

Luca Carraro

Date of birth: March 20, 1989

luca.carraro@eawag.ch

Nationality: Italian

web: <https://www.eawag.ch/en/aboutus/portrait/organisation/staff/profile/luca-carraro>

ORCID: <https://orcid.org/0000-0002-3933-1144>

Twitter: @lu_ca_rraro

Current position

University of Zurich – Zurich, Switzerland

July 2022 – present Lecturer (SNF Ambizione Fellow)

Unit: Department of Evolutionary Biology and Environmental Studies (IEU)

Hosted at: Department of Aquatic Ecology (ECO), Eawag, Dübendorf, Switzerland

Previous positions

University of Zurich – Zurich, Switzerland

Oct 2019 – Jun 2022 Postdoctoral Fellow

Advisor: Prof. Dr. Florian Altermatt

Unit: Department of Evolutionary Biology and Environmental Studies (IEU)

Hosted at: Department of Aquatic Ecology (ECO), Eawag, Dübendorf, Switzerland

Swiss Federal Institute of Aquatic Science and Technology (Eawag) – Dübendorf, Switzerland

Oct 2018 – Sep 2019 Postdoctoral Fellow

Advisors: Prof. Dr. Jukka Jokela, Prof. Dr. Florian Altermatt

Unit: Department of Aquatic Ecology (ECO)

École Polytechnique Fédérale de Lausanne (EPFL) – Lausanne, Switzerland

May 2018 – Sep 2018 Postdoctoral Fellow

Advisor: Prof. Dr. Andrea Rinaldo

Unit: Laboratory of Ecohydrology (ECHO)

Education

École Polytechnique Fédérale de Lausanne (EPFL) – Lausanne, Switzerland

Apr 2014 – May 2018 Ph.D., Doctoral Program in Civil and Environmental Engineering

Thesis title: *Ecohydrological and Metacommunity Studies of Proliferative Kidney Disease Spread in Freshwater Salmonid Fish* (awarded with EPFL Outstanding PhD Thesis Distinction)

Advisors: Prof. Dr. Andrea Rinaldo, Prof. Dr. Enrico Bertuzzo

Unit: Laboratory of Ecohydrology (ECHO)

University of Padua – Padua, Italy

Jan 2012 – Apr 2014 M.Sc., Civil Engineering - specialization in Hydraulics (Grade: 108/110)

Sep 2008 – Nov 2011 B.Sc., Civil Engineering (Grade: 110/110)

Publication record*

Total articles: 13

Total citations: 783

h-index: 10

Publications

Peer-reviewed articles

- [13] **Carraro, L.**, Altermatt, F. (2022) Optimal Channel Networks accurately model ecologically-relevant geomorphological features of branching river networks. *Communications Earth & Environment* 3, 125. <https://doi.org/10.1038/s43247-022-00454-1>.
- [12] **Carraro, L.**, Stauffer, J. B., Altermatt, F. (2021). How to design optimal eDNA sampling strategies for biomonitoring in river networks. *Environmental DNA*, 3(1), 157-172. <https://doi.org/10.1002/edn3.137>.
- [11] **Carraro, L.**, Mächler, E., Wüthrich, R., Altermatt, F. (2020). Upscaling spatial patterns of biodiversity in freshwater ecosystems. *Nature Communications*, 11(1), 3585. <https://doi.org/10.1038/s41467-020-17337-8>.
- [10] **Carraro, L.**, Bertuzzo, E., Fronhofer, E. A., Furrer, R., Gounand, I., Rinaldo, A., Altermatt, F. (2020). Generation and application of river network analogues for use in ecology and evolution. *Ecology and Evolution*, 10(14), 7537-7550. <https://doi.org/10.1002/ece3.6479>.
- [9] Gatto, M., Bertuzzo, E., Mari, L., Miccoli, S., **Carraro, L.**, Casagrandi, R., Rinaldo, A. (2020). Spread and dynamics of the COVID-19 epidemic in Italy: Effects of emergency containment measures. *Proceedings of the National Academy of the United States of America*, 117(19), 10484-10491. <https://doi.org/10.1073/pnas.2004978117>.
- [8] **Carraro, L.**, Toffolon, M., Rinaldo, A., Bertuzzo, E. (2020). SESTET: a spatially explicit stream temperature model based on equilibrium temperature. *Hydrological Processes*, 34(2), 355-369. <https://doi.org/10.1002/hyp.13591>.
- [7] González-Ferreras, A.M., Bertuzzo, E., Barquín, J., **Carraro, L.**, Alonso, C., Rinaldo, A. (2019). Effects of altered river network connectivity on the distribution of *Salmo trutta*: Insights from a metapopulation model. *Freshwater Biology*, 64(11), 1877-1895. <https://doi.org/10.1111/fwb.13379>.
- [6] **Carraro, L.**, Hartikainen, H., Jokela, J., Bertuzzo, E., Rinaldo, A. (2018). Estimating species distribution and abundance in river networks using environmental DNA. *Proceedings of the National Academy of Sciences of the United States of America*, 115(46), 11724-11729. <https://doi.org/10.1073/pnas.1813843115>.
- [5] **Carraro, L.**, Mari, L., Gatto, M., Rinaldo, A., Bertuzzo, E. (2018). Spread of proliferative kidney disease in fish along stream networks: A spatial metacommunity framework. *Freshwater Biology*, 63(1), 114-127. <https://doi.org/10.1111/fwb.12939>.
- [4] **Carraro, L.**, Bertuzzo, E., Mari, L., Fontes, I., Hartikainen, H., Strepparava, N., Schmidt-Posthaus, H., Wahli, T., Jokela, J., Gatto, M., Rinaldo, A. (2017). Integrated field, laboratory, and theoretical study of PKD spread in a Swiss prealpine river. *Proceedings of the National Academy of Sciences of the United States of America*, 114(45), 11992-11997. <https://doi.org/10.1073/pnas.1713691114>.

