RESILIENCE AND STABILITY OF PERMO-TRIASSIC KAROO BASIN COMMUNITIES: THE IMPORTANCE OF SPECIES RICHNESS AND FUNCTIONAL DIVERSITY TO ECOLOGICAL STABILITY AND ECOSYSTEM RECOVERY

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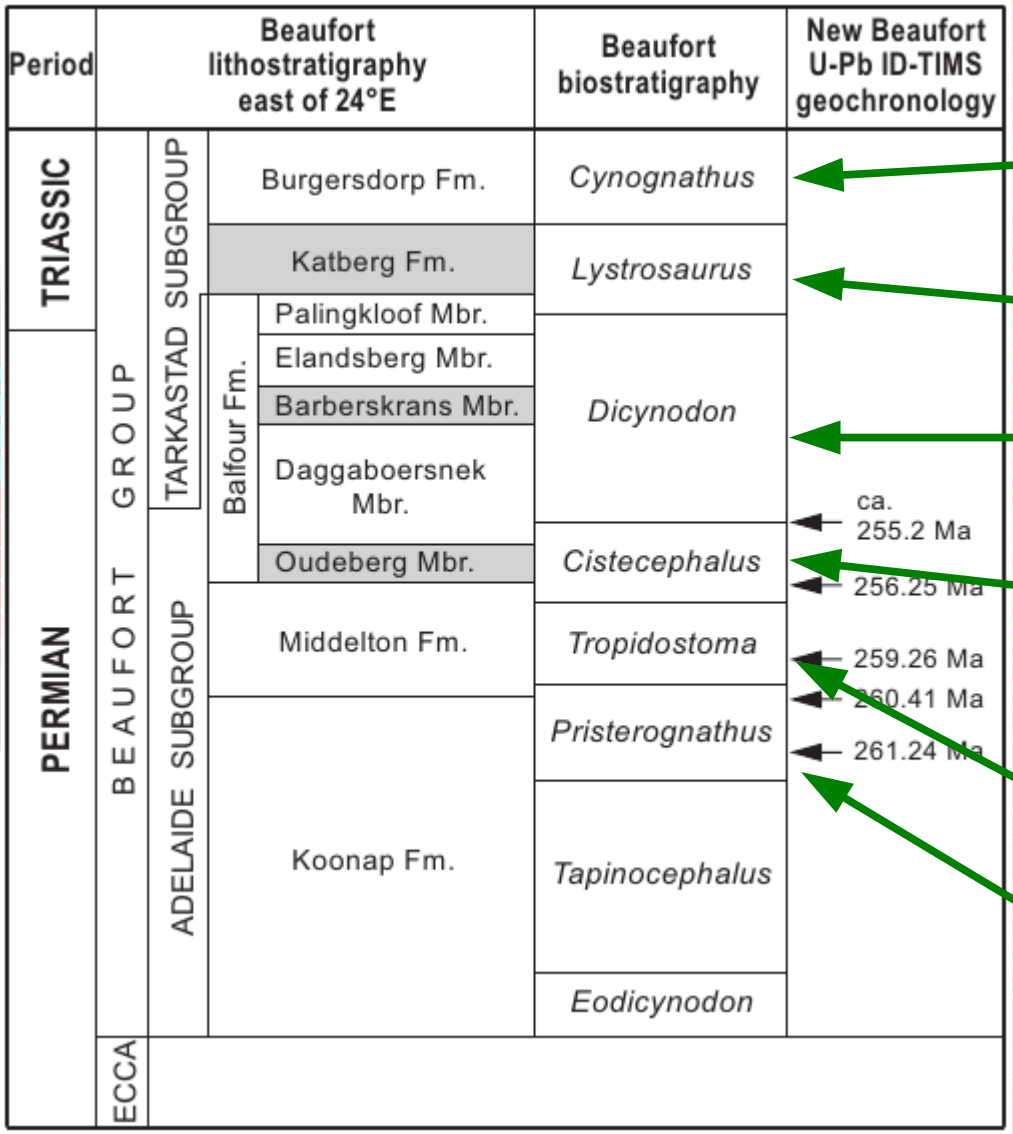
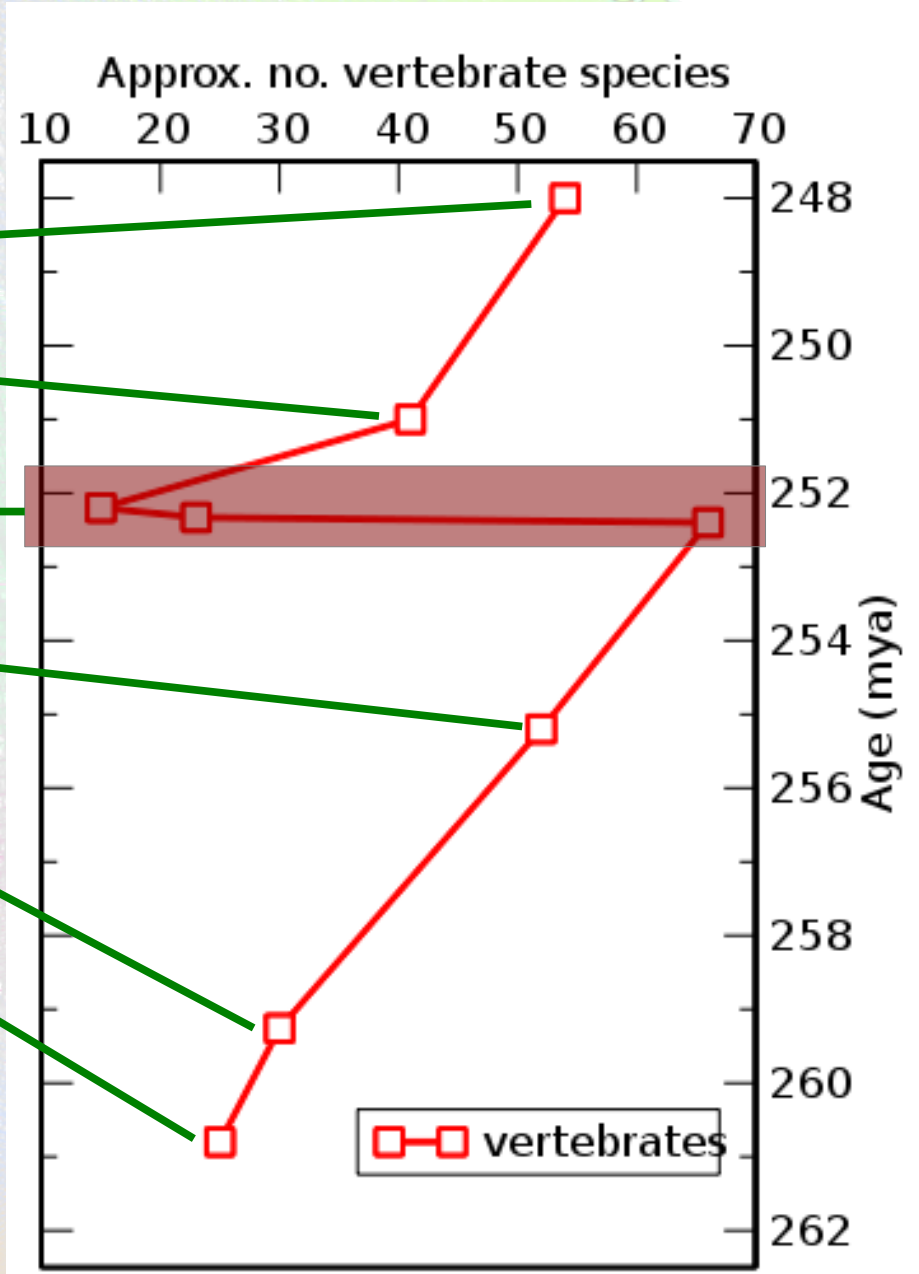
Hypothesis

- **Community structure and dynamics are major determinants of taxon loss and recovery during and from mass extinctions.**
  - **Community dynamics take on greater evolutionary roles during extinction and recovery.**



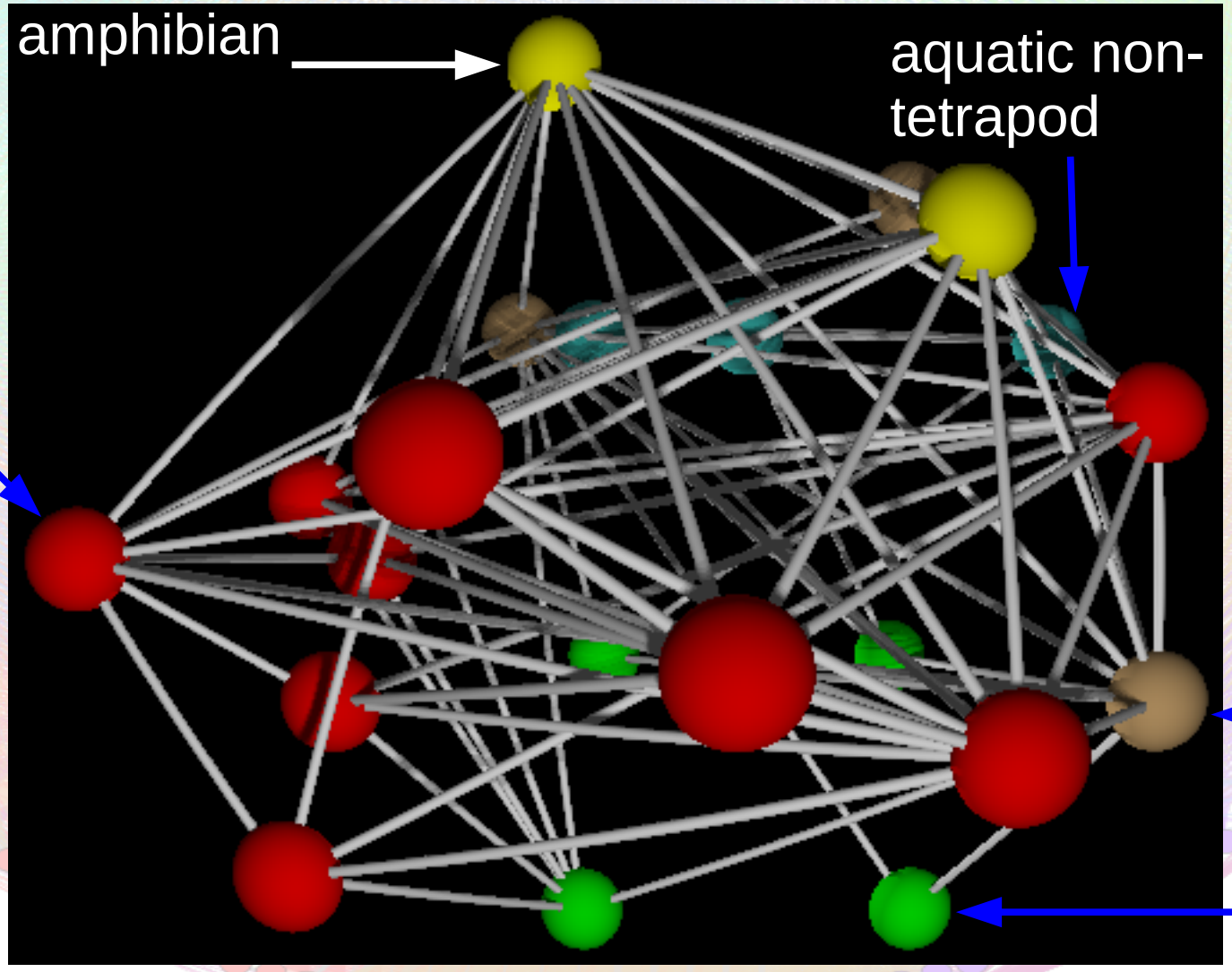
(*Rubidge et al., 2013*)



