Supplementary material

A closer look at anthropogenic fiber ingestion in *Aristeus antennatus* in the NW Mediterranean Sea: differences among years and locations and impact on health condition

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Table S1. Categorization of fibers encountered in the digestive system of *Aristeus antennatus* according to visual characteristics (general aspect) and results of the identification of 119 anthropogenic fibers (2.9% of the total) by means of FTIR (percentage of each polymer identified in %). Polymers identified Acr. = Acrylic; Cel. = Cellulose; PA = Polyamide; PET = Polyethylene terephthalate; PP = polypropylene.

Category	Description	Polymer identified (%)				
		Acr.	Cel.	PA	PET	PP
A	• Uniform diameter and round cross-section • Sometimes with wide molten or frayed ends • Generally smooth surface texture. Granular backbone texture. Pilling or fraying surface when damaged • Mostly transparent, yellowed or brownish	0	0	**70.8**	16.7	12.5
B	• Mostly uniform diameter (sometimes with molten bends) and round cross-section • Clean ends, sometimes molten • Smooth surface texture. Refringent. Usually with delustrant agents visible as a bubbly backbone texture • Generally transparent or bright colored	8.1	0	0	**81.1**	10.8
C	• Non-uniform diameter, flat or film-like • Diagonal-cut ends • Wrinkled surface with angular edges. Sometimes fraying surface • Mostly transparent, blue or black, usually non-uniform	0	**100**	0	0	0
D	• Non-uniform diameter with dumbbell cross-section • Usually with fraying ends • Smooth and homogeneous surface and backbone texture. • Mostly transparent or bright colors	**80**	0	0	14.3	5.7
E	• Non-uniform diameter with almost round-section • Generally clean ends • Wrinkled with smoothed or round edges • Mostly smooth texture (no fraying) • Mostly with dark colors	10	20	0	**70**	0

Table S2. Descriptive parameters for fiber occurrence and load in individuals of *Aristeus antennatus* from three localities along the Catalan Coast (off Costa Brava, off Barcelona city, and off Ebro Delta) for spring and summer samplings in 2018 and according to their location in the digestive tract (stomach or intestine). Significant differences are indicated with superscripts as follows: seasonal differences (within the same locality) are denoted with numbers and spatial differences (within the same season) are indicated with letters (low case letters for spring and capital letters for summer). Absence of letters or numbers indicates no differences were found. Mean values ± standard deviation are given except for occurrence values (in percentage). FO: fiber occurrence; TA: total abundance of fiber per individual; TL: total length of fibers per individual; TLs: total length of synthetic fibers per individual; BO: ball occurrence; BA: estimated area per ball; BD: estimated density per ball.

