Assessing the potential for trophic transfer of microplastics through the Thames food web

By

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Supplementary material submitted in addition to thesis.

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School of Biological Sciences, Royal Holloway, University of London

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London NERC DTP, Cohort 4

Contents

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S1. FTIR in-house and commercial libraries.

Library	**Number of matches**
Commercial libraries	
HR Aldrich organometallic inorganic silanes, boranes and deuterated compounds	1
HR comprehensive forensic FTIR collection	79
HR Hummel polymer and additives	8
HR inorganics	1
HR Nicolet sampler library	2
HR polymer additives and plasticizers	42
HR spectra polymers additives and plasticizers by ATR – corrected	2
Hummel polymer sample library	34
Wizard library	13
In-house libraries	
Carbon-1	2
Common materials	11
Minera-1	1
Resink-2	172
Textil-1	432
Transm-1	381
Libraries of unknown origin	
Polyatr	7
Polymer	37
Polymer laminate films	11
Resins	3
U.S. geological survey minerals	1

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S2. Examples of animals reported to have consumed plastic. Wherever possible, the proportion of the sample to have ingested plastic, the amount of plastic ingested and the number of species found to ingest plastic is listed for each study.

Animal group	Plastic consumption	Sample size	Protocol	Reference
Plankton	13 species	>6 individuals per treatment	Collected with a plankton net and exposed to fluorescent polystyrene beads.	Cole et al. (2013)
▲	3–6% of individuals, 2 species	1,373	Collected with bongo nets and digested with nitric acid at 80 °C for 30 minutes.	Desforges et al. (2015)
▲	0.003–0.14 particle per individual, 1–38% of individuals, 7 groups	10–700 individual per group	Digested in 65% nitric acid heated to 80 °C for 30 mins.	Amin et al. (2020)
▲	0.056 ± 0.117 particles per individual	20 – 200 individuals per group	Collected in bongo nets and digested in KOH (10%) heated to 60 °C for 48 hours.	Zheng et al. (2020)
Annelids	100% of individuals, 1.2 ± 2.8 particles per gram, 1 species		Collected with a bait-pump or shovel, faeces used in NaI extraction and organism digested in 69% nitric acid overnight followed by boiling and dilution with 80 °C water.	Van Cauwenberghe et al. (2015)
▲	1 particle per individual, 3 species	6	Collected manually, samples fixed in 2% glutaraldehyde and visually inspected.	Gusmão et al. (2016)
▲	25–40% of individuals, 2 species	40	Collected manually and digested in 10% KOH at 50 °C overnight followed by a density separation with NaCl (1.2g cm^{-3}).	Bour et al. (2018)
▲	20–46.79 particles per individual, 1 species	95	Digested in NaOH at 60 °C for 48 hours.	Hamzah et al. (2021)
▲	42 – 93% of individuals, 1 ± 1.62–3.35 ± 2.60 per individual, 2 species	108	Digested in KOH (10%) at 60 °C for 12 hours.	Vecchi et al. (2021)
Molluscs	0.26–0.51 particles per gram, 2 species	15	Some collected manually and some purchased from stores, digested with nitric acid (65%) and perchloric acid (68%) 4:1 overnight	De Witte et al. (2014)

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			at room temperature, followed by 10 minutes of boiling and dilution with 500 ml water.	
	0.36 ± 0.07 – 0.47 ± 0.16 particles per gram, 2 species	46	Acquired direct from aquaculture or purchased from supermarket, digested in nitric acid (69%) overnight at room temperature followed by 2 hours of boiling and dilution 1:10 with 80 °C water.	Van Cauwenberghe and Janssen (2014)
	33% of individuals, 1 species	12	Collected from fish markets and fishermen, digested in KOH (10%) overnight at 60 °C.	Rochman et al. (2015)
	100% of individuals, 0.2 ± 0.3 particles per gram, 1 species	Not specified	Collected manually, faeces used in NaI extraction and organism digested in 69% nitric acid overnight followed by boiling and dilution with 80 °C water	Van Cauwenberghe et al. (2015)
	0.05–0.62 particles per gram, 4 species	100	Collected with an organism collector and digested in H_2O_2 (30%) at 60 °C for 1 hour and then placed on an oscillating plate until fully digested.	Bonello et al. (2018)
	41.1% of individuals, 1 species	12	Collected in a sediment grab and manually picked and digested in 10% KOH at 50 °C overnight followed by a density separation with NaCl (1.2g cm^{-3})	Bour et al. (2018)
	1.03 particles per gram, 6 species	18 pooled samples	Manually collected or collected in fishing nets, pooled together and digested in KOH (10%) in an incubator oscillator ay 65 °C overnight. If not fully digested, left for up to 48 hours at room temperature.	Abidli et al. (2019)
	95% of individuals, 0.97 ± 0.74 particles	5 groups of 5 individuals	Collected from fisheries markets,	Cho et al. (2019)

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	per individual, 4 species	pooled per species	digested with KOH (10%) at 60 °C overnight with a magnetic stirrer at 100rpm.	
▲	90% of individuals, 3.66 ± 2.59 particles per gram, 1 species	60	Soft tissue digested in KOH (10%) at 60 °C for 24 hours.	Bruzaca et al. (2022)
Chaetognaths	1 particle per individual, 1 species	1	Collected with a plankton tow and visually inspected.	Carpenter et al. (1972)
Echinoderms	48% of individuals, 0.68 ± 0.1 – 1.62 ± 0.9 particles per individual, 3 species	66	Collected with epibenthic sleds, digested with trypsin enzyme (0.3125%) with a magnetic stirrer (250rpm) heated to 38 – 42 °C for 25 minutes.	Courtene-Jones et al. (2017)
▲	20–40% of individuals, 3 species	45	Collected in a sediment grab and manually picked and digested in 10% KOH at 50 °C overnight followed by a density separation with NaCl (1.2g cm^{-3})	Bour et al. (2018)
▲	35%, 4 species	46	Collected by hand, samples were sieved (212 µm) and a density separation performed with $CaCl_2$ (2.15 g cm^{-3}) Filters were dried at 50 °C for 24 hours.	Plee and Pomory (2020)
Crustaceans	83% of individuals, 1 species	120	Collected with trawls and visually examined.	Murray and Cowie (2011)
▲	63% of individuals, 0.68 ± 0.55 particles per gram, 1.23 ± 0.99 per individual, 1 species	165	Collected with a shrimp trawl or beam trawl and digested overnight in nitric acid (65%) and perchloric acid (68%) 4:1 at room temperature, then boiled for 10 minutes and diluted with 500 ml of water and boiled a second time until digestion was complete.	Devriese et al. (2015)
▲	1.5 particles per gram, 7.8 per individual, 1 species	25	Collected by trawling, digested in H_2O_2 (35%) and KOH (4%) for 72 hours at 60 °C, followed by $HClO_4$ (68%) and HNO_3 (65%) 1:4	Abbasi et al. (2018)

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			digestion for 10 minutes.	
	65% individuals, 1 species	20	Collected in a sediment grab and manually picked and digested in 10% KOH at 50 °C overnight followed by a density separation with NaCl (1.2g cm^{-3})	Bour et al. (2018)
	39.2% of individuals, 1 species	148	Collected with a semi-balloon otter trawl and visually inspected.	Carreras-Colom et al. (2018)
	6% of individuals, 1 particle per individual, 1 species	116	Collected with fyke, trammel and shrimp nets and visually examined.	McGoran et al. (2018)
	60–85% of individuals, 1.66 ± 0.11 – 5.5 ± 0.8 particles per individual, 2 species	152	Collected with trawls, density extraction with NaCl (1.2 g cm^{-3}) and digestion with H2O2 (15%).	Cau et al. (2019)
	6.6 ± 2 – 7.8 ± 2 particles per individual, 2 species	30 (pooled)	Collected in trawls or with set bag net fishing and digested in H_2O_2 (30%) at 65 °C for 24 hours followed by room temperature digestion for 24 – 48 hours.	Hossain et al. (2019)
	72% of individuals, 0.9 ± 0.4 – 3.3 ± 0.7 particles per individual, 3 species	90	Collected with funnel traps and digested in KOH (10%) for 48 hours at 40 °C.	Jamieson et al. (2019)
	5.5% of individuals, 1.1 ± 0.7 particles per individual, 1 individual ingested 117 particles, 1 species	180	Collected with traps and digested with either sodium dodecyl sulfate at 50 °C for 24 hours followed by 24 hours at room temperature with Biozym F (lipase), Biozym SE (protease and amylase) or KOH (1 M) at room temperature for 48 hours.	Piarulli et al. (2019)
	31% of individuals, 0.39 ± 0.6 particles per individual, 1 species	330	Collected with a shrimp trawl and digested in KOH (10%) at 60 °C for 24 hours.	Daniel et al. (2020)
	83% of individuals, 1.75 ± 2.01 particles per individual, 1 species	150	Collected with trawling and digested in either KOH (10%) for 48 hours heated to 40	Hara et al. (2020)

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			°C and stained with Nile red.	
	36% of individuals, 0.52 ± 0.55 particles per individual, 1 species	100	Collected with dip nets and digested in NaOH (2N) at 60 °C for 12 hours.	Nan et al. (2020)
Insects	1 species	80	Colonies of mosquitoes were reared and visually examined for fluorescent particles.	Al-Jaibachi et al. (2018)
	4.3 ± 4.3–11.2 ± 5.9 particles per individual, 3 species	29	Collected with pond nets and digested in 20 ml of KOH (concentration not specified) and 20 ml of H2O2 (35%) for 120 hours at room temperature.	Akindele et al. (2020)
	0.73 ± 0.51–1.34 ± 1.11 per individual, 1 species	180	Sampled with aquatic dip nets and digested in H_2O_2 (30%) for 7 days at room temperature.	Maneechan and Prommi (2022)
Fishes	2.1–33% of individuals, 8 of 14 species	270	Collected with a plankton tow and visually inspected.	Carpenter et al. (1972)
	0.38% of individuals, 1.22 particles per individual, 10 species	17,212	Collected in nets protecting swimming beaches followed by visual inspection.	Cliff et al. (2002)
	35% of individuals, 2.1 particles per individual, 6 species	670	Collected with manta trawls, followed by visual inspection.	Boerger et al. (2010)
	9.2% of individuals, 8 of 27 species	141	Collected with trawls and bongo nets. Stomach contents was stained with rose Bengal and visually inspected.	Davidson and Asch (2011)
	36.5% of individuals, 1.90 ± 0.10 particles per individual, 10 species	504	Collected in trawls followed by visual examination.	Lusher et al. (2013)
	8–10% of individuals, 33 of 52 species	535	Collected with electrofishing or donated by anglers and visually inspected.	Phillips and Bonner (2015)
	25–28% of individuals	140	Collected from fish markets and fishermen, digested in KOH (10%) overnight at 60 °C.	Rochman et al. (2015)
	20–75% of individuals, 0.2 ± 0.42–0.85 ± 1.17	76	Collected wit fyke nets and visually examined.	McGoran et al. (2017)

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	particles per individual, 2 species			
	21.8 particles per individual, 5 species	90	Collected by trawling, digested in H_2O_2 (35%) and KOH (4%) for 72 hours at 60 °C, followed by $HClO_4$ (68%) and HNO_3 (65%) 1:4 digestion for 10 minutes.	Abbasi et al. (2018)
	5.9–55% of individuals, 3 species	57	Collected with trawling and digested in 10% KOH at 50 °C overnight followed by a density separation with NaCl (1.2g cm^{-3}).	Bour et al. (2018)
	36% of individuals, 1.5–5.83 particles per individual, 13 of 20 species	760	Collected with beam trawls, fyke, trammel and shrimp nets and visually examined.	McGoran et al. (2018)
	49% individuals, 1 species	122	Collected in gill nets and purse seine nets, then visually inspected.	Cardozo et al. (2018)
	24.3 ± 1.4% of individuals, 2.4 ± 0.2 particles per individual, 33 of 34 species	932	Collected from local fishermen then the stomach content was homogenised and digested in H_2O_2 (15%) at 60 °C until organic matter was digested (up to 14 days).	Markic et al. (2018)
	1 species	NA	Inspection of photos on social media.	Abreo et al. (2019)
	9% of individuals, 1 particle per individual, 1 species	78	Collected with fyke nets and electrofishing, then the stomach content was dried at 60 °C and homogenised. Followed by density separation in NaI (1.6 – 1.8 g cm^{-3}) and then digested in H_2O_2 (15%) at 60 °C for several hours.	Slootmaekers et al. (2019)
	50% of individuals, 1.4–1.5 ± 0.1 particles per individual, 2 species	529	Collected with otter trawl and fyke nets, then visually inspected.	Ferreira et al. (2019)
	21% of individuals, 0.37 ± 0.16 particles per individual, 5 species	116	Collected with otter trawls and gill nets, then digested in KOH (10%) at room temperature for two weeks.	Moore et al. (2022)