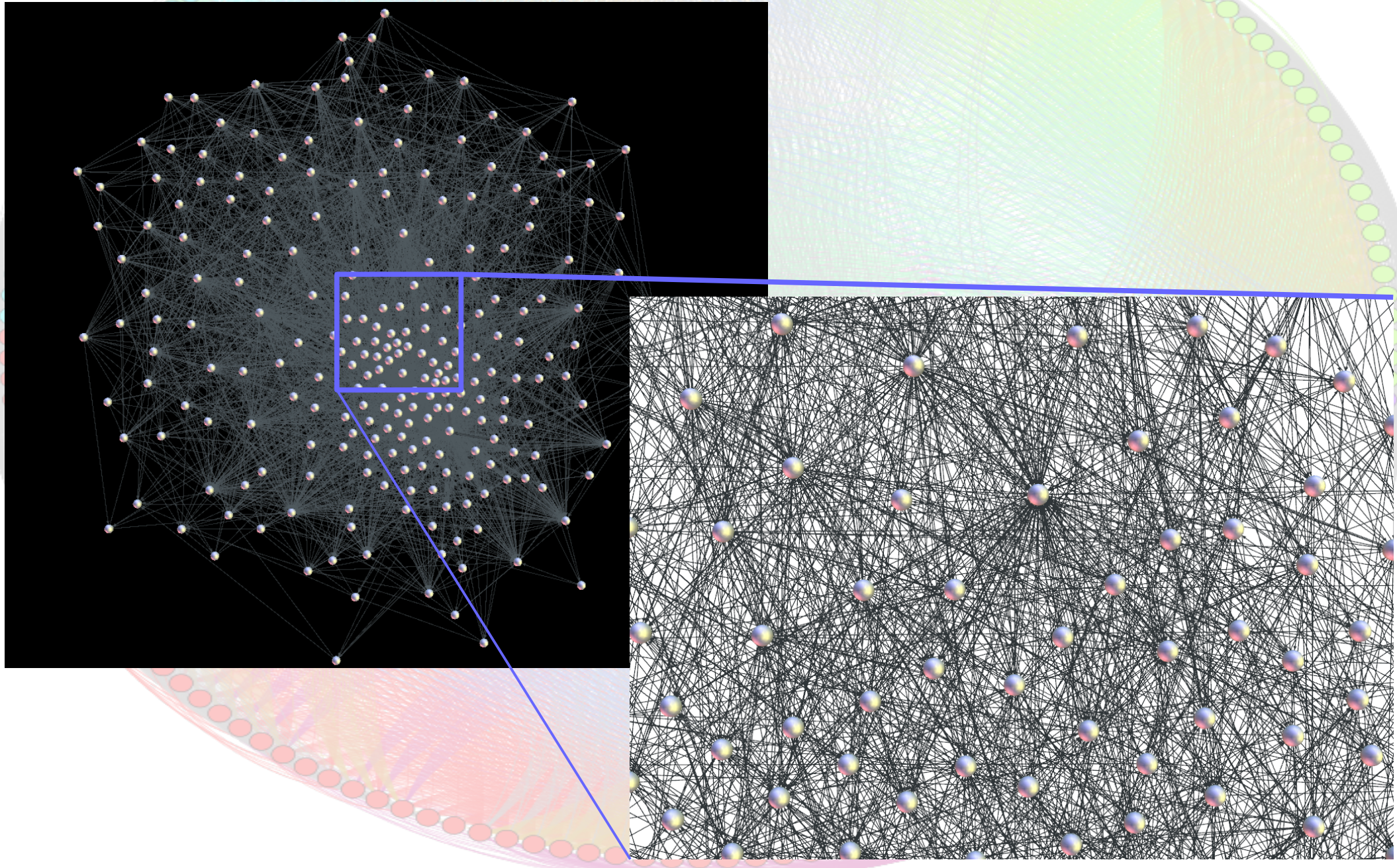
(*Smith and Botha-Brink, 2014*)

Paleocommunity state

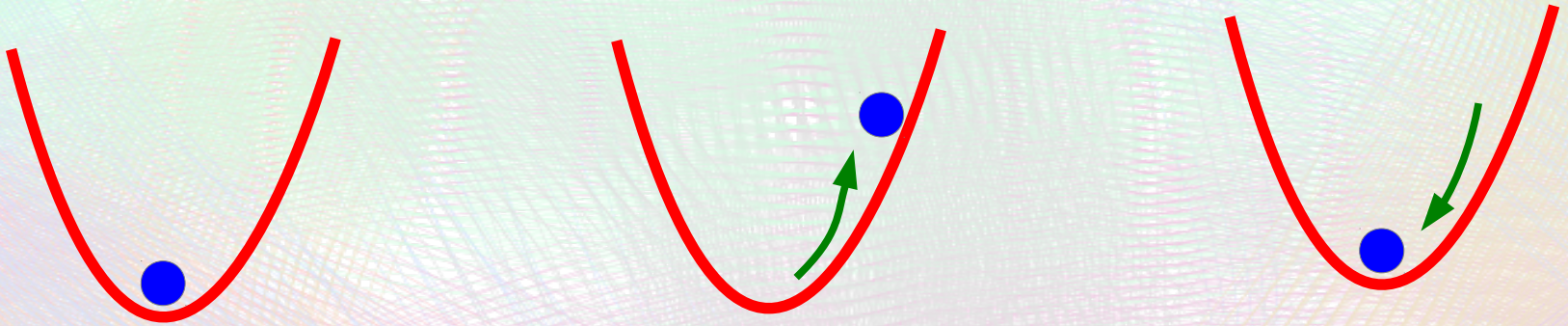
- **No. of taxa, N**
- **No. of guilds, G**
- **S(N,G)**



