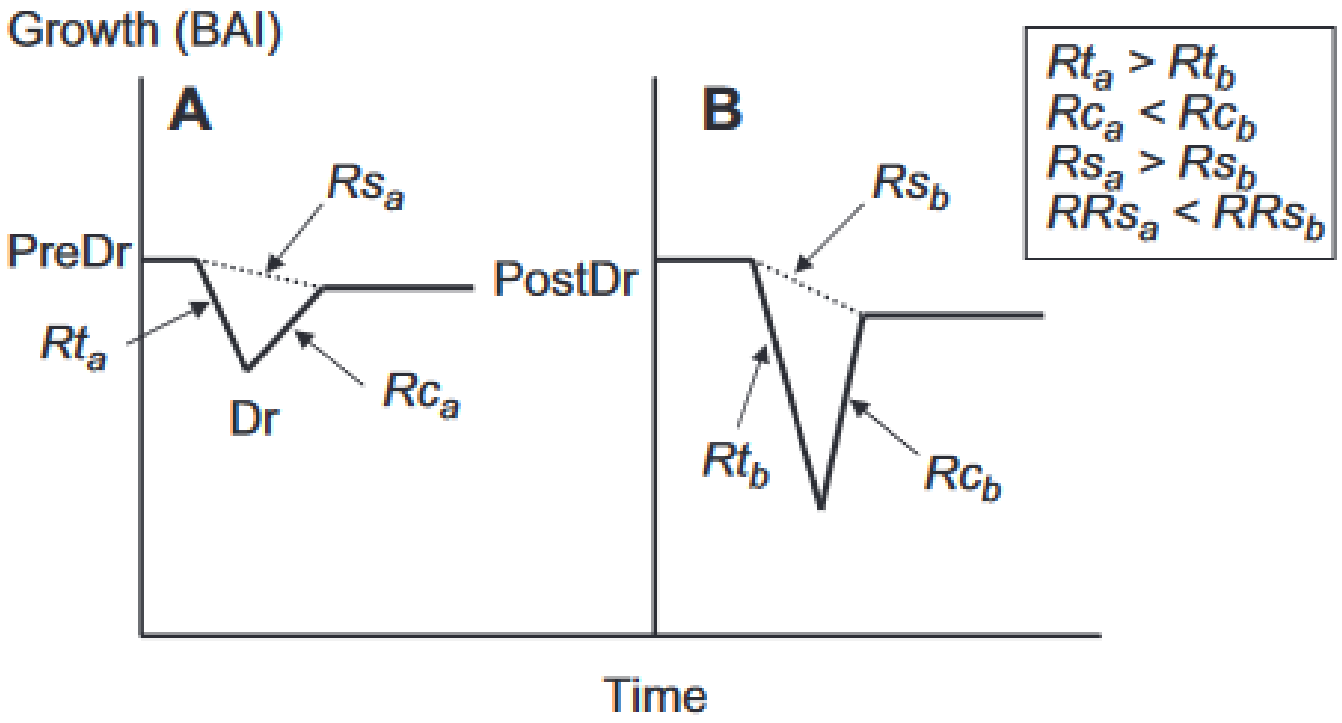
# Lloret et al. 2011. Oikos




Resistance *Rt* = Dr/PreDr
Recovery *Rc* = PostDr/Dr
Resilience *Rs* = PostDr/PreDr
Relative resilience *RRs* = ((PostDr-Dr)/(PreDr-Dr)) (1-(Dr/PreDr))

