



Curriculum vitae Jürg W. Spaak

Personal information

Name:	Jürg Spaak
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E-Mail	j.w.spaak@gmail.com
Date of birth	22 nd of June 1991, Uster, Switzerland
Nationality	Swiss
Marital status	Married
Children	Nora Spaak, 10 th November 2015 Johanna Spaak, 2 nd June 2017 Arthur Spaak, 4 th April 2020
Orcid-Id	0000-0001-5157-9188
Google Scholar:	https://scholar.google.ch/citations?user=hOyLv_8AAAAJ&h
Languages	German (mother language), English, Dutch, French, Russian (beginner)
Programming	Python, R, slurm, Latex

Research Interests

I focus on species coexistence in multispecies communities. What are the determinants of species coexistence? Which mechanisms are central? I hereby focus on multispecies communities and multitrophic networks and try to obtain general answers (i.e. not what is possibly important, but what is probably important). I investigate these networks using computer simulations and mathematics. While the results are mainly theoretical, I base my models on empirical data including uncertainties and probabilistic approaches.

Education

PhD in ecology at the University of Namur, Belgium | 10/2016-11/2020

Supervisor: Frederik de Laender (google scholar: bkuO-dAAAAAJ)

Study of modern coexistence theory. Solving numerically and analytically differential equations of community models. Performing and analysing microcosm experiments with phytoplankton.

Master in mathematics at the ETH Zurich, Switzerland | 09/2013-02/2016

Specialising in theoretical mathematics (final grade 5.44/6)

Bachelor in mathematics at the ETH Zurich, Switzerland | 09/2010-07/2015

General mathematical education (final grade 5.36/6)



Professional Positions

SNF early PostDoc mobility, independent researcher | 02/2021-today

Applying modern coexistence theory to an aquatic foodweb

Postdoctoral researcher, University of Namur | 12/2020-02/2021

PhD Candidate (advisor Frederik De Laender) | 10/2016-11/2020

High school teacher in Mathematics, Wetzikon, Switzerland | 08/2015-05/2016

Teaching and evaluating independently high school students. Developing curriculum

Teaching assistant at the ETH Zurich | 09/2012-05/2015

Organising classes, correcting and grading homework

Obligatory swiss military service as combat medic | 02/2010-7/2010

Prizes and awards

Bronze medal at International Mathematical Olympiad 2010, Kazakhstan

Silver medal at Swiss Mathematical Olympiad 2010

Bronze medal at BeNeLux Mathematical Olympiad 2010

Honourable mention at International Mathematical Olympiad 2009, Germany

Silver medal at Swiss Mathematical Olympiad 2009

Silver medal at Swiss Biological Olympiad 2009

Honourable mention at European Mathematical Olympiad 2008

Finalist at Swiss Mathematical Olympiad 2008

Teaching experience

Co-organized two field courses (2018, 2019, ~30 Master students)

Highschool teacher for one semester (2015-2016)

Teaching Assistant at ETH (2012-2015)

Instructor at Swiss Biological Olympiad (2010-2012)

Supervision of students

*: The results of this project will be published in a peer-reviewed paper

Master thesis: Lisa Buche, Review of existing niche and fitness differences*

Current Position: PhD student at University of Queensland

Master project: Lisa Buche, Review of existing niche and fitness differences*

Master thesis: Remi Millet, The effects of linearization on niche and fitness differences*

Current Position: Masters student at SeaTech Ecole d'ingénieurs



Bachelor Thesis: Stan Roelens, The influence of pollutants on aquatic ecosystems

Current Position: Biotechnology and drone technician

Master Thesis: Elif Kardas, Evaluating the effects of pharmaceuticals on phytoplankton coexistence using computational and experimental methods

Current Position: PhD student at Universidad de Puerto Rico

References:

Frederik de Laender, Professor at the university of Namur, PhD Supervisor, frederik.deLaender@unamur.be, expert in coexistence theory, biodiversity ecosystem functioning, theory

Francesco Pomati group leader at EAWAG, Switzerland, member of the PhD committee, Francesco.Pomati@eawag.ch, expert in Phytoplankton, lakes, biodiversity, community dynamics,