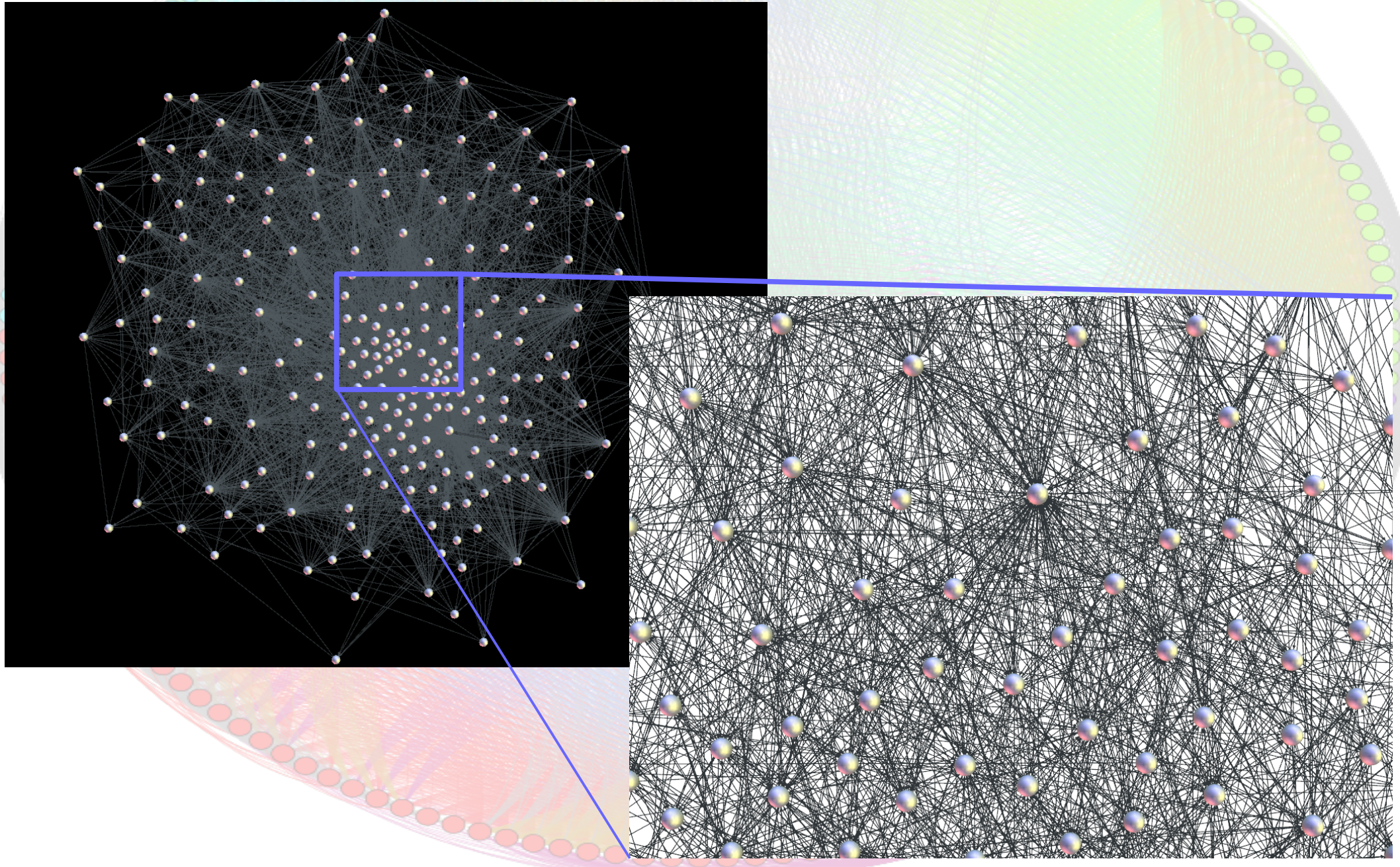
Late Permian, Karoo



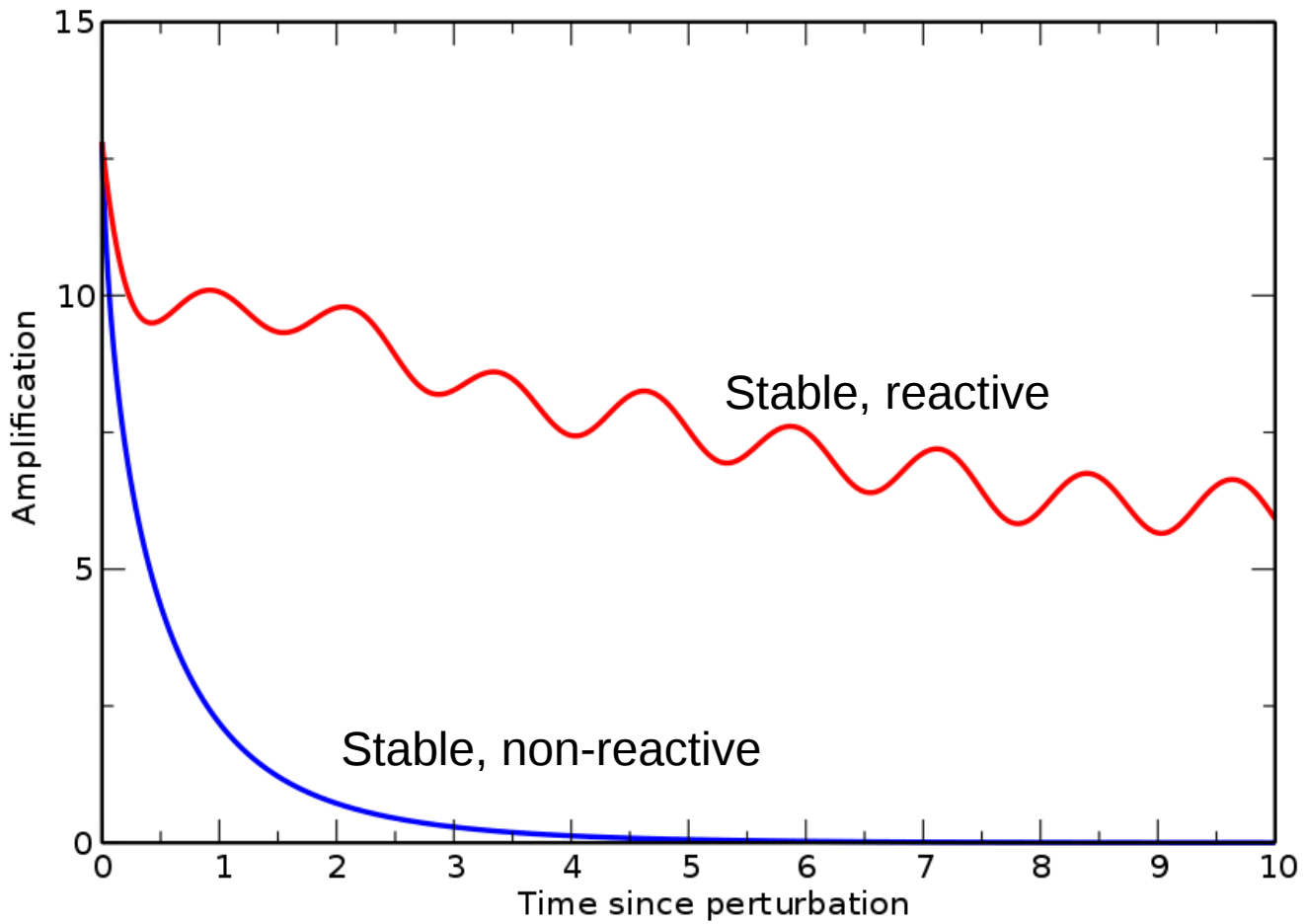
Local stability - resilience



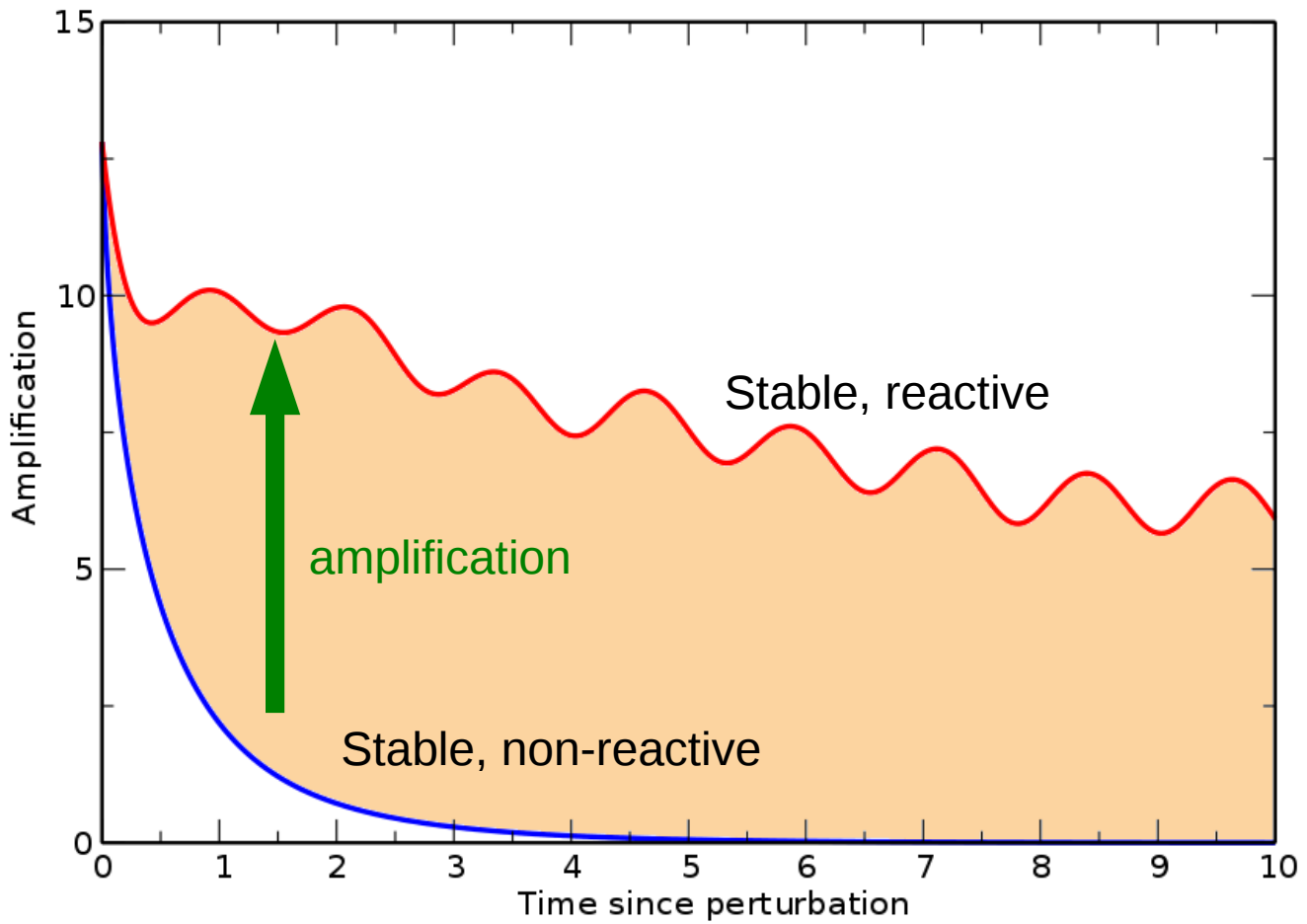
Cistecephalus Zone, L. Permian



Resilience, transience and amplification

