

Manuel Kleiner
www.kleinerlab.org

North Carolina State University
Dept. of Plant & Microbial Biology
Campus Box 7612
4510B Thomas Hall
Raleigh, NC 27695

+1 919 515 3792 (office)
+1 812 391 2577 (mobile)
manuel_kleiner@ncsu.edu
Twitter: @Manuel_Kleiner

RESEARCH AND TEACHING INTERESTS

Microbial physiology and metabolism, microbiomes, symbiosis, diet-microbiota interactions, plant-microbe interactions, intra- and interspecies microbe-microbe interactions, genomics and metagenomics, proteomics and metaproteomics, environmental microbiology, computational biology, method and software development, evolution, horizontal gene transfer, the role of bacteriophages in horizontal gene transfer, microbial ecology, marine microbiology, renewable resources, and origins of life.

CURRENT POSITION

8/2023 **Associate Professor** and University Faculty Scholar, Chancellor's Faculty Excellence Program Cluster on Microbiomes and Complex Microbial Communities, NC State University

EDUCATION AND PROFESSIONAL EXPERIENCE

8/2017-
8/2023 **Assistant Professor** and University Faculty Scholar, Chancellor's Faculty Excellence Program Cluster on Microbiomes and Complex Microbial Communities, NC State University

9/2014 –
8/2017 Banting **Postdoctoral** Fellow, University of Calgary
Energy Bioengineering Group, Marc Strous (advisor)

1/2013 –
8/2017 **Guest Faculty**, Lora Hooper's Laboratory, UT Southwestern Medical Center, Dallas

1/2013 –
8/2014 **Postdoctoral** Scientist, Max Planck Institute for Marine Microbiology, Bremen, Germany

2012 **Ph.D.**, summa cum laude, Max Planck Institute for Marine Microbiology, Bremen, Germany
Symbiosis Group, Nicole Dubilier (advisor)
Dissertation title: "Metabolism and evolutionary ecology of chemosynthetic symbionts from marine invertebrates."

2008/2009 Postgraduate research year: Visiting fellow in the labs of James Reilly, Indiana University, Bloomington, IN and Nathan VerBerkmoes, Oak Ridge National Laboratory, Oak Ridge, TN

2008 **Diplom** in Biology, University of Greifswald, Germany (4 years of classes + 1 year thesis work in the groups of Michael Hecker and Thomas Schweder)
Grade: 1.0 (best possible grade, best student in class)
Major: Microbial Physiology / Molecular Biology
Minors: Microbial Ecology and Computer Science
Thesis title: “Metaproteomics of the bacterial symbionts of the marine oligochaete worm *Olavius algarvensis*.”

PUBLICATIONS

(* = contributed equally, ^ = corresponding authorship, \$ = student/postdoc supervised by MK)

