Contribution ID: **422** Type: **Oral Presentation**

Mast seeding: puzzles and mathematical opportunities

Thursday, 12 July 2018 10:30 (30 minutes)

Mast seeding is the intermittent synchronous production of large seed crops by a population of perennial plants. This process is noteworthy in various ways. To the lay public, masting is noteworthy because it is very obvious when an occasional huge seed crop covers large areas.

In evolutionary terms it is noteworthy because delayed reproduction imposes inescapable costs on the plants, so it cannot occur unless there are compensating advantages (the search for which has occupied much of the relevant masting literature).

Ecologically it is noteworthy because of the need for a mechanism which can produce synchrony among plants, even though the plants cannot communicate. Most often this mechanism involves an external cue (usually weather), combined with some internal mechanisms such as resource sensitivity of flowering. Ecologically masting is also noteworthy because of the large downstream ecological consequences of pulsed resources.

Mathematically masting is noteworthy for four reasons. Firstly, masting is an emergent (population-level) phenomenon which reflects the sum of individual plant decisions. Constructing mechanistic models which have the right population-level properties is a challenge.

Secondly there is a competitive tension between model approaches which are driven largely by external cues (such as weather-cue models, with or without a resource veto), versus models largely driven by internal plant resource dynamics with some modest synchronizing cue (such as local pollen coupling or occasional flowering failure).

Thirdly some plant flowering time series are mathematically chaotic. Working out ways this complex population-level pattern can be created by simple within-plant mechanisms is interesting. One published example seems to have evolved because of selection on the plants for hard-to-predict time series.

Finally one of the proposed underlying mechanisms, the delta-T model, suggests plants are measuring a temperature difference across two summers and using that as the flowering cue. The mechanism by which plants could measure such a temperature difference is unknown. More interestingly, the delta-T model gives a better fit to some synthetic data which were created with a different underlying mechanism (resources plus last year's absolute temperature) than the real underlying mechanism does. Reasons for this implausibly good predictive ability of the delta-T model are currently unknown.

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Session Classification: Unravelling mechanisms underlying reproductive synchrony: from gene to ecosystems

Track Classification: Minisymposium: Unravelling mechanisms underlying reproductive synchrony: from gene to ecosystems