Lisa Buche, Ph.D. candidate at University of Queensland, Reference for my supervisor skills, buchel9844@gmail.com

Steven P. Ellner, Professor at Cornell University, Post-doc supervisor, spe2@cornell.edu, expert in coexistence theory, theoretical ecology, spatial coexistence

Grants and Fellowships:

2020 SNF early Post-doc mobility fellowship, 149'075 CHF

Publications:

* indicate a supervised undergrad student

Published and accepted (7 papers):

[Shifts of community composition and population density substantially affect ecosystem function despite invariant richness](#), **Jürg W Spaak**, Jan M Baert, Donald J Baird, Nico Eisenhauer, Lorraine Maltby, Francesco Pomati, Viktoriia Radchuk, Jason R Rohr, Paul J Van den Brink, Frederik De Laender, 2017 Ecology Letters

We combine theoretical and empirical work on environmental stressors to proof that effects on ecosystem function arise before effects on richness are present. This publication shows my ability to collaborate with a large group of scientists and to publish in high impact journals

[Food Web Uncertainties Influence Predictions of Climate Change Effects on Soil Carbon Sequestration in Heathlands](#), Wouter Reys, Francois Rineau, **Jürg W Spaak**, Oscar Franken, Matty P Berg, Fons Van Der Plas, Richard D Bardgett, Natalie Beenaerts, Frederik De Laender, 2019 Microbial Ecology

We conclude that ecological food webs must be included into models of carbon sequestration in heathlands. In this publication I advised the lead author in mathematical and modelling questions. It shows my ability to leave my comfort zone and collaborating with people outside my subfield.



[Intuitive and broadly applicable definitions of niche and fitness differences](#), **Jurg W. Spaak**, Frederik De Laender, 2020 Ecology Letters

Here we define the niche and fitness differences, that apply to multispecies communities and mutualistic communities. This publication shows my ability to explain complex mathematical constructions to a broad audience, using clear language and effective visualisation strategies.

[Effects of pigment richness and size variation on coexistence, richness and function in light limited phytoplankton](#), **J.W. Spaak**, F. De Laender, 2021 Journal of Ecology

Here we show that trait richness in light limited phytoplankton communities are not sufficient to explain the high biodiversity observed in nature – contrary to expectations from the literature. The extensive simulations done in this publications show my programming skills and my trait based approach

[Reinterpreting the relationship between number of species and number of links connects community structure and stability](#), Camille Carpentier, **Jurg W. Spaak**, Gyuri Barabas, Frederik De Laender, 2021 Nature ecology and Evolution

We define a new metric b that links species richness and the number of species interactions. We show that b is related to stability (real part of largest eigenvalue) and robustness (number of species extinctions). I helped with the theoretical interpretation and mathematical derivation of b

Mapping the diversity of species interactions, **Jurg W. Spaak**, Oscar Godoy, Frederik De Laender, OIKOS, accepted

We use niche and fitness differences to map species interactions. This map allows cross community comparisons and serves as a common currency between different fields. We also show which part of the map are well explored (competitive communities and priority effects) and which deserve more attention (facilitation and higher trophic levels).

[Fitness differences, not niche differences, limit species richness](#), **Jurg W. Spaak**, Camille Carpentier, Frederik De Laender, on bioRxiv, Ecology letters, accepted

We shed light on multispecies coexistence by analysing the effect of species richness on niche and fitness differences. We show that fitness differences are the main limitation of multispecies coexistence. Furthermore this paper shows, that our definition might be used to combine coexistence theory and biodiversity-ecosystem function.