*Verified on Scopus on July 12, 2022.

- [3] **Carraro, L.**, Mari, L., Hartikainen, H., Strepparava, N., Wahli, T., Jokela, J., Gatto, M., Rinaldo, A., Bertuzzo, E. (2016). An epidemiological model for proliferative kidney disease in salmonid populations. *Parasites and Vectors*, 9(1), 487. <https://doi.org/10.1186/s13071-016-1759-z>.
- [2] Queloz, P.[†], **Carraro, L.**[†], Benettin, P., Botter, G., Rinaldo, A., Bertuzzo, E. (2015). Transport of fluoro-benzoate tracers in a vegetated hydrologic control volume: 2. Theoretical inferences and modeling. *Water Resources Research*, 51(4), 2793-2806. <https://doi.org/10.1002/2014WR016508>.
- [1] Queloz, P., Bertuzzo, E., **Carraro, L.**, Botter, G., Miglietta, F., Rao, P. S. C., Rinaldo, A. (2015). Transport of fluorobenzoate tracers in a vegetated hydrologic control volume: 1. Experimental results. *Water Resources Research*, 51(4), 2773-2792. <https://doi.org/10.1002/2014WR016433>.

Preprints

- [3] **Carraro, L.**, Blackman, R. C., Altermatt, F. (2022). Modelling eDNA transport in river networks reveals highly resolved spatio-temporal patterns of freshwater biodiversity *bioRxiv*. <https://doi.org/10.1101/2022.01.25.475970>.
- [2] Boschman, L., Cassemiro, F. A. S., **Carraro, L.**, de Vries, J., Altermatt, F., Hagen, O., Hoorn, C., Pellissier, L., (2021). South American freshwater fish diversity shaped by Andean uplift since the Late Cretaceous *bioRxiv*. <https://doi.org/10.1101/2021.05.14.444133>.
- [1] Jacquet, C.[†], **Carraro, L.**[†], Altermatt, F. (2021). Meta-ecosystem dynamics drive the spatial distribution of functional groups in river networks. *bioRxiv*. <https://doi.org/10.1101/2021.06.04.447105>.

Invited seminars and talks

- [7] **Carraro, L.** (Mar 2022). *Spatial processes shape biodiversity patterns in river networks*. Environmental Engineering Seminar Series, EPFL, Lausanne, Switzerland.
- [6] **Carraro, L.** (Dec 2021). *Integrating hydrology and environmental DNA to advance monitoring of freshwater biodiversity*. (virtual) SEBES Seminar Series, University of Zurich, Switzerland.
- [5] **Carraro, L.** (Dec 2021). *Using environmental DNA as a tracer to advance hydrological research* (virtual, invited e-poster). AGU Fall Meeting, New Orleans, USA.
- [4] **Carraro, L.** (Mar 2021). *Spread of a disease lethal to salmonids: intertwined roles of water, vegetation and climate* (virtual talk, in Italian). XX Giornata Mondiale dell'Acqua – Acqua, vegetazione, clima: l'avvento dell'ecoidrologia. Accademia dei Lincei, Rome, Italy.
- [3] **Carraro, L.** (May 2020). *Generating synthetic river networks and perspectives in freshwater biodiversity assessment* (webinar). Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Birmensdorf, Switzerland.
- [2] **Carraro, L.** (Oct 2019). *eDNA as a tool to reconstruct biodiversity patterns in river networks*. BEEES Seminar Series, University of Zurich, Zurich, Switzerland.
- [1] **Carraro, L.** (May 2018). *Using environmental DNA to study species distributions in river networks*. Eawag, Dübendorf, Switzerland.

