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Pharmaceuticals and endocrine disruptors: transfer from water to land ecosystems



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Pharmaceuticals and endocrine disruptors increasingly contaminate the world's freshwaters. New research provides direct evidence of their transfer from aquatic to terrestrial ecosystems via the consumption of aquatic insects by terrestrial predators such as spiders, birds and bats. This exposure may have negative impacts on the physiology and population dynamics of predators, suggesting a need for improved [risk-assessment](#) guidelines and practices.

Every year, a wide range of pharmaceuticals and endocrine disruptors enter global freshwaters via wastewater. The fate, behaviour and transport of these contaminants in aquatic ecosystems depend on the interplay of many physical, [chemical](#) and biological processes, presenting a challenge to framing appropriate guidelines for risk monitoring and management. This study highlights the importance of considering the potential of contaminants to cross ecosystem boundaries — from [water](#) to land. To date, however, such consideration has been limited by a relative lack of research on the transfer of contaminants via links between aquatic and terrestrial ecosystems.

The study provides direct evidence of transfer of pharmaceuticals and endocrine disruptors from aquatic to terrestrial ecosystems via terrestrial predators that feed on aquatic insects. The ecological impacts of chronic exposure to a complex and variable mixture of pharmaceutical- and endocrine-disruptor contaminants were investigated using both a laboratory microcosm experiment (an artificial, simplified ecosystem used to simulate and predict the behaviour of natural ecosystems) and a field study.

In the laboratory experiment, the researchers exposed two caddisfly (Trichoptera) insect species to a mixture of contaminants over a 65-day period, and quantified their uptake in samples of aquatic larvae and emergent adults.



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Pharmaceuticals and endocrine disruptors: transfer from water to land ecosystems (continued)

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In the field study, researchers collected samples of water, biofilm, aquatic and terrestrial stages of two aquatic insect orders (Odonata (flying insects that include dragonflies and damselflies) and Trichoptera). Researchers also obtained riparian spiders (which depend on aquatic and terrestrial ecosystems) from five sites affected with [waste-water](#) effluents and agricultural runoff, and quantified the contaminants.

The results demonstrate the transfer of pharmaceuticals and endocrine disruptors from aquatic to terrestrial ecosystems via aquatic insects. They also show that the transfer is determined by several factors, including type of insect metamorphosis and feeding behaviour. In particular, adult Trichoptera were found to have an increased body burden of contaminants following exposure during the aquatic larval stage. Since Trichoptera are an important food source for riparian predators, such as spiders, birds and bats, this suggests that terrestrial species are being exposed to mixtures of pharmaceuticals and endocrine disruptors of aquatic origin, which may impact their physiology and population dynamics.

The study's insights suggest a need to formulate improved guidelines for the monitoring and management of this [emerging risk](#). The researchers posit that such guidelines should rely on research that investigates the ecological impacts of chronic exposure to a complex and variable mixture of pharmaceutical- and endocrine-disrupting contaminants, since this is the most environmentally relevant scenario. The researchers suggest that further multidisciplinary research on links between aquatic and terrestrial ecosystems is required to support the selection of the most appropriate biomarkers (indicators of an organism's health and biological state) and bioindicators (organisms used as an indicator of an ecosystem's quality) for monitoring purposes.