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Assessment of Microplastic Content in Surface Waters of the Russian Part of the Sea of Japan Basin

Kachur A*, Kozlovskii N and Popova A

Pacific Institute of Geography FEB RAS, Russia

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***Corresponding author:** Kachur A, Pacific Institute of Geography FEB RAS, Vladivostok, Russia

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Short Communication

The threat of contamination of water environment with plastic waste has recently become one of the most discussed issue due to potential of polymers to contain and emit persistent toxic substances and plasticizers, in addition to widely discussed physical impacts of these items on water biota. As shown in a large number of studies, the key sources of marine pollution with plastic materials (75-90%) are believed to be land-based and a significant contribution to pollution is made by rivers [1]. As part of the work to assess the state of surface waters in the Russian part of the Sea of Japan basin (Figure 1), as well as and Lake Khanka (as a part of Amur basin) (Figure 2) studies were carried out to assess their pollution with microplastics [2,3]. Sampling sites in the Peter the Great Gulf. Red dots indicate sampling sites in the littoral water, blue dots correspond to samples from; Red circles with numbers correspond to the areas where selected rivers discharge. 1-Tumen River, 2- Tsukanovka River, 3- Narva River, 4-Barabashevka River, 5- Amba River, 6-Razdolnaya/Suifenhe River, 7-Artemovka River, 8-Partizanskaya River. The main forms of plastic particles identified in the study in the waters of the rivers of the Sea of Japan basin were films (morphotype I), fragments (morphotype II), fibers (morphotype III), foam (morphotype IV) and microbeads (morphotype V) (Figure 3) Morphotype I was predominant over other types in the waters of the main rivers of the Sea of Japan basin: the Tumen River (0.923pcs/m^3) and the Razdolnaya River (0.558pcs/m^3 and 0.358pcs/m^3). Morphotype II was not predominant in any of the studied rivers, but its concentrations were quite high in the Tumen (0.727pcs/m^3) and Razdolnaya (0.370 and 0.206pcs/m^3) rivers. It was also recorded in almost all the studied rivers [4].

Lake Khanka is the largest transboundary lake between China and Russia. Lake Khanka is the largest freshwater body in the Russian Far East, and it is the largest freshwater lake in East Asia (Figure 2). Research in the lake basin is considered as a model for the Amur River basin, the largest river in northeast Asia. On the Russian side, the lake has 16 confluents; and only one river, the Sungacha, flows out of the lake, which ties the lake with the Ussuri River, a southern tributary of the river Amur. 8 rivers flow into the lake on the Chinese side. A stream from the Mulinghe River flowing into Khanka through the Musin Canal is the largest influx [2]. (Figure 2) Lake Khanka basin and sampling points. Sampling points: 1-source of the Sungachi River; 2-mouth of the Spasovka River; 3-cordon “Vostochny; 4-the Ilistaya River; 5-the Komissarovka River. I-settlements; II - lakes; III-rivers. IV - Musin Canal; V - the Mulinghe River basin; VI - the territory of the Lake Khanka basin with the designation of the rivers flowing into the lake naturally.; Boundaries: VII - drainage basin; VIII - state PRC; IX - state RF. On both the Russian and Chinese sides, the population within the basin is mainly engaged in agriculture. Due to its transboundary location anthropogenic impacts on Lake Khanka are mainly associated with the scale of irrigated agriculture. Pollutants such as pesticides, phenols, petroleum products, nutrients, microplastics, etc. enter the lake with surface runoff through irrigation canals. Untreated wastewater from industrial and agricultural enterprises

An AIM-9000 SHIMADZU IR microscope was used to quantitatively assess microplastic particles in river water samples from the lake basin, as well as for rivers in the Russian part of the Sea of Japan basin. Identification of the qualitative composition was carried out using Fourier transform IR spectroscopy [4].

