SUPPLEMENTARY INFORMATION

FUNCTIONAL TRAIT BASED EVIDENCE OF MICROPLASTIC EFFECTS ON AQUATIC SPECIES

Table S1 **Description of the five functional traits examined in the meta-analysis and keywords for the measured variables used in the selected studies for each functional trait category.** Specifically, the two functional traits – behaviour and metabolism – and the three performance traits – growth, reproduction, survival – as from Arnold's (1983) framework revisited by Violle et al. (2007). Regarding the quantification of variables such as those associated with behaviour, we followed the quantification reported by the authors, according to the methods they applied.

Functional Trait	Description	Keywords
Behaviour	Organisms behavioural and feeding changes reported after the ingestion or exposure to microplastics compared to an unexposed control group	Activity rate, locomotor activity, mobility, swimming velocity, maximum velocity, distance travelled, spontaneous movement, turning behaviour, inactivity, use of the tank, predatory activity, feeding success, foraging time
Growth	Variation in organism size per unit of time, capability to grow specific parts of the organism or complete transformation stages measured after exposure to microplastics compared to an unexposed control group	Body weight, body length, standard length, total length, weight gain rate, body mass, changes in body mass, length-weight ratio, biometric measurements, head length, head height, head depth, liver weight, gill weight, gonad weight, swim bladder area, optic vesicle area, pericardium area, angle between myosepts, distance between myosepts, interocular distance
Metabolism	Metabolic energy expenditure or available as reserves for the individual after the ingestion of microplastics compared to an unexposed control group	Energy consumption, oxygen consumption, assimilation efficiency, macronutrient, condition factor, hepatosomatic index, gonadosomatic index, heart beats, mucus secretion, byssus secretion
Reproduction	Variation in gametes or embryos production or impairment in asexual reproduction after exposure to microplastics compared to an unexposed control group	Oocite production, sperm motility, brood size, embryos production, egg production, fertilization rate
Survival	Survival rate of organisms exposed to microplastics compared to an unexposed control group	Survival rate, survival percentage

Table S2 **Summary of all the studies included in the global dataset ordered by species name.** Country where the experiment took place, species name, habitat, trophic level and life stage of the organisms used are listed together with functional traits and number of case studies reported as *k*.

Authors	Country	Species	Habitat	Trophic level	Life stage	Trait	k
Critchel et al., 2018[1]	Australia	*Acanthochromis polyacanthus*	Marine	Level 1	Juvenile	Behaviour	10
						Metabolism	12
						Growth	33
Rochman et al., 2016[2]	USA	*Acipenser transmontanus*	Estuarine	Level 2	Juvenile	Behaviour	4
						Metabolism	4
Naidoo et al., 2019[3]	South Africa	*Ambassis dussumieri*	Estuarine	Level 2	Juvenile	Growth	9
Jabeen et al., 2018[4]	China	*Carassius auratus*	Freshwater	Level 1	Adult	Growth	6
						Metabolism	3
Choi et al., 2018[5]	Republic of Korea	*Cyprinodon variegatus*	Estuarine	Level 1	Larvae	Behaviour	16
Xia et al., 2020[6]	China	*Cyprinus carpio*	Freshwater	Level 1	Larvae	Growth	3
Chen et al., 2017[7]	China	*Danio rerio*	Freshwater	Level 2	Larvae	Behaviour	21
Duan et al., 2020[8]	China						
Karami et al., 2107[9]	Malaysia					Metabolism	15
Qiang & Cheng, 2019[10]	China						
Malafaia et al., 2020[11]	Brazil					Growth	132
Le Moine et al., 2018[12]	Canada						
Qiao et al., 2019[13]	China				Juvenile	Metabolism	4
						Growth	6
Kim et al., 2019[14]	Republic of Korea				Adult	Behaviour	29
Jin et al., 2018[15]	China					Metabolism	4
Limonta et al., 2019[16]	Italy					Growth	4
Zhao et al., 2020[17]	China						

Mazurais et al., 2015[18]	France	*Dicentrarchus labrax*	Marine	Level 2	Larvae	Behaviour	2
Barboza et al., 2018[19]	Portugal	*Dicentrarchus labrax*	Marine		Juvenile	Metabolism	6
Pedà et al., 2016[20]	Italy	*Dicentrarchus labrax*	Marine		Adult	Growth	16
						Survival	1
Jinhui et al., 2019[21]	China	*Hippocampus kuda*	Marine	Level 2	Juvenile	Growth	14
						Metabolism	7
						Survival	1
Guven et al., 2018[22]	Vietnam	*Lates calcarifer*	Estuarine	Level 2	Larvae	Behaviour	1
					Juvenile	Behaviour	1
Zhu et al., 2020[23]	USA	*Orizias latipes*	Freshwater	Level 2	Larvae	Behaviour	6
Chisada et al., 2019[24]	Japan					Growth	14
Hu et al., 2020[25]	USA				Adult	Growth	40
Pannetier et al., 2019[26]	France					Metabolism	12
						Reproduction	30
Cong et al., 2019[27]	China	*Oryzias melastigma*	Freshwater	Level 2	Larvae	Behaviour	39
Le Bihanic et al., 2020[28]	France					Growth	20
Li et al., 2020[29]	China					Survival	4
Wang et al., 2019[30]	China				Juvenile	Metabolism	12
					Adult	Reproduction	7
Lönnstedt et al., 2016[31]	Sweden	*Perca fluviatilis*	Freshwater	Level 1	Larvae	Behaviour	22
						Growth	2
Malinich et al., 2018[32]	USA	*Pimephales promelas*	Freshwater	Level 1	Larvae	Behaviour	12
					Juvenile	Growth	7
de Sá et al., 2015[33]	Portugal	*Pomatoschistus microps*	Estuarine	Level 2	Juvenile	Behaviour	20
Ferreira et al., 2016[34]							
Fonte et al., 2016[35]						Growth	4
Luís et al., 2015[36]							
Miranda et al., 2019[37]							
Schmieg et al., 2020[38]	Germany	*Salmo trutta*	Freshwater	Level 2	Juvenile	Growth	1