Publication overview available at

https://scholar.google.com/citations?hl=en&user=4O7OP3wAAAAJ&view_op=list_works

- Parnell, J. J.\$, G. Pal\$, A. Awan\$, S. Vintila, G. Houdinet, C. V. Hawkes, P. Balint-Kurti, M. R. Wagner, **M. Kleiner**[^] (2023). Effective seed sterilization methods require optimization across maize genotypes. [bioRxiv](https://www.biorxiv.org/content/10.1101/2023.12.14.571779v1)
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- Bartlett, A.\$, A. Blakeley-Ruiz\$, T. Richie\$, C. M. Theriot, **M. Kleiner**[^] (2023). Large quantities of bacterial DNA and protein source used in microbiome studies. [bioRxiv](https://www.biorxiv.org/content/10.1101/2023.12.07.570621v1)
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- Kleiner, M.**[^], L. Polerecky, C. Lott, C. Bergin, S. Haeusler, M. Liebeke, C. Wentrup, N. Musat, M. M. M. Kuypers, N. Dubilier (2023). Mechanism of high energy efficiency of carbon fixation by sulfur-oxidizing symbionts revealed by single-cell analyses and metabolic modeling. [bioRxiv](https://www.biorxiv.org/content/10.1101/2023.11.25.568684v1)
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- González Porras, M. Á., A. Assié, M. Tietjen, M. Violette\$, **M. Kleiner**, H. R. Gruber-Vodicka, N. Dubilier, N. Leisch (2023). An intranuclear bacterial parasite of deep-sea mussels expresses apoptosis inhibitors acquired from its host. [bioRxiv](https://www.biorxiv.org/content/10.1101/2023.06.11.544495v1) <https://www.biorxiv.org/content/10.1101/2023.06.11.544495v1>
- Parnell, J. J.\$, S. Vintila, C. Tang\$, M. R. Wagner, **M. Kleiner**[^] (2023). Evaluation of ready-to-use freezer stocks of a synthetic microbial community for maize root colonization. [Microbiology Spectrum](https://doi.org/10.1093/mis/mzab024) e02401-23
- Michellod, D., T. Bien, D. Birgel, M. Violette\$, **M. Kleiner**, S. Fearn, C. Zeidler, H. R. Gruber-Vodicka, N. Dubilier, M. Liebeke (2023). De novo phytosterol synthesis in animals. [Science](https://doi.org/10.1126/science.1250526) 380(6644): 520-526.
- Swift, J. F., M. R. Kolp, A. Carmichael, N. E. Ford, P. M. Hansen, B. A. Sikes, **M. Kleiner**, M. R. Wagner (2023). Legacy effects of precipitation and land use impact maize growth and microbiome assembly under drought stress. [bioRxiv](https://www.biorxiv.org/content/10.1101/2023.04.11.536405v1) <https://www.biorxiv.org/content/10.1101/2023.04.11.536405v1>
- Zvi-Kedem, T., S. Vintila, **M. Kleiner**, D. Tchernov, M. Rubin-Blum (2023). Metabolic handoffs between multiple symbionts may benefit the deep-sea bathymodioline mussels. [ISME Communications](https://doi.org/10.1093/ismecomm/3.4.34) 3:48.
- Kleiner, M.**[^], A. Kouris, M. Violette\$, G. D'Angelo\$, Y. Liu, A. Korenek\$, N. Tolić, T. Sachsenberg, J. McCalder, M. S. Lipton, M. Strous (2023). Ultra-sensitive isotope probing to quantify activity and substrate assimilation in microbiomes. [Microbiome](https://doi.org/10.1038/s41564-023-01111-1) 11:24.
- Bartlett, A.\$ and **M. Kleiner**[^] (2022). Dietary protein and the intestinal microbiota: An understudied relationship. [iScience](https://doi.org/10.1016/j.isci.2022.105313) 25: 105313.
- Salvato, F.\$, S. Vintila, O. M. Finkel, J. L. Dangl, **M. Kleiner**[^] (2022). Evaluation of protein extraction methods for metaproteomic analyses of root-associated microbes. [Molecular Plant-Microbe Interactions](https://doi.org/10.1016/j.mpi.2022.100988) 35(11): 977-988.
- Beck, A. E., **M. Kleiner**, A.-K. Garrell\$ (2022). Elucidating plant-microbe-environment interactions through omics-enabled metabolic modelling using synthetic communities. [Frontiers in Plant Science](https://doi.org/10.1093/fpls/fzab377) 13: 910377
- Wilson, N. J., C. M. Smith-Moore, Y. Xu, B. Edwards, C. La Hovary, S. Barampuram, K. Li, D. Aslett, M. Ji, X. Lin, S. Vintila\$, **M. Kleiner**, D. Xie, Y. Shachar-Hill, A. Grunden, and H. Sederoff (2022). Introduction of a condensed, reverse tricarboxylic acid cycle for additional CO₂ fixation in plants. [bioRxiv](https://www.biorxiv.org/content/10.1101/2022.03.04.483018v1.full)
<https://www.biorxiv.org/content/10.1101/2022.03.04.483018v1.full>
- Mankowski, A., **M. Kleiner**, C. Erséus, N. Leisch, Y. Sato, J.-M. Volland, B. Hüttel, C. Wentrup, T. Woyke, J. Wippler, N. Dubilier, and H. Gruber-Vodicka (2021). Highly variable fidelity drives symbiont community composition in an obligate symbiosis. [bioRxiv](https://www.biorxiv.org/content/10.1101/2021.04.28.441735v1.full) <https://www.biorxiv.org/content/10.1101/2021.04.28.441735v1.full>