$$Resilience = Resistance \times Recovery$$

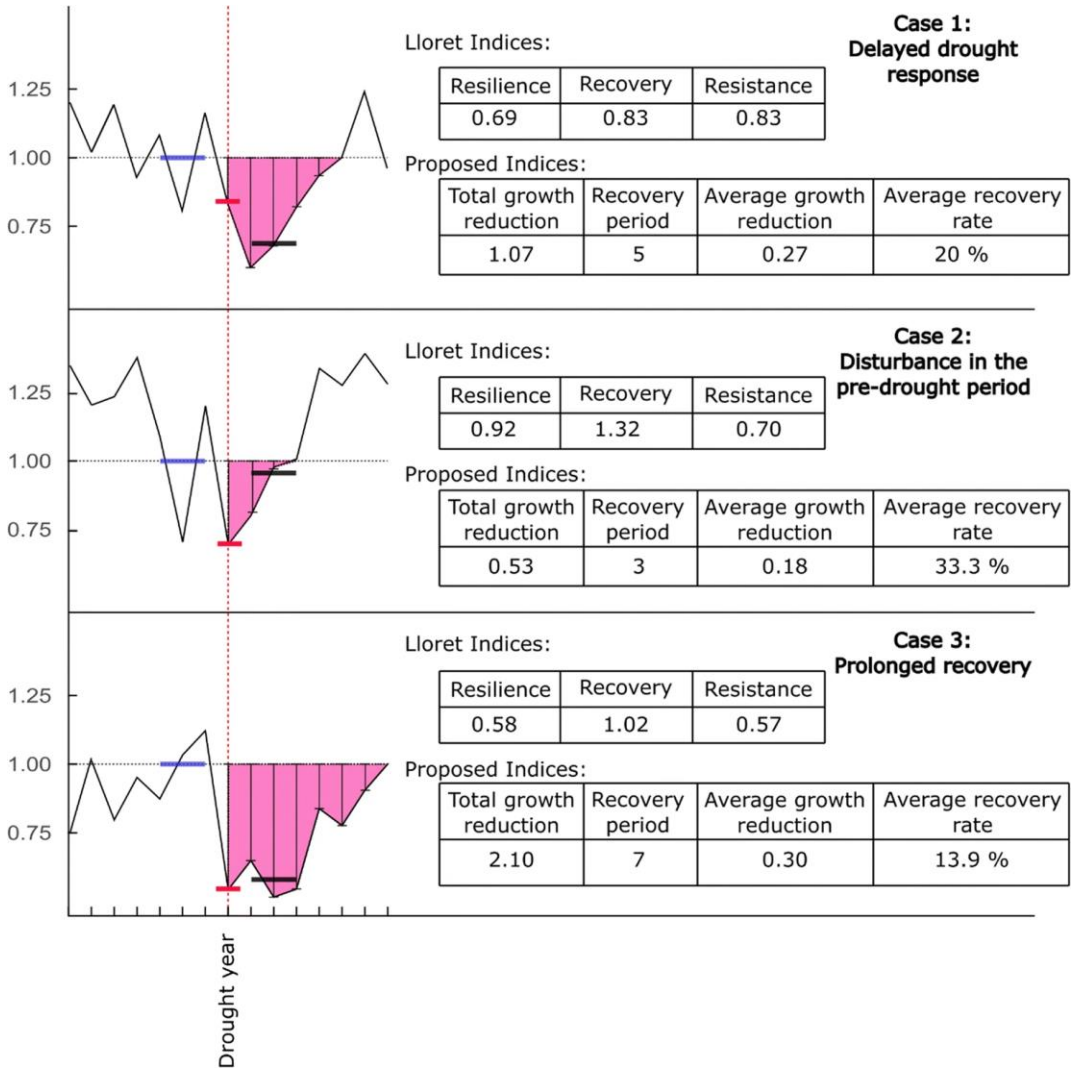
$$Relative\ resilience = Resilience - Resistance$$

Impact = (PreDr - Dr) / PreDr

Problemas:

- Se necesita un baseline period (¿de cuántos años?¿qué pasa cuándo las perturbaciones son muy freq?)
- No tiene en cuanta clima antes y después (solución: meterlos en los modelos)
- trade-off entre índices
- Comparación entre sitios, especies, etc

# Schwarz et al. 2020. Curr. For. Rep.




**Case 1: Delayed drought response**

Lloret Indices:

| Resilience | Recovery | Resistance |
|---|---|---|
| 0.69 | 0.83 | 0.83 |

Proposed Indices:

| Total growth reduction | Recovery period | Average growth reduction | Average recovery rate |
|---|---|---|---|
| 1.07 | 5 | 0.27 | 20 % |