Submitted or under revision (4 papers)

All available upon request

Stressor richness intensifies productivity loss but mitigates biodiversity loss, Mark Holmes, **Jurg W. Spaak**, Frederik De Laender, submitted to Ecology and Evolution, major revisions

We investigate how stressor richness affects biodiversity and ecosystem function. We find that decoupling stressor richness from stressor intensity reveals new phenomena. Stressor richness per se is good for species richness, but not for ecosystem function.



cyanoFilter: automated identification of *Synechococcus* cyanobacteria population contained in flow cytometry data, Oluwafemi D. Olusoji, **Jurg W. Spaak**, Frederik De Laender, Thomas Neyens and Marc Aerts, submitted to Ecological modelling, major revisions

We program an automated code (now available as R package: [cyanoFilter](#)) that clusters cyano bacteria measurements. We compare “human/visual” methods to “cluster/computer” methods. I helped with the clustering algorithms and flowcytometer expert knowledge

The effects of linearization on niche and fitness differences, **Jurg W. Spaak**, Remi Millet*, Andrew Letten, Po-Ju Ke, Frederik De Laender, on bioRxiv, submitted to Journal of Theoretical Biology

We compare the new definitions to linear approximations of niche and fitness differences. We show that these linear approximations affect niche and fitness differences and qualitatively change the interpretation of coexistence. Finally, we put forward that reducing the complexity (linear approximations of community models) will remove/hide many coexistence mechanisms and should therefore be avoided. Rather we should start to use models that allow for non-linear interactions or, even better, mechanistic models.

In preparation, (all submitted at least once, 4 papers)

All available upon request

Measuring individual-level trait diversity: a critical assessment of methods, Olusoji, Oluwafemi; **Spaak, Jurg**; Neyens, Thomas; Fontana, Simone; Aerts, Marc; De Laender, Frederik

We compare different methods to measure individual level trait diversity and find that no good metrics exist for trait richness and trait evenness. I helped with the theoretical understanding of the trait metrics and the mathematical improvement of some trait metrics.

Niche and fitness differences across environmental conditions and ecosystem types, Lisa Buche*, **Jurg W. Spaak**, Frederik De Laender, in preparation for Journal of Ecology

*We review existing empirical data on niche and fitness differences and find that different ecological communities have different ranges of niche and fitness differences. More complex communities (e.g. perennial plants) have higher niche and fitness differences than simpler communities (e.g. phytoplankton). However, different definitions of niche and fitness differences lead to qualitatively different interpretations of underlying community structure. We argue that **MCT** must agree on one golden standard to measure niche and fitness differences.*

Thesis:

[Reinterpretation of niche and fitness differences improves our understanding of species coexistence](#)

PhD thesis, University of Namur under the supervision of Frederik De Laender

Invited seminars:



2017, Eawag, aquatic ecology, Switzerland
2018, ILEE Namur, Belgium
2019, Eawag, aquatic ecology, Switzerland
2020, University of Cadiz, Spain
2021, Dalhousie University

Presentations at international conferences (6 presentations):

“Using Fourier series to understand phytoplankton coexistence” **Jurg W. Spaak**, Frederik De Laender. Netherlands annual ecology meeting. 02/2018, Oral presentation

“cyanoFilter, An Automated Framework for identifying picocyanobacteria populations obtained via flow cytometry” Olusoji O. D., Aerts M., De Laender F., Neyens T., **Spaak J.** Belgium statistical society annual meeting, 10/2018

“cyanoFilter”, An Automated Framework for identifying Synechococcus type cyanobacteria populations obtained via flow cytometry Olusoji O. D., De Laender F., **Spaak J.**, Neyens T., Aerts M. Use R Conference 07/2019

[Measuring intraspecific diversity: A critical assessment of methods](#), OD Olusoji, **J Spaak**, T Neyens, S Fontana, M Aerts, F De Laender, 08/2019 ESA conference

How multiple environmental changes affect species richness, Frederik De Laender, **Jurg W. Spaak**, 08/2019 ESA conference

A unified definition of niche and fitness differences, **Jurg W. Spaak**, Frederik De Laender, 08/2019 ESA conference

Mapping the diversity of species interactions with niche and fitness differences, **Jurg W. Spaak**, Oscar Godoy, Frederik De Laender, 08/2020, ESA conference

Applying modern coexistence theory to aquatic foodwebs, **Jurg W. Spaak**, Peter Adler, Steve Ellner, 08/2021, ESA conference

Reviews done for the following Journals:

Ecology letters, Trends in ecology and evolution, Nature communications, Methods in ecology and evolution, American Naturalist, Hydrobiologia, Journal of Ecology, Journal of Theoretical Biology, Frontiers in Ecology and Evolution