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Abstract Book

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Climatic effects on the synchrony and stability of temperate headwater invertebrates over four decades

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Understanding the ecological effects of climate change on freshwater ecosystem dynamics requires assessment of the influence of other large-scale processes. However, few studies allow such assessments over decadal timescales. Here, we examined how variation in annual weather patterns associated with the North Atlantic Oscillation (NAO) over four decades affected synchrony and stability in a metacommunity of stream invertebrates across contrasting headwater streams in central Wales (UK). Prolonged warmer and wetter conditions during positive NAO winters synchronised variations in population and community composition among and within streams thereby reducing stability across levels of organisation. This climatically-mediated synchronisation occurred in all streams irrespective of acid-base status and land use, but was weaker where invertebrate communities were more functionally diverse. Wavelet modelling indicated that variation in the NAO explained up to 50% of overall synchrony in species abundances at a timescale of 6-8 years. However, the synchronising effect of the NAO varied across species groups, with cold-adapted species showing high sensitivity to climate variation. The NAO had no effects on spatial synchrony in hydrochemistry, instead appearing to affect ecological dynamics through local variations in temperature, precipitation and discharge.
Our findings illustrate how large-scale climatic fluctuations generated over the North Atlantic can affect population persistence and dynamics in continental freshwater ecosystems in ways that transcend local catchment character. The analyses also suggest that protecting and restoring functional diversity in stream communities can increase their stability in the face of warmer, wetter conditions that are analogues of ongoing climate change.