Surprising discovery of pollutants in gammarids

December 3, 2018 | Mirella Wepf, Stephanie Schnydrig
Topics: Wastewater | Biodiversity | Ecosystems | Pollutants

Amphipods in Swiss waters are exposed to insecticides, pharmaceutical residues and other trace substances, and accumulate these in their bodies. However, when water-treatment plants are upgraded, practically no trace substances are found in these organisms according to a new study carried out by Eawag researchers.

The water in Swiss streams is contaminated with numerous micropollutants. However, very little research has been carried out to determine how these trace substances affect organisms in bodies of water. An Eawag research group has been able to show for the first time on a large scale that such trace substances accumulate in gammarids and possibly have a negative effect on them.

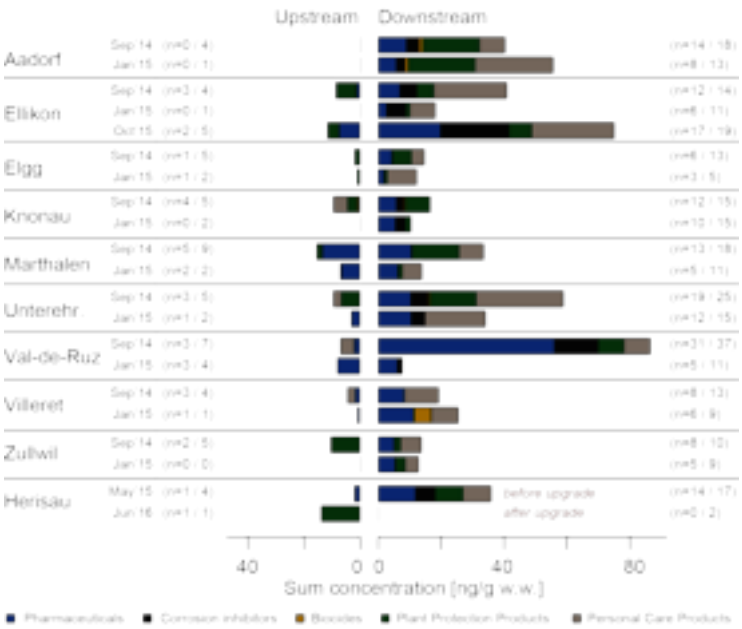
“Because the trace substances are highly diluted, we didn’t know at the start whether we would find them at all in the gammarids,” says Juliane Hollender, head of the Environmental Chemistry department at Eawag. But her doctoral student Nicole Munz used innovative measuring methods and found a whole cocktail of substances in the organisms. Munz deployed a tried and tested method for detecting substances in fish, as well as methods from food analysis.

Encouraging data from Herisau

As part of the international EU “Solutions” project and Eawag’s “EcoImpact” research programme (see box), Munz took water samples above and below 13 water-treatment plants (WTP) and collected gammarids. Munz extracted 63 different substances from the animals she removed from around the WTPs. The samples above the WTP discharge sites contained four substances on average, while those below the WTPs contained an average of 14.

Nicole Munz taking samples in the Itziker Ried. The researcher found unaffected gammarids in these nearly natural waters for her comparative study of artificial channel systems. (Photo: Eawag, Qiuguo Fu)

The case of the Herisau WTP was particularly interesting. During Munz's research work this was upgraded with an additional purifying stage designed to eliminate micropollution. The findings showed that before the upgrade, one gram of gammarids contained nearly forty nanograms of trace substances, whereas afterwards none could be detected. "This result is very encouraging," says Hollender, as the Swiss Water Protection Act calls for an additional purifying stage in about a hundred WTPs.



The graph shows how many nanograms of trace substances are found in one gram of gammarid, with the trace substance concentration markedly higher below the WTP outflows than above. Notably, during the period of research the Herisau WTP acquired an additional purifying stage. After the upgrade no micropollutatnts were found in the gammarids.

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch

Graph: Eawag/Nicole Munz, impression with the kind permission of Environmental Science & Technology.

Insecticides with toxic effects

The substances found most often in the gammarids were the antidepressant Citalopram, the UV filter Benzophenon, the metal-corrosion protection agent Benzotriazol and the insecticide Thiacloprid. The latter substance is known to have a toxic effect on gammarids and other invertebrates.

In addition to Thiacloprid, Munz found three other insecticides: Imidacloprid, Acetamiprid und Clodthianidin. Although these were only present in the water samples in low concentrations, or not at all, they were surprisingly prevalent the gammarids – indicating that the organisms accumulate the substances in their bodies.

In order to gain a more precise understanding of this accumulation process, Munz collected additional gammarids in nearly natural, uncontaminated waters. She placed the animals in an artificial channel system in order to ascertain how many trace substances would be accumulated by the gammarids within one month. Using this experiment with semi-realistic conditions she obtained data comparative to the field samples and thus gained a better understanding of the accumulation process.

The results do not, however, explain how the significant accumulation of insecticides in the gammarids arises. Juliane Hollender intends to investigate this question through further research. “It is possible that the gammarids take in these materials not only through water but also in their food,” says Hollender. “They eat fallen autumn leaves, for example, which could also be a factor.” For this reason, so-called biomonitoring, which measures the accumulation of substances in living things, becomes ever more important in aquatic risk management. According to Hollender the method developed by Munz is a major factor in showing how water pollution affects organisms.

The EcoImpact research project

With the decision to upgrade around 100 water-treatment plants with an additional purification stage for eliminating micropollution, Switzerland is an international pioneer in the water protection field. The move offers researchers a unique opportunity to investigate and compare the effects of these trace substances on aquatic ecosystems.

EcoImpact records molecular, physiological and ecological parameters in 24 selected stretches of streams in the Swiss Central Plateau and in the Jura. In parallel, the researchers are studying the effects of micropollution in controlled experiments using an experimental system with flumes in which micropollutants can be selectively added to the water. It is hoped that EcoImpact will provide clarity on what particular effects micropollutants have on aquatic ecosystems. In additions, studies are being carried out to ascertain whether different types of micropollution have different effects.

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch
eawag aquatic research

Publication

Munz, N. A.; Fu, Q.; Stamm, C.; Hollender, J. (2018) Internal concentrations in gammarids reveal increased risk of organic micropollutants in wastewater-impacted streams, *Environmental Science and Technology*, 52(18), 10347-10358, doi:10.1021/acs.est.8b03632 , Institutional Repository

Further publication

Preliminary study by Nicole Munz, in which she shows that pesticides present the greatest risk for gammarids in comparison with other micropollutants in water.

Munz, N. A.; Burdon, F. J.; de Zwart, D.; Junghans, M.; Melo, L.; Reyes, M.; Schönenberger, U.; Singer, H. P.; Spycher, B.; Hollender, J.; Stamm, C. (2017) Pesticides drive risk of micropollutants in wastewater-impacted streams during low flow conditions, *Water Research*, 110, 366-377, doi:10.1016/j.watres.2016.11.001, Institutional Repository

Related Links

EcoImpact

Contact

Juliane Hollender

Senior scientist / Group leader

Tel. +41 58 765 5493

juliane.hollender@eawag.ch

https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/surprising-discovery-of-pollutants-in-gammarids