

MICROSCOPIC ANTHROPOGENIC PARTICLES IN SWEDISH WATERS

MANY MORE THAN BELIEVED.

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The Swedish Environmental Protection Agency has financed a study on the abundance of microscopic (<0,5 mm) anthropogenic particles in Swedish waters during the autumn of 2008 based on samples from 19 localities in the national pelagic monitoring program. The anthropogenic particles found were mainly:

- Microscopic fibers with a diameter of 10-40 μm consisting of ~60 % natural polymers (e.g. wool and cotton) and 23 % plastic polymers, mostly polyester.
- Non-fibrous particles with diameters from 5 μm to 500 μm can be divided into two major groups – red/blue particles made of epoxy polymers and black particles with a still undefined constituent, but the particles were rich in hydrocarbons and had a strong morphological similarity to road wear particles.

In previous studies it has been shown that the number of small plastic particles suspended in the water has increased in number and in correlation to world production of plastic. All earlier surveys used zooplankton nets with a mesh size of 0,33 to 0,5 mm and the measured concentrations ranged from 0,01 to 20 per m^3 .

This study used a plankton net with mesh size of 20 μm to concentrate 100 liters of water to a smaller volume that was filtered onto a 5 μm filter for analysis in microscope. See Fig 1.

The majority of anthropogenic particles could be divided into easily distinguishable groups of fibers: Black (39 %), blue (32 %), transparent (18 %) and red (8 %) fibers and the second group of non-fibrous particles: Black (67 %), red (25 %) and blue (6 %). In Table 1 all particles are summarized irrespective of colour.

The particles of the different groups were exactly the same from all 19 station which implies a regional dispersion, see Fig 2 or <http://picasaweb.google.se/PicturefromNresearch/Microparticles#> for a larger collage.

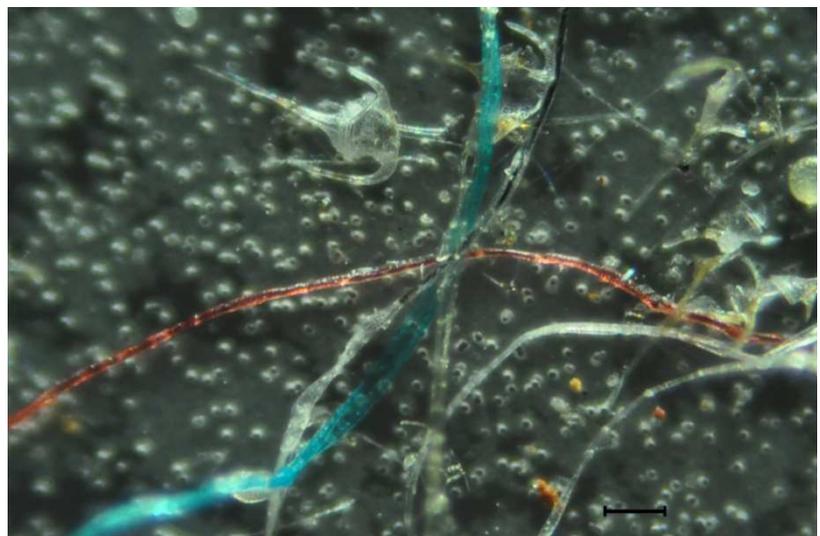
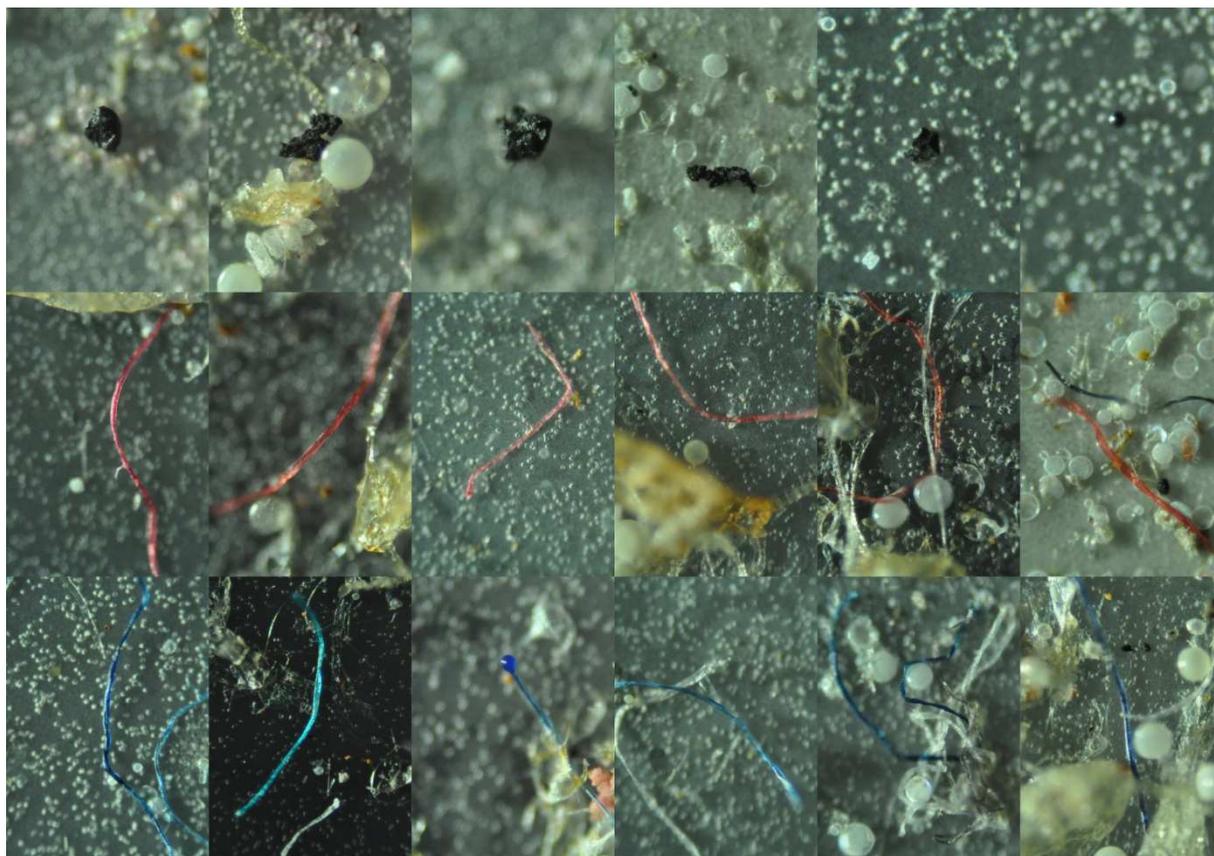


