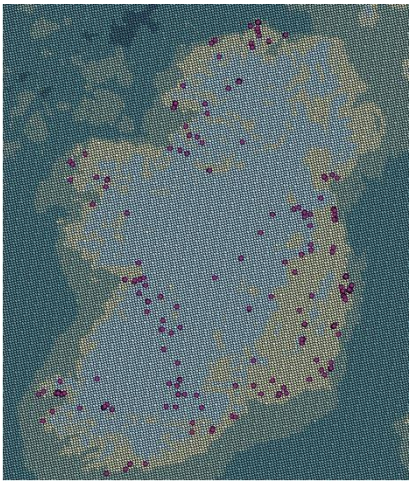
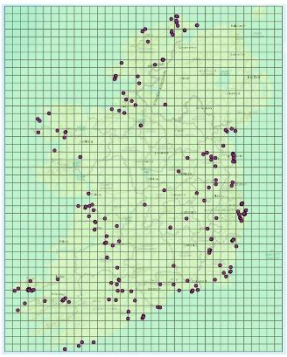
Best Water Related Presentation at Environ 2020

Winner Ruben De la Torre Cerro, University College Cork

Quantifying phenological mismatches: Climate change drivers and their impacts on biotic interactions through different trophic levels in Ireland



Phenology is the science that studies timing of key life cycle events of organisms such as plant flowering, bird migrations, and insect emergence, therefore phenology plays an important role in ecosystem maintenance. Climate change is altering the phenologies of many species, but the response across species is not uniform since not all species follow the same environmental cues, and because of their different sensitivities to several climate change drivers. For instance, many migrant bird species have advanced their migrations, arriving earlier at breeding grounds due to climate change, but insect migration and emergence are much more influenced by changes in weather conditions, leading to potential mismatches in food availability across trophic levels, with potential negative consequences.



This study investigates the relevance of different meteorological drivers on phenological events of several plant and animal species at a national level. This research also identifies phenological asynchronies within species linked through the trophic network, in order to evaluate the effect of climate change and phenological asynchronies on biotic interactions across Ireland. By using citizen science records, we gathered information of phenological events of different bird, butterfly, and moth species, for a period of ten years, and determined advancements and delays in phenological events at species level. We have also used new technologies, such as satellite imagery to monitor plant phenology, by determining start and end of the growing season from the normalised differenced vegetation index (NDVI). The spatial and temporal dimension of each species' phenological events has been taken into account by using 10km grids covering Ireland's surface which were combined with information on meteorological drivers derived from Met Éireann Re-Analysis (MÉRA), maximum and minimum temperature and total precipitation, with fine spatial and temporal resolution.

Species sensitivity to the meteorological drivers has been explored though evaluating the time windows in which these events are most influenced by each meteorological driver over ten years. In general, trends of an advanced phenology have been

identified for all the studied species. This trend is clearer in the case of birds, whereas in the case of butterflies and moths their phenological events showed marked fluctuations in their timing within years. These results suggest different sensitivity within species and groups to changes in the meteorological drivers explored. By creating an asynchrony index accounting for mismatches within phenologies of interactor species we will be able to identify areas across Ireland with higher risk to experience phenological shifts and therefore to determine climate change impact on biotic interactions.