Figure 1:

Figure 2:

Of the total number of particles found using an IR microscope, only fibers and its fragments were detected with fibers making up the majority, from 66.7% to 100%, in all samples taken. Microplastics and particles of natural origin were detected in all the studied samples with a concentration range from 6 to 27pcs/m^3 in the spring-summer sampling period. In the autumn-winter sampling period, a high concentration of microparticles was detected with a concentration range from 5 to 24pcs/m^3. All found particles of micro-sized pollution were divided into two groups: microplastics of synthetic and mixed nature, as well as a natural group. Based on the results of IR spectroscopy, the dominant materials were identified, which can be divided into nine main groups depending on their chemical composition (Figure 4). Qualitative composition of microplastics in the water of Lake Khanka and the rivers of its basin. Microplastic groups: synthetic - I polypropylene, II viscose + polyester, III polyester, IV viscose + nylon; mixed - V wool + viscose, VI viscose + linen, VII cotton + viscose, nylon, acrylic. Natural group: VIII fragments of particles of natural origin, IX -natural fiber. The predominant type of microparticles are fibers of synthetic, mixed and natural origin. According to the data obtained, the river runoff in the studied region is a significant source of microplastic contamination of the coastal and marine environment. The importance of this problem cannot be underestimated, and all available measures should be taken for its prevention.

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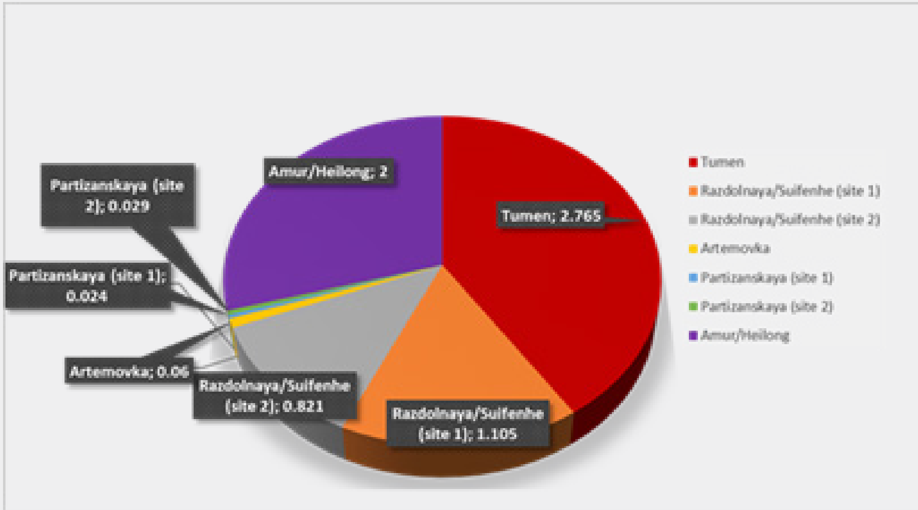

Figure 3: Concentrations of microplastics (size over 0.1mm) per 1m3 in all study rivers, including river Amur.

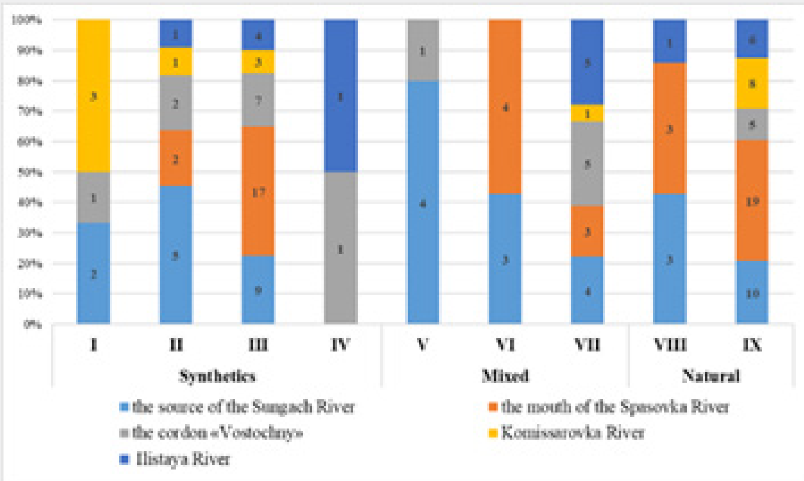

Figure 4: Qualitative composition of microplastics in the water of Lake Khanka and the rivers of its basin. Microplastic groups: synthetic - I polypropylene, II viscose + polyester, III polyester, IV viscose + nylon; mixed - V wool + viscose, VI viscose + linen, VII cotton + viscose, nylon, acrylic. Natural group: VIII fragments of particles of natural origin, IX – natural fiber.

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