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			Followed by Tergazyme digestion.	
Birds	1 species	9	Visual inspection.	Parslow and Jefferies (1972)
	32% of individuals, 1.57 particles per individual, 1 species	15	Visual inspection.	Rothstein (1973)
	86% of individuals, 6.67 particles per individual, 1 species	7	Visual inspection.	Connors and Smith (1982)
	2.3–2.7% of individuals, 0.03 particles per individual, 5 of 20 species	115	Visual inspection.	Avery-Gomm et al. (2013)
	75–98% of individuals, 7.2–22.3 particles per individual, 1 species	363	Visual inspection.	Donnelly-Greenan et al. (2014)
	32.1% of individuals, 1–40 particles per individual, 32 of 51 species	1733	By-catch collected and visually inspected.	Roman et al. (2019)
	100% of individuals, 6.22 ± 2.46 particles per individual, 8 of 9 species	63	Deceased bird collected and digested with KOH (10%) heated to 65 °C for 48 hours, followed by 24 hours at room temperature.	Carlin et al. (2020)
	46.9% of samples, 0.9 ± 0.1 particles per sample, 1 species	121	Collected faecal and regurgitated pellets, followed by visual inspection.	D'Souza et al. (2020)
Turtles	5% of individuals, 3 particles per individual, 1 species	99	By-catch collected, inspected and released.	Gramentz (1888)
	1 individual, 8 particles per individual, 1 species	1	By-catch collected and visually examined.	Barreiros and Barcelos (2001)
	5.6% to 100% of individuals, 2 of 15 species	76	Stranded individuals collected and visually examined.	Deaville et al. (2010)
	90% of individuals, 13 particles per individual, 1 species	62	Deceased individuals collected and visually examined.	Carman et al. (2014)
	2 species	NA	Citizen science utilising online images.	Abreo et al. (2019)
	100% of individuals, 7 species	107	Collected deceased individuals and stomach contents sieved. A subsample was collected for enzymatic digestion.	Duncan et al. (2019)
Cetaceans	2.2% to 14.3% of individuals, 5 species	3430	Stranded individuals	Deaville et al. (2010)

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			collected and visually examined.	
	100% of individuals, 1 species	2	Stranded animals visually examined.	Jacobsen et al. (2010)
	16 particles, 1 species	1	Gut contents sieved and then digested in KOH (10%).	Besseling et al. (2015)
	66% of individuals, 15.5 particles per individual, 1 species	3	Gut contents was washed through stacked sieves, with material passing through all sieves digested in KOH (10%) for three weeks at room temperature.	Lusher et al. (2015)
	10 species	NA	Citizen science utilising online images.	Abreo et al. (2019)
	100% of individuals, 5.5 particles per individual, 8 species	43	Necropsy on stranded animals, stomach contents digested with Proteinase K at 55 °C for 24 hours, followed by addition of 400 µl of $NaClO_4$, incubated at 55 °C for 72 hours.	Nelms et al. (2019)
	100% individuals, 97 ± 42 per individual, 1 species	7	Collected from local harvesters, stomach contents digested with KOH (10%) for two weeks at room temperature.	Moore et al. (2020)
Seals	1.13 particles per individual, 1 species	145	Scats collected rinsed through stacked sieves (lowest pore size 0.5 mm), followed by visual examination.	Eriksson and Burton (2003)
	12.2% of individuals, 0.26 particles per individual, 1 species	107 stomachs, 100 intestines, 125 scats	Deceased animals and scats collected and samples were visually inspected.	Bravo Rebolledo et al. (2013)
	67% of individuals, 2.7 to 13.35 particles per gram, 1 species	51	Scats collected and digested in KOH (20%) for 7 days at room temperature.	Perez-Venegas et al. (2018)
	100% of individuals, 5.5 particles per individual, 2 species	7	Necropsy on stranded animals, stomach contents digested with Proteinase K at 55 °C for 24 hours, followed by addition of 400 µl of $NaClO_4$, incubated	Nelms et al. (2019)

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			at 55 °C for 72 hours.	
Humans	100% of individuals, 20 particles per individual, 1 species	8	Chemical digestion of stool samples.	Schwabl et al. (2019)
	65% of lung tissue samples, 33 particles total, 1 species	20	Tissue samples collected during necropsy and digested in Corolase 7089 at 60 °C for 12 hours, followed by density separation with $ZnCl_2$ (1.5 g cm^{-3}).	Amato-Lourenço et al. (2021)
	66% of placenta, 12 particles total, 1 species	6	Samples digested in KOH (10%) for 7 days at room temperature.	Ragusa et al. (2021)
	77% of blood samples, between 2.4 µg/ml and 7.1 µg/ml, 1 species.	22	Samples treated with TRIS-HCL buffer and heated to 60 °C for 1 hour, followed by digestion in Proteinase K at 50 °C for 2 hours, with shaken for 20 minutes and finally heated to 60 °C for a further 20 minutes.	Leslie et al. (2022)

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S~~31~~. Location of trawling at Erith, Thames Estuary and the species collected ~~in trawls~~ as estimated on the boat. Trawls can be visualised on Google My Maps (https://www.google.com/maps/d/u/0/edit?mid=1yVzdSrKS47Kit3VG63xL5Tu8RcYE8xTp&usp=sharing).

Results of trawling at Erith on Tuesday 4 December 2018 from *Boy Daniel*.

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Station 1. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, ca. 51° 29.313′ N 000° 12.536′ E, 1046 hrs, 6.9 m, mud sample.

Station 2. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, ca. 51° 29.313′ N 000° 12.536′ E, 1101 hrs, 8.2 m, mud sample.

Station 3. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, ca. 51° 29.313′ N 000° 12.536′ E, 1105 hrs, 6.7 m, mud sample.

Station 4. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.241′ N 000° 12.582′ E, 1132 hrs, 11.9 m, out 51° 29.165′ N 000° 11.537′ E, 1149 hrs, 11.9 m.

Catch

Chelidonichthys lucerna (tub gurnard) 2

Carcinus maenas (European shore crab) 2

Eriocheir sinensis (Chinese mitten crab) 22

Trisopterus luscus (pouting) 15

Platichthys flesus (European flounder) 17

Agonus cataphractus (hooknose pogge) 2

Station 5. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.234′ N 000° 12.418′ E, 1207 hrs, 11.3 m, out 51° 29.166′ N 000° 11.705′ E, 1220 hrs, 10.7 m.

Catch

Chelidonichthys lucerna (tub gurnard) 1

Eriocheir sinensis (Chinese mitten crab) 11

Trisopterus luscus (pouting) 14

Merlangius merlangus (whiting) 2

Platichthys flesus (European flounder) 26

Agonus cataphractus (hooknose pogge) 1

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.239′ N 000° 12.560′ E, 1234 hrs, 11.9 m, out 51° 29.178′ N 000° 11.933′ E, 1246 hrs, 11.6 m.

Catch

Chelidonichthys lucerna (tub gurnard) 4

Eriocheir sinensis (Chinese mitten crab) 4

Merlangius merlangus (whiting) 2

Agonus cataphractus (hooknose pogge) 1

Platichthys flesus (European flounder) 1

Station 7. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.526′ N 000° 12.518′ E, 1258 hrs, 11 m, out 51° 29.194′ N 000° 11.844′ E, 1313 hrs, 9.2 m.

Catch

Chelidonichthys lucerna (tub gurnard) 2

Merlangius merlangus (whiting) 6

Eriocheir sinensis (Chinese mitten crab) 2

Station 8. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.246′ N 000° 12.460′ E, 1324 hrs, 11.3 m, out 51° 29.169′ N 000° 11.830′ E, 1339 hrs, 10.4 m.

Catch

Chelidonichthys lucerna (tub gurnard) 4

Merlangius merlangus (whiting) 4

Pomatoschistus minutus (sand goby) 1

Station 9. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.240′ N 000° 12.456′ E, 1355 hrs, out 51° 29.212′ N 000° 11.913′ E, 1410 hrs.

Catch

Merlangius merlangus (whiting) 4

Station 10. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, in 51° 29.254′ N 000° 12.552′ E, 1429 hrs, out 51° 29.201′ N 000° 11.955′ E, 1435 hrs.

Catch

Merlangius merlangus (whiting) 4

Station 11. Midwater trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, in 51° 29.007′ N 000° 12.241′ E, 1446 hrs, out 51° 28.962′ N 000° 11.845′ E, 1501 hrs.

Catch

Merlangius merlangus (whiting) 2

Total 160

Platichthys flesus (European flounder) 44 (some misidentified as plaice on the boat)

Merlangius merlangus (whiting) 25 (One whiting was misidentified on the boas and later identified as *Osmerus eperlanus*, European smelt)

Chelidonichthys lucerna (tub gurnard) 13

Carcinus maenas (European shore crab) 2

Eriocheir sinensis (Chinese mitten crab) 39

Trisopterus luscus (pouting) 29

Agonus cataphractus (hooknose pogge) 4

Pomatoschistus minutus (sand goby) 1

Crangon crangon (brown shrimp) 1

Shrimp sp. 1

Results of trawling at Erith on Wednesday 6 March 2019 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.164′ N 000° 11.943′ E to 51° 29.198′ N 000° 12.265′ E, 1025–1040 hrs.

Catch

Clupea harengus (Atlantic herring) 3

Osmerus eperlanus (European smelt) 1

Shrimp sp. 1

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.194′ N 000° 12.036′ E to 51° 29.207′ N 000° 12.389′ E, 1051–1105 hrs.

Catch

Clupea harengus (Atlantic herring) 1

Osmerus eperlanus (European smelt) 1

Shrimp sp. 1

Station 3. Midwater trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.002′ N 000° 12.090′ E, 51° 29.088′ N 000° 12.568′ E, 1117–1132 hrs.

Catch

Clupea harengus (Atlantic herring) 1

Osmerus eperlanus (European smelt) 8

Dicentrarchus labrax (European bass) 1

Shrimp sp. 2

Station 4. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.198′ N 000° 12.028′ E to 51° 29.232′ N 000° 12.430′ E, 1150–1205 hrs.

Catch

Clupea harengus (Atlantic herring) 5

Station 5. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.221′ N 000° 12.098′ E to 51° 29.265′ N 000° 12.685′ E, 1220–1235 hrs.

Catch

Clupea harengus (Atlantic herring) 5

Osmerus eperlanus (European smelt) 4

Pomatoschistus minutus (sand goby) 1

Shrimp sp. 4

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.213′ N 000° 11.994′ E to 51° 29.266′ N 000° 12.598′ E, 1247–1303 hrs. No depth recorded.

Catch

Platichthys flesus (European flounder) 1

Osmerus eperlanus (European smelt) 3

Station 7. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.186′ N 000° 11.812′ E to 51° 29.249′ N 000° 12.539′ E, 1318–1334 hrs. No depth recorded.

Catch

Platichthys flesus (European flounder) 1

Osmerus eperlanus (European smelt) 3

Station 8. 3.5 L grab, Off Erith Jetty, Kent, South Erith Rands, River Thames, 51° 28.914′ N 000° 11.205′ E to 51° 29.088′ N 000° 12.568′ E, 1350 hrs, 12 m.

Station 9. 3.5 L grab, Off Erith Jetty, Kent, South Erith Rands, River Thames, 51° 28.914′ N 000° 11.205′ E to 51° 29.088′ N 000° 12.568′ E, 1400 hrs, 12 m.

Station 10. 3.5 L grab, Off Erith Jetty, Kent, South Erith Rands, River Thames, 51° 28.914′ N 000° 11.205′ E to 51° 29.088′ N 000° 12.568′ E, 1408 hrs, 12 m.

Station 11. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.041′ N 000° 12.344′ E to 51° 28.958′ N 000° 11.917′ E, 1427 –1438 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 30

Dicentrarchus labrax (European bass) 13

Platichthys flesus (European flounder) 17

Trisopterus luscus (pouting) 12

Merlangius merlangus (whiting) 5

Clupea harengus (Atlantic herring) 2

Agonus cataphractus (hooknose pogge) 1

Eriocheir sinensis (Chinese mitten crab) 2

Shrimp sp. 26

Station 12. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.061′ N 000° 12.541′ E to 51° 29.014′ N 000° 12.225′ E, 1458–1513 hrs. No depth recorded.

Catch

Clupea harengus (Atlantic herring) 3

Osmerus eperlanus (European smelt) 1

Agonus cataphractus (hooknose pogge) 1

Shrimp sp. 1

Eriocheir sinensis (Chinese mitten crab) 1

Total 162

Clupea harengus (Atlantic herring) 20

Osmerus eperlanus (European smelt) 21

Dicentrarchus labrax (European bass) 14

Pomatoschistus minutus (Sand goby) 1

Platichthys flesus (European flounder) 17

Agonus cataphractus (hooknose pogge) 2

Solea solea (Dover sole) 30

Trisopterus luscus (pouting) 12

Merlangius merlangus (whiting) 5

Shrimp sp. 35

Eriocheir sinensis (Chinese mitten crab) 3

Results of trawling at Erith on Friday 14 June 2019 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.179′ N 000° 11.757′ E to 51° 29.209′ N 000° 12.365′ E, 1020–1035 hrs.

Catch

Clupea harengus (Atlantic herring) 1

Osmerus eperlanus (European smelt) 4

Shrimp sp. 3

Platichthys flesus (European flounder) 1

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.173′ N 000° 11.928′ E to 51° 29.216′ N 000° 12.329′ E, 1044–1059 hrs.

Catch

Clupea harengus (Atlantic herring) 2

Dicentrarchus labrax (European bass) 1

Platichthys flesus (European flounder) 2

Crangon crangon (brown shrimp) 4

Shrimp sp. 1

Station 3. Midwater trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.240′ N 000° 12.540′ E to 51° 29.185′ N 000° 11.767′ E, 1105–1125 hrs.