	Costa Brava		Barcelona city		Ebro Delta	
	spring	summer	spring	summer	spring	summer
STOMACH						
FO (%)	68.2	60.0 ^{A}	80.8	94.4 ^{B}	100.0	76.5 ^{AB}
TA (n fibers/ind)	1.82 ± 2.11 ^{a}	10.0 ± 29.59 ^{A}	7.48 ± 17.90 ^{1,b}	157.33 ± 129.45 ^{2,B}	7.89 ± 4.08 ^{c}	16.41 ± 23.49 ^{A}
TL (mm of fibers/ind)	6.44 ± 7.05 ^{a}	33.34 ± 71.32 ^{A}	32.36 ± 54.22 ^{1,b}	888.73 ± 637.59 ^{2,B}	32.42 ± 18.79 ^{b}	85.63 ± 109.28 ^{A}
BO (%)	4.5 ^{1,a}	35.0 ^{2,A}	34.8 ^{1,b}	88.9 ^{2,B}	77.8 ^{1,c}	52.9 ^{1,A}
BA (mm2/ball)	1.02 ^{1,a*}	1.73 ± 0.98 ^{2,A}	2.06 ± 0.26 ^{1,b}	18.53 ± 19.76 ^{2,B}	1.48 ± 0.66 ^{c}	2.63 ± 1.65 ^{A}
BD (mm/mm2·ball)	17.37 ^{1,a*}	36.55 ± 26.20 ^{2,A}	32.36 ± 41.88 ^{1,b}	62.46 ± 34.39 ^{2,B}	28.98 ± 20.21 ^{c}	43.54 ± 30.24 ^{A}
INTESTINE						
FO (%)	50.0 ^{1}	5.0 ^{2,A}	30.4 ^{1}	88.9 ^{2,B}	66.7 ^{1}	17.6 ^{2,A}
TA (n fibers/ind)	0.91 ± 1.11 ^{1}	0.05 ± 0.22 ^{2,A}	0.65 ± 1.23 ^{1}	6.72 ± 5.05 ^{2,B}	1.11 ± 0.93 ^{1}	0.24 ± 0.56 ^{2,A}
TL (mm of fibers/ind)	2.19 ± 2.86 ^{1}	0.27 ± 1.20 ^{2,A}	2.62 ± 8.06 ^{1}	26.32 ± 21.61 ^{2,B}	1.95 ± 1.62	0.97 ± 2.20 ^{A}
TOTAL						
FO (%)	77.3	65.0 ^{A}	95.7	94.4 ^{B}	100	82.4 ^{AB}
TA (n fibers/ind)	2.73 ± 2.69 ^{a}	10.05 ± 29.58 ^{A}	8.13 ± 17.78 ^{1,b}	164.06 ± 130.47 ^{2,B}	9.00 ± 4.58 ^{b}	16.65 ± 23.54 ^{A}
TL (mm of fibers/ind)	8.63 ± 7.74 ^{a}	33.61 ± 71.19 ^{A}	34.98 ± 53.60 ^{1,b}	915.05 ± 640.56 ^{2,B}	34.37 ± 20.09 ^{b}	86.60 ± 109.19 ^{A}
TLs (mm of plastic/individual)	7.07 ± 6.66 ^{a}	32.03 ± 70.99 ^{A}	34.65 ± 53.12 ^{1,b}	899.34 ± 630.04 ^{2,B}	33.38 ± 19.88 ^{b}	73.72 ± 104.23 ^{A}

* Only one ball found.

Table S3. Descriptive parameters for fiber occurrence and load in individuals in individuals of *Aristeus antennatus* off Barcelona city (just in front of the Besòs River or just south of the Llobregat River) for spring and summer samplings in 2007, 2017 and 2018, and according to their location in the digestive tract (stomach or intestine). Significant differences are indicated with superscripts as follows: seasonal differences (within the same year and locality) are denoted with numbers and temporal differences (within the same season and locality) are indicated with letters (low case letters for spring and capital letters for summer). Mean values ± standard deviation are given except for occurrence values (in percentage). FO: fiber occurrence; TA: total abundance of fibers per individual; TL: total fiber length; TLs: total length of synthetic fibers per individual; BO: ball occurrence; BA: ball area; BD: ball density. More details on each sampling station can be found in Table 1.