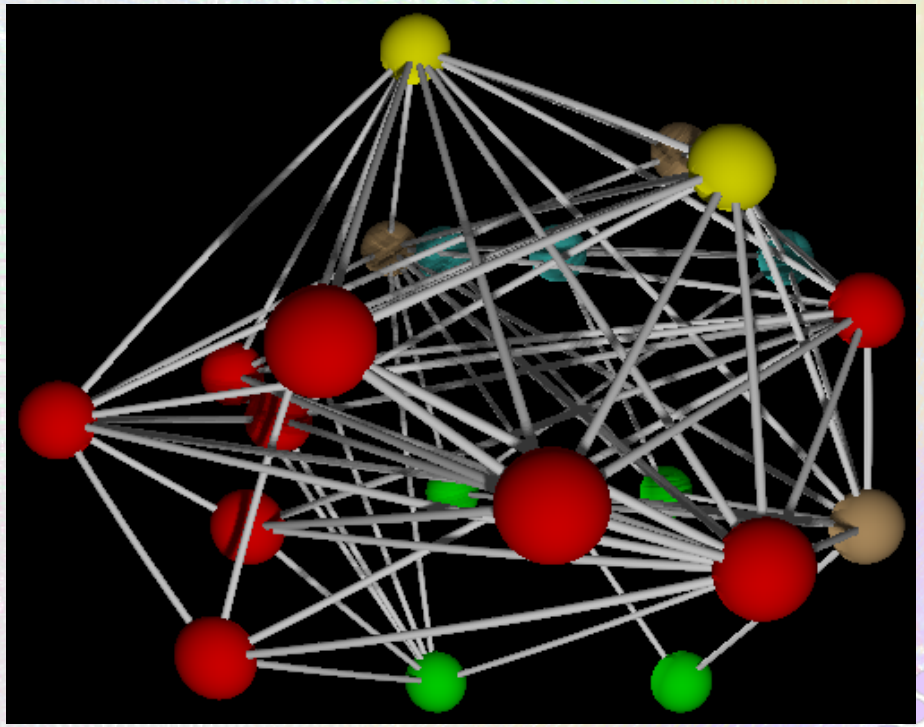


Resilience, transience and amplification

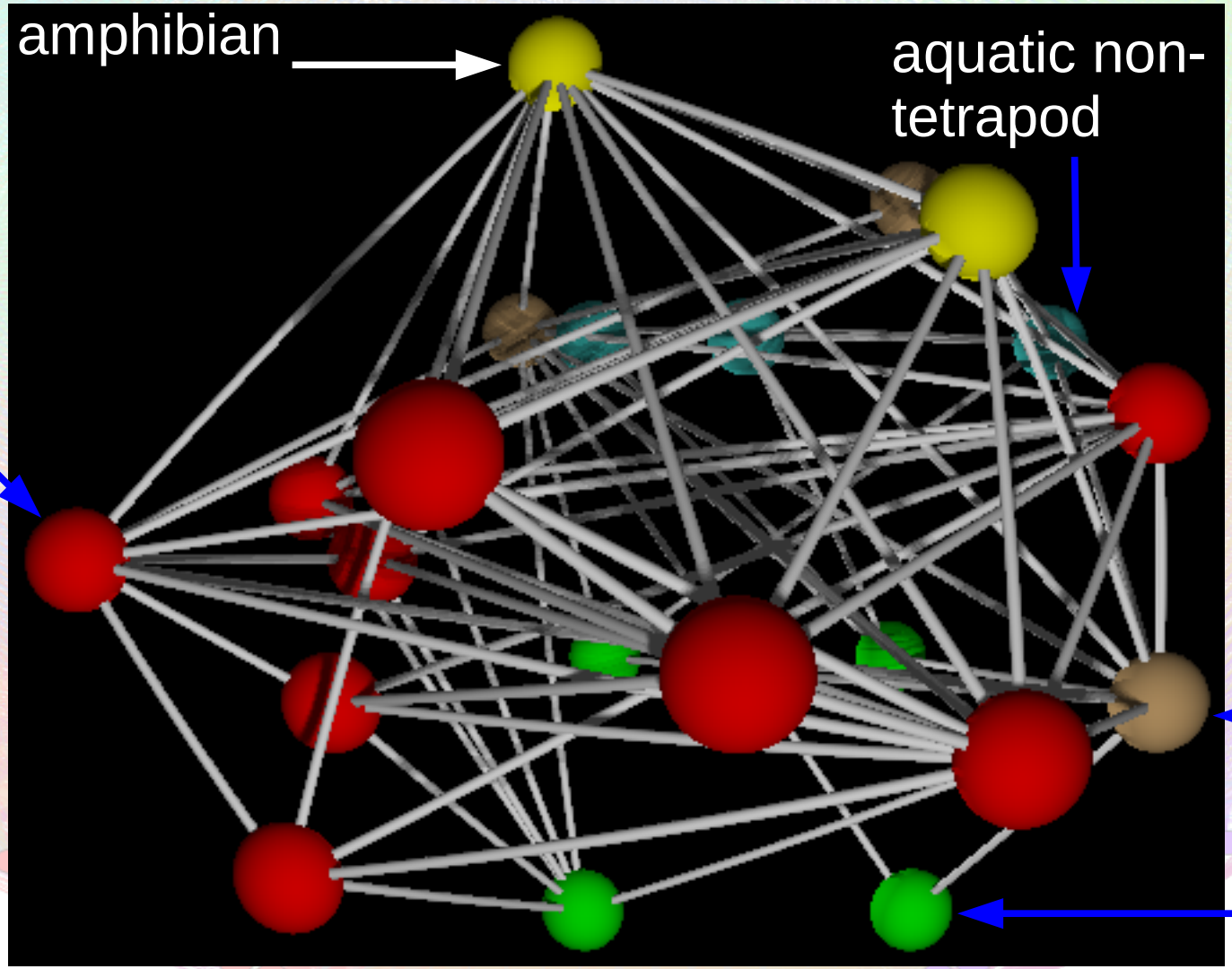


Three “experiments”

- General effect of functional structure
- Effect of observed functional structure
- Patterns of extinction and recovery