Catch

Osmerus eperlanus (European smelt) 1

Crangon crangon (brown shrimp) 2

Station 4. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.223′ N 000° 12.172′ E to 51° 29.210′ N 000° 12.968′ E, 1127–1143 hrs.

Catch

Osmerus eperlanus (European smelt) 1

Shrimp sp. 1

Crangon crangon (brown shrimp) 1

Station 5. 3.5 L grabs (4 samples), Off Erith Jetty, Kent, South Erith Rands, River Thames, 51° 28.914′ N 000° 11.203′ E, 1200–1214 hrs, 12 m.

Sample 4 was for eDNA study of *Eriocheir sinensis* (Chinese mitten crab).

Station 6. Midwater trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 28.945´ N 000° 11.600´ E to 51° 29.089´ N 000° 12.798´ E, 1220-1235 hrs.

Catch

Trisopterus luscus (pouting) 3

Osmerus eperlanus (European smelt) 2

Solea solea (Dover sole) 2

Platichthys flesus (European flounder) 4

Shrimp sp. 5

Crangon crangon (brown shrimp) 11

Station 7. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.016´ N 000° 12.247´ E to 51° 28.943´ N 000° 11.591´ E, 1248–1303 hrs. No depth recorded.

Catch

Carcinus maenas (European shore crab) 56

Platichthys flesus (European flounder) 30

Solea solea (Dover sole) 30

Trisopterus luscus (pouting) 30

Dicentrarchus labrax (European bass) 1

Osmerus eperlanus (European smelt) 2

Crangon crangon (brown shrimp) 50

Shrimp sp. 50

Station 8. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.017´ N 000° 12.414´ E to 51° 28.981´ N 000° 12.045´ E, 1352–1404 hrs. No depth recorded.

Catch

Carcinus maenas (European shore crab) 14

Eriocheir sinensis (Chinese mitten crab) 1

Shrimp sp. 37

Total 350

Clupea harengus (Atlantic herring) 3

Osmerus eperlanus (European smelt) 10

Dicentrarchus labrax (European bass) 2

Platichthys flesus (European flounder) 37

Solea solea (Dover sole) 32

Trisopterus luscus (pouting) 30

Shrimp sp. 97

Crangon crangon (brown shrimp) 68

Carcinus maenas (European shore crab) 70

Eriocheir sinensis (Chinese mitten crab) 1

Results of trawling at Erith on Wednesday 2 October 2019 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.180′ N 000° 11.977′ E to 51° 29.209′ N 000° 12.247′ E, 1217–1232 hrs.

Catch

Clupea harengus (Atlantic herring) 1

Osmerus eperlanus (European smelt) 2

Engraulis encrasicolus (European anchovy) 1

Pipefish sp. 1

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.236′ N 000° 12.082′ E to 51° 29.268′ N 000° 12.402′ E, 1243–1258 hrs.

Catch

Osmerus eperlanus (European smelt) 1

Merlangius merlangus (whiting) 1

Platichthys flesus (European flounder) 1

Crangon crangon (brown shrimp) 17

Shrimp sp. 4

Station 3. Midwater trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 29.212′ N 000° 11.972′ E, to 51° 29.246′ N 000° 12.22′ E, 1310–1325 hrs.

Catch

Osmerus eperlanus (European smelt) 1

Chelidonichthys lucerna (tub gurnard) 1

Shrimp sp. and *Crangon crangon* (brown shrimp) 6

1 isopod

Station 4. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.197′ N 000° 11.676′ E to 51° 29.226′ N 000° 12.031′ E, 1341–1356 hrs.

Catch

Osmerus eperlanus (European smelt) 8

Pomatoschistus minutus (sand goby) 3

Solea solea (Dover sole) 1

Shrimp sp. and *Crangon crangon* (brown shrimp) 16

Station 5. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.224′ N 000° 11.918′ E to 51° 29.289′ N 000° 12.440′ E, 1406–1421 hrs.

Catch

Engraulis encrasicolus (European anchovy) 3

Osmerus eperlanus (European smelt) 2

Clupea harengus (Atlantic herring) 4

Pomatoschistus minutus (sand goby) 1

Shrimp sp. and *Crangon crangon* (brown shrimp) 23

Isopod sp. 1

Station 6. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 28.998′ N 000° 12.091′ E to 51° 29.057′ N 000° 12.536′ E, 1436–1415 hrs, 9.4 m.

Catch

Osmerus eperlanus (European smelt) 1

Pomatoschistus minutus (sand goby) 1

Shrimp sp. and *Crangon crangon* (brown shrimp) 6

Station 7. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.191′ N 000° 12.986′ E to 51° 29.273′ N 000° 12.516′ E, 1507-1522hrs, 11.3 m.

Catch

Platichthys flesus (European flounder) 30

Solea solea (Dover sole) 30

Trisopterus luscus (pouting) 13

Pomatoschistus minutus (sand goby) 2

Osmerus eperlanus (European smelt) 2

Gadus morhua (Atlantic cod) 1

Carcinus maenas (European shore crab) 3

Shrimp sp. and *Crangon crangon* (brown shrimp) 65

Station 8. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.187′ N 000° 11.890′ E to 51° 29.222′ N 000° 12.344′ E, 1538–1553 hrs, 13 m.

Catch

Shrimp sp. 2

1 ragworm

Station 9. 3.5 L grabs (3 samples) Erith Pier, 51° 28.908´ N 000° 11.183´ E.

Station 10. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 28.990´ N 000° 12.176´ E to 51° 28.962´ N 000° 11.775´ E, 1645 – 1650 hrs, 10 m.

Catch

Trisopterus luscus (pouting) 13

Carcinus maenas (European shore crab) 19

3 shrimp sp.

Total 290

Engraulis encrasicolus (European anchovy) 4

Gadus morhua (Atlantic cod) 1

Platichthys flesus (European flounder) 31

Pomatoschistus minutus (sand goby) 5

Chelidonichthys lucerna (tub gurnard) 1

Clupea harengus (Atlantic herring) 5

Isopod sp. 2

Pipefish (*Syngathus acus / rostellatus*) 1

Trisopterus luscus (pouting) 26

Ragworm sp. 1

Shrimp sp. and *Crangon crangon* (brown shrimp) 142

Carcinus maenas (European shore crab) 22

Osmerus eperlanus (European smelt) 17

Solea solea (Dover sole) 31

Merlangius merlangus (whiting) 1

Results of trawling at Erith on Thursday 19 December 2019 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.177′ N 000° 11.918′ E to 51° 29.280′ N 000° 10.955′ E, 1136–1152 hrs.

Catch

Osmerus eperlanus (European smelt) 13

Chelon ramada (thin-lipped grey mullet) 9

Pomatoschistus minutus (sand goby) 1

Sprattus sprattus (sprat) 2

Dicentrarchus labrax (European bass) 3

Crangon crangon (brown shrimp) 13

Shrimp sp. 8

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.199′ N 000° 12.372′ E to 51° 29.151′ N 000° 11.313′ E, 1211–1227 hrs.

Catch

Osmerus eperlanus (European smelt) 2

Chelon ramada (thin-lipped grey mullet) 1

Dicentrarchus labrax (European bass) 3

Sprattus sprattus (sprat) 11

Clupea harengus (Atlantic herring) 1

Shrimp sp. 5

Station 3. 3.5 L grab (3 samples) Erith Pier, 51° 28.942′ N 000° 11.108′ E, 1240 hrs.

Station 4. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.206′ N 000° 11.218′ E, to 51° 29.166′ N 000° 12.305′ E, 1319–1334 hrs.

Catch

Osmerus eperlanus (European smelt) 3

Sprattus sprattus (sprat) 16

Chelon ramada (thin-lipped grey mullet) 2

Dicentrarchus labrax (European bass) 4

1 shrimp sp.

Station 5. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.135′ N 000° 11.497′ E to 51° 29.157′ N 000° 12.456′ E, 1349–1404 hrs.

Catch

Osmerus eperlanus (European smelt) 13

Dicentrarchus labrax (European bass) 3

Pomatoschistus minutus (sand goby) 3

Crangon crangon (brown shrimp) 25

Shrimp sp. 16

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.232′ N 000° 12.061′ E to 51° 29.264′ N 000° 12.816′ E, 1422–1437 hrs. No depth recorded.

Catch

Chelon ramada (thin-lipped grey mullet) 18

Dicentrarchus labrax (European bass) 18

Platichthys flesus (European flounder) 31

Solea solea (Dover sole) 1

Pomatoschistus minutus (sand goby) 1

Eriocheir sinensis (Chinese mitten crab) 3

Station 7. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.190′ N 000° 11.966′ E to 51° 29.249′ N 000° 12.597′ E, 1454 – 1510 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 5

Pomatoschistus minutus (sand goby) 6

Eriocheir sinensis (Chinese mitten crab) 9

Station 8. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 28.978′ N 000° 11.821′ E to 51° 29.023′ N 000° 12.33′ E, 1526–1541 hrs. No depth recorded.

Catch

12 *Eriocheir*

Pomatoschistus minutus (sand goby) 4

Station 9. Benthic trawl, Off Erith Yacht, Kent, South Erith Rands, River Thames, 51° 28.996′ N 000° 11.814′ E to 51° 29.035′ N 000° 12.267′ E, 1557–1612 hrs. No depth recorded.

Catch

Pomatoschistus minutus (sand goby) 9

Total 275

Platichthys flesus (European flounder) 31

Pomatoschistus minutus (sand goby) 24

Clupea harengus (Atlantic herring) 1

Shrimp sp. 30

Crangon crangon (brown shrimp) 38

Osmerus eperlanus (European smelt) 31

Solea solea (Dover sole) 6

Eriocheir sinensis (Chinese mitten crab) 24

Chelon ramada (thin-lipped grey mullet) 30

Sprattus sprattus (sprat) 29

Dicentrarchus labrax (European bass) 31

Results of trawling at Erith on Thursday 19 March 2020 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.256’ N 000° 12.640’ E to 51° 29.194’ N 000° 11.874’ E, 1035–1050 hrs.

Catch

Osmerus eperlanus (European smelt) 10

Sprattus sprattus (sprat) 7

Crangon crangon (brown shrimp) 27 [collected for MSc student at RHUL]

Shrimp sp. 1

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.224’ N 000° 12.467’ E to 51° 29.182’ N 000° 11.792’ E, 1103–1118 hrs.

Catch

Osmerus eperlanus (European smelt) 20

Sprattus sprattus (sprat) 12

Dicentrarchus labrax (European bass) 1

Pomatoschistus minutus (sand goby) 2

Crangon crangon (brown shrimp) 49 [collected for MSc student at RHUL]

Shrimp sp. 2

Station 3. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.279’ N 000° 12.555’ E to 51° 29.206’ N 000° 11.952’ E, 1132–1147 hrs.

Catch

Osmerus eperlanus (European smelt) 3

Sprattus sprattus (sprat) 11

Clupea harengus (Atlantic herring) 2

Chelon ramada (thin-lipped grey mullet) 1

Pomatoschistus minutus (sand goby) 2

Crangon crangon (brown shrimp) 26 [collected for MSc student at RHUL]

Shrimp sp. 4

Station 4. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.224’ N 000° 12.444’ E to 51° 29.191’ N 000° 11.903’ E, 1202–1217 hrs. No depth recorded.

Catch

Platichthys flesus (European flounder) 30

Solea solea (Dover sole) 9

Dicentrarchus labrax (European bass) 3

Pomatoschistus minutus (sand goby) 5

Eriocheir sinensis (Chinese mitten crab) 3

Crangon crangon (brown shrimp) 130 [100 for present thesis, 30 collected for MSc student at RHUL]

Shrimp sp. 30

Amphipod sp. 4

Station 5. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.037′ N 000° 12.457′ E to 51° 29.012′ N 000° 11.944′ E, 1239–1254 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 3

Dicentrarchus labrax (European bass) 2

Crangon crangon (brown shrimp) 5 [collected for MSc student at RHUL]

Anguilla anguilla (European eel) 1 – relatively small, released immediately

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.197′ N 000° 12.535′ E to 51° 29.187′ N 000° 12.322′ E, 1310–1316 hrs, terminated due to capture of extremely large boulder. No depth recorded.

Catch

Solea solea (Dover sole) 2

Station 7. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 28.943′ N 000° 11.107′ E, 1404–1438 hrs, mud sample, 12 m.

Station 8. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, ca. 51° 28.943′ N 000° 11.107′ E, 1404–1438 hrs, mud sample, 12 m.

Station 9. 3.5 L grab, Off Wennington Marshes, Essex, North Erith Rands, River Thames, ca. 51° 28.943′ N 000° 11.107′ E, 1404–1438 hrs, mud sample, 12 m.

Total

Platichthys flesus (European flounder) 30

Solea solea (Dover sole) 14

Osmerus eperlanus (European smelt) 33

Chelon ramada (thin-lipped grey mullet) 1

Dicentrarchus labrax (European bass) 6

Sprattus sprattus (sprat) 30

Clupea harengus (Atlantic herring) 2

Pomatoschistus minutus (sand goby) 9

Eriocheir sinensis (Chinese mitten crab) 3

Crangon crangon (brown shrimp) 232

Shrimp sp. 37

Amphipod sp. 4

Anguilla anguilla (European eel) 1 [caught and returned]

Results of trawling at Erith on Tuesday 21 July 2020 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.167′ N 000° 11.797′ E to 51° 29.210′ N 000° 12.187′ E, 1034–1049 hrs.