- Sato, Y., J. Wippler, C. Wentrup, R. Ansorge, M. Sadowski, H. R. Gruber-Vodicka, N. Dubilier, **M. Kleiner**[^] (2022). Fidelity varies in the symbiosis between a gutless marine worm and its microbial consortium. Microbiome 10:178.
- Blakeley-Ruiz, J. A.\$ and **M. Kleiner**[^] (2022). Considerations for constructing a protein sequence database for metaproteomics. Computational and Structural Biotechnology Journal 20: 937-952.
- Mordant, A.\$ and **M. Kleiner**[^] (2021). Evaluation of sample preservation and storage methods for metaproteomics analysis of intestinal microbiomes. Microbiology Spectrum 9(3): e01877-21.
- Ataiean, M., A. Vadlamani, M. Haines, D. Mosier, X. Dong, **M. Kleiner**, M. Strous and A. K. Hawley (2021). Proteome and strain analysis of cyanobacterium *Candidatus* “Phormidium alkaliphilum” reveals traits for success in biotechnology. iScience 24(12): 103405.
- Smith, S., F. Salvato\$, A. Garikipati, **M. Kleiner** and Alecia Septer (2021). Activation of the type VI secretion system in the squid symbiont *Vibrio fischeri* requires the transcriptional regulator TasR and the structural proteins TssM and TssA. Journal of Bacteriology 203(21): e00399-21.
- Jensen, M.\$, J. Wippler and **M. Kleiner**[^] (2021). Evaluation of RNA*later* as a field-compatible preservation method for metaproteomic analyses of bacterium-animal symbioses. Microbiology Spectrum 9(2):e01429-21.
- Sogin, E. M., **M. Kleiner**, C. Borowski, H. R. Gruber-Vodicka and N. Dubilier (2021). Life in the dark: Phylogenetic and physiological diversity of chemosynthetic symbioses. Annual Review of Microbiology 75: 695-718.
- Van Den Bossche, T., B. J. Kunath, K. Schallert, S. S. Schäpe, [38 co-authors in alphabetical order including M. Jensen\$, **M. Kleiner**], L. Martens and T. Muth (2021). Critical Assessment of MetaProteome Investigation (CAMPI): a multi-laboratory comparison of established workflows. Nature Communications 12: 7305.
- Salvato, F.\$, R. L. Hettich and **M. Kleiner**[^] (2021). Five key aspects of metaproteomics as a tool to understand functional interactions in host-associated microbiomes. PLOS Pathogens 17(2): e1009245.
- Hinzke, T.\$, **M. Kleiner**, M. Meister, R. Schlüter, C. Hentschker, J. Pané-Farré, P. Hildebrandt, H. Felbeck, S. M. Sievert, F. Bonn, U. Völker, D. Becher, T. Schweder and S. Markert (2021). Bacterial symbiont subpopulations have different roles in a deep-sea symbiosis. eLife 10:e58371.
- Sato, Y., J. Wippler, C. Wentrup, T. Woyke, N. Dubilier and **M. Kleiner** (2020). High-quality draft genome sequences of the uncultured Delta3 endosymbiont (Deltaproteobacteria) assembled from metagenomes of the gutless marine worm *Olavius algarvensis*. Microbiology Resource Announcements 9:e00704-20.
- Wagner, M. R., C. Tang\$, F. Salvato\$, K. M. Clouse, A. Bartlett\$, S. Vintila, L. Phillips, S. Sermons, M. Hoffmann, P. J. Balint-Kurti and **M. Kleiner**[^] (2021). Microbe-dependent heterosis in maize. Proceedings of the National Academy of Sciences 118(30): e2021965118.
- Sato, Y., J. Wippler, C. Wentrup, N. Dubilier and **M. Kleiner** (2020). High-quality draft genome sequences of two deltaproteobacterial endosymbionts, Delta1a and Delta1b, from uncultured Sva0081 clade, assembled from metagenomes of the gutless marine worm *Olavius algarvensis*. Microbiology Resource Announcements 9:e00276-20.
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- Speare, L., S. Smith, F. Salvato\$, **M. Kleiner** and A. N. Septer (2020). Environmental viscosity modulates interbacterial killing during habitat transition. mBio 11(1): e03060-19.
- Ponnudurai, R., S. E. Heiden, L. Sayavedra, T. Hinzke, **M. Kleiner**, C. Hentschker, H. Felbeck, S. M. Sievert, R. Schlueter, D. Becher, T. Schweder and S. Markert (2020). Comparative proteomics of related symbiotic mussel species reveals high variability of host-symbiont interactions. ISME Journal 14(2): 649-656.
- Assié, A., N. Leisch, D. V. Meier, H. Gruber-Vodicka, H. E. Tegetmeyer, A. Meyerdirks, **M. Kleiner**, T. Hinzke\$, S. Joye, M. Saxton, N. Dubilier and J. M. Petersen (2020). Horizontal acquisition of a patchwork Calvin cycle by symbiotic and free-living Campylobacterota (formerly Epsilonproteobacteria). ISME Journal 14(1): 104-122.
- Hinzke, T., **M. Kleiner**, C. Breusing, H. Felbeck, R. Häslar, S. M. Sievert, R. Schlüter, P. Rosenstiel, T. B. H. Reusch, T. Schweder and S. Markert (2019). Host-microbe interactions in the chemosynthetic *Riftia pachyptila* symbiosis. mBio 10(6): e02243-19.
- Zorz, J. K.\$, C. Sharp, **M. Kleiner**, P. M. K. Gordon, R. T. Pon, X. Dong and M. Strous (2019). A shared core microbiome in soda lakes separated by large distances. Nature Communications 10:4230.
- Seah, B. K. B., C. P. Antony, B. Huettel, J. Zarzycki, L. S. v. Borzyskowski, T. J. Erb, A. Kouris, **M. Kleiner**, M. Liebeke, N. Dubilier and H. R. Gruber-Vodicka (2019). Sulfur-oxidizing symbionts without canonical genes for autotrophic CO₂ fixation. mBio 10(3): e01112-19.