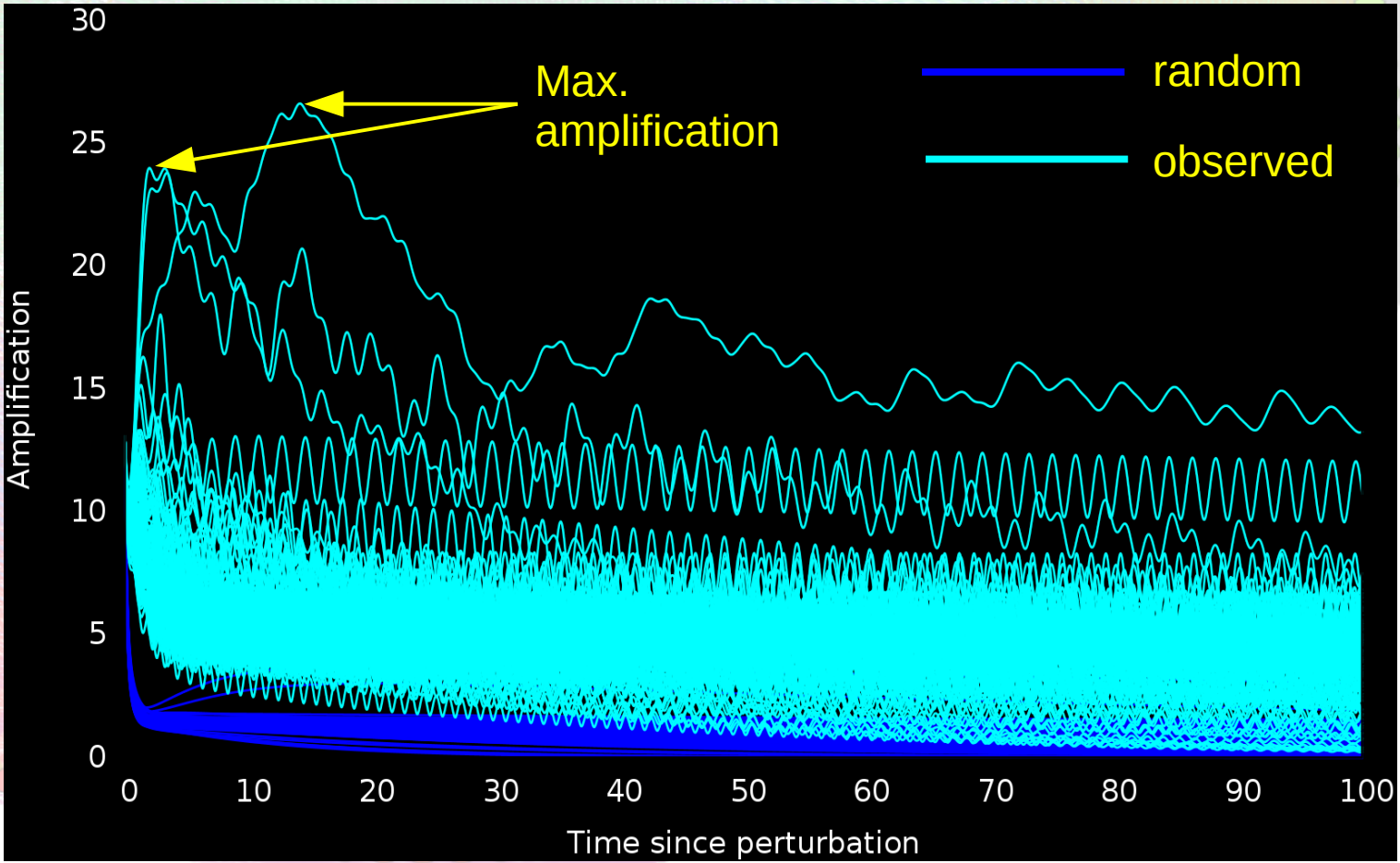


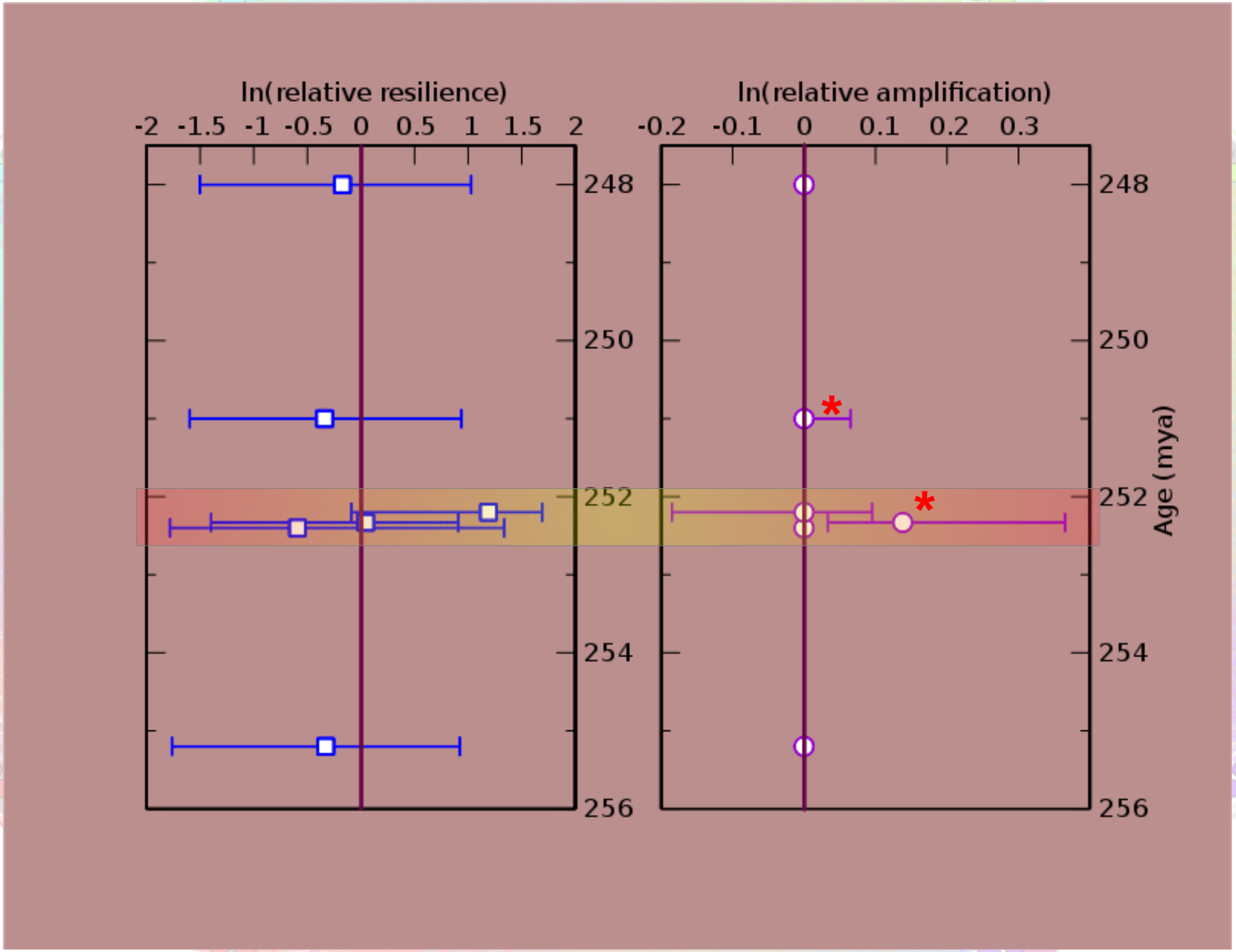
Effect of functional structure



Functional structure

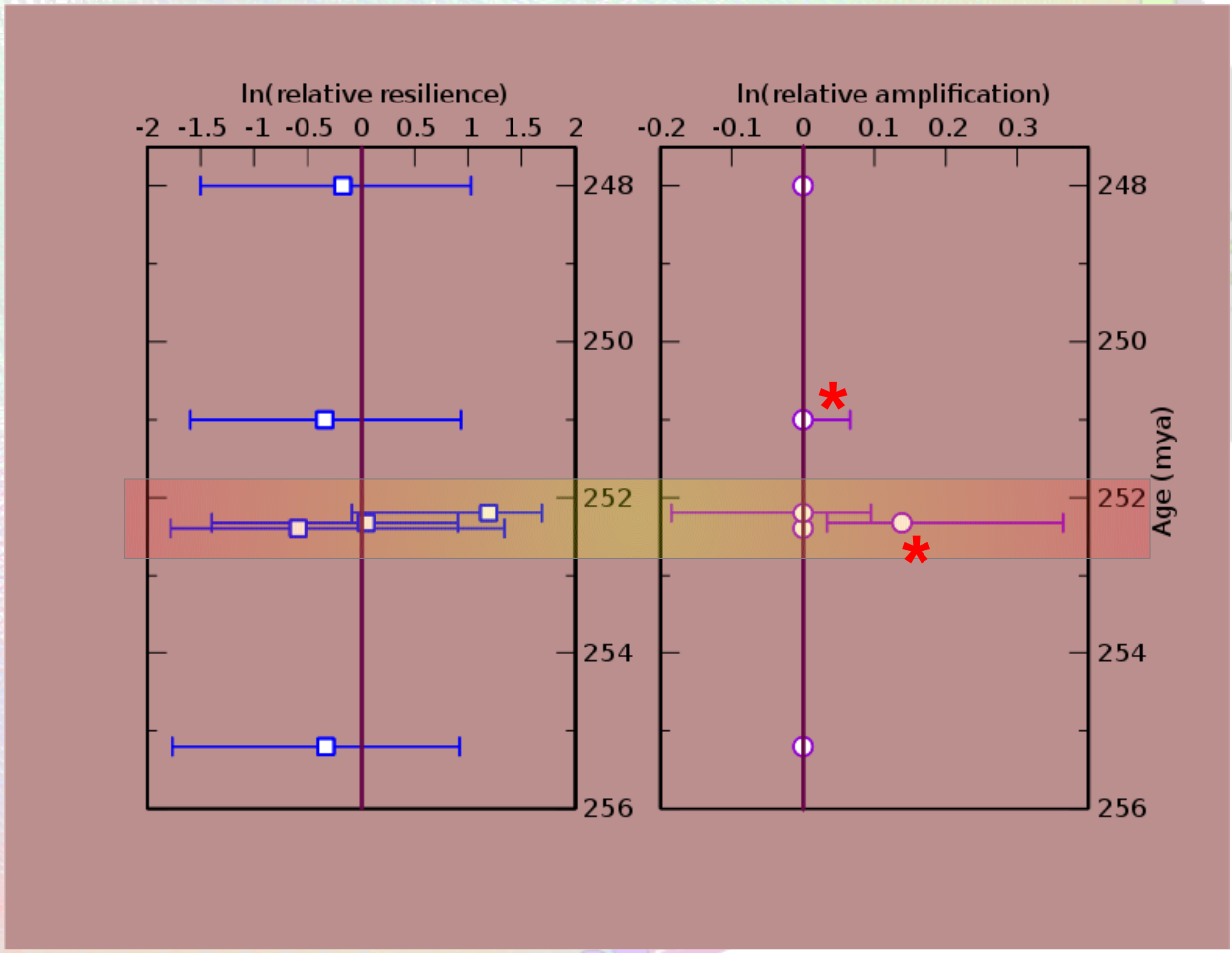
- Observed communities more reactive on short-term than communities of equal N but lacking functional structure!



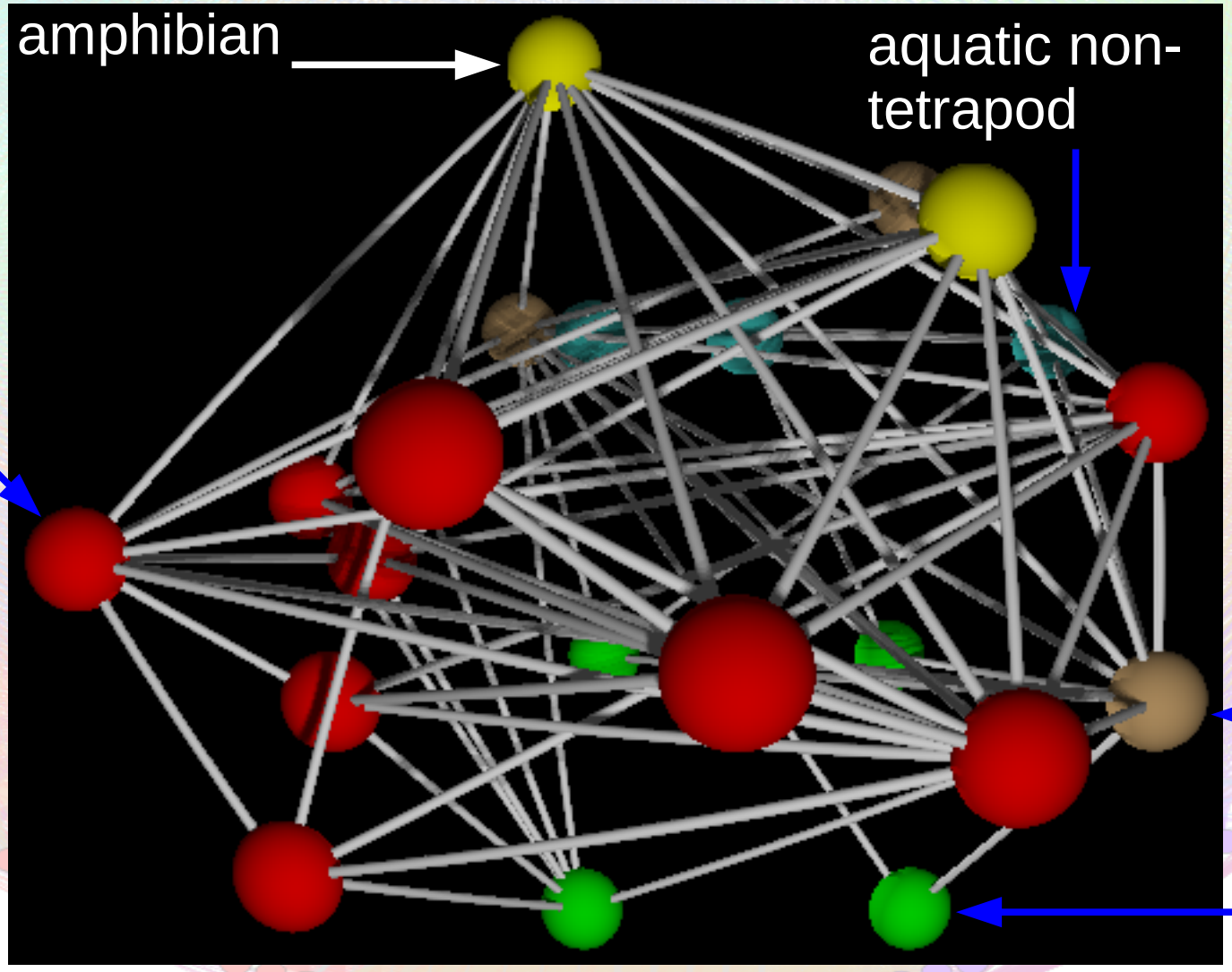

ln(relative resilience)
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
ln(relative amplification)
-0.2
-0.1
0
0.1
0.2
0.3
248
250
252
254
256
Age (mya)
*
*