Catch

Osmerus eperlanus (European smelt) 30 mainly small

Crangon crangon (brown shrimp) 7

Stickleback sp. 1

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.225′ N 000° 11.983′ E to 51° 29.268′ N 000° 12.544′ E, 1105–1120 hrs.

Catch

Clupea harengus (Atlantic herring) 1

Pomatoschistus minutus (sand goby) 8

Crangon crangon (brown shrimp) 35

Shrimp sp. 3

Platichthys flesus (European flounder) 1

Station 3. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.170′ N 000° 11.872′ E to 51° 29.214′ N 000° 12.207′ E, 1134–1150 hrs.

Catch

Osmerus eperlanus (European smelt) 21

Pomatoschistus minutus (sand goby) 7

Crangon crangon (brown shrimp) 61

Shrimp sp. 5

We did not continue with next 2 middle water hauls because of catching too many *Osmerus eperlanus* (European smelt) which do not survive being trawled.

Station 4. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.206′ N 000° 11.893′ E to 51° 29.259′ N 000° 12.444′ E, 1206–1220 hrs. No depth recorded.

Catch

Platichthys flesus (European flounder) 13

Solea solea (Dover sole) 5

Trisopterus luscus (pouting) 1

Pomatoschistus minutus (sand goby) 10

Crangon crangon (brown shrimp) 133

Shrimp sp. 19

Isopod sp. 2

Station 5. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.151′ N 000° 11.878′ E to 51° 29.232′ N 000° 12.391′ E, 1242–1257 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 1

Crangon crangon (brown shrimp) 40

Pomatoschistus minutus (sand goby) 1

Shrimp sp. 2

Platichthys flesus (European flounder) 1

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.246′ N 000° 11.939′ E to 51° 29.281′ N 000° 12.256′ E, 1311–1326 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 25

Platichthys flesus (European flounder) 16

Carcinus maenas (European shore crab) 24

Eriocheir sinensis (Chinese mitten crab) 1

Clupea harengus (Atlantic herring) 1

Pomatoschistus minutus (sand goby) 48

Stopped and did not continue with next 2 benthic trawls because of catching too many *Osmerus eperlanus* (European smelt) which do not survive being trawled.

Station 7. 3.5 L grab (3 samples), South Erith Rands, River Thames, 51° 28.806′ N 000° 11.572′ E, 1440 hrs, 12 m.

Total

Osmerus eperlanus (European smelt) 51

Crangon crangon (brown shrimp) 241

Stickleback sp. 1

Clupea harengus (Atlantic herring) 2

Pomatoschistus minutus (sand goby) 72

Shrimp sp. 29

Platichthys flesus (European flounder) 31

Solea solea (Dover sole) 31

Trisopterus luscus (pouting) 1

Isopod sp. 2

Carcinus maenas (European shore crab) 24

Eriocheir sinensis (Chinese mitten crab) 1

Results of trawling at Erith on Thursday 3 September 2020 from *Boy Daniel.*

Station 1. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.181′ N 000° 11.796′ E to 51° 29.189′ N 000° 12.023′ E, 1130–1145 hrs.

Catch

Osmerus eperlanus (European smelt) 11

Crangon crangon (brown shrimp) 75

Shrimp sp. 20

Sprattus sprattus (sprat) 2

Pomatoschistus minutus (sand goby) 21

Station 2. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.201′ N 000° 11.951′ E to 51° 29.225′ N 000° 12.436′ E, 1158–1213 hrs.

Catch

Pomatoschistus minutus (sand goby) 12

Crangon crangon (brown shrimp) 38

Shrimp sp. 8

Osmerus eperlanus (European smelt) 7

Sprattus sprattus (sprat) 1

Station 3. Midwater trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.188′ N 000° 11.802′ E to 51° 29.215′ N 000° 12.127′ E, 1225–1240 hrs.

Catch

Osmerus eperlanus (European smelt) 18

Crangon crangon (brown shrimp) 110

Shrimp sp. 9

Platichthys flesus (European flounder) 2

Swimming crab probably *Liocarcinus depurator* 1

We did not continue with next 2 middle water hauls because of catching too many *Osmerus eperlanus* (European smelt) which do not survive being trawled.

Station 4. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.202′ N 000° 11.587′ E to 51° 29.251′ N 000° 12.172′ E, 1259–1314 hrs. No depth recorded.

Catch

Platichthys flesus (European flounder) 30

Solea solea (Dover sole) 6

Trisopterus luscus (pouting) 1

Carcinus maenas (European shore crab) 2

Station 5. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.179′ N 000° 11.871′ E to 51° 29.220′ N 000° 12.331′ E, 1331–1346 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 5

Carcinus maenas (European shore crab) 3

Trisopterus luscus (pouting) 3

Dragonet sp. 1

Station 6. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.181′ N 000° 11.079′ E to 51° 29.229′ N 000° 12.579′ E, 1400–1416 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 3

Trisopterus luscus (pouting) 3

Station 7. Benthic trawl, Off Wennington Marshes, Essex, North Erith Rands, River Thames, 51° 29.224′ N 000° 11.878′ E to 51° 29.265′ N 000° 12.436′ E, 1430–1445 hrs. No depth recorded.

Catch

Solea solea (Dover sole) 13

Trisopterus luscus (pouting) 1

Carcinus maenas (European shore crab) 40

Osmerus eperlanus (European smelt) 3

Stopped and did not continue with next benthic trawl because of catching too many *Osmerus eperlanus* (European smelt) which do not survive being trawled.

Station 8. 3.5 L grabs (3 samples), South Erith Rands, River Thames, 51° 28.7936′ N 000° 11.632′ E, 1510 hrs, 12 m.

Total

Osmerus eperlanus (European smelt) 39

Crangon crangon (brown shrimp) 223

Pomatoschistus minutus (sand goby) 33

Shrimp sp. 37

Platichthys flesus (European flounder) 27

Solea solea (Dover sole) 32

Trisopterus luscus (pouting) 8

Carcinus maenas (European shore crab) 45

Dragonet sp. 1

Swimming crab probably *Liocarcinus depurator* 1

Sprattus sprattus (sprat) 3

S4. Fish collected from the Firth of Clyde, Scotland in November 2015 and May 2016 (McGoran et al., 2018) used in the present thesis for the development of a digestion protocol.

Phase I Digestions										
	HNO_3 R 1	**HNO_3 R 2**	**HNO_3 R 3**	**HNO_3 R 4**	**HNO_3 R 5**	**KOH R 1**	**KOH R 2**	**KOH R 3**	**KOH R 4**	**KOH R 5**
witch, *Glyptocephalus cynoglossus* (Linnaeus, 1758)	1	1	0	1	1	1	3	2	2	4
dab, *Limanda limanda* (Linnaeus, 1758)	3	14	8	10	15	15	15	5	27	0
lesser spotted dogfish, *Scyliorhinus canicula* (Linnaeus, 1758)	1	0	0	0	0	1	0	0	0	0
plaice, *Pleuronectes platessa* (Linnaeus, 1758)	1	3	0	2	12	9	4	11	3	9
long rough dab, *Hippoglossoides platessoides* (Fabricius, 1780)	1	1	0	0	6	3	4	13	9	6
European flounder, *Platichthys flesus* (Linnaeus, 1758)	1	0	0	0	1	1	2	1	0	33
sole, *Solea solea* (Linnaeus, 1758)	0	1	0	0	0	0	0	0	0	0
haddock, *Melanogrammus aeglefinus* (Linnaeus, 1758)	0	1	0	0	1	0	1	0	0	0
bull rout, *Myoxocephalus scorpius* (Linnaeus, 1758)	0	0	1	0	1	1	0	1	0	0
whiting, *Merlangius merlangus* (Linnaeus, 1758)	0	0	0	0	1	0	0	0	0	0
sea scorpion, *Taurulus bubalis* (Euphrasen, 1786)	0	0	0	1	0	0	1	0	0	0
hooknose, *Agonus cataphractus* (Linnaeus, 1758)	0	0	0	0	1	1	0	1	0	0
red gurnard, *Chelidonichthys cuculus* (Linnaeus, 1758)	0	0	0	0	0	1	0	0	0	0
Norwegian topknot, *Phrynorhombus norvegicus* (Günther, 1862)	0	0	0	0	0	1	0	0	0	0
poor cod, *Trisopterus minutus* (Linnaeus, 1758)	0	0	0	0	0	1	0	0	0	0
butterfish, *Pholis gunnellus* (Linnaeus, 1758)	0	0	0	0	0	0	0	1	0	0
TOTAL	*8*	*21*	*9*	*14*	*39*	*35*	*30*	*35*	*41*	*52*
Phase II Digestions										
	Pooled samples divided into 1 g (DW)									
witch, *Glyptocephalus cynoglossus* (Linnaeus, 1758)	4									
dab, *Limanda limanda* (Linnaeus, 1758)	87									
plaice, *Pleuronectes platessa* (Linnaeus, 1758)	14									
long rough dab, *Hippoglossoides platessoides* (Fabricius, 1780)	11									
haddock, *Melanogrammus aeglefinus* (Linnaeus, 1758)	1									
bullrout, *Myoxocephalus scorpius* (Linnaeus, 1758)	1									
sea scorpion, *Taurulus bubalis* (Euphrasen, 1786)	1									
cod, *Gadus morhua* (Linnaeus, 1758)	1									
TOTAL	*120*									

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S52. Daily rainfall data at Dartford S WKS (station site number 6762) seven days prior to sampling and on the day of sampling (Met Office, 2006). Dartford station is located at 51.466, 0.23488 and the rain gauge number is 291628.

Sample	**Rainfall (mm)**							
41218								
	27th Nov '18	28th Nov '18	29th Nov '18	30th Nov '18	1st Dec '18	2nd Dec '18	3rd Dec '18	4th Dec '18
	0	4	1.8	3.8	1.8	3.8	0.2	2.6
60319								
	27th Feb '19	28th Feb '19	1st Mar '19	2nd Mar '19	3rd Mar '19	4th Mar '19	5th Mar '19	6th Mar '19
	0	0	7.7	0	3	11.5	0.5	2.6
140619								
	7th June '19	8th June '19	9th June '19	10th June '19	11th June '19	12th June '19	13th June '19	14th June '19
	0	5.4	0.5	9	12.1	13.4	12.3	0
21019								
	25th Nov '19	26th Nov '19	27th Nov '19	28th Nov '19	29th Nov '19	30th Nov '19	1st Oct '19	2nd Oct '19
	6.2	5.5	0	3.2	6.1	0.2	6.3	11.6
191219								
	12th Dec '19	13th Dec '19	14th Dec '19	15th Dec '19	16th Dec '19	17th Dec '19	18th Dec '19	19th Dec '19
	0	8	3.6	10.6	1.7	8.7	1.2	5.7
190320								
	12th Mar '20	13th Mar '20	14th Mar '20	15th Mar '20	16th Mar '20	17th Mar '20	18th Mar '20	19th Mar '20
	0.2	0.1	0.6	0.1	1.7	0	0	0.1
210720								
	14th July '20	15th July '20	16th July '20	17th July '20	18th July '20	19th July '20	20th July '20	21st July '20
	5.3	0	0.4	1.1	17.1	0.7	0	0.1
30920								
	27th Aug '20	28th Aug '20	29th Aug '20	30th Aug '20	31st Aug '20	1st Sept '20	2nd Sept '20	3rd Sept '20
	0	17.5	4.2	0.6	0	0	0	0.6

S63. Cumulative rainfall data at Dartford S WKS (station site number 6762) seven days prior to sampling up until the day of sampling (Met Office, 2006). Dartford station is located at 51.466, 0.23488 and the rain gauge number is 291628.

Sample	**Rainfall (mm)**							
41218								
	27th Nov '18	28th Nov '18	29th Nov '18	30th Nov '18	1st Dec '18	2nd Dec '18	3rd Dec '18	4th Dec '18
	0	4	5.8	9.6	11.4	15.2	15.4	18
60319								
	27th Feb '19	28th Feb '19	1st Mar '19	2nd Mar '19	3rd Mar '19	4th Mar '19	5th Mar '19	6th Mar '19
	0	0	7.7	7.7	10.7	22.2	22.7	25.3
140619								
	7th June '19	8th June '19	9th June '19	10th June '19	11th June '19	12th June '19	13th June '19	14th June '19
	0	5.4	5.9	14.9	27	40.4	52.7	52.7
21019								
	25th Nov '19	26th Nov '19	27th Nov '19	28th Nov '19	29th Nov '19	30th Nov '19	1st Oct '19	2nd Oct '19
	6.2	11.7	11.7	14.9	21	21.2	27.5	39.1
191219								
	12th Dec '19	13th Dec '19	14th Dec '19	15th Dec '19	16th Dec '19	17th Dec '19	18th Dec '19	19th Dec '19
	0	8	11.6	22.2	23.9	32.6	33.8	39.5
190320								
	12th Mar '20	13th Mar '20	14th Mar '20	15th Mar '20	16th Mar '20	17th Mar '20	18th Mar '20	19th Mar '20
	0.2	0.3	0.9	1	2.7	2.7	2.7	2.8
210720								
	14th July '20	15th July '20	16th July '20	17th July '20	18th July '20	19th July '20	20th July '20	21st July '20
	5.3	5.3	5.7	6.8	23.9	24.6	24.6	24.7
30920								

	27th Aug '20	28th Aug '20	29th Aug '20	30th Aug '20	31st Aug '20	1st Sept '20	2nd Sept '20	3rd Sept '20
	0	17.5	21.7	22.3	22.3	22.3	22.3	22.9

S74. Recognisable brands on litter recovered from the River Thames.