Yin et al., 2019[39]	China	*Sebastes schlegelii*	Marine	Level 2	Juvenile	Behaviour	11
Yin et al., 2018[40]						Metabolism	3
Espinosa et al., 2017[41]	Spain	*Sparus aurata*	Marine	Level 2	Adult	Growth	8
Wen et al., 2018[42]	China	*Symphysodon aequifasciatus*	Freshwater	Level 2	Juvenile	Growth	2
						Survival	2
Green et al., 2016[43]	Northern Ireland	*Arenicola Marina*	Marine	Level 1	Adult	Behaviour	9
van Cauwenberghe et al., 2015[44]	Belgium					Metabolism	14
						Growth	9
Bour et al., 2018[45]	Norway	*Abra nitida*	Marine	Level 1	Adult	Metabolism	36
						Growth	9
Redondo et al., 2018[46]	Netherlands	*Asellus aquaticus*	Freshwater	Level 1	Adult	Behaviour	7
						Growth	7
						Survival	7
Xu et al., 2017[47]	Hong Kong	*Atactodea striata*	Marine	Level 1	Adult	Behaviour	6
						Metabolism	12
Lei et al., 2018[48]	China	*Caenorhabditis elegans*	Freshwater	Level 1	Adult	Growth	6
						Reproduction	12
						Survival	21
Watts et al., 2015[49]	UK	*Carcinus maenas*	Marine	Level 2	Adult	Behaviour	12
Watts et al., 2016[50]						Metabolism	15
						Growth	12
Cole et al., 2015[51]	UK	*Crassostrea gigas*	Marine	Level 1	Larvae	Behaviour	8
						Growth	2
Sussarellu et al., 2016[52]	France				Adult	Metabolism	1
						Growth	5
						Reproduction	3
Ziajahromi et al., 2018[53]	Australia	*Chironomus tepperi*	Freshwater	Level 1	Larvae	Growth	12
						Survival	4
Messinetti et al., 2018[54]	Italy	*Ciona robusta*	Marine	Level 1	Larvae	Growth	12

						Survival	4
Guilhermino et al., 2018[55]	Portugal	*Corbicula fluminea*	Freshwater	Level 1	Adult	Behaviour	8
Oliveira et al., 2018[56]	Portugal						
Rochman et al., 2017[2]	USA						
Bruck et al., 2018[57]	UK	*Echinogammarus marinus*	Marine	Level 2	Adult	Behaviour	18
						Growth	4
Bour et al., 2018[45]	Norway	*Ennucula tenuis*	Marine	Level 1	Adult	Metabolism	36
						Growth	9
Yu et al., 2018[58]	China	*Eriocheir sinensis*	Marine	Level 2	Adult	Metabolism	4
Blarer et al., 2016[59]	Switzerland	*Gammarus fossarum*	Freshwater	Level 1	Adult	Behaviour	24
Straub et al., 2017[60]						Growth	24
						Metabolism	24
Weber et al., 2018[61]	Germany	*Gammarus pulex*	Freshwater	Level 1	Juvenile	Behaviour	5
						Metabolism	10
						Growth	5
Redondo et al., 2018[46]	Netherlands				Adult	Behaviour	12
						Metabolism	10
						Growth	12
						Survival	7
Redondo et al., 2018[46]	USA	*Hyalella azteca*	Freshwater	Level 1	Juvenile	Growth	4
						Survival	8
Au et al., 2015[62]	Netherlands				Adult	Growth	10
						Survival	6
Hämer et al., 2014[63]	Germany	*Idotea emarginata*	Marine	Level 2	Juvenile	Behaviour	42
						Growth	6
Redondo et al., 2018[46]	Netherlands	*Lumbriculus variegatus*	Freshwater	Level 1	Adult	Behaviour	10
						Growth	7
						Reproduction	7

