Three examples of multiple working hypotheses  
Matt Ayres, April 2008

All have the structure of being a question with a number of different possible answers.

Research question #1: Why are stands of longleaf pine less susceptible to southern pine beetle than stands of loblolly pine?
H1. Null hypothesis. Within forests, *D. frontalis* infestations occur within stands of longleaf pine and loblolly pine in proportion to their abundance. The conventional wisdom that there are fewer infestations with longleaf is a false impression created by the low abundance of longleaf pine in the contemporary landscape.
H2. Compared to loblolly pines, the resin defenses of longleaf afford better protection against bark beetles.
H3. Greater inter-tree spacing in longleaf stands compared to loblolly limits the ability of *frontalis* to aggregate during attacks and dampens population growth as a result.
H4. The searching behavior of dispersing adults of *D. frontalis* is biased against stands of longleaf pine compared to stands of loblolly pine.
H5. When struck by lightning, longleaf pines are less suitable than loblolly pines for colonization by *D. frontalis* and its fungal associates.

Research question #2: What produces positive density-dependence (Allee effect) in the population dynamics of *D. frontalis*? i.e., why do large infestations grow more than small infestations?
H1. The apparent phenomenon is actually just exponential growth and not truly an Allee effect.
H2. When local populations are larger, tree-specific attack rates are greater, resin defenses of trees are more quickly depleted, and per capita reproductive success is greater.
H3. Small infestations are more likely to collapse due to an interruption in attacks (from demographic stochasticity and variance in emergence times).
H4. In relatively small infestations, there is increased mortality of attacking adults because it is difficult for beetles to locate trees with a favorable (low to moderate) density of adults already present.

Research question #3: Why are there large fluctuations in the abundance of some forest insects?
H1: The populations cycle due to delayed density-dependent feedback from specialist predators.
H2: The populations cycle due to delayed density-dependent feedback from inducible plant defenses
H3: The populations fluctuate due to density-independent effects from climatic variation
H4: The populations fluctuate due to density-independent variation in host quality, natural enemies, mutualists, or competitors.