Brand	Description	Number of Items Recovered
ASDA	Carrier bag and food packaging	2
August Storck KG	Werther's Original sweets	2
Bahlsen	Pick Up! biscuit wrapper	1
Benson and Hedges	Cigarette wrapper	1
Coca-Cola	Innocent coconut water and cola wrapper	2
Colombina	Sweet wrappers	2
Co-op	Yoghurt pot	1
Danone	Evian and Volvic water bottle wrappers and Actimel wrapper	4
Desnoes and Geddes LTD	Old Jamaica ginger beer	1
Dorval	SourPower sweets	1
Dragon Ball Z / Score Entertainment	Trading card game	1
Earth Rated	Compostable dog waste bags	1
Family Choice	Ice lolly wrapper	1
Ferrero	Kinder Bueno and Rafarell wrappers	3
Garaoto	Sweet wrappers	2
General Mills	Fibre One bar wrapper	1
GlaxoSmithKline	Ribena carton	1
Golden Wonder	Crisp packets	2
Greggs	Carrier bag	2
Haribo	Maoam and Haribo wrappers	3
Heineken	Desparados beer label	1
Kellogg's	Squares wrappers	2
Kerry Foods	Cheesestring wrapper	1
Kentucky Fried Chicken	Carrier bag	1
KP	Hula Hoops and NikNaks crisp packets	4
Kraft-Heinz	Milka chocolate wrapper and mustard sachet	2
Lancaster Caramel Company	Hersheys cookies and cream chocolate	2
Lindt	Lindor chocolate wrappers	2
Lotus	Biscoff biscuit wrappers	2
Marks & Spencer	Carrier bag, crisp packet and clothing packaging	3
Mars	Twix, Mars, Galaxy, Magic Stars, Heroes, Snickers, Starburst, MilkyWay wrappers	18
McDonalds	Cup lids	2

McVities	Mini Cheddars crisps packets	3
Mondelez	Mostly Cadburys chocolate wrappers and one Barny Bear wrapper	20
Navsen	Avant water wrapper	1
Nestle	Toffee Crisp, KitKat and Milky Bar wrappers	6
New Choice	Food wrapper	1
Organix	Food wrapper	1
Paterson	Food wrapper	1
PepsiCo	Walkers and Doritos crisp packets	16
Perfitti van Melle	Fruitella and Chuppa Chups wrappers	6
Poundland	Carrier bags	3
Refresh Co	Calypso drink carton	1
Republic Technologies	Swan cigarette filter wrappers	4
Sainsburys	Carrier bag and pita bread wrapper	2
ScoFro	Frozen seafood wrapper	1
SmithKline Beecham	Ribena carton	1
St Ives	Yogurt carton	1
Sunny	Indian sweet sunpari	1
Suntory	Lucozade wrappers	2
Sweet Heart Int	Drink container	1
Sweet Zone	Sweet wrappers	1
Swizzles Matlon	Refreshers wrapper	1
Tampax	Tampon wrapper	1
Tesco	Crisp packet	2
Unilever	Magnum wrapper and Pot Noodle flavour sachet	2
United Biscuits	Go Ahead! wrapper	1
Vincinni	Chocolate wrapper	1
Waitrose	Food wrapper	1
Whitworths	Fruit and biscuit shot wrapper	2
Whooo!	Filled crepe wrapper	1

S8. Global microplastic concentrations in riverine and estuarine sediments with sampling and extraction methods for comparison. The results of the present study have been highlighted.

Location	Sampling method	Mean concentration (± SD)	Extraction method	Reference
Europe				
River Thames Estuary, UK	Ekman grab	1,007 ± 1,146 per kg	Density separation ($ZnCl_2$)	The present study
River Thames tributaries, UK	Surface sediment (10 cm) collected along a transect with stainless-steel scoop.	185 ± 42 per kg to 660 ± 77 per kg	Density separation ($ZnCl_2$)	Horton et al. (2017)
Ebro River, Spain	Surface sediment (10 cm) collected with Van Veen grab.	2,052 ± 746 per kg	Density separation (NaCl)	Simon-Sánchez et al. (2019)
Rhine River and Main River, Germany	Surface sediment (2–3 cm) collected with a stainless-steel spoon.	228–3,763 per kg and 786–1,368 per kg (range not mean)	Density separation (NaCl)	Klein et al. (2015)
Amsterdam urban canals, Netherlands	Surface sediment (10 cm) collected with Van Veen grab.	2,071 ± 4,146 per kg	Density separation (NaCl)	Leslie et al. (2017)
Rhine River, Germany	Surface sediment (7 cm) was collected with a stainless steel spoon.	260 ± 10 per kg to 11,070 ± 600 per kg	Density separation ($ZnCl_2$)	Mani et al. (2019)
Asia				
Yongfeng river, China	Sediment collected with a Peterson Gravity Sampler.	26 ± 23 per kg	Density separation (NaCl) with H_2O_2 and HNO_3 digestion	Rao et al. (2020)
Ciwalengke River, Indonesia	Sediment collected with an Ekman grab.	30.3 ± 15.9 per kg	Density separation (NaCl)	Alam et al. (2019)
Tibet Plateau rivers, Tibet	Surface sediment (2 cm) collected with stainless steel shovel.	50 ± 7 per kg to 195 ± 64 per kg	H_2O_2 digestion followed by density separation ($ZnCl_2$)	Jiang et al. (2019)
Shuangtaizi River, Daliao River and Liaohe Estuary, China	Surface sediment collected with a steel grab sampler.	170 ± 96 per kg, 237 ± 129 per kg and 120 ± 46 per kg	Density separation ($ZnCl_2$) followed by H_2O_2 digestion	Xu et al. (2020)
Bang Yai Canal, Thailand	Surface sediment (5 cm) collected with an Ekman grab.	200 ± 105 per kg to 450 ± 196 per kg	H_2O_2 digestion followed by density separation (NaCl)	Jiwarungrueangkul et al. (2021)
Southern Caspian Sea, Iran	Surface sediment (5 cm) and subsurface sediment (5–15 cm) were collected from a metal frame with a spoon.	350.6 ± 232.6 per kg	Two step density separation (NaCl followed by $ZnCl_2$) with a H_2O_2 digestion	Ghayebzadeh et al. (2021)

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Beijiang River, China	Surface sediment (2 cm) was sampled with a stainless-steel shovel.	178 ± 69 per kg to 544 ± 107 per kg	Density separation (NaCl)	Wang et al. (2017)
Shanghai urban rivers, China	Surface sediment (5 cm) collected with a shovel.	802 ± 594 per kg	Density separation (NaCl)	Peng G. et al. (2018)
Pearl River, China	Sediment collected with a Van Veen grab.	1,669 per kg	Density separation (NaCl) followed by KOH digestion	Lin et al. (2018)
Africa				
Bloukrans River, South Africa	Surface sediment (5 cm) collected.	6.3 ± 4.3 per kg (summer) and 160.1 ± 139.5 per kg (winter)	Density separation (NaCl)	Nel et al. (2018)
Americas				
Ottawa River, Canada	Sediment was collected with a Ekman grab.	0.22 per kg	H_2O_2 digestion followed by density separation (NaCl)	Vermaire et al. (2017)
St Lawrence River, Canada	Surface sediment collected with a petite Ponar grab.	832 ± 150 per kg	Stacked sieves and canola oil extraction	Crew et al. (2020)
Belize River, Belize	Sediment collected with a Van Veen grab.	200 – 6,500 ± 1,273 per kg	Density separation (NaCl) followed by KOH and NaClO digestion	Silburn et al. (2022)
Amazon rivers, Brazil	Surface sediment (5–10 cm) was collected with a Van Veen grab.	417–8,178 per kg (range not mean)	H_2O_2 digestion followed by density separation ($ZnCl_2$)	Gerolin et al. (2020)
Australia				
Brisbane River, Australia	Surface sediment (3 cm) was collected with a Ponar stainless steel grab.	10–520 per kg (range mot mean)	Density separation ($ZnCl_2$)	He et al. (2020)

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S5. FTIR in-house and commercial libraries.

Library	Number of matches
Commercial libraries	
HR Aldrich organometallic inorganic silanes, boranes and deuterated compounds	1
HR comprehensive forensic FTIR collection	79
HR Hummel polymer and additives	8
HR inorganics	1
HR Nicolet sampler library	2
HR polymer additives and plasticizers	42
HR spectra polymers additives and plasticizers by ATR – corrected	2
Hummel polymer sample library	34
Wizard library	13
In-house libraries	
Carbon-1	2
Common materials	11
Minera-1	1
Resink-2	172
Textil-1	432
Transm-1	381
Libraries of unknown origin	
Polyatr	7
Polymer	37
Polymer laminate films	11
Resins	3
U.S. geological survey minerals	1

S9. Details of stranded baleen whales in the Thames Estuary, UK.

A juvenile female humpback whale (*Megaptera novaeangliae*) was reported stranded at Greenhithe, Kent, UK on 8th October 2019. The dead-stranded animal, which measured 837 cm in length, was examined by CSIP and baleen collected. Evidence showed the animal was nutritionally compromised with no signs of recent feeding. There was a heavy parasite burden in the intestines and linear scars on the dorsal fin and ventral tail flukes indicated historic entanglement. Ship strike was the proximal cause of death.

A juvenile sei whale (*Balaenoptera borealis*) was reported floating in the Thames at Gravesend, Kent, UK on 18th October 2019. The animal measured 970 cm in length and was dead at sea with evidence of live stranding. A necropsy was performed and baleen collected. The animal was in moderate nutritional condition with no sign of recent feeding and no evidence of entanglement, ship strike or trauma prior to death. The animal also had a heavy parasite burden in the intestine.

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S106. Plastic abundance in sediment and common biota samples collected across 24 months from Erith on the River Thames, UK. Diversity of plastic refers to the number of colour and form combinations recovered (i.e., red fibres, red beads). Mean averages are reported with standard deviation.

	Dec 2018	Mar 2019	June 2019	Oct 2019	Dec 2019	Mar 2020	July 2020	Sept 2020
Sediment								
Sample size	15	15	15	15	12	15	15	15
% Contaminated	100%	100%	100%	100%	100%	100%	100%	100%
Average (50 g)	8.67 ± 6.28	35.13 ± 35.35	17.2 ± 10.09	30.67 ± 25.15	19.08 ± 11.75	17.4 ± 15.73	128.13 ± 62.34	118.47 ± 46.34
Average (per gram)	0.17 ± 0.13	0.70 ± 0.71	0.34 ± 0.20	0.61 ± 0.71	0.38 ± 0.24	0.35 ± 0.31	2.56 ± 1.25	2.37 ± 0.92
Most abundant form	Clear fibres 43%	White fibres 36%	White fibres 34%	White fibre 30%	White fibres 37%	White fibres 39%	Clear fibres 38%	White fibres 28%
Average diversity	4.64 ± 2.44	8.8 ± 4.66	6.4 ± 2.90	7.67 ± 3.39	5.5 ± 2.54	6.83 ± 3.92	18.4 ± 5.52	20.4 ± 3.72
Platichthys flesus								
Sample size	45	18	38	34	31	31	30	31
Average length (mm)	172 ± 34.85	138 ± 53.11	127.74 ± 45.09	141.38 ± 29.63	172.77 ± 67.4	174.84 ± 42.43	166.23 ± 48.46	164.39 ± 52.74
Average mass (g)	107.53 ± 67.1	65.88 ± 63.28	53.7 ± 60.5	63.41 ± 44.1	86.65 ± 92.58	107.6 ± 68.85	106.49 ± 73.79	110.87 ± 91.02
% Contaminated	96	61	84	62	52	58	43	42
% in GIT	76	44	74	41	42	45	30	19
% on gills	91	33	58	26	23	23	20	26
Average (all)	4.53 ± 3.22	1.78 ± 1.90	4.84 ± 5.52	1.06 ± 1.04	1.87 ± 2.53	2.13 ± 3.59	0.63 ± 0.89	0.58 ± 0.85
Average (contaminated)	4.74 ± 3.14	2.91 ± 1.58	5.57 ± 5.57	1.71 ± 0.78	3.63 ± 2.45	3.67 ± 4.1	1.46 ± 0.78	1.38 ± 0.77
Most abundant form	Blue fibres 25%	Clear fibres 31%	Clear fibres 23%	Blue fibres 25%	Clear fibres 29%	Clear fibres 41%	Blue/Clear fibres 32%	Blue fibres 50%
Average diversity (all)	2.93 ± 1.47	1.28 ± 1.18	2.74 ± 2.21	0.85 ± 0.82	1.35 ± 1.84	1.16 ± 1.51	0.57 ± 0.73	0.48 ± 0.63
Average diversity (contaminated)	3.07 ± 1.35	2.09 ± 0.7	3.25 ± 2.03	1.38 ± 0.59	2.63 ± 1.78	2 ± 1.5	1.31 ± 0.48	1.15 ± 0.38
Solea solea								
Sample size	0	33	36	37	6	14	34	27
Average length (mm)	NA	95.27 ± 55.72	149.42 ± 68.69	98.68 ± 39.66	85 ± 5.62	114.86 ± 45.2	113.85 ± 56.81	87.19 ± 57.46
Average mass (g)	NA	33.47 ± 89.63	85.14 ± 105.53	23.52 ± 53.41	7.07 ± 2.11	34.16 ± 55.34	42.96 ± 78.44	30.66 ± 82.59
% Contaminated	NA	70	81	32	17	36	9	41
% in GIT	NA	48	64	24	0	36	6	19
% on gills	NA	55	64	11	17	14	3	33
Average (all)	NA	1.45 ± 1.25	4.14 ± 5.11	0.57 ± 0.96	0.17 ± 0.41	0.57 ± 0.85	0.09 ± 0.29	0.85 ± 1.35
Average (contaminated)	NA	2.09 ± 0.95	5.14 ± 5.22	1.75 ± 0.87	1 ± 0	1.6 ± 0.55	1 ± 0	2.09 ± 1.38
Most abundant form	NA	Clear fibres 35%	Clear fibres 23%	Blue/Red fibres 24%	Purple fibres 100%	Blue fibres 50%	Blue fibres 67%	Blue fibres 52%
Average diversity	NA	1.21 ± 1.02	2.33 ± 1.76	0.54 ± 0.93	0.17 ± 0.41	0.5 ± 0.76	0.09 ± 0.29	0.70 ± 0.99
Average diversity (contaminated)	NA	1.74 ± 0.75	2.89 ± 1.47	1.67 ± 0.89	1 ± 0	1.4 ± 0.55	1 ± 0	1.73 ± 0.79

