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Introduction

Recent global changes in climate such as increasing temperature have notable effects on the timing of biological events (phenology) of plants and animals. The effects are however variable across space and between species. The proposed study will consider climate change impacts on phenology of plants and birds at a local scale (in Ireland) in order to clarify the spatial range and variation across species and trophic levels. To do this we are conducting an analysis of the existing phenological data in Ireland. This data will form the basis for the establishment of a range of experiments and models focused on clearly identifying the current and future impacts of climate change on Irish ecosystems.

Changes in tree phenology

Increasing temperatures have been shown to advance certain key phenophases of trees. For example, earlier leafing of trees leave them particularly vulnerable to late frosts. By combining a series of field observations with experimental data, such as the response of dormancy induction and bud burst to different photoperiod and temperature conditions in Birch (*Betula*; Fig 4a), we will quantify the effects of climate change on tree phenology. A mechanistic model of budburst will be calibrated and tested, which will enable us to make future phenological predictions under climate scenarios for Ireland. Furthermore, we will investigate the ability of trees to adapt to new climates by comparing local adaptation with phenotypic plasticity in Poplar (*Populus*; Fig 4b).

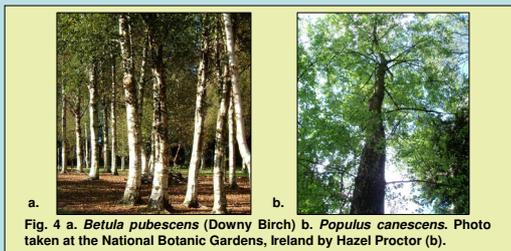


Fig. 4 a. *Betula pubescens* (Downy Birch) b. *Populus canescens*. Photo taken at the National Botanic Gardens, Ireland by Hazel Proctor (b).

Did you know?

Leaf unfolding has advanced by three weeks since 1970 for the Common Beech (*Fagus sylvatica*; Fig. 3) in Ireland. This phenomenon is linked with increasing average spring temperatures.



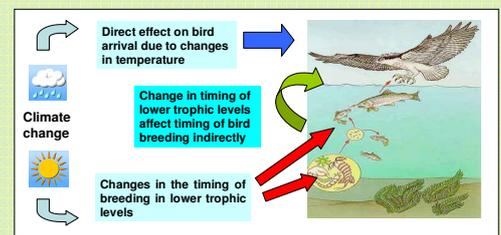
Fig. 3 Common Beech.

Birds

Patterns of change

Phenological changes at high trophic levels may be direct or indirect. Direct phenological changes occur when species are affected by changes in temperature resulting in a shift in the timing of life cycle events (Fig. 1). Indirect effects in contrast may arise from changes in the timing of phenophases in lower trophic levels. These may result in a mismatch in the timing of phenophases between higher trophic levels and their food source.

Fig. 1 Phenological changes at different levels of the food chain



Many bird phenological phases (timing of arrival, breeding etc) have been shown to be affected by changes in climate. We are exploring temporal and spatial shifts in bird distributions in Ireland in regard to climatic variables. We will also examine how direct and indirect feed back loops affect the timing of biological events.

Did you know?

Little egrets (*Egretta Garzetta*; Fig. 2) started to overwinter in Ireland for the first time in 1990. There were significant autumn arrivals since the mid-1990's which led to a small but significant winter population in Ireland for the first time. The first nesting took place in 1997 and since then the species has spread to many areas along the south and east coast of Ireland.



Fig. 2 Little egret. Photo taken on Bull Island, Ireland by Tom Cooney.

Phenological Research

Desperately seeking phenological data!

We are looking for any existing data of phenological recordings (i.e. timing of arrival or departure of species, timing of breeding, first appearance data, bud burst etc.) from:

- Plants
- Mammals
- Insects
- Birds
- Bats

to add to our phenological data base.

If you know of any such data or where we may locate records, please contact us at:

Alison.donnelly@tcd.ie

Expanding the Irish Phenological network

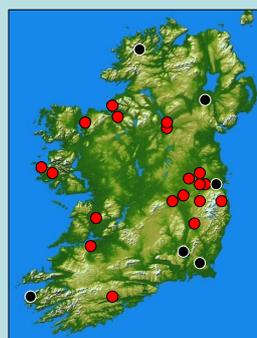


Fig. 5 Locations of existing IPGs (black) and potential new sites (red) in Ireland.

Currently, Ireland is part of a Europe wide phenological network which comprises more than 50 International Phenological Gardens (IPGs) in which the phenology of genetically identical trees of a suite of different species is being monitored. We intend to expand the IPG network across Ireland (Fig. 5) and aim to include both inland and coastal sites at varying elevations. Once established this network will enable us to quantify the impacts of climate change -in particular increasing temperature- on tree phenology at a local level. Some of the phenophases currently being monitored include leaf unfolding (Fig. 6).



Fig. 6 Leaf unfolding, leaf colouring and leaf fall of *Betula pubescens* (Photos: Finnish Forest Research Institute)