- Gruber-Vodicka, H. R., N. Leisch, **M. Kleiner**, T. Hinzke\$, M. Liebeke, M. McFall-Ngai, M. G. Hadfield and N. Dubilier (2019). Two intracellular and cell type-specific bacterial symbionts in the placozoan *Trichoplax* H2. Nature Microbiology 4:1465–1474.
- Kleiner, M.**^ (2019). Metaproteomics: Much more than measuring gene expression in microbial communities. mSystems 4(3): e00115-19.
- Jäckle, O., B. K. B. Seah, M. Tietjen, N. Leisch, M. Liebeke, **M. Kleiner**, J. S. Berg and H. R. Gruber-Vodicka (2019). Chemosynthetic symbiont with a drastically reduced genome serves as primary energy storage in the marine flatworm *Paracatenula*. Proceedings of the National Academy of Sciences 116(17):8505-8514.
- Hinzke, T.\$, A. Kouris, R.-A. Hughes, M. Strous and **M. Kleiner**^ (2019). More is not always better: Evaluation of 1D and 2D-LC-MS/MS methods for metaproteomics. Frontiers in Microbiology 10(238).
- Rubin-Blum, M., N. Dubilier and **M. Kleiner**^ (2019). Genetic evidence for two carbon fixation pathways (the Calvin-Benson-Bassham Cycle and the Reverse Tricarboxylic Acid Cycle) in symbiotic and free-living bacteria. mSphere 4:e00394-18.
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- Kleiner, M.**^, X. Dong, T. Hinzke\$, J. Wippler\$, E. Thorson\$, B. Mayer and M. Strous (2018). Metaproteomics method to determine carbon sources and assimilation pathways of species in microbial communities. Proceedings of the National Academy of Sciences 115(24): E5576-E5584.
- Zorz, J. K.\$, J. A. Kozłowski, L. Y. Stein, M. Strous and **M. Kleiner**^ (2018). Comparative proteomics of three species of ammonia-oxidizing bacteria. Frontiers in Microbiology 9(938).
- Fida, T. T., J. Voordouw, M. Ataeian, **M. Kleiner**, G. Okpala, J. Mand and G. Voordouw (2018). Synergy of sodium nitroprusside and nitrate in inhibiting the activity of sulfate reducing bacteria in oil-containing bioreactors. Frontiers in Microbiology 9(981).
- Hinzke T., **M. Kleiner** and S. Markert (2018). Centrifugation-based enrichment of bacterial cell populations for metaproteomic studies on bacteria-invertebrate symbioses. Methods in Molecular Biology, Microbial Proteomics. D. Becher, Ed. Springer. 1841: 319-334.
- Kleiner, M.***^, E. Thorson*\$, C. E. Sharp, X. Dong, C. Li and M. Strous (2017). Assessing species biomass contributions in microbial communities via metaproteomics. Nature Communications 1558.
- Ponnudurai, R., L. Sayavedra, **M. Kleiner**, S. E. Heiden, A. Thürmer, H. Felbeck, R. Schlüter, S. M. Sievert, R. Daniel, T. Schweder and S. Markert. (2017). Genome sequence of the sulfur-oxidizing *Bathymodiolus thermophilus* gill endosymbiont. Standards in Genomic Sciences 12:50.
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- Dong, X., **M. Kleiner**, C. E. Sharp, E. Thorson\$, C. Li, D. Liu and M. Strous (2017). Fast and simple analysis of MiSeq amplicon sequencing data with MetaAmp. Frontiers in Microbiology 8(1461).
- Kleiner, M.**^ (2017). Normalization of metatranscriptomic and metaproteomic data for differential gene expression analyses: The importance of accounting for organism abundance. PeerJ Preprints 5:e2846v1.
- Ponnudurai, R. P.*, **M. Kleiner***, L. Sayavedra, J. M. Petersen, M. Moche, A. Otto, D. Becher, T. Takeuchi, N. Satoh, N. Dubilier, T. Schweder and S. Markert. (2017). Metabolic and physiological interdependencies in the *Bathymodiolus azoricus* symbiosis. The ISME Journal 11: 463-477.
- Wippler, J.* \$, **M. Kleiner***^, C. Lott, A. Gruhl, P. Abraham, R. Giannone, J. C. Young, R. L. Hettich and N. Dubilier. (2016). Transcriptomic and proteomic insights into innate immunity and adaptations to a symbiotic lifestyle in the gutless marine worm *Olavius algarvensis*. BMC Genomics 17(1): 942.
- Yu, Y.-T. N., **M. Kleiner** and G. J. Velicer (2016). Spontaneous reversions of an evolutionary trait loss reveal regulators of a sRNA that controls multicellular development in the myxobacteria. Journal of Bacteriology 198(23): 3142-3151.
- Petersen, J. M., A. Kemper, H. Gruber-Vodicka, U. Cardini, M. van der Geest, **M. Kleiner**, S. Bulgheresi, M. Mussmann, C. Herbold, B. K. B. Seah, C. P. Antony, D. Liu, A. Belitz and M. Weber. (2016). Chemosynthetic sulphur-oxidizing symbionts of marine invertebrate animals are capable of nitrogen fixation. Nature Microbiology 2:16195.