	Besòs			Llobregat		
	2007		2017	2007	2018	
	spring (B2B)	summer (B3B)	spring (P0B)	summer (B3V)	spring (P1V)	summer (P2V)
STOMACH						
FO (%)	93.8 ^{1,a}	71.0 ^{1}	56.0 ^{b}	80.0 ^{A}	91.3 ^{1}	94.4 ^{1,A}
TA (n fibers/ind)	6.38 ± 7.54 ^{1,a}	15.32 ± 26.55 ^{1}	2.60 ± 4.85 ^{b}	5.10 ± 7.85 ^{A}	7.48 ± 17.90 ^{1}	157.33 ± 129.45 ^{2,B}
TL (mm of fibers/ind)	42.87 ± 51.89 ^{1,a}	61.75 ± 99.05 ^{1}	18.74 ± 37.06 ^{b}	29.80 ± 59.93 ^{A}	32.36 ± 54.22 ^{1}	888.73 ± 637.59 ^{2,B}
BO (%)	50.0 ^{1,a}	38.7 ^{1}	16.0 ^{b}	25.0 ^{A}	34.8 ^{1}	88.9 ^{2,B}
BA (mm2/ball)	2.97 ± 1.88 ^{1,a}	3.60 ± 3.12 ^{1}	4.87 ± 2.88 ^{a}	3.09 ± 3.07 ^{A}	2.06 ± 0.26 ^{1}	18.53 ± 19.76 ^{2,B}
BD (mm/mm2·ball)	27.58 ± 17.70 ^{1,a}	50.34 ± 28.62 ^{1}	15.44 ± 4.23 ^{b}	33.45 ± 17.07 ^{A}	32.36 ± 41.88 ^{1}	62.46 ± 34.39 ^{2,B}
INTESTINE						
FO (%)	68.8 ^{1,a}	32.3 ^{2}	48.0 ^{a}	35.0 ^{A}	30.4 ^{1}	88.9 ^{2,B}
TA (n fibers/ind)	1.50 ± 1.59 ^{1,a}	0.55 ± 1.09 ^{2}	1.20 ± 2.10 ^{a}	0.50 ± 0.76 ^{A}	0.65 ± 1.23 ^{1}	6.72 ± 5.05 ^{2,B}
TL (mm of fibers/ind)	5.67 ± 8.12 ^{1,a}	2.03 ± 5.49 ^{2}	4.34 ± 7.29 ^{a}	2.25 ± 3.86 ^{A}	2.62 ± 8.06 ^{1}	26.32 ± 21.61 ^{2,B}
TOTAL						
FO (%)	100.0 ^{1,a}	74.2 ^{2}	72.0 ^{b}	85.0 ^{A}	95.7 ^{1}	94.4 ^{1,A}
TA (n fibers/ind)	7.88 ± 7.86 ^{1,a}	15.87 ± 26.51 ^{1}	3.80 ± 5.31 ^{b}	5.60 ± 8.24 ^{A}	8.13 ± 17.78 ^{1}	164.06 ± 130.47 ^{2,B}
TL (mm of fibers/ind)	48.54 ± 53.19 ^{1,a}	63.78 ± 98.23 ^{1}	23.08 ± 37.51 ^{b}	32.05 ± 60.39 ^{A}	34.98 ± 53.60 ^{1}	915.05 ± 640.56 ^{2,B}
TLs (mm of synthetic fibers/individual)	47.65 ± 53.78 ^{1,a}	62.37 ± 95.42 ^{1}	22.45 ± 37.39 ^{b}	31.15 ± 60.52 ^{A}	34.65 ± 53.12 ^{1}	899.34 ± 630.04 ^{2,B}

Table S4. Summary of biological parameters, including size and body condition indices, for each sampling station. Mean values ± SD are given.

Code	*n*	CL (mm)	Kn	HSI	GSI
B2B	16	35.0-47.4	0,957 ± 0,070	6,29 ± 1,67	0,40 ± 0,20
B3B	31	22.9-46.6	0,957 ± 0,064	4,31 ± 1,97	3,11 ± 3,14
B3V	20	22.5-44.7	0,978 ± 0,074	2,96 ± 1,49	3,43 ± 2,34
P0B	25	33.8-42.5	1,051 ± 0,073	6,48 ± 1,54	0,39 ± 0,23
P1G	22	26.8-31.2	1,013 ± 0,100	7,36 ± 1,18	0,38 ± 0,22
P1V	23	26.8-35.6	1,019 ± 0,066	8,02 ± 2,31	1,63 ± 1,00
P1D	9	33.4-37.3	1,026 ± 0,066	5,91 ± 1,73	0,34 ± 0,22
P2G	20	25.9-31.9	1,023 ± 0,088	5,72 ± 1,80	3,73 ± 2,12
P2V	18	31.1-38.3	0,984 ± 0,050	5,54 ± 1,24	6,67 ± 2,34
P2D	17	33.1-40.7	0,994 ± 0,062	5,39 ± 1,05	1,26 ± 0,93

Table S5. Studies conducted in the NW Mediterranean Sea reporting environmental concentrations of microplastics or marine litter.

