The role of resource dynamics in the reproduction of masting plants

In numerous plant species seed production varies strongly among years, with some having exceptionally large crop years followed by seasons when they reproduce less or even none. Such a year of an extremely high crop is called a "mast year". Mast seeding is very often synchronized over large areas, up to thousands of kilometers. This variation introduces pulses of resources into ecosystems that magnify through food webs and has important consequences, both ecological (e.g. dramatic changes in abundance of granivores) and socioeconomic (e.g. affects Lyme disease risk in humans by influencing the number of disease-transmitting ticks). The phenomenon attracts significant scientific attention but basic questions concerning the nature of masting remain unresolved. Observational studies of masting patterns amassed over the past 50 years have led to considerable theoretical advances, yet there have been few experimental tests of those theories. Thus, the next step towards advancing our understanding of masting is an experimental evaluation of the proposed models, a significant void of the field. This proposal will address key questions concerning the mechanisms of masting which will result in a substantial step forward in understanding this phenomenon.

There are three main hypotheses for their involvement of internal plant resources in driving masting. First is the resource matching hypothesis that predicts a fixed fraction of resources is allocated to reproduction each year. Consequently, Annual variation in seed production is thus a consequence of annual variation in resource acquisition. The resource switching hypothesis predicts that a variable fraction of current-year resource gain is used to produce seeds. Years with more available resources, e.g. with favorable weather, see greater investment in reproduction, whereas years with fewer available resources result in more investment in plant growth and less reproduction. Finally, the resource storage hypothesis predicts that plants accumulate resources over several years, eventually investing them in a large "mast crop". The last two hypotheses became paradigm of the field, even though they lack experimental evaluation (see section 2: Significance). This proposal will close that gap.

This project will be the first experimental test of resource-dynamics as drivers of reproduction patterns of masting trees. These concepts have been a central feature of masting models since the masting field emerged 50 years ago, they lack experimental evaluation. Yet, this is now urgent to understand the impact of global climate change on trees fecundity and the ability of forests to regenerate. How tree reproduction responds to climate change will determine the structure and diversity of 21st century forests, the function of food webs, and ecosystem services important for human welfare. The unpredictable recruitment of trees has emerged as a key obstacle to understanding forest change and the consequences for mast consumers. Mechanistic understanding of the reproductive patterns of trees is the first step that will allow predictive distributions of recruitment potential of trees and food availability for consumers as habitats change.