[†]Equally contributing authors.

Conference presentations

- [5] **Carraro, L.**, Jacquet, C., Altermatt, F. (Jun 2022). Meta-ecosystem dynamics drive spatial distribution of functional groups in rivers. *World Biodiversity Forum*, Davos, Switzerland.
- [4] **Carraro, L.**, Mächler, E., Wüthrich, R., Altermatt, F. (May 2021). Modelling environmental DNA transport and decay allows upscaling spatial patterns of biodiversity in riverine ecosystems. *Society for Freshwater Science Annual Meeting* (virtual).
- [3] **Carraro, L.**, Hartikainen, H., Jokela, J., Rinaldo, A., Bertuzzo, E., Mächler, E., Little, C. J., Wüthrich, R., Altermatt, F. (Apr 2019). Reconstructing species distribution and abundance patterns in rivers with environmental DNA. *EGU General Assembly*, Vienna, Austria.
- [2] **Carraro, L.**, Rinaldo, A., Toffolon, M., Bertuzzo, E. (Jun 2018). A spatially-explicit stream temperature model for ecohydrological applications. *5th IAHR Europe Congress - New Challenges in Hydraulic Research and Engineering*, Trento, Italy.
- [1] **Carraro, L.**, Hartikainen, H., Jokela, J., Bertuzzo, E., Rinaldo, A., (Apr 2018). Using environmental DNA to study species distributions in river networks. *EGU General Assembly*, Vienna, Austria.

Conference posters

- [5] **Carraro, L.**, Blackman, R., Altermatt, F. (Jun 2022). Modelling eDNA transport in rivers reveals spatiotemporal biodiversity patterns. *World Biodiversity Forum*, Davos, Switzerland.
- [5] **Carraro, L.**, Blackman, R., Altermatt, F. (Oct 2021). Modelling environmental DNA transport and decay reveals spatiotemporal patterns of freshwater biodiversity. *URPP Fall Symposium*, University of Zurich, Switzerland.
- [4] **Carraro, L.**, Mächler, E., Wüthrich, R., Altermatt, F. (Feb 2020). Environmental DNA allows upscaling of spatial patterns of biodiversity in freshwater ecosystems. *World Biodiversity Forum*, Davos, Switzerland.
- [3] **Carraro, L.**, Bertuzzo, E., Toffolon, M., Rinaldo, A. (Apr 2018). A spatially-explicit stream temperature model for ecohydrological applications. *EGU General Assembly*, Vienna, Austria.
- [2] **Carraro, L.**, Bertuzzo, E., Mari, L., Gatto M., Rinaldo, A. (May 2017). A metacommunity model for the spread of proliferative kidney disease in stream networks. *Impact of Environmental Changes on Infectious Diseases*, Trieste, Italy.
- [1] **Carraro, L.**, Bertuzzo, E., Mari, L., Gatto, M., Strepparava, N., Hartikainen, H., Rinaldo, A. (Apr 2015). An epidemic model for the interactions between thermal regime of rivers and transmission of proliferative kidney disease in salmonid fish. *EGU General Assembly*, Vienna, Austria.

Other publications

- [3] Vasemägi, A., Wahli, T., Debes, P., **Carraro, L.**, Bailey, C. (2020) Exploring proliferative kidney disease in a disease ecology context. *Book chapter*. Accepted.

- [2] **Carraro, L.**, Altermatt, F., Fronhofer, E. A., Furrer, R., Gounand, I., Rinaldo, A., Bertuzzo, R. (2019). OCNet - Generate and analyze Optimal Channel Networks. *R Package*. Hosted on CRAN: <https://cran.r-project.org/web/packages/OCNet/index.html>.
- [1] **Carraro, L.** (2018). Ecohydrological and metacommunity studies of proliferative kidney disease spread in freshwater salmonid fish. *Ph.D. Thesis*. EPFL, Lausanne, Switzerland. Advisors: Prof. Dr. Andrea Rinaldo, Prof. Dr. Enrico Bertuzzo. Accepted on May 8, 2018.