**Case 2: Disturbance in the pre-drought period**

Lloret Indices:

| Resilience | Recovery | Resistance |
|---|---|---|
| 0.92 | 1.32 | 0.70 |

Proposed Indices:

| Total growth reduction | Recovery period | Average growth reduction | Average recovery rate |
|---|---|---|---|
| 0.53 | 3 | 0.18 | 33.3 % |

**Case 3: Prolonged recovery**

Lloret Indices:

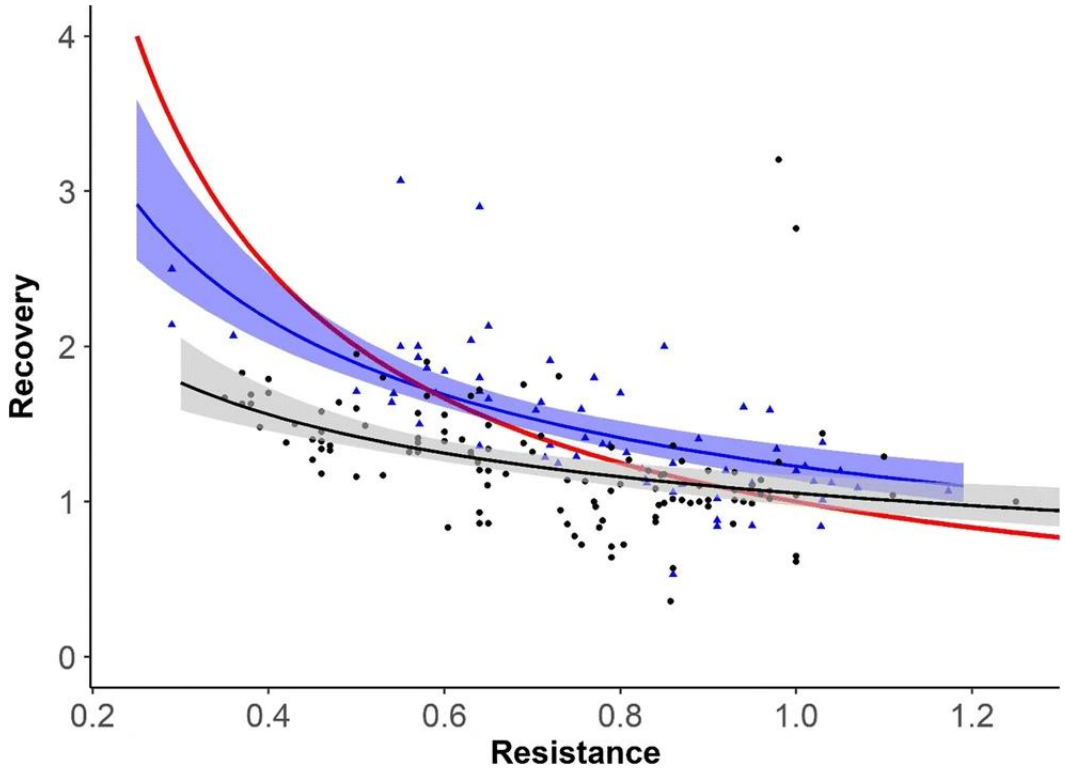
| Resilience | Recovery | Resistance |
|---|---|---|
| 0.58 | 1.02 | 0.57 |

Proposed Indices:

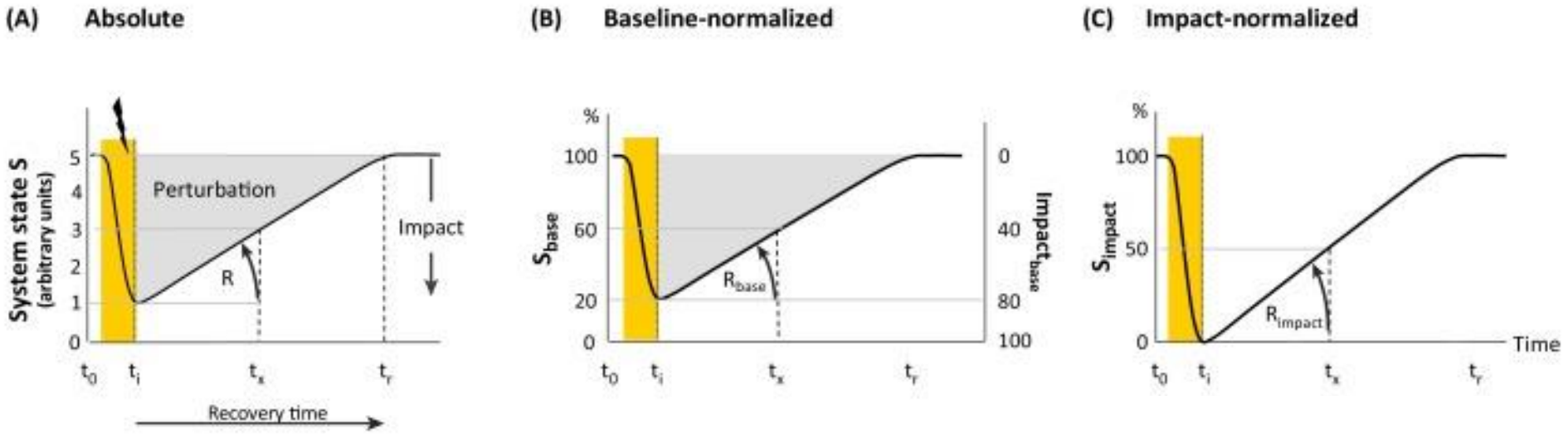
| Total growth reduction | Recovery period | Average growth reduction | Average recovery rate |
|---|---|---|---|
| 2.10 | 7 | 0.30 | 13.9 % |

*Average growth reduction* calculated as the ratio of *total growth reduction* divided by the length of the *recovery period*

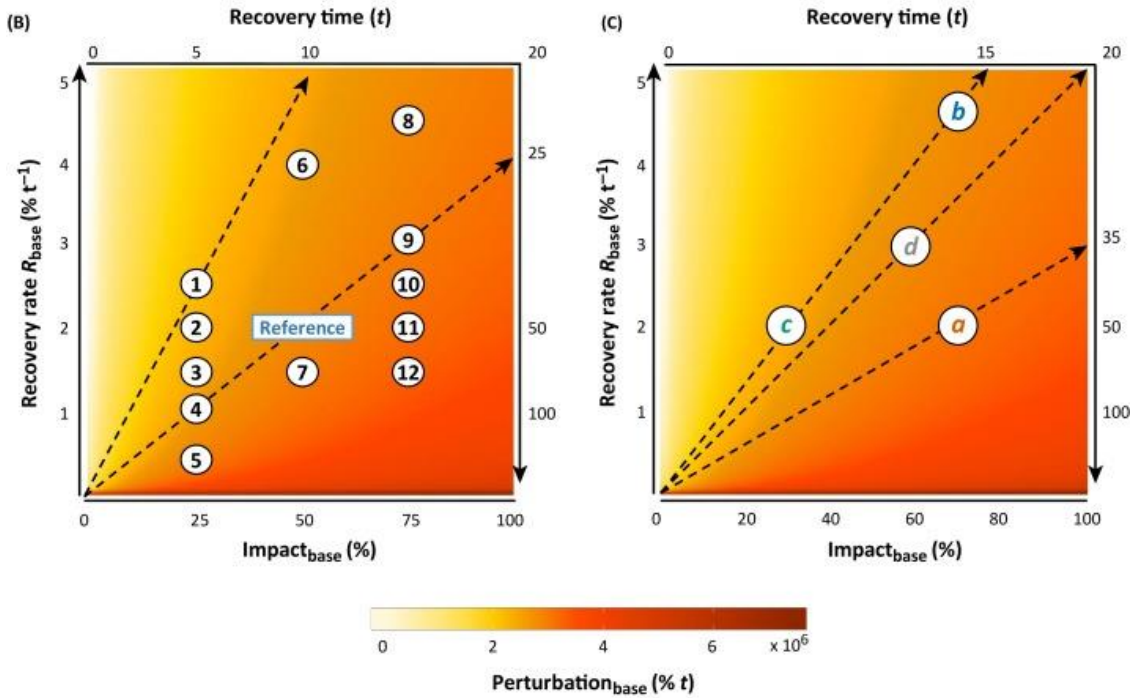
*Average recovery rate* as the magnitude of growth reduction in the drought year (equals 1 minus Resistance) divided by the length of the *recovery period* and expressed as percentage of the magnitude of growth reduction in the drought year