Location	Year	Size range (mm)	Analysis Method	Depth range (m)	Particle concentrations		Source	Notes
					average (± SD)	units		
Blanes	2018	0.16-22.4	Digestive content screening	396-641	6.399	fibers ·ind^{-1}	Our study	
					21.12	mm ·ind^{-1}		
Barcelona	2007	0.35-37.7	Digestive content screening	790	9.78	fibers ·ind^{-1}	Our study	
					48.12	mm ·ind^{-1}		
Barcelona	2017-2018	0.21-37.3	Digestive content screening	572-785	58.66	fibers ·ind^{-1}	Our study	
					324.37	mm ·ind^{-1}		
Delta	2018	0.62-37.9	Digestive content screening	425-551	12.83	fibers ·ind^{-1}	Our study	
					60.49	mm ·ind^{-1}		
Surface waters								
Blanes [a]	2011-2012	0.33-5	Manta trawl (335 µm)	0	80000-160000	items · km^{-2}	[1]	No exact values given for the specific area of Blanes.
Blanes [a]	2015	0.33-5	Manta trawl (335 µm)	0	0.497	items · m^{-2}	[2]	Fibers were not counted.
					0.080	mg·m^{-2}		
Barcelona [b]	2011-2012	0.33-5	Manta trawl (335 µm)	0	>320000	items · km^{-2}	[1]	No exact values given for the specific area of Barcelona.
Barcelona [b]	2015	0.33-5	Manta trawl (335 µm)	0	0.110	items · m^{-2}	[2]	Fibers were not counted.
					0.023	mg·m^{-2}		
Catalan coast	2015	0.33-5	Manta trawl (335 µm)	0	0.183 ± 0.158	items · m^{-2}	[2]	Fibers were not counted.
					0.025 ± 0.025	mg·m^{-2}		
Balearic Basin	2013	0.2-1000	Neuston net (200 µm)	0.2	549.6	g · km^{-2}	[3]	Broader area than our study area.
Gulf of Lion	2010	0.33-5	Manta trawl (335 µm)	0	0.06	mg·m^{-2}	[4]	Close, yet not our area of study.
Gulf of Lion	2015	0.2-5	WP2 net (200 µm)	0	0.23 ± 0.20	items · m^{-3}	[5]	Close, yet not our area of study
W Mediterranean	2010	0.33-5	Manta trawl (335 µm)	0	0.116	items · m^{-2}	[4]	Much broader area than our study area.
					2.02	mg·m^{-2}		
All Mediterranean	2011-2012	0.33-5	Manta trawl (335 µm)	0	129682	items · km^{-2}	[1]	Much broader area than our study area.
					62.211	mg·km^{-2}		
All Mediterranean	2011-2012	>5	Manta trawl (335 µm)	0	5700	items · km^{-2}	[1]	Much broader area than our study area.
					12000	mg·km^{-2}		

Sardinian-Balearic transect	2013-2016	>200	Visual survey	0	2.5	items · km^{-2}	[6]	Close, yet not our study area. Macrolitter, including non-plastic items, considered
Coastal sediments / Beach sand								
Barcelona [b]	2015-2017	<5*	Beach sediment	0	148	items · kg^{-1}	[7]	Far from deep-sea areas.
Ebro Delta [c]	2017	<0.05->0.3	Beach sediment	0-5	422 ± 119	items · kg^{-1}	[8]	Far from deep-sea areas.
Ebro Delta [c]	2017	<0.05->0.3	Riverbed sediment	0-5	2052 ± 746	items · kg^{-1}	[8]	Far from deep-sea areas.
Cap Croisette (Gulf of Lion)	2016	0.063 – >5	Beach sediment	0	4,654	items · m^{-2}	[9]	Far from deep-sea areas.
Balearic Islands	2013	0.063 – 5	Subtidal sediment	8-10	0.27	items · g^{-1}	[10]	Far from deep-sea areas.
Seafloor								
Blanes [a]	2009-2012	3-8	Deep-sea sediment	67-2222	8222 ± 3,700	fibers · m^{-2}	[11]	Similar approach (man-made fibers counted).
Blanes [a]	1994-1996	macro	Trawl composition	40-1600	~1,600	items · km^{-2}	[12]	Macrolitter considered, yet only plastic items.
Blanes [a]	1999-2011	macro	Trawl composition	35-4500	31.1 0.7-1.2	items · ha^{-1} kg · ha^{-1}	[13]	Macrolitter, including non-plastic items, considered
Blanes [a]	2009	macro	Trawl composition	900-2700	0.02-3264.6	kg · km^{-2}	[14]	Macrolitter, including non-plastic items, considered
Blanes [a]	2015	macro	Visual survey	860-1509	1559	items · km^{-2}	[15]	Macrolitter, including non-plastic items, considered
Barcelona [b]	1993-1994	macro	Trawl composition	-	1762.6	items · km^{-2}	[16]	Macrolitter, including non-plastic items, considered
Cap de Creus	2009	20-500	Trawl composition	40-80	60.03	items · ha^{-1}	[17]	Macrolitter, including non-plastic items, considered
Catalan coast	2007-2017	>20	Trawl composition	0-800	~3,1	kg · km^{-2}	[18]	Macrolitter, including non-plastic items, considered
French coast	1992-1998	macro	Trawl composition	-	19.35	items · ha^{-1}	[19]	Macrolitter, including non-plastic items, considered

