Experiment Exposé

Stability of aquatic communities under increasing Temperature and pulsed pesticide stress

Objectives:

* Explore resilience and instability in lab nanocosm communities by looking at trajectories together with frequent monitoring of environmental conditions
* Identify drivers of community change
* Identify critical transitions in nanocosm systems and warning signals
* Model communities with DEB model parameterized by calibrating to data from previous lab experiments with individuals
* Evaluate applicability of an object detection algorithm to improve and ease image analysis
* (Planned) evaluate the influence of refuges on the stability of nanocosm communities.

Hypotheses:

1. Communities recover from small disturbances
2. Attractors of stability regions move due to environmental/contaminant history of the system
3. Coincidence of several small disturbances or few large disturbances are sufficient to move a system out of region of stability towards irreversible degradation
4. Refuges stabilize systems and enable them to tolerate higher amounts of disturbance
5. Lab nanocosm communites can be modelled with DEB models calibrated to data from experiments with individuals

Interesting but yet unplanned questions:

1. Development of genetic diversity
2. Can degraded systems be successfully recolonized (since I will inevitably face collapsed nanocosms, it would be a waste not to address this question)

Method:

1. Setup

* Teflonfüße zum rutschen
* 60 to 80 semi-closed systems are designed, where Culex Pipiens Molestus (C), Daphnia Magna (D) and the Algae Desmodesmus Subspicata (A) populate artificial ecosystems made up of a sediment layer ADaM growth Medium and over water supply for emerged Mosquitos.
* Initially communities are let converge towards a stable attractor (1-2 Months)
* After the initialization period, communities are exposed to slowly increasing temperatures and pesticide pulses (different timing / different magnitude)
* (planned) Periodically add external organisms to some nanocosms

1. Treatment plan

n=80

n=40

n=40

n=20

n=20

n=20

n=20

5

5

5

5

5

5

5

5

5

5

5

5

5

5

5

5

+Temp

-Temp

+ Refug

- Refug

Pesticide concentrations

1. Monitoring

* Monitoring of C and D is done by image analysis of Photographs taken twice per week
* Monitoring of Algae density is done via cell counting of water column samples (weekly)
* Water quality parameters are monitored semi-quantitavely every two weeks – maybe weekly (pH, NH4, NO3, NO2, PO4)
* Temperature is monitored more closely. Procedure yet not clear
* (optional) Total accumulation of carbon (productivity of a system) by comparing ash free weight before and after the end of the experiment
* Messung der Größenverteilung der Partikel am Casey

Expected Results:

It is expected that the nanocosms after initialization will diverge based on random differences in sediments, fungal spores entering the system, differences in individuals and other uncontrollable natural randomness. However, the individual systems are expected to converge to a semi stable state (fluctuating around an attractor).

The systems are put under stress by external influx and emerging stress from within the system. Following stressors are foreseen:

1. Pesticide stress (external)
2. Temperature stress (external)
3. Food limitation (internal – D,C, densities are high)
4. Population structure – neonates are more susceptible to pesticide than adults
5. Water quality (pH, nutrients)

Frequent non-invasive monitoring allows us to follow the trajectories of the systems closely. I hypothesize that coincidence of small doses of multiple stressors may push a system sufficiently out of a stability region so that it consecutively degrades.

Thus I expect to observe critical phase transition between stable states with following endpoints

* + C, D vital
  + C extinct, D vital
  + C vital, D extinct
  + C, D extinct