Summary

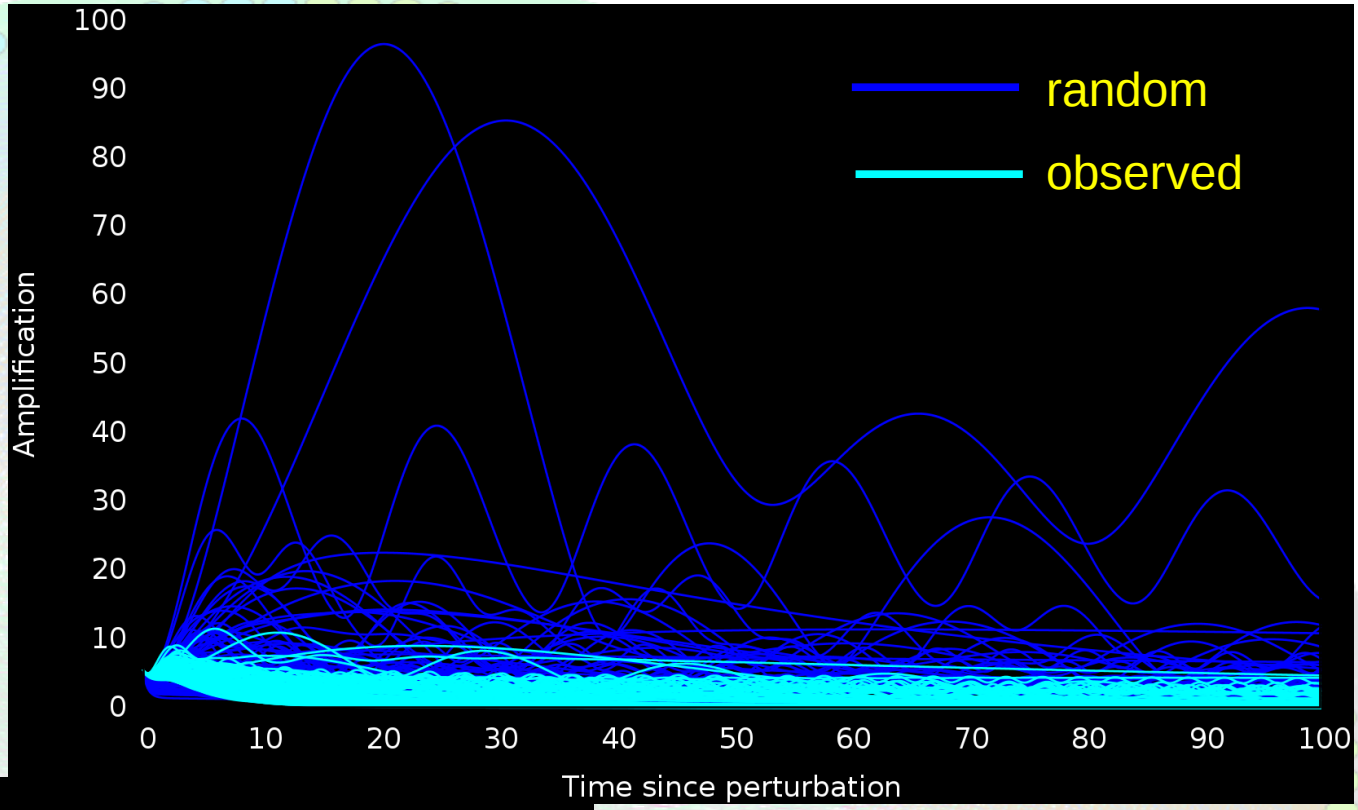
- General:
  - Observed systems more reactive
  - But no effect on resilience or amplification
- Stage 1 & recovery
  - Perturbations amplified

