Stabilizing Mechanisms of Artificial Ecological Communities under Environmental and Chemical Stress

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This is the abstract

Introduction

Motivation

Species have varying sensitivity to chemical and environmental stress. If stress is recurring and time for recovery is not sufficient, resilient species will outcompete the other (Liess et al. 2013) in ecosystems which are under default conditions stable for both species.

Sokolova urges to consider the effect of temperatures in all studies of the effects of multiple stressors in natural populations

We know that pesticides are applied multiple times throughout the year, starting in spring and moving on towards harvest. During this time temperatures cyclically increase and decrease, with peaks in summer. By additionally avoiding feeding in the water column the system is governed by the dynamic of primary production and community competition for a shared food resource.

Thus we aim to approximate a natural pond system very closely and thus identify the interaction between temperature, resource availability / competition, chemical pollution and community structure. and identify states and possibly times when communities are particularly vulnerable

Background information

Culex pipeens larvae thrive in stagnant water with high input of organic material

Recent Findings

(Gessner and Tlili 2016) context dependency in stress-effect analyses has until 2016 been under researched.

check research of gardeström et al (2016). They made a research of communities in streams and the dependence of outcome on the contamination legacy. This may be important for the second part of the current nanocosm experiment repeated contamination with low dose pesticide after initial contamination with esfenvalerate of different dose

(Wood and Goulson 2017) show how neonicotinoides are flushed into rivers after peak rain events. This shows that repeated pulse exposures are a much more meaningful approach to testing the effect of pesticides in contrast to continuous exposure, which practically does not take place. It would be interesting to have a small background exposure present at all times.

Assumptions

(1) Communities converge towards a cyclic attractor after initialization.

(2) Environmental stress affects the stability of the attractors

(3) Refuges and renewal of population would generally stabilize the communities

Research Questions

(1) Identify the drivers of community change. Candidates are: Stressors (Pesticides, Environmental Variables, Community Structure - Competition, Timing)

(2) When are communities resilient to pesticides and environmental stress? And when are they particularly vulnerable?

(3) Can organisms be detected and quantified with machine learning algorithms -> upscaling of non invasive techniques.

(4) Genetic variation in population during time course or after stress events

(5) Contamination history relevance for reaction to contaminating event

(6) PICT questions in relation to selection of resistant individuals sample individuals from nanocosms over different time points and make experiments with offspring

Hypotheses

(1)

(2) Communities can recover from small perturbations but ecosystems will change after larger perturbations occurred

Method

Start Population: Populate Nanocosms from offspring of one individual?!

Treatments: In the shelves, 40 nanocosms can be placed, if arranged in single rows. Double rows it could be 80 but this would be a large increase in workload and inconvenience in handling during the experiment duration. start with 100 to allow for losses

Two environmental settings (green shelf + normal shelf)

- How many pesticide concentrations? Control, low, high? I am not so interested in dose response relationships as in the interplay between environmental effects and pesticides.

Nanocosm design:

- 3-4 cm of Sediment (does not need to be as much as we have now.)
- aeration U-tubes located at 45° to not interfere with camera.
- Hoses from above with some room for movement of the tanks for taking fotos.
- Black pond foil (buy new)

Analyses:

- Pesticide concentration (Twisters?)
- photosynthesis activity
- Take samples with syringes
- Store water samples?
- water quality parameters (Temperature, pH, Conductivity, NO32-, NO3-, NH3, P, Cellcounter)

Temperature:

- Tauchsieder - Mehrfachsteckdosen
- Wieviele gibt es. Die Müssten ja auch überall mit reingehangen werden.

Light:

- Install dimmer of left hand shelves to adjust light conditions of all shelves to the same level.

Image Detection:

- How to shoot photographs of the upper nanocosms

Routine

- capture images two times per week (Friday, Tuesday)
- analysis once per week. Should be set up mostly automated. Cluster?
- water quality parameters - every two weeks
- temperature: More often (in Situ)

Workload distribution

- Can Franz assist me in some of the recurring tasks?
- Bachelor / Master thesis for recurring lab tasks

References

idea

Gessner, Mark O., and Ahmed Tlili. 2016. "Fostering integration of freshwater ecology with ecotoxicology." *Freshwater Biology* 61 (12): 1991–2001. https://doi.org/10.1111/fwb.12852.

Liess, Matthias, Kaarina Foit, Anne Becker, Enken Hassold, Ida Dolciotti, Mira Kattwinkel, and Sabine Duquesne. 2013. "Culmination of low-dose pesticide effects." *Environmental science & technology* 47 (15): 8862–8. https://doi.org/10.1021/es401346d.

Wood, Thomas James, and Dave Goulson. 2017. "The environmental risks of neonicotinoid pesticides: a review of the evidence post 2013." *Environmental science and pollution research international* 24 (21): 17285–17325. https://doi.org/10.1007/s11356-017-9240-x.