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Osmerus eperlanus								
Sample size	1	22	10	14	33	32	50	40
Average length (mm)	147 ± 0	69.36 ± 21.98	102.6 ± 16.8	113.07 ± 12.48	126.3 ± 18.29	124.47 ± 9.95	101.04 ± 40.67	113.75 ± 35.91
Average mass (g)	29.4 ± 0	4.01 ± 7.86	11.15 ± 5.92	15.26 ± 5.05	22.32 ± 14.25	20.16 ± 4.97	16.85 ± 15.97	18.53 ± 14.56
% Contaminated	0	100	80	71	39	13	36	38
% in GIT	0	43	30	43	27	13	32	25
% on gills	0	86	80	29	27	3	6	18
Average (all)	0	2.64 ± 1.76	2.6 ± 1.9	1.29 ± 1.07	0.85 ± 1.44	0.16 ± 0.45	0.58 ± 0.93	0.73 ± 1.26
Average (contaminated)	0	NA	3.25 ± 1.49	1.8 ± 0.79	2.15 ± 1.57	1.25 ± 0.5	1.61 ± 0.85	1.93 ± 1.39
Most abundant form	NA	Blue fibres 31%	Blue fibres 50%	Blue fibres 39%	Blue fibres 43%	Blue fibres 40%	Blue fibres 55%	Blue fibres 45%
Average diversity	0	2 ± 1.16	2 ± 1.16	1.14 ± 0.95	0.58 ± 0.87	0.16 ± 0.45	0.48 ± 0.71	0.5 ± 0.72
Average diversity (contaminated)	0	NA	2.5 ± 1.41	1.6 ± 0.7	1.46 ± 0.78	1.25 ± 0.5	1.33 ± 0.49	1.33 ± 0.49
Trisopterus luscus								
Sample size	29	10	34	19	0	0	2	8
Average length (mm)	165.17 ± 12.73	159.8 ± 17.87	88.15 ± 29.57	128.26 ± 36.05	NA	NA	138 ± 73.54	127.63 ± 35.76
Average mass (g)	84.39 ± 24.61	74.39 ± 26.53	16.66 ± 28.91	48.66 ± 30.82	NA	NA	76.2 ± 91.78	46.95 ± 48.65
% Contaminated	55	60	76	21	NA	NA	50	0
% in GIT	14	30	53	16	NA	NA	0	0
% on gills	52	50	62	5	NA	NA	50	0
Average (all)	1.03 ± 1.3	2.3 ± 2.41	2.06 ± 1.98	0.26 ± 0.59	NA	NA	0.5 ± 0.5	0
Average (contaminated)	1.88 ± 2.2	3.83 ± 1.83	2.69 ± 1.85	1.25 ± 0.5	NA	NA	1 ± 0	0
Most abundant form	Blue fibres 33%	Blue fibres 39%	Blue fibres 49%	Various	NA	NA	Purple fibres 100%	NA
Average diversity	0.93 ± 1.13	1.2 ± 1.4	1.47 ± 1.24	0.26 ± 0.59	NA	NA	0.5 ± 0.5	0
Average diversity (contaminated)	1.69 ± 1.01	2 ± 1.26	1.92 ± 1.06	1.25 ± 0.5	NA	NA	1 ± 0	0
Crangon crangon								
Sample size	0	13	50	50	50	104	50	50
Average length (mm)	NA	44.62 ± 4.01	46.96 ± 5.25	46.96 ± 5.05	45.68 ± 0.76	39.62 ± 4.41	43.14 ± 3.83	43.38 ±6.07
Average mass (g)	NA	1.38 ± 0.34	1.74 ± 0.47	1.47 ± 0.46	1.3 ± 0.38	0.78 ± 0.27	1.15 ± 0.27	1.05 ± 0.41
% Contaminated	NA	23	8	22	34	26	34	38
Average (all)	NA	0.23 ± 0.44	0.08 ± 0.27	0.28 ± 0.57	0.44 ± 0.76	0.38 ± 0.75	0.5 ± 0.79	0.7 ± 1.91
Average (contaminated)	NA	1 ± 0	1 ± 0	1.27 ± 0.47	1.29 ± 0.77	1.44 ± 0.8	1.47 ± 0.67	1.84 ± 2.77
Most abundant form	NA	Blue fibres 67%	Blue/Purple fibres 50%	Red/Blu fibres 29%	Blue fibres 36%	Blue fibres 62%	Blue fibres 44%	Blue fibres 23%
Average diversity	NA	0.23 ± 0.44	0.08 ± 0.27	0.26 ± 0.53	0.44 ± 0.76	0.33 ± 0.63	0.44 ± 0.67	0.46 ± 0.68
Average diversity (contaminated)	NA	1 ± 0	1 ± 0	1.18 ± 0.4	1.29 ± 0.77	1.26 ± 0.59	1.29 ± 0.47	1.21 ± 0.54

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S11~~7~~. Size of microplastics measured in ImageJ. Length and width of microplastics were measured from photographs. Thickness of plastics could not be measured.

Species / Sample	Number measured	Smallest length (µm)	Largest length (µm)	Average Length (µm) ± SD	Smallest width (µm)	Largest width (µm)	Average Width (µm) ± SD
Agonus cataphractus	21	259.9	3911.597	1453.371 ± 1148.577	10.006	48.289	24.799 ± 10.375
Chelidonichthys lucerna	26	423.724	17264.682	3380.093 ± 4502.999	4.784	391.93	37.044 ± 73.336
Corophium volutator	95	14.276	5505.004	995.413 ± 1122.141	6.039	157.42	23.878 ± 19.175
Crangon crangon	65	74.678	7819.787	1446.226 ± 1391.445	11.19	222.664	33.503 ± 32.011
Dicentrarchus labrax	19	176.87	12889.4	2721.467 ± 3228.314	7.991	84.941	24.794 ± 19.638
Halichoerus grypus	213	61.748	29757.4	2110.745 ± 2634.246	8.813	1089.128	72.586 ± 152.289
Hediste diversicolor	42	153.197	3993.65	1137.988 ± 1021.854	9.782	131.562	20.100 ± 18.198
Merlangius merlangus	43	38.783	15843.14	2908.273 ± 2978.186	8.58	6079.649	311.285 ± 1088.239
Osmerus eperlanus	221	31.889	37553.97	1805.359 ± 3651.36	9.597	19616.88	241.169 ± 1738.337
Phocoena phocoena	59	104.502	4837.026	1471.277 ± 953.357	7.619	1113.88	59.608 ± 169.943
Platichthys flesus	672	59.555	77861.32	4155.026 ± 6419.888	6.021	10908.02	98.732 ± 522.806
Pomatoschistus minutus	3	968.797	1169.437	1069.887 ± 100.329	19.294	20.878	19.982 ± 0.812
Solea solea	277	67.044	62319.02	3096.567 ± 5959.359	5.931	4483.267	73.063 ± 334.586
Sprattus sprattus	2	854.43	279.426	566.928 ± 406.589	13.756	15.606	14.697 ± 1.305

Trisopterus luscus	121	154.225	34560.15	2745.568 ± 4480.179	2.428	1708.994	49.543 ± 162.442
Sediment Total	1174	93.55	42931.94	1960.94 ± 2315.222	6.11	11276.17	141.543 ± 454.038
Dec2018 Sediment	104	140.317	42931.94	2758.149 ± 4535.791	10.695	2632.54	129.305 ± 291.881
Mar2019 Sediment	402	135.52	16682.25	1753.567 ± 1421.741	6.11	3987.242	125.57 ± 363.307
Jun2019 Sediment	61	124.185	18190.99	1899.376 ± 2744.933	6.254	1748.17	169.943 ± 325.774
Oct2019 Sediment	120	450.617	7211.767	1947.86 ± 1294.252	11.191	2268.993	124.972 ± 300.482
Dec2019 Sediment	26	105.763	4570.403	1422.761 ± 1030.099	11.547	455.523	75.539 ± 106.444
Mar2020 Sediment	44	219.598	38430.49	3169.023 ± 5940.805	14.106	11276.17	381.994 ± 1710.198
Jul2020 Sediment	214	131.557	11420.48	2051.802 ± 1580.42	7.511	1575.782	123.652 ± 249.503
Sep2020 Sediment	203	93.55	17343.38	1700.704 ± 1508.241	7.207	3355.066	155.904 ± 320.29
Trophic level 1	137	14.276	5505.004	1039.125 ± 1090.631	6.039	157.42	22.720 ± 18.895
Trophic level 2	65	74.678	7819.787	1446.226 ± 1391.445	11.19	222.664	33.503 ± 32.011
Trophic level 3	949	59.555	77861.32	3846.076 ± 6304.245	5.931	10908.02	91.240 ± 475.595
Trophic level 4	164	38.783	34560.15	2788.229 ± 4131.284	2.428	6079.649	118.170 ± 581.299
Trophic level 5	272	61.748	29757.4	1972.037 ± 2385.945	7.619	1113.88	69.771 ± 156.053

S12~~8~~. Results of FTIR analysis (10% representative subset), where n is the number of items analysed. A PerkinElmer Spectrum One FTIR spectrometer, with an AutoIMAGE FTIR Microscope System PerkinElmer attachment and Nicolet iN10 MX Infrared Microscope were used to individually analyse microplastics. A background spectrum collected before every analysis and between samples. A total of 16 scans were collected for each item, with the average result being used to generate an absorption spectrum between 500–4000 cm^{-1} and 650–4000 cm^{-1} respectively. Polymer identity was confirmed by visual comparison with library spectra (in-house and commercial, S5) rather than with a percentage match threshold.

		Level 1		Level 2	Level 3		Level 4		Other		Level 5	
	Sediment	*Hediste*	*Corophium*	*Crangon*	*Platichthys*	*Solea*	*Trisopterus*	*Merlangius*	*Osmerus*	Fish sp.	*Halichoerus*	*Phocoena*
n	696	39	61	NA	131	68	66	7	82	17	77	43
Acrylic	62				9	6	6		1		6	2
Alcosphere											2	
ALKYD (polyester resin)	4											
Avicel	4		1		1				2			1
Azlon	1											
Bamboo					1	1						
Carboxmethyl cellulose sodium salt		1									3	
Cardboard			1									
Cellophane	2				1				3		1	2
Cellulose	12	1	3		2	1	3		2	1	1	4
Cellulose acetate	1											
Chipboard	3		1			1		1				
Cotton	37	22	42		28	24	26	3	39	5	28	7
Denim												
Epoxy resin	2					1	1					
Epoxy resin and polyvinyl butyral and bisphenol A	2						1					

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Ethylene vinyl acetate	1											
Linen					1							
Melamine urea formaldehyde resin	1											
Mineral	9	1				2			2		2	
Modacrylic	1											
Nylon	51				4	2	2					
Organic (vegetation)	4										3	
Paint (blue base/color coat, styrene modified acrylic) (vehicle, BASF, NAD, Inmont) (Pigment, lunar yellow 27 fluorescent dyed / pigmented Benzog)	3											
Paper					1							
Polyacrylate												5
Polyacrylate:styrene	1									1		
Polyacrylonitrile butadiene styrene	2											

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Polyallomer	2												
Polybutylene					3								
Polyester	120		1		40	9	6	1	6	5	2	1	
Polyether urethane	1												
Polyethyl acrylate	1												
Polyethyl acrylate: methacrylate	1												
Polyethyl acrylate: st: acrylamide	1												
Polyethylene	20		1		6				1				
Polyethylene HDPE	24				2								
Polyethylene LDPE	21		1						1				
Polyethylene 4-methyl-1-pentene	1												
Polyethylene acrylic acid	2												
Polyethylene methacrylic acid	3												
Polyethylene:propylene	12					1							
Polyethylene:propylene:diene	2												
Polyethylene terephthalate	1						1						

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Polyisoprene	1											
Polyloom(olefin)	1											
Polymethacrylate	1											
Polymethylmethacrylate	1											
Polypropylene	244				13	7	2		6		2	2
Polypropylene + 20% talcum	1											
Polypropylene - amorphous	1											
Polypropylene:butenone						2						
Polystyrene							1					
Polystyrene resin	1											
Polystyrene-4-sulfonate	1											
Polystyrene:acrylate:ester	1				1		2		1			
Polystyrene:butadiene						1					1	
Polyurethane							1	1				
Polyvinylacetate:ethylene												
Polyvinylchloride	4											
Polyvinylchloride:vin					1							

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yl acetate:hydroxylpropyl acrylate terpoly													
Potassium oleate (emulsifier)									1				
Rayon	1					1	1				1	1	
RTV silicone (27-17)	1												
Thermoplastic rubber TPV	2												
Viscose	6	13	9		9	9	10	1	14	3	12	16	
Wool	7	1	1		2		1		2	1	1		
No match	6				6		2		1	1	11	2	

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S13~~9~~. Results of dietary analysis on biota recovered from the Thames Estuary. Where specified, species which could be identified are separated out and the remaining prey items were identified to the lowest taxonomic level and grouped. When not specified, all species were grouped together.