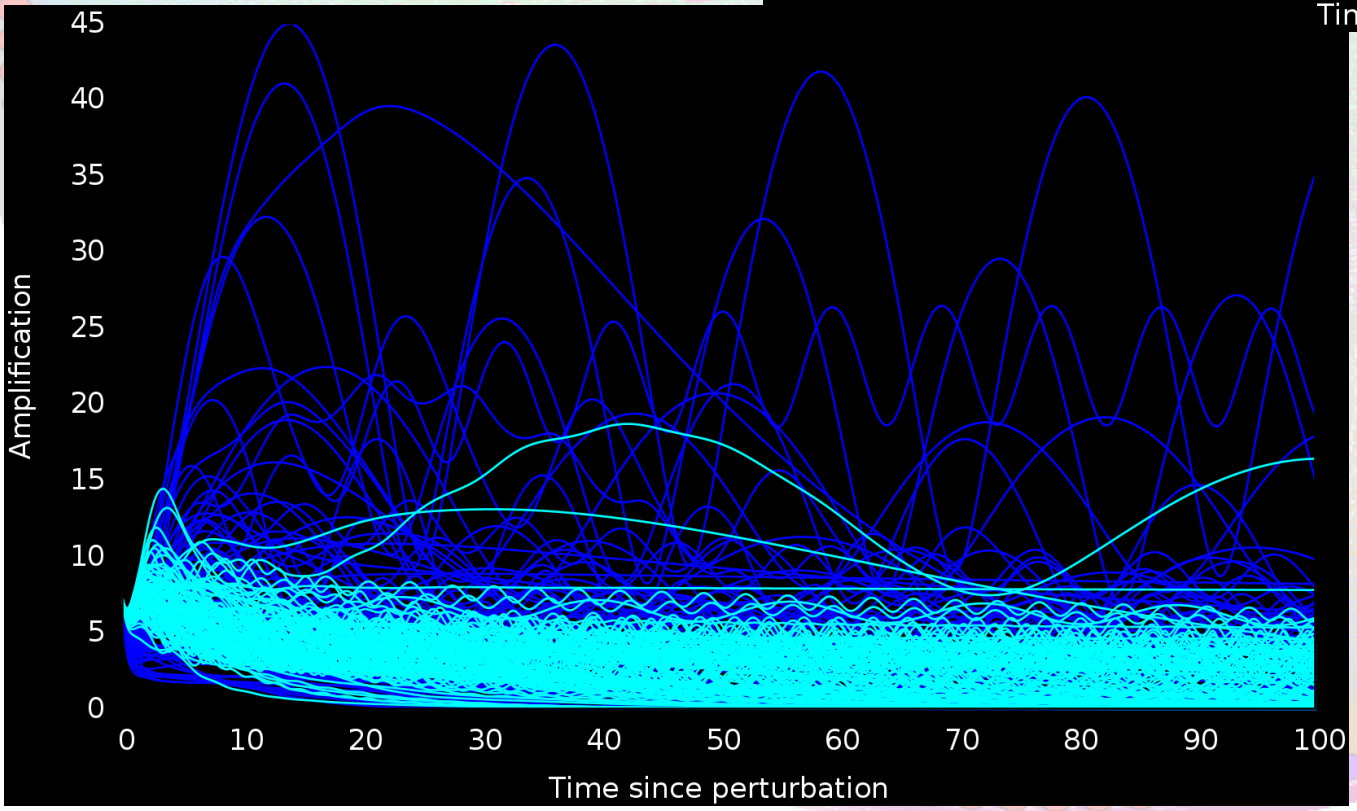


Effect of pattern of functional structure

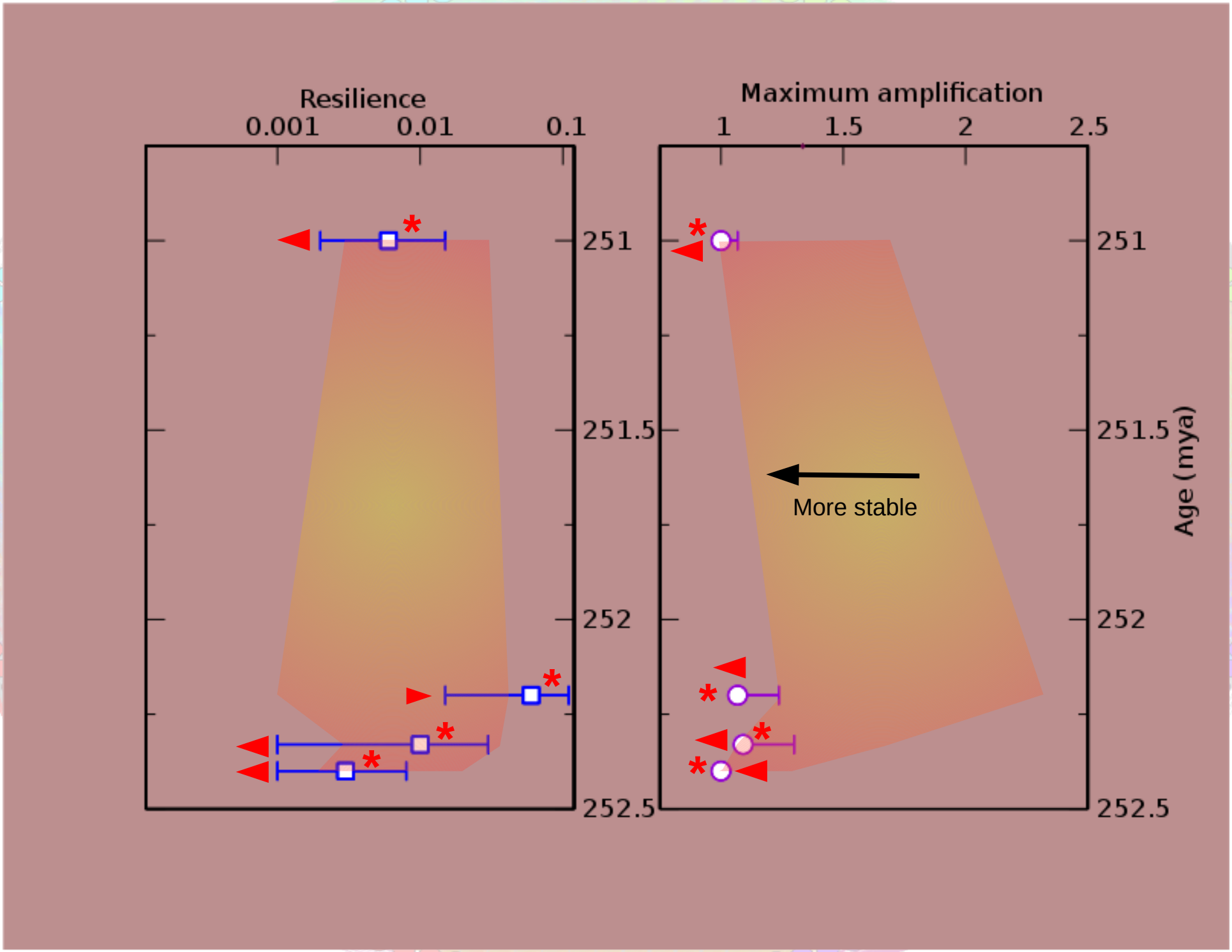


Extinction
Stage 2



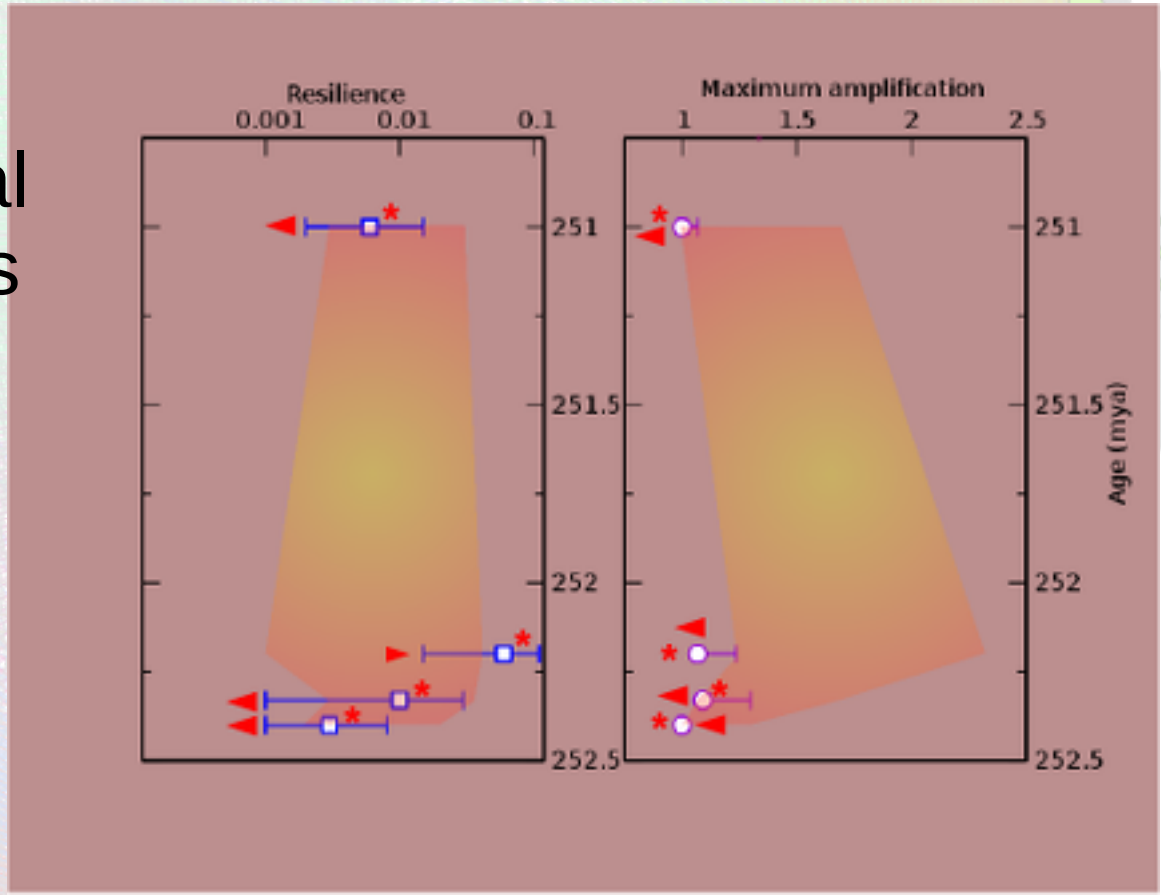


Extinction
Stage 1

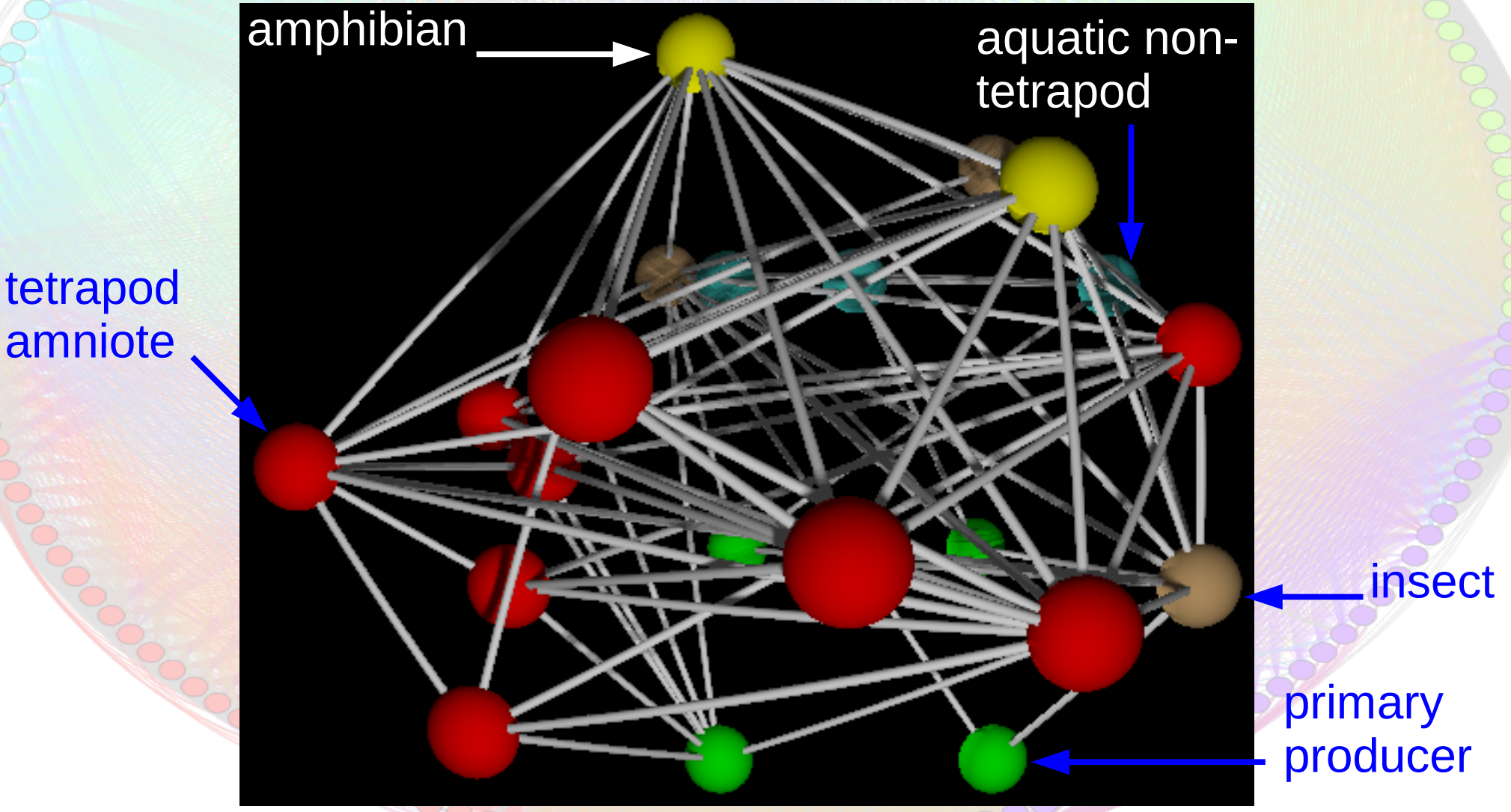

Resilience
0.001
0.01
0.1
Maximum amplification
1
1.5
2
2.5
251
251.5
252
252.5
Age (mya)
More stable