Outreach

- [4] **Carraro, L.**, (2022) The structure of dendritic river networks shapes ecological dynamics (blog post). Nature Portfolio Earth & Environment Community. <https://tinyurl.com/36yds9xr>
- [3] **Carraro, L.**, (2020) Predicting the biodiversity of rivers (blog post). Nature Portfolio Ecology & Evolution Community. <https://tinyurl.com/3wbk5f9d>
- [2] **Carraro, L.**, Altermatt, F., Blackman R. C. (2020) Environmental DNA reveals hidden diversity in riverine ecosystems. *Hotspot* (magazine of the Forum Biodiversität Schweiz).
- [1] **Carraro, L.**, Mariani, D. (2020). In Italy, 200'000 hospitalizations averted thanks to lockdown. Interview with the Swiss Italian television (in Italian). <https://tinyurl.com/ybtcdsgj>.

Teaching activities

University of Zurich – Zurich, Switzerland

- | | |
|----------------|---|
| Feb 2022 | Ecological Theories 2 (Course for Ph.D. students in Ecology) |
| Role: | Lecture on freshwater ecosystem modelling |
| 2020 - 2021 | Field Course in Biodiversity Assessment and Monitoring (M.Sc. in Quantitative Environmental Sciences) |
| Role: | Teaching assistant (support in data analysis) |
| Sep - Oct 2020 | Block Course in Aquatic Ecology (B.Sc. in Biology) |
| Role: | Teaching assistant (supervision of student project) |

École Polytechnique Fédérale de Lausanne (EPFL) – Lausanne, Switzerland

- | | |
|---------------------|--|
| Apr 2014 – Jan 2018 | Water Resources Engineering (M.Sc. in Environmental Sciences and Engineering) |
| Role: | Teaching assistant (course material preparation, exercise sessions, project supervision, preparation and grading of final exams) |
| Feb 2017 – Jul 2017 | Mathématiques 2A, 2B (B.Sc., remedial classes on linear algebra and geometry) |
| Role: | Teaching assistant (exercise sessions, grading of final exam) |

Student supervision

Swiss Federal Institute of Aquatic Science and Technology (Eawag) – Dübendorf, Switzerland

Summer 2019 Julian Stauffer, B.Sc. summer project: "Assessing the effectiveness of environmental DNA sampling design strategies in river networks" (co-supervisor)

École Polytechnique Fédérale de Lausanne (EPFL) – Lausanne, Switzerland

Spring 2019 Pascal Arbella, M.Sc. Thesis: "Patching large missing gaps of dissolved oxygen data in an intermittent stream: comparison of interpolation techniques, including machine learning models" (external examiner)

Spring 2017 Mattia Petar, M.Sc. Thesis: "A spatially explicit water temperature model for the river Wigger" (co-supervisor)

Fall 2016 Charlotte Burki, M.Sc. semester project: "Water temperature modelling in the river Wigger" (co-supervisor)

Fall 2015 Yasmin Dressler, M.Sc. semester project: "Proliferative Kidney Disease in brown trout: modelling the disease evolution in fish" (co-supervisor)

Funding

2021 University of Zurich Forschungskredit postdoc grant (CHF 44,154)

2021 Swiss National Science Foundation Ambizione grant (CHF 845,183)

Awards

2019 EPFL Outstanding Ph.D. Thesis Distinction in Civil and Environmental Engineering

Academic service

Jun 2022 Convener of session "Integrating biodiversity and ecosystem functioning in aquatic and terrestrial systems across rivers", *World Biodiversity Forum*, Davos, Switzerland

Since 2019 38 reviews[‡] for journals *Acta Veterinaria Scandinavica*, *Advances in Water Resources*, *Aquatic Sciences*, *Diversity and Distributions*, *Earth and Space Science*, *Earth Surface Processes and Landforms*, *Ecosphere*, *Environmental DNA*, *Freshwater Biology*, *Frontiers in Ecology and Evolution*, *Hydrological Processes*, *Hydrology and Earth System Sciences*, *Journal of Hydrology*, *Methods in Ecology and Evolution*, *Molecular Ecology*, *Molecular Ecology Resources*, *Oikos*, *Proceedings of the National Academy of the United States of America*, *Rendiconti Lincei*, *Royal Society Open Science*.

Zurich, July 12, 2022

[‡]Verified on Publons on July 12, 2022.