FIGURE 1 FOUR TYPES OF MICROSCOPIC FIBERS FOUND IN A WATER SAMPLE.

	Particle conc. (range min-max)	
	Fibers (m^{-3})	Non-fibrous particles (m^{-3})
Skagerrak - Kattegat	340-1 320	760-7 200
Baltic Sea	620-1 340	1 620-3 340
Gulf of Bothnia	5 380-14 620	2 500-104 780

TABLE 1 SUMMARY OF PARTICLE CONCENTRATION FROM 19 LOCATIONS



FIGUR 2 DIFFERENT KINDS OF ANTHROPOGENIC PARTICLES FOUND IN ALL WATER SAMPLES. TOP ROW: BLACK PARTICLES (SIZE ~0,1) MIDDLE ROW: RED FIBERS (FIBER DIAM. ~20 μm) BOTTOM ROW: BLUE FIBERS (FIBER DIAM. ~20 μm).

The material composition of the particles was initially analyzed using SEM-EDX and FTIR microscopy. The fibers consist of 62 % natural fibers (such as cotton and wool), 23 % plastic polymers (mostly polyester) and 15 % fibers with a high grade of chemical breakdown. The non-fibrous particles consisted of epoxy materials (red and blue particles). The black particles were not possible to identify using the same techniques. But the FTIR microscopy identified the particles as different oils and other aromatic hydrocarbons. In the EDX analysis the black particles had similarities to road wear particles (asphalt). This is also the finding based on morphology.

Our hypothesis is that the fibers are textile fibers in various forms. The red and blue particles are a paint, maybe marine anti-fouling and hull paint. The black particles are wear particles from road traffic, both from road materials and rubber tyres.

The risks of anthropogenic particles in the sea are following 1. Plastics submersed in the sea are known to accumulate high concentrations of persistent organic pollutants on the particle surface – and the smaller a particle is the larger the surface/volume quota is, so smaller particles can transport more pollutants per kg plastics than larger litter 2. The anthropogenic particles are in the same size range as phytoplankton and can thus be taken up as food by filtrating and detritivorous animals 3. Some particles, i.e. road and tyre wear particles has toxic effect on biota in themselves.