**Conceptual Background:**

* Priority effects are an important, though understudied element of community assembly.
* While studies of community assembly have greatly expanded in number in the last 25 years, they have often emphasized functional and phylogenetic patterns of assembly.
* Trait and phylogenetic patterns fit readily into our conceptual framework of community dynamics. Priority (or historical contingency) effects can be much more difficult to understand, as they often complicate the “search for deterministic patterns and processes that are amenable to general predictions” (Fukami 2015).
* However, the limited work on priority effects suggests that historical contingency can be major drivers of community composition, even over long timescales.
* Conceptually, priority effects can be divided into two key categories (Fukami 2015):
  + Niche pre-emption
    - Occupancy of a niche by an early arriving species that excludes late arriving species of an equivalent niche
  + Niche modification
    - Colonization by an early-arriving species produces a shift in the availability of otherwise unoccupied niches.
* While niche pre-emption is predominantly an inhibitory effect (the late arriving species are limited by the early arriving ones), niche modification can be both inhibitory and facultative (late arriving species are enhanced by early arriving species).
* This framework of priority effects and community assembly is valuable, particularly in more applied contexts, such as restoration:
  + Communities with desirable properties, such as invader suppression, may be designed through functional diversity to produce a broad pre-emption effect.
  + However, these same properties can be produced through niche modification – species in a community designed to generate niche modification may be entirely different from those with the greatest niche pre-emption effect.
    - I.e. strong competitors may not have the largest inhibitory effect
* Therefore, studies that aim to determine the relative strength of these mechanisms can be a major step in understanding processes governing community assembly and state transitions over time.

**California Specific:**

* In plant systems where propagule limitation is a major driver of community composition and most plants exhibit a perennial life history, priority effects can be easier to understand. Early arriving species are able to establish before their functionally similar counterparts, with effects playing out on decadal (or longer) timescales.
* In California, grasses produce a tremendous number of reproductive propagules that germinate simultaneously with spring rains. This system is also annually dominated – few species exhibit long-term persistence, suggesting that niche pre-emption may not be as important of a driver of temporal priority.
* However, California grasslands are known to be governed, in part, by plant-soil feedbacks, which can produce positive or negative feedback loops depending on species identity and functional group.
* Plant-soil feedbacks thought to be key to understanding the interplay between native-naturalized-invasive species, linked to a long history of decline in native species abundance.
* To better understand how these feedbacks may structure communities, examining how communities assembled with different colonizing species fluctuate over time.

**Key Questions:**

* When planted simultaneously, what is the competitive hierarchy of species in this system? Does a single functional group (or species) predominate over time?
  + Are these relationships dependent on the environment? Does fertilization, watering, or clipping affect what species are the best performers?
* How does planting composition influence the trajectory of communities over time? Are some communities more static than others? Are all communities converging on the same composition over time?
  + What species, in particular, seem most attributed to this stability?
* What environmental variables seem to be correlated with stability? Is community biomass in one year correlated with chance of

**Methodology:**

* Tracking the relative proportion of different functional groups over time (annuals, perennials, exotics) in control treatments (all species added simultaneously).
  + Species-specific analysis: which seem to predominate?
* Tracking relative proportion of planted species over time in priority treatments.
* Dissimilarity between priority treatments and planted treatments.