Browne et al., 2008[64]	UK	*Mytilus edulis*	Marine	Level 1	Larvae	Growth	39
Green et al., 2017[65]	Northern Ireland						
Green et al., 2019[66]	Northern Ireland						
Rist et al., 2019[67]	Denmark				Adult	Behaviour	14
van Cauwenberghe et al., 2015[44]	Belgium						
Woods et al., 2018[68]	USA					Metabolism	5
Capolupo et al., 2018[69]	Italy	*Mytilus galloprovincialis*	Marine	Level 1	Larvae	Behaviour	2
Beiras et al., 2018[70]	Spain					Growth	15
Détrée et al., 2018[71]	Chile				Adult	Growth	3
Devriese et al., 2017[72]	Belgium	*Nephrops norvegicus*	Marine	Level 2	Adult	Behaviour	5
Welden et al., 2016[73]	UK					Metabolism	2
						Growth	5
Green et al., 2017[65]	Northern Ireland	*Ostrea edulis*	Marine	Level 1	Adult	Behaviour	8
Green et al., 2016[74]						Metabolism	2
						Growth	4
Beiras et al., 2018[75]	Spain	*Paracentrotus lividus*	Marine	Level 1	Larvae	Growth	24
Beiras et al., 2019[70]							
Messinetti et al., 2018[54]	Italy						
Leung et al., 2018[76]	Hong Kong	*Perinereis aibuhitensis*	Marine	Level 1	Adult	Growth	14
Santana et al., 2018[77]	Brazil	*Perna perna*	Marine	Level 1	Adult	Behaviour	1
Rist et al., 2016[78]	Indonesia	*Perna viridis*	Marine	Level 1	Adult	Behaviour	2
						Metabolism	1
Gardon et al., 2018[79]	French Polynesia	*Pinctada margaritifera*	Marine	Level 1	Adult	Behaviour	6
						Metabolism	3
						Growth	6
Tosetto et al., 2016[80]	Australia	*Platorchestia smithi*	Marine	Level 1	Adult	Behaviour	2
						Growth	2
						Survival	2
Imhof et al., 2016[81]	Germany	*Potamopyrgus antipodarum*	Freshwater	Level 1	Adult	Growth	53

						Reproduction	6
						Survival	14
Redondo et al., 2018[46]	Netherlands	*Sphaerium corneum*	Freshwater	Level 1	Adult	Growth	7
						Survival	3
Kaposi et al., 2014[82]	Australia	*Tripneustes gratilla*	Marine	Level 1	Larvae	Behaviour	2
						Growth	8
						Survival	4
Redondo et al., 2018[46]	Netherlands	*Tubifex spp.*	Freshwater	Level 1	Adult	Behaviour	10
						Growth	7
						Survival	7

Table S3 **Summary of grouping and case studies number for concentration analysis**. Number of case studies reported for: per each medium (i.e. water, sediment and food); grouping factor depending on the technique adopted to measure microplastic; unit used to measure microplastic's concentration depending on the medium used for the experiment; final number of case studies after standardization to a common unit of measure per each of the three experiment's medium.

Medium		Group	Case studies	Unit used	Case studies	Standardized unit	Case studies
Water	937	Number	261	n MPs/ml	102	n MPs/ml	261
				n MPs/ 300ml	12		
				n MPs/individvidual	48		
				n MPs/L	99		
		Weight	676	µg MPs/ml	69	mg MPs/L	676
				µg MPs/L	51		
				mg MPs/L	556		
Sediment	234	Number	21	n MPs/ kg sediment	16	n MPs/kg sed	21
				n MPs/g sediment	5		
		Weight	90	mg MPs/Kg sediment	90	g MPs/Kg sed	213
		Percentage	123	%MPs/sediment.weight	123		
Food	205	Number	88	n MPs/mg food	23	n MPs/g food	88
				n MPs/g food	65		
		Number/Surface	1	n MPs/surface	1	removed	1
		Percentage	45	%MPs/mg food	45	g MPs/kg food	45
		Weight	71	mg MPs/g food	45		71
				mg MPs/g food	8		

				g MPs/kg food	18		
NA	97						

Table S4 **Summary of model with continuous factor**. Result for the meta-regression models analyzing effect size and microplastic concentration (expressed in different unit). Both results for complete and without outliers (out.rm) model are reported. Analysis conducted with mixed-effects model, using the rma.mv function of the metaphor package in R, including study Id and functional trait as random factor. Significant results ($p \leq 0.05$) are indicated in bold.

Medium	Unit	Model	*p*-value	Correlation
Water	n MPs/liter	mod1– complete	**0.0103**	negative
		mod2 – out.rm1	**0.0176**	positive
		mod3 – out.rm2	0.1461	NS
	mg MPs/liter	mod1 – complete	0.1712	NS
		mod2 – out.mr	**0.0330**	positive
Sediment	n MPs/kg sediment	mod1 - complete	**< .0001**	positive
	g MPs/kg sediment	mod1 - complete	0.6835	NS
Food	n MPs/kg food	mod1 - complete	0.3263	NS
		mod2 – out.rm	0.2721	NS
	g MPs/g food	mod1 - complete	0.5467	NS
		mod2 – out.rm	0.4828	NS

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