenoidosa. Science of the Total Environment, 783: 146919

Yang W, Gao P, Ma G, Huang J, Wu Y, Wan L, Ding H, Zhang W (2021b). Transcriptome analysis of the toxic mechanism of nanoplastics on growth, photosynthesis and oxidative stress of microalga Chlorella pyrenoidosa during chronic exposure. Environmental Pollution, 284: 117413

Yao M, Mu L, Gao Z, Hu X (2023). Persistence of algal toxicity induced by polystyrene nanoplastics at environmentally relevant concentrations. Science of the Total Environment, 876: 162853

You X, Cao X, Zhang X, Guo J, Sun W (2021). Unraveling individual and combined toxicity of nano/microplastics and ciprofloxacin to Synechocystis sp. at the cellular and molecular levels. Environment International, 157: 106842

Yu J, Chen L, Gu W, Liu S, Wu B (2022). Heterogeneity effects of nanoplastics and lead on zebrafish intestinal cells identified by single-cell sequencing. Chemosphere, 289: 133133

Yu Z, Yan C, Qiu D, Zhang X, Wen C, Dong S (2023). Accumulation and ecotoxicological effects induced by combined exposure of different sized polyethylene microplastics and oxytetracycline in zebrafish. Environmental Pollution, 319: 120977

Zhang Y, Li X, Liang J, Luo Y, Tang N, Ye S, Zhu Z, Xing W, Guo J, Zhang H (2022). Microcystis aeruginosa's exposure to an antagonism of nanoplastics and MWCNTs: The disorders in cellular and metabolic processes. Chemosphere, 288(Pt 2): 132516

Zhao T, Tan L, Han X, Wang X, Zhang Y, Ma X, Lin K, Wang R, Ni Z, Wang J, Wang J (2022). Microplastic-induced apoptosis and metabolism responses in marine Dinoflagellate, Karenia mikimotoi. Science of the Total Environment, 804: 150252