**Introduction**

1. Evolvability is an important concept for understanding/predicting the ability of populations/species to evolve morphological change through time
   1. If don’t know selection regimes, want to know how much variation alone can explain
   2. Schluter (1996) was the first to show empirically that G seems to predict directions of evolutionary change across time.
   3. Houle has shown that just knowing G predicts the direction of evolution on macroevolutionary timescales (no fossils though)
2. The modern quantification of evolvability is done using G matrices
   1. It is difficult to get the G matrix, very data intensive and requires breeding studies
   2. P matrix may substitute
      1. As proposed by Cheverud
   3. effect of time averaging on P; showed 1% greater variation in paleo P than modern P, so P in the past is a good proxy for P
   4. Still, don’t know how representative P is of G
      1. Cheetham and Porto et al showed pooled G works
         1. (yes, it “works” in the sense that you can always substitute P for G, but whether P reflects G is an empirical question which Cheetham nor our reanalysis of his Metrarabdotos data never investigated thoroughly.
3. Want to know how these things change through time: how G changes though time, how P relates to G through time
   1. Why is looking at this through time an important concept??
      1. In which directions in phenospace can evolution most easily happen and does those directions change through time?
      2. Expect to change in direction of Gmax or higher than average evolvability; if G didn’t change, and G constrains evolution, then we expect evolution to be constrained in the same directions across time.
   2. To do so, need to be able to estimate G through time, which is difficult because don’t have known breeding populations millions of years ago
4. Can use bryozoans to address this!
   1. Clones, so all variation among clones is due to E, not G
   2. Have a fossil record through time
   3. Specficially *Steginoporella magnifica*
      1. Simple system
5. Specifically, we ask:
   1. How well does P represent G?
   2. Does G change through time?
   3. Does Pmax align with G max?
   4. Is evolution happening in directions of above average evolvability?