Summary

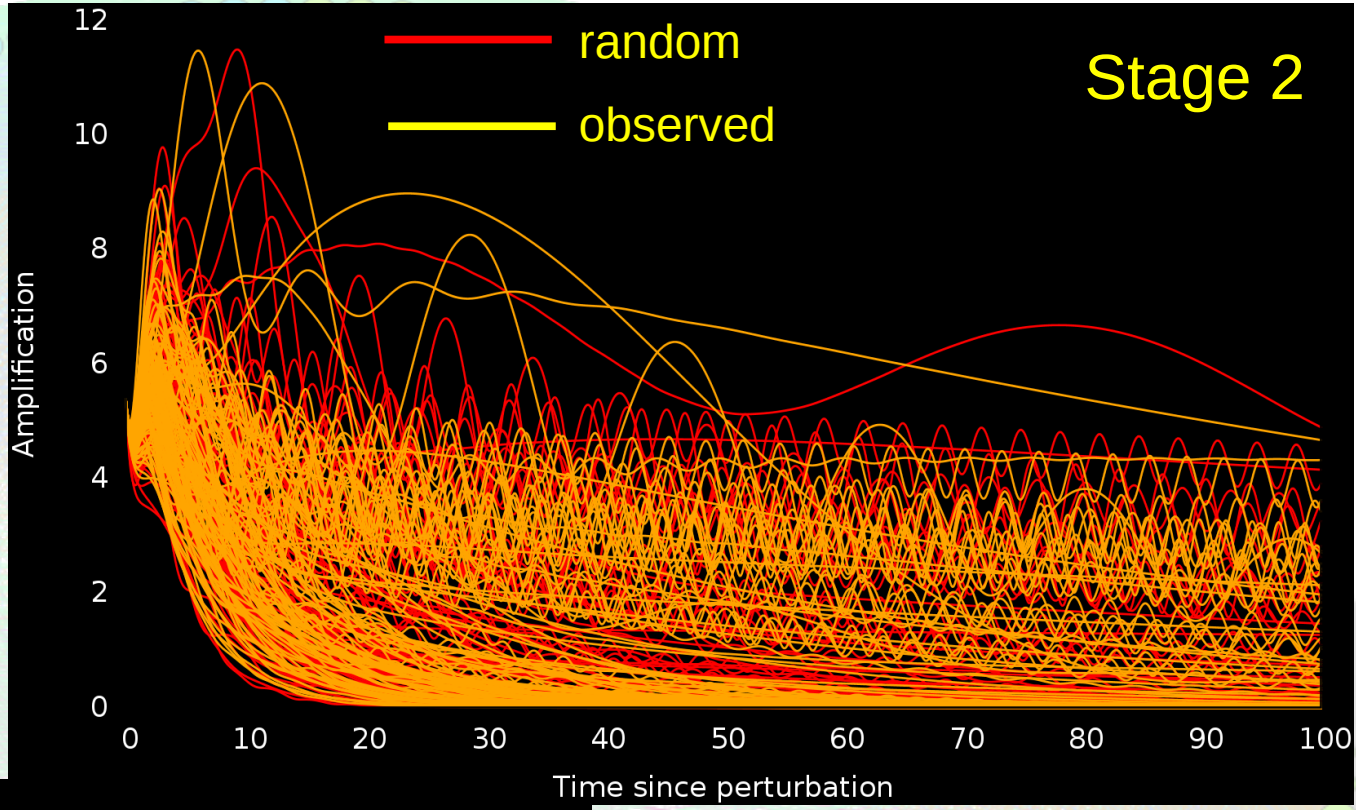
- Observed functional structures more stable than expected.
- Community during final stage of extinction was the **most resilient of series**!
  - Community structure highly improbable and stable.

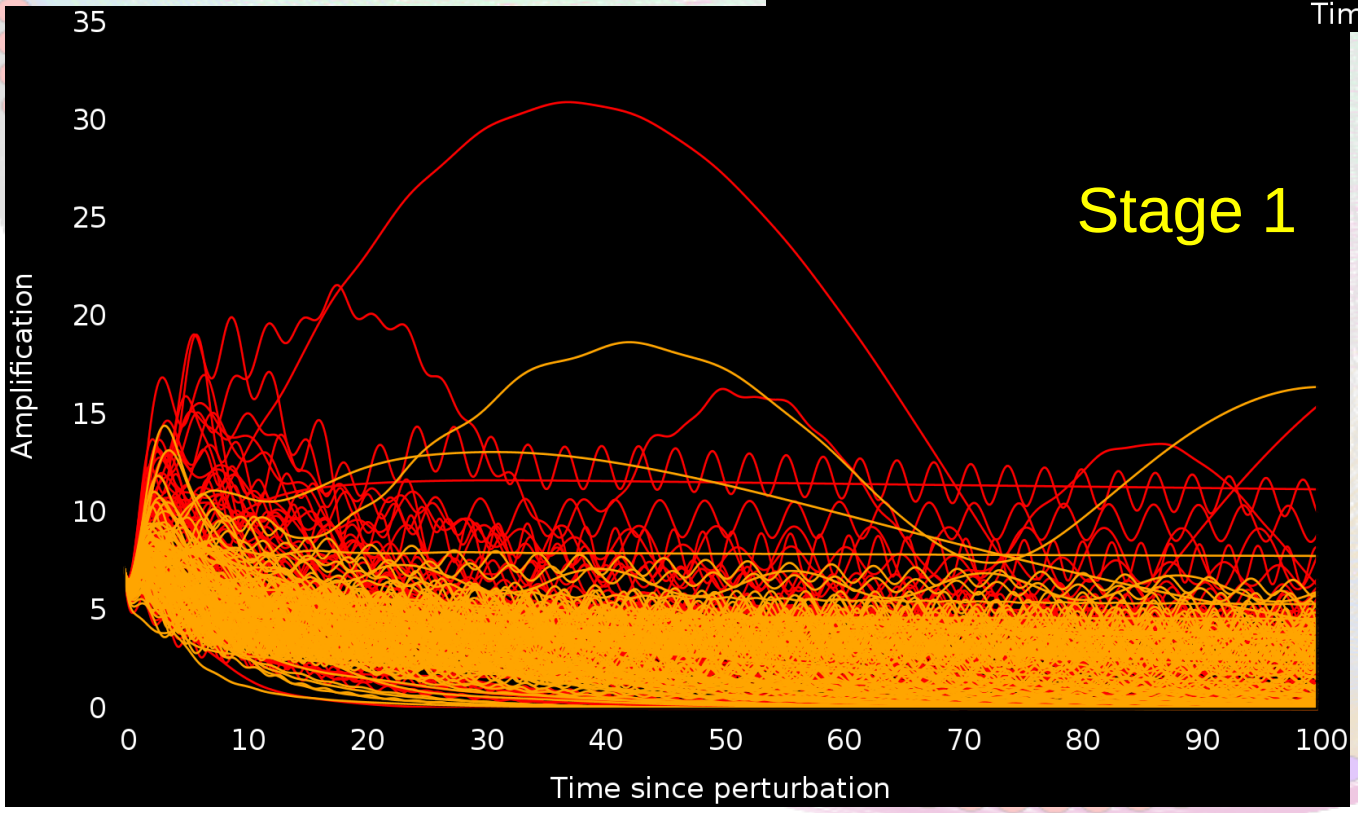


Patterns of extinction and recovery



Resilience, p = 0.217
Transience, p = 0.253

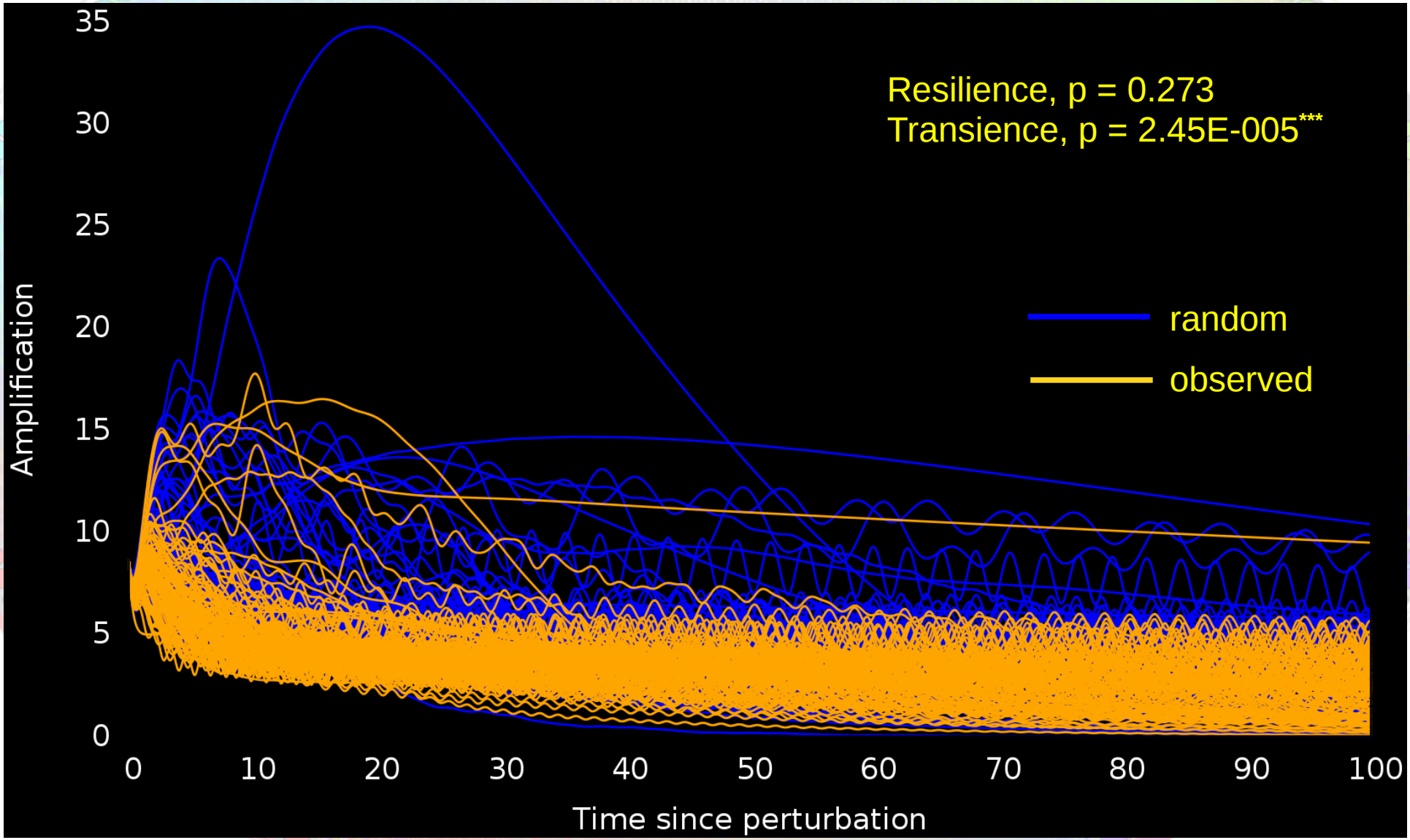




EXTINCTION

Resilience, p = 0.246
Transience, p = 1.55E-006***

RECOVERY


Resilience, p = 0.273
Transience, p = 2.45E-005***
random
observed
Amplification
Time since perturbation
0
5
10
15
20
25
30
35
0
10
20
30
40
50
60
70
80
90
100

Conclusions

- **Emergent community dynamics bias patterns of evolution, extinction and persistence**
- **Community stability paramount during intervals of mass extinction**
  - Patterns of functional extinction maximize stability
  - Patterns of functional recovery maximize stability
- **Beware the Invisible Hand for it does not exist. Selection does.**

National Science Foundation
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