Species	Items in the diet	Count of presence in fish from McGoran et al. (2018)	Count of presence in fish from current research
Platichthys flesus	Amphipods (unidentified)	55	70
	Corophium volutator	0	54
	Shrimp (unidentified)	0	44
	Crangon crangon	6	8
	Mysid shrimp	3	0
	Polychaetes	21	8
	Fish	13	6
	Isopods	0	7
	Bivalves	6	5
	Barnacles	0	3
	Gastropods	0	3
	Shell fragments (unidentified)	0	1
	Vegetation	2	3
	Carcinus maenas	0	2
	Insect larvae (unidentified)	1	0
	Damselfly nymphs	0	1
	Hydroids	2	0
	Stones/sediment	11	31
Agonus cataphractus	Amphipods (unidentified)	NA	2
Chelidonichthys lucerna	Shrimp (unidentified)	0	4
	Crangon crangon	5	0
	Fish	3	1
Pomatoschistus minutus	Shrimp	NA	1
	Amphipods	NA	1
Sprattus sprattus	No prey	NA	NA
Merlangius merlangus	Fish	3	16
	Shrimp	15	25
	Mysid shrimp	9	0
	Polychaetes	0	1
	Amphipods	13	3
	Bivalves	1	0
	Isopods	2	0
	Crustaceans (unidentified)	0	1
	Vegetation	3	0
Osmerus eperlanus	Shrimp	NA	47
	Amphipods	NA	68
	Fish	NA	4
	Polychaetes	NA	4
	Vegetation	NA	1
Trisopterus luscus	Shrimp	6	88
	Barnacle	0	1
	Amphipods	0	33
	Fish	1	16
	Crustaceans (unidentified)	0	2
	Sediment	0	3
	Polychaetes	1	2
	Isopods	0	1
	Cumaceans	1	0
	Bryozoans	1	0
	Vegetation	1	0
Solea solea	Sediment	0	42
	Crustacean (unidentified)	0	3

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	Fish	2	11
	Shell fragments	0	2
	Polychaetes	5	33
	Amphipods	0	110
	Shrimp	10	17
	Brachyuran crab	1	1
	Tanaids	0	1
	Isopods	0	1
	Bivalves	6	0
	Insect larvae	2	0
	Cumaceans	3	0
	Holothurians	4	0
	Annelids	2	0
Dicentrachus labrax	Polychaetes	NA	2
	Amphipods	NA	2
	Fish	NA	1
	Shrimp	NA	1
Anguilla anguilla	*Crangon crangon*	1	NA
	Fish	1	NA
Gadus morhua	Fish	1	NA
Raja clavata	*Crangon crangon*	3	NA
	Amphipods	1	NA
	Isopods	2	NA
	Brachyuran crab	1	NA
	Pagurids	1	NA
Scyliorhinus canicula	Pagurids	1	NA
	Crangon crangon	1	NA
	Polychaetes	1	NA
	Fish	5	NA
	Sediment	1	NA
	Vegetation	1	NA
Halichoerus grypus	*Belone belone*	NA	2
	Anapagurus sp.	NA	1
	Pisidia longicornis	NA	1
	Cephalopods	NA	1
	Gadoids	NA	1
	Polychaete	NA	1
	Amphipod	NA	1
Phocoena phocoena	No prey	NA	NA
Crangon crangon	Amphipods (unidentified)	10	14
	Corophium volutator	4	1
	Polychaetes	12	2
	Barnacles	0	1
	Tanaid	0	1
	Gastropods	0	1
	Stones/sediment	2	4
	Vegetation	1	0
	Crustaceans (unidentified)	23	0
	Crangon crangon	1	0
	Bivalves	1	0
	Fish	2	0
	Chironomid larvae	1	0
Corophium volutator	No prey	NA	NA
Hediste diversicolor	No prey	NA	NA

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S14. Fish remains recovered during dietary analysis, including otoliths and skeletal remains. Where possible, fish size was estimated using Härkönen (1986) and Camphuysen and Henderson (2017). The average of the two estimates is reported below, except for estimates marked with * which were calculated from Härkönen (1986) alone.

Object	Recovered from	Species	Length (mm)	Estimated fish length (mm)
Otolith	301018 *Halichoerus grypus* Margate3	*Scophthalamus rhombus*	6	338.65
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	10	183.6
Otolith	301018 *Halichoerus grypus* Margate3	*Trisopterus luscus*	7	144.25
Otolith	301018 *Halichoerus grypus* Margate3f	*Pleuronectes platessa*	6.5	300.2
Otolith	301018 *Halichoerus grypus* Margate3	*Pleuronectes platessa* or *Platichthys flesus*	5	234.34*
Otolith	301018 *Halichoerus grypus* Margate3	*Pleuronectes platessa* or *Platichthys flesus*	5.7	267.681*
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	7	127.6
Otolith	301018 *Halichoerus grypus* Margate3	*Pleuronectes platessa* or *Platichthys flesus*	4	186.71*
Otolith	301018 *Halichoerus grypus* Margate3	*Solea solea*	4	305.85
Otolith	301018 *Halichoerus grypus* Margate3	*Trisopterus luscus*	9	217.13*
Otolith	301018 *Halichoerus grypus* Margate3	*Trisopterus luscus*	9.5	238.105*
Otolith	301018 *Halichoerus grypus* Margate3	*Trisopterus luscus*	4	7.38*
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	10 (damaged)	183.6
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	11 (eroded)	201.6
Otolith	301018 *Halichoerus grypus* Margate3	*Pleuronectes platessa*	5.7	261.75
Otolith	301018 *Halichoerus grypus* Margate3	*Pleuronectes platessa*	6	276.15
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	11 (damaged)	201.6
Otolith	301018 *Halichoerus grypus* Margate3	*Merlangius merlangus*	13 (damaged)	238.6
Vertebra	301018 *Halichoerus grypus* Margate3	*Clupea harengus*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	Salmonidae	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	NA (damaged)	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	*Belone belone*	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	Cottidae	NA	NA
Vertebra	301018 *Halichoerus grypus* Margate3	NA (damaged)	NA	NA

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Otolith	041218 *Merlangius merlangus* MWMM2	*Solea solea*	1.2	95.4592*
Otolith	041218 *Merlangius merlangus* MWMM2	*Anguilla anguilla*	1.5	240.144*
Otolith	041218 *Merlangius merlangus* MM1	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MM1	*Solea solea*	1.1	76.3691*
Otolith	041218 *Merlangius merlangus* MM1	*Solea solea*	1	68.279*
Otolith	041218 *Merlangius merlangus* MWMM5	*Osmerus eperlanus*	2.6	74.46*
Otolith	041218 *Merlangius merlangus* MWMM5	*Osmerus eperlanus*	2.3	64.845*
Otolith	041218 *Merlangius merlangus* MWMM5	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MWMM5	No ID (eroded)	0.6	NA
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.6	116.8196*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.3	92.5493*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.1	76.3691*
Otolith	041218 *Merlangius merlangus* MWMM3	*Solea solea*	1.1	76.3691*
Otolith	041218 *Merlangius merlangus* MWMM3	No ID (eroded)	0.5	NA
Otolith	041218 *Merlangius merlangus* MWMM6	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MWMM6	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MWMM6	*Solea solea*	1.2	95.4592*
Otolith	041218 *Merlangius merlangus* MWMM6	*Solea solea*	1.1	76.3691*
Otolith	041218 *Merlangius merlangus* MM6	*Solea solea*	1.6	116.8196*
Otolith	041218 *Merlangius merlangus* MM6	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MM6	No ID (eroded)	0.7	NA
Otolith	041218 *Merlangius merlangus* MM6	No ID (eroded)	0.4	NA
Otolith	041218 *Merlangius merlangus* MWMM9	*Clupea harengus* or *Sprattus sprattus*	1.9	NA
Otolith	041218 *Merlangius merlangus* MWMM9	*Clupea harengus* or *Sprattus sprattus*	1.7	NA
Otolith	041218 *Merlangius merlangus* MWMM9	*Osmerus eperlanus*	1.7	45.615*
Otolith	041218 *Merlangius merlangus* MWMM9	*Osmerus eperlanus*	1.8	48.82*
Otolith	041218 *Merlangius merlangus* MWMM9	No ID (eroded)	0.7	NA
Otolith	041218 *Merlangius merlangus* MWMM9	No ID (eroded)	0.8	NA
Otolith	041218 *Merlangius merlangus* MWMM7	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MWMM7	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MM14	*Solea solea*	1.8	132.9998*

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Otolith	041218 *Merlangius merlangus* MM14	*Merlangius merlangus*	6.6	118.084*
Otolith	041218 *Merlangius merlangus* MM10	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MM10	*Solea solea*	1.5	107.393*
Otolith	041218 *Merlangius merlangus* MM10	Goby sp.	0.4	NA
Otolith	041218 *Merlangius merlangus* MM10	Goby sp.	0.3	NA
Otolith	041218 *Merlangius merlangus* MM10	No ID (eroded)	0.6	NA
Otolith	041218 *Merlangius merlangus* MM10	No ID (eroded)	0.6	NA
Otolith	041218 *Merlangius merlangus* MM10	No ID (eroded)	0.3	NA
Otolith	041218 *Merlangius merlangus* MM5	*Osmerus eperlanus*	1.2	29.59*
Otolith	041218 *Merlangius merlangus* MM5	*Solea solea*	1.2	95.4592*
Otolith	041218 *Merlangius merlangus* MM5	*Solea solea*	1.4	100.6394*
Otolith	041218 *Merlangius merlangus* MM5	No ID (eroded)	0.8	NA
Otolith	041218 *Chelidonichthys lucerna* CL7	*Solea solea*	1.5	107.393*
Otolith	041218 *Chelidonichthys lucerna* CL7	*Solea solea*	1.3	92.5493*
Otolith	041218 *Chelidonichthys lucerna* CL7	*Solea solea*	1.3	92.5493*
Otolith	041218 *Chelidonichthys lucerna* CL7	*Solea solea*	1.5	107.393*
Otolith	041218 *Chelidonichthys lucerna* CL7	*Solea solea*	1.6	116.8196*
Otolith	041218 *Trisopterus luscus* TL3	*Solea solea*	1.4	100.6394*
Otolith	041218 *Trisopterus luscus* TL27	*Solea solea*	1.3	92.5493*
Otolith	041218 *Trisopterus luscus* TL8	*Solea solea*	1.4	100.6394*
Otolith	041218 *Trisopterus luscus* TL8	*Solea solea*	1.3	92.5493*
Otolith	041218 *Trisopterus luscus* TL5	*Solea solea*	0.9	60.1889*
Otolith	041218 *Trisopterus luscus* TL17	*Solea solea*	1.2	95.4592*
Otolith	041218 *Trisopterus luscus* TL17	*Solea solea*	1.3	92.5493*
Otolith	021019 *Trisopterus luscus* TL14	*Clupea harengus* or *Sprattus sprattus*	1.8	NA
Otolith	021019 *Trisopterus luscus* TL24	*Clupea harengus* or *Sprattus sprattus*	1.9	NA
Otolith	021019 *Trisopterus luscus* TL20	*Solea solea*	1.7	124.9097*
Otolith	021019 *Trisopterus luscus* TL20	*Solea solea*	1.8	132.9998*
Otolith	021019 *Trisopterus luscus* TL6	*Solea solea*	1.6	116.8196*
Otolith	210720 *Osmerus eperlanus* OE11	*Clupea harengus* or *Sprattus sprattus*	2.4	NA
Otolith	030920 *Platichthys flesus* PF28	*Solea solea*	1.4	100.6394*
Otolith	030920 *Trisopterus luscus* TL1	*Solea solea*	1.5	107.393*
Otolith	030920 *Trisopterus luscus* TL1	*Solea solea*	1.4	100.6394*

S150. Plastic abundance in fauna collected from Erith on the River Thames, UK. Diversity of plastic refers to the number of colour and form combinations recovered (i.e., red fibres, red beads). Length and width of microplastics were measured from photographs. Thickness of plastics could not be measured. Means are reported with standard deviation.

