Temporal changes in leaf fall have consequences for amphipods

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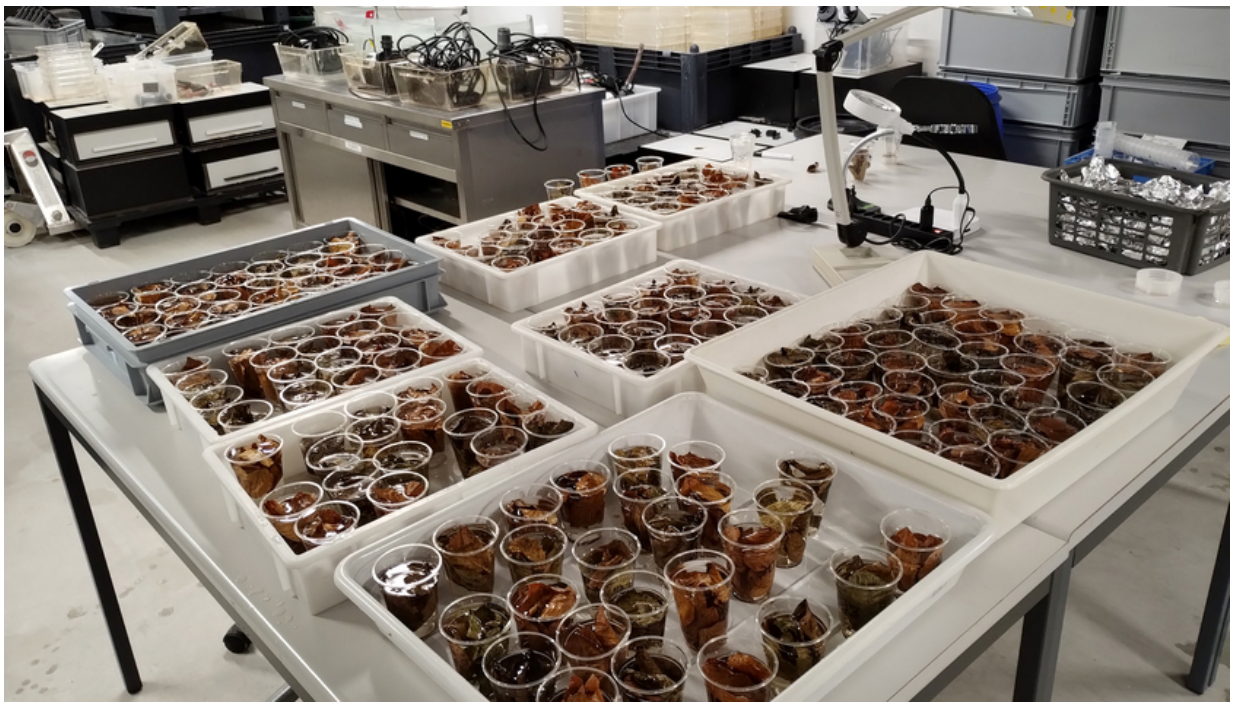
Aquatic ecosystems are fragile. But just how fragile they are has been revealed in a new study by the Swiss Federal Institute of Aquatic Science and Technology (Eawag) and the University of Zurich. Researchers investigated how climate change is affecting amphipods by shifting the timing of leaf fall in autumn. These creatures feed on leaves and, as the base of the food chain, have an impact on the entire ecosystem.

We associate autumn with changing colours and falling leaves that rustle under our shoes when we walk in the woods. For us, the colourful splendour of the leaves is a beautiful side effect, but for many creatures in streams and rivers, it is an important source of food – even during the colder months of the year. If the natural course of the seasons is disrupted by climate change, this can have consequences for the entire ecosystem.

‘In our study, we investigated how the order of arrival and duration of exposure of leaves from two tree species can affect ecosystem function,’ explains Luke Ireland, lead author of the study and PhD student in the research group of Prof. Dr. Florian Altermatt at Eawag and University of Zurich. After all, a leaf is not just a leaf. Research distinguishes between high-quality leaves (i.e. nutrient-rich) and low-quality leaves (nutrient-poor). Depending on which leaves fall first and, above all, how long they lie on the ground, this has an impact on the creatures that feed on these very leaves.



The leaf buffet for amphipods in the Eawag laboratory. (Photo: Luke Ireland)

A leaf buffet for refined palates

To find out how changes in exposure and sequence affect organisms, Ireland set up a veritable leaf buffet. This menu was enjoyed by amphipods, which occur naturally throughout the year in streams and rivers in Switzerland. In the different test phases, the amphipods were first given either beech leaves (low in nutrients) or black alder leaves (rich in nutrients), for varying periods of time. After this time period, amphipods that were given alder first were then presented with beech and vice versa.

Ireland observed that after longer periods of feeding on nutrient-poor beech leaves, the creatures consumed significantly more of the higher-quality alder leaves – which was to be expected. What surprised Ireland, however, was that the reverse was also true! ‘We would have expected the amphipods to be more satiated after prolonged consumption of the nutrient-rich leaves,’ said Ireland. But: they seem to like variety!

Small changes – far-reaching consequences

Ideally, the amphipods have different types of leaves available; they take advantage of the variety and utilise different types of leaves. The problem, however, is that different leaves decompose at different rates. Nutrient-poor leaves decompose more slowly and provide the amphipods with a stable food supply during the winter months, while high-quality leaves decompose more quickly and therefore need to be utilised rapidly. Depending on which leaves fall into the water at what time, this influences how balanced and available the food supply for the amphipods will be in the following months,’

Effects are already visible

The availability and sequence of the different leaves therefore have a massive impact on the

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consumption rate of the amphipods. When which leaves fall is determined by the climate, which has changed significantly in recent years and has destabilised this highly structured seasonal system. After hot summers with high drought, certain leaves fall earlier. Or a mild autumn delays the discolouration and fall of certain leaves. Both have now been shown to have a significant impact on the entire ecosystem.

The effects are already visible, as researchers are observing a shift in the timing of autumn leaf fall of several days per decade. And this trend is expected to continue. Florian Altermatt therefore advocates a comprehensive approach, both in research and in practice: ‘The study clearly shows how important it is to also investigate temporal aspects. Only then can we truly understand the impact of climate change on the functions within ecosystems.’

Cover picture: Leaves are the main food source for amphipods and play a key role in the functioning of the ecosystem. (Photo: Florian Altermatt, Eawag)

Original publication

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