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Nature's Clock Is Falling Out of Sync: Plants and Animals Respond Differently to Climate Change

A study by CREAF scientists shows that the timing of cyclical events in living things is becoming out of sync between plants and animals, with increasing risks to ecosystems around the world. With climate warming, plants adjust their seasonal behaviors faster than animals, creating imbalances that could threaten key ecological interactions.

llions of years, plants and animals have evolved together, timing their life cycles to the ns. Flowers bloom as pollinators arrive, and migratory birds reach breeding grounds food is abundant. Now, that synchrony is beginning to break down. As the climate , plants are shifting their seasonal behaviors faster than animals, thus creating mismatches that could threaten key ecological interactions.

In a major study published in *Nature Ecology & Evolution*, we show that the timing of life cycle events, known as phenology, is diverging between plants and animals, posing growing risks to ecosystems worldwide.

Led by Dr. Weiguang Lang and Prof Shilong Piao (Peking University) with Professor Josep Peñuelas (CREAF, CSIC, Spain) and Professor Ivan Janssens (University of Antwerp, Belgium), we analyzed nearly 500,000 records from around the globe — the most

comprehensive assessment of phenological shifts to date.

Our results reveal that climate change is not affecting all species equally. Plants are accelerating their seasonal rhythms — leafing, flowering, and fruiting earlier in response to warming — while animals are shifting more slowly and less consistently. This creates a temporal mismatch in nature's calendar.

We compiled more than 42 years of field data (1980–2022), covering 470,337 phenological time series from over 2,500 plant and animal species across Europe, Asia, and North America. The data include first flowering dates in temperate forests, insect emergence, bird migration, and amphibian activity.

A clear trend emerges: plants are changing faster than animals. In many ecosystems, these shifts can disrupt interactions such as pollination, seed dispersal, and predator–prey relationships. Later-season plant events — like fruiting and leaf senescence — are advancing even faster than earlier events such as budburst and flowering, likely due to a "carryover effect" in which one event influences the timing of the next.

By contrast, animal phenology is less predictable. Some insects and amphibians extend their active seasons with warming, while many birds and mammals show weaker or more variable shifts. This variability may reflect behavioral strategies, migration constraints, or reliance on cues other than temperature.

These mismatches have real consequences for biodiversity, food webs, and ecosystem functioning. A pollinator that emerges after peak flowering or a migratory bird that arrives too late to find its usual food can suffer reduced survival and reproduction, and over time such mismatches can destabilize entire communities.

We also found that the rate and direction of phenological change vary by region, with temperate and boreal ecosystems showing the most pronounced shifts. This could amplify climate impacts on already stressed systems, affecting crop pollination, forest regeneration, and biodiversity.

Time, it turns out, is as critical as temperature or sea level. Species are no longer responding in unison, and that is a clear warning sign. Nature relies on relationships — and those relationships are now at risk.

ndings highlight the urgent need to integrate phenology into conservation planning, management, and climate models. By tracking the timing of natural events, we can protect ecosystems and help them remain resilient in a rapidly changing world.

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References

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