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- This paper was featured** on the BacterioFiles Podcast (#240)
- Sayavedra, L., **M. Kleiner**, R. Ponnudurai, S. Wetzel, E. Pelletier, V. Barbe, N. Satoh, E. Shoguchi, D. Fink, C. Breusing, T. B. H. Reusch, P. Rosenstiel, M. B. Schilhabel, D. Becher, T. Schweder, S. Markert, N. Dubilier and J. M. Petersen. (2015). Abundant toxin-related genes in the genomes of beneficial symbionts from deep-sea hydrothermal vent mussels. eLife 4:e07966.
- Kleiner, M.**, L. V. Hooper and B. A. Duerkop (2015). Evaluation of methods to purify virus-like particles for metagenomic sequencing of intestinal viromes. BMC Genomics 16(7).
- Winkel M., P. Pjevac, **M. Kleiner**, S. Littmann, A. Meyerdierks, R. Amann and M. Mußmann (2014). Identification and activity of acetate-assimilating bacteria in diffuse fluids venting from deep-sea hydrothermal systems. FEMS Microbiology Ecology 90(3): 731-746.
- Kleiner, M.**^{*}, J. C. Young^{*}, M. Shah, N. C. VerBerkmoes and N. Dubilier (2013). Metaproteomics reveals abundant transposase expression in mutualistic endosymbionts. mBio 4(3): e00223-13.
- Kleiner, M.**[^], C. Wentrup, C. Lott, H. Teeling, S. Wetzel, J. Young et al. (2012). Metaproteomics of a gutless marine worm and its symbiotic microbial community reveal unusual pathways for carbon and energy use. Proceedings of the National Academy of Sciences 109(19): E1173-E1182.
- This paper was highlighted** in numerous newspapers, magazines and blogs e.g. Science Daily, CNN light years and in Nature.
- Kleiner, M.**[^], J. M. Petersen and N. Dubilier (2012). Convergent and divergent evolution of metabolism in sulfur-oxidizing symbionts and the role of horizontal gene transfer. Current Opinion in Microbiology 15(5): 621-631.
- Kleiner, M.**, T. Woyke, C. Ruehland and N. Dubilier (2011). The *Olavius algarvensis* metagenome revisited: lessons learned from the analysis of the low diversity microbial consortium of a gutless marine worm. Handbook of Molecular Microbial Ecology II: Metagenomics in Different Habitats. F. J. d. Bruijn, Ed. Hoboken, NJ, USA, John Wiley & Sons, Inc. 2: 321-334.
- Markert, S., A. Gardebrecht, H. Felbeck, S. M. Sievert, J. Klose, D. Becher, D. Albrecht, A. Thürmer, R. Daniel, **M. Kleiner**, M. Hecker and T. Schweder (2011). Status quo in physiological proteomics of the uncultured *Riftia pachyptila* endosymbiont. Proteomics 11(15): 3106-3117.