Trophic level 1	
Hediste diversicolor	
Sample size	76
Average length (mm)	25.6 ± 18.8
% Contaminated	26%
Average (all)	0.4 ± 0.9
Average (contaminated)	1.7 ± 0.9
Most abundant form	Purple fibres
Average diversity	0.3 ± 0.6
Corophium volutator	
Sample size	384
Average length (mm)	5.6 ± 1.7
% Contaminated	53%
Average (all)	0.9 ± 1.1
Average (contaminated)	1.7 ± 1.0
Most abundant form	Blue fibres
Average diversity	0.8 ± 0.9
Trophic level 2	
Crangon crangon	
Sample size	367
Average length (mm)	43.5 ± 5.6
Average mass (g)	1.2 ± 0.5
% Contaminated	27%
Average (all)	0.4 ± 1.0
Average (contaminated)	1.4 ± 1.4
Most abundant form	Blue fibres
Average diversity	0.3 ± 0.6
Trophic level 3	
Platichthys flesus	
Sample size	258
Average length (mm)	157.9 ± 49.4
Average mass (g)	88.7 ± 73.8
% Contaminated	65%
Average in GIT	1.6 ± 2.9
Average on gills	0.8 ± 1.4
Average (all)	2.4 ± 3.4
Average (contaminated)	3.7 ± 3.7
Most abundant form	Clear fibres
Average diversity	1.5 ± 1.7
Solea solea	
Sample size	187
Average length (mm)	109.7 ± 58.0
Average mass (g)	42.0 ± 82.4
% Contaminated	44%
Average in GIT	0.7 ± 1.5
Average on gills	0.6 ± 1.9
Average (all)	1.4 ± 2.8
Average (contaminated)	3.0 ± 3.5
Most abundant form	Blue fibres
Average diversity	0.9 ± 1.3

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Trophic level 4	
Merlangius merlangus	
Sample size	30
Average length (mm)	208.5 ± 52.3
Average mass (g)	122.9 ± 67.5
% Contaminated	67%
Average in GIT	0.7 ± 1.3
Average on gills	0.7 ± 0.9
Average (all)	1.5 ± 1.5
Average (contaminated)	2.2 ± 1.2
Most abundant form	Blue fibres
Average diversity	1.3 ± 1.1
Trisopterus luscus	
Sample size	102
Average length (mm)	128.6 ± 42.0
Average mass (g)	51.2 ± 41.4
% Contaminated	52%
Average in GIT	0.44 ± 1.0
Average on gills	0.8 ± 1.3
Average (all)	1.3 ± 1.7
Average (contaminated)	2.4 ± 1.7
Most abundant form	Blue fibres
Average diversity	0.9 ± 1.2
Trophic level 5	
Halichoerus grypus	
Sample size	4~~3~~
Average length (mm)	1486.7 ± 310.1
% Contaminated	100%
Average (all)	~~77.7 ± 64.8~~214.8 ± 70.7
Average (stomach)	18.~~0~~8 ± ~~8.9~~7.4
Average (intestines)	196~~59.7~~ ± ~~64.6~~277.7
Most abundant form	Clear~~Blue~~ fibres
Average diversity	10 ± ~~3.6~~2.9
Phocoena phocoena	
Sample size	1
Length (mm)	1670
% Contaminated	100%
Amount	102
Amount (fore stomach)	1
Amount (main stomach)	4
Amount (fore stomach)	36
Amount (intestines)	61
Most abundant form	Clear fibres
Diversity	9

S16. Comparison of microlitter ingestion, number of eggs and hatched offspring in the brood pouch of *Corophium volutator*.

Introduction

Corophium volutator carry eggs in a brood pouch. The presence of eggs in brood pouches of amphipods is often used in ecological tests as an indicator of effects on fitness after a treatment (e.g., Schrank et al., 2019). As an ecotoxicological study fell outside the scope of the present thesis, comparison between microlitter presence and number of eggs and offspring was reserved for the Supplementary Material.

Methods

Sampling methods are described in the main text of the thesis (Chapter 2). Eggs and offspring were counted prior to dissection. Statistical analysis was conducted in R version 4.0.3 (R Core Team, 2020).

Model S1 - GLM(Number of eggs ~ Number of microplastics, family = gamma (link = log))

Model 2 – GLM(Number of offspring ~ Number of microplastics, family = gamma (link = identity))

Results

For Model S1, AIC scores were Poisson 1,056.5050, Negative Binomial 453.0067, Gamma (link = identity) 451.5355, Gamma (link = log) 451.4336 and Gamma (link = inverse) 451.5568. On average 3.2 ± 10.4 eggs were present per individual, or 19.0 ± 18.7 when zeros were removed to account for skew. Microplastic abundance did not significantly affect egg count. For Model S2, AIC scores were Poisson 72.71623, Negative Binomial 67.33193, Gamma (link = identity) 65.34884, Gamma (link = log) 65.40988 and Gamma (link = inverse) 65.47096. On average 0.1 ± 1.0 offspring were present per individual, or 3.8 ± 3.3 when zeros were removed to account for skew. Microplastic abundance did not significantly affect offspring count.

Discussion

The effects of microplastic ingestion, especially with regards to their proposed ability to increase chemical pollutant exposure, has long been debated. Historically exposure experiments to quantify the harm of microplastic ingestion have used unrealistically high concentrations. As a result, there has been a push to collect baseline data from many ecosystems to identify the realistic levels that exposure experiments should use. But

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environmental evidence alone is insufficient to determine if there are ill-effects from microplastic exposure. In the present study microplastics were ingested by *C. volutator*, including individuals which were carrying eggs or offspring in the brood pouch. Unfortunately, it is not possible to determine the residence time of microplastics from the present study and therefore the conclusions that can be drawn from the data are limited. Statistical analysis found no significant association between the amount of plastic and the number of offspring or eggs in the brood pouch. Whilst egg counts are an easy and effective method of determining potential negative impacts of microplastics in amphipods, it is harder to identify in fish species. Studies into the detrimental effects of plastic ingestion in fish have shown that microplastics ingested via transfer from contaminated prey did not affect the behaviour of fish (Tosetto et al., 2017). It has been demonstrated that predator avoidance can be negatively impacted by plastic leachates (Seuront, 2018) and therefore in some food webs, predators may be more likely to predate on contaminated prey.

S17. Microlitter ingestion in smelt, *Osmerus eperlanus*, and infection by a microsporidian parasite.

Introduction

European smelt (*O. eperlanus*) in the River Thames are known to be infected by microsporidians (Georgina Fauconier pers. comm.). Several other smelt species, including *O. mordax* (rainbow smelt), *Hypomesus olidus* (pond smelt) and *Coregonus* sp., have also been recorded with *Ichthyosporidium hertwigi* and *Pleistophora ladogensis* microsporidian infections (Haley, 1952; Legualt and Delisle, 1967; Pekcan-Hekim et al., 2005). Infection causes the formation of numerous white cysts, primarily on the posterior intestines decreasing in abundance towards the anterior (Legualt and Delisle, 1967). Cysts have also been reported on the liver, pyloric caeca, heart, gonads, skin and muscle (Haley, 1952; Legualt and Delisle, 1967; Pekcan-Hekim et al., 2005).

Methods

Sampling methods are described in the main text of the thesis (Chapter 2). Statistical analysis was conducted in R version 4.0.3 (R Core Team, 2020).

Model S3 - GLM(Infection ~ Date + Microplastic Abundance, family = binomial)

Results

During sampling and dissection, it was observed that some individuals of *O. eperlanus* had white cysts on the digestive tract. In many cases, the cysts were so numerous that they resulted in a mass protruding ventrally from the intestines and were visible prior to dissection (Figure 4.7).

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Figure. Smelt (*Osmerus eperlanus*) infected with a microsporidian parasite, resulting in the formation of white cysts primarily on the intestines. A) Individual OE6 caught in December 2019 with large white cysts visible prior to dissection; B) Individual OE4 caught in March 2020 with a visible bulge ventrally as a result of numerous small cysts; C) Individual OE13 caught in December 2019, post-dissection several cysts of varying sizes are present on the intestines and other internal organs damaging the integrity of the viscera. Scale bars = cms.

Of the 202 individuals sampled in the present study, 50 had cysts. The cysts were the result of a microsporidian infection that was becoming frequently reported in *O. eperlanus* from the River Thames. The infection was common in young individuals, but it was it known whether mortality occurred before adulthood (Georgina Fauconier pers. comm.). Nearly half of infected individuals contained identifiable prey items (22 individuals). Model S3 determined that sampling date and amount of ingested plastic did not significantly affect whether *O. eperlanus* was infected.

Discussion

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Nearly 24% of *O. eperlanus* in the present study were contaminated, with visible cysts on the viscera. Some individuals presented with few small cysts, whilst other individuals contained numerous cysts of varying size that caused the body to extend ventrally. Microsporidia are known to infect primarily juvenile smelt, with individuals becoming infected as early as 3 months after hatching (Pekcan-Hekim et al., 2005). In juvenile populations, infection can cause high mortality. Several hundred dead individuals were reported in Quebec in 1966 (Legualt and Delisle, 1967) with similar numbers reported by Haley (1952). In some reports, infection of smelt populations was low (< 1%). This is indicative of high mortality in juveniles as few infected individuals survive to adulthood (Costa et al., 2016). Cysts grow into the intestine and occlude the lumen which can result in starvation or intestinal poisoning which can be fatal (Legualt and Delisle, 1967). The infection is thought to completely impair normal function and reduces the integrity of the intestine to such a degree that other intestinal parasites cannot survive (Haley, 1952). In addition to the debilitation of individuals, it is proposed that infected fish may be more susceptible to predation (Costa et al., 2016). Microplastic ingestion has been shown to negatively affect immune function (Liu et al., 2019) as have the chemicals associated with them (Hall et al., 2018). Whilst microplastics might leave organisms prone to infection, it is not likely to affect microsporidian parasitism. Microsporidians evade immune responses by taking over host cells, transforming them into cysts containing spores. Histology does not show signs of inflammation nor the presence of immune cells (Georgina Fauconier pers. comm.). Indeed, the present thesis reported no relationship between the presence of microsporidians and the amount of ingested microplastics in *O. eperlanus*, further supporting the theory that microplastics do not make fishes susceptible to microsporidia. It is possible that an occluded intestine as a result of

infection would reduce an individual's exposure to microplastics as feeding rates will be affected. In this instance, however, the individual is unlikely to survive for long.

S181. Microplastic contamination in a spectacled porpoise (*Phocoena dioptrica*) from the Falkland Islands.

A spectacled porpoise stranded at San Carlos, Falklands on 27 January 2017 and was dissected at the Natural History Museum. For the transport and storage of the specimen it was wrapped in black bin liners. This is a potential source of contamination. The animal was in a good condition with no bloating or external wounds, though it was malnourished. The specimen was identified as a female with a body length of 192 cm which indicates it was an adult. The maximum girth was 87.8 cm. The digestive tract was examined following the protocols described in chapter 6. All control measures outlined in chapter 6 were followed for this analysis. On average 1.4 blue fibres, 1.2 black fibres, 3 clear fibres, 0.1 black film, 0.1 white fibre and 0.1 tangle per filter were found in contamination controls.

After contamination was accounted for, the spectacled porpoise ingested 101 items, with all sections of the GIT containing microplastics. Of the items recovered 85% were fibres. Nine colours of items were ingested. FTIR analysis was conducted on ca. 10% of items. The majority of items (62%) were semi-synthetic, mostly viscose. Viscose is a rayon polymer which is commonly used in sanitary products and textiles. Two items were found to be organic, a grey fibre and a grey film. The remaining items were acrylic, polypropylene and epoxy resin and bisphenol A (8% of the subsample each). Bisphenol A is an endocrine disrupting chemical which is structurally similar to oestrogen and in high enough concentrations can negatively impact fitness. No previous evidence of entanglement in or ingestion of plastic has been reported in the species (Kühn and Van Franeker, 2020).

All microplastics were measured in ImageJ. –The smallest recorded length of a microplastic was 22.458 µm and the longest was 27717.64 µm (mean 2142.403 ± 3111.816 µm). The smallest recorded width of a microplastic was 8.879 µm and the largest width was 3546.83 µm (mean 156.776 ± 427.555 µm).

	n	Clear Fibre	Blue Fibre	Blue Film	Purple Fibre	Grey Fibre	Grey Film	Brown Fibre	Black Fibre	Grey Fibre	White Fibre	Clear Film	Clear Fragment	Green Film	Green Fragment	Red Fibre	Red Film	Tangle	Filters
Fore Stomach	1						1												1 filter
Fundic Stomach	8										2							6	1 filter
Pyloric Stomach	3										3								1 filter
Final Stomach Wash	17			1					2		6		1		1			6	1 filter
Intestine	72		18	2	2	6	1	1	14	1	2	1		4	2	3	1	14	6 filters
Total	101		18	3	2	6	2	1	16	1	13	1	1	4	3	3	1	26	10 filters

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