[a] Equivalent to our Costa Brava sampling location
[b] Equivalent to our Barcelona sampling location
[c] Equivalent to our Delta sampling location

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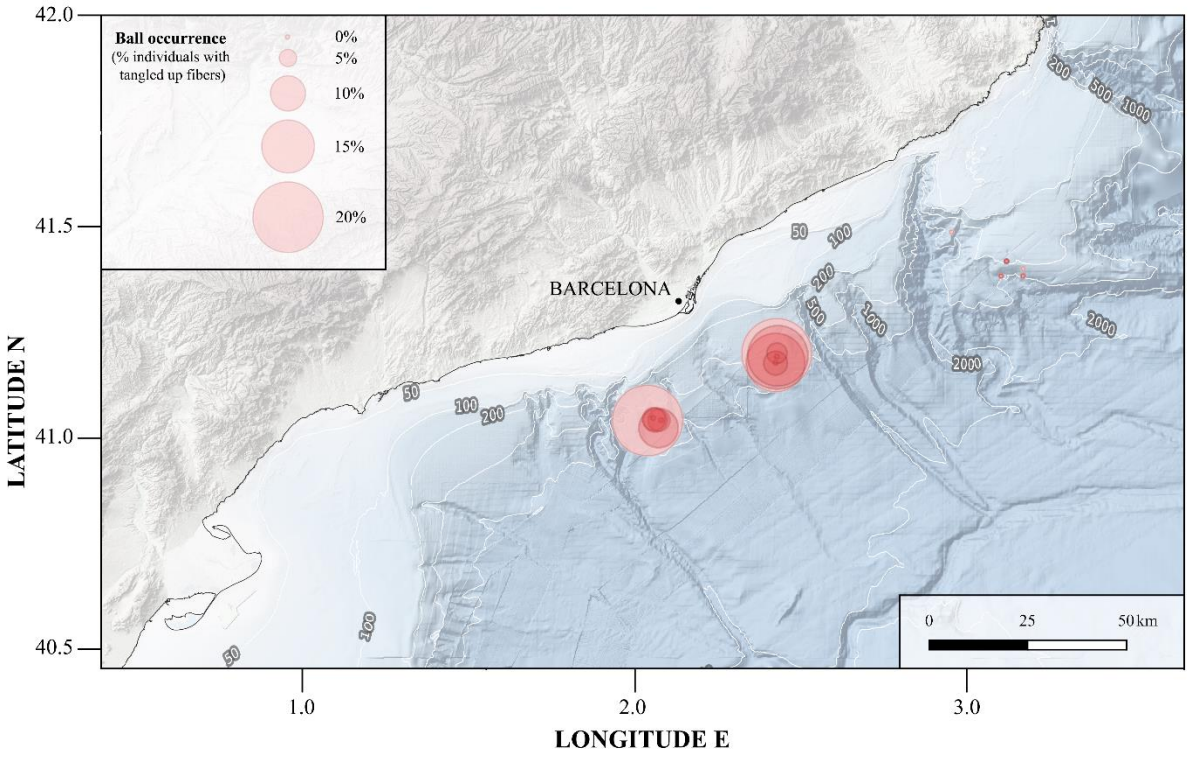

Fig. S1. Map of the study area showing the occurrence of balls (BO in %) in stomachs of *Aristeus antennatus* captured along the Catalan coast during 1988-1989 in a monthly sampling (n=768 specimens analyzed for diet studies). BO is calculated as the percentage of individuals with balls (tangled up fibers) over the total of individuals analyzed per each sampling. Largest circles represent BO = 20%. Differences in color intensity compared to the legend presented are due to the superposition of values for individuals from different samplings.