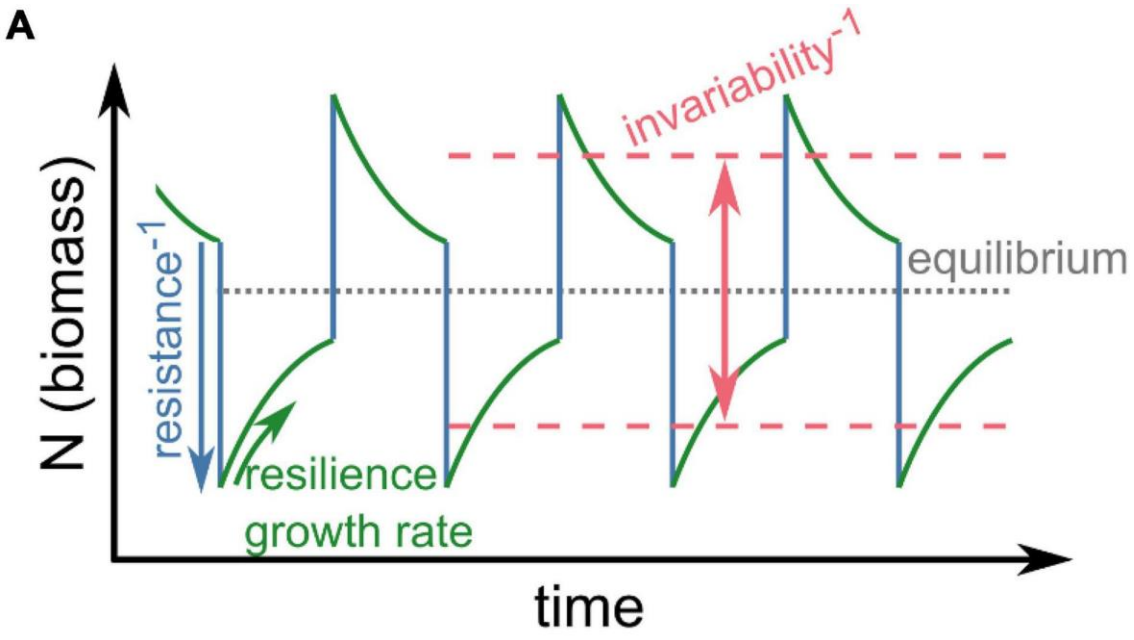
# Ingrisch and Bahn 2018. TREE




The disturbance impact can be quantified by the change in ecosystem state; that is, the difference between the pre-disturbance state and the state at the time of peak impact. The recovery rate can be quantified by the change of ecosystem state per unit time after disturbance. Both the impact and the recovery rate determine the recovery time: the smaller the impact and the higher the recovery rate



# Other approaches for evaluating stability in time series




Resistance (blue lines) is defined as the inverse of the change of biomass as a consequence of the direct effect of the disturbance. The growth rate and the initial resilience of the system (green lines) both quantify the rate at which the system tends to recover to the equilibrium after the effect of the disturbance. The main difference between growth rate and initial resilience is whether it is computed relatively to the biomass prior the disturbance (growth rate), or relatively to the distance between the biomass after the perturbation and the equilibrium biomass (initial resilience). Finally, invariability (red dashed lines) represents the ability of the systems to remain close to the equilibrium when multiple disturbances affect (periodically or randomly)

e.g. Jarillo et al. 2022. Front. Ecol. Evol.

See equations for each component in the paper