PATENTS

Kleiner, M. and Bartlett, A. 2020. Prediction of diet by metaproteomic analysis of stool samples. U.S. Patent Application 63/088,532, filed October 2020. Patent Pending.

SOFTWARE

Calis-p: includes several algorithms for protein-based stable isotope probing metaproteomics (Protein-SIP) and protein-based stable isotope fingerprinting (Protein-SIF) using high-resolution mass spectrometry data. The software uses open formats for input (mzML and mzIdentML) and various tabular output formats to maximize usability for data generated with a diversity of mass spectrometry platforms. The **java version (2.1)** software is available from <https://sourceforge.net/projects/calis-p/> and <https://doi.org/10.5281/zenodo.5619585>, and the **python version (3.0)** software is available from <https://github.com/kinestetika/Calisp>.

BROADER IMPACTS OUTCOMES

2020 – 2023 As part of the NSF IOS Collaborative Research project on insect symbioses we developed the Book “Unseen Jungle: The Microbes That Secretly Control Our World” with Dr. Eleanor Spicer Rice.

AWARDS, HONORS AND RESEARCH SUPPORT

2023 University Faculty Scholar (<https://provost.ncsu.edu/ofe/awards-and-honors/university-faculty-scholars/>)

2023 – 2026 NIH R01, (Co-PI, Total: \$2,717,702, To Kleiner Lab: \$334,552)

2022 – 2025 DOE BER, (Co-PI, Total: \$2,894,700, To Kleiner Lab: \$705,000)

2022 – 2024 USDA NIFA, (PI, Total: \$849,000, To Kleiner Lab: \$460,000)

2021 – 2024 Goodnight Early Career Innovator (PI, \$66,000)

2020 – 2023 NSF PGRP, (Co-PI, Total: \$900,000, To Kleiner Lab: \$310,000)

2020 – 2023 USDA NIFA, (Co-PI, Total: \$740,000, To Kleiner Lab: \$570,000)

2020 – 2025 NIH R35 MIRA, (PI, \$1,831,430)

2020 – 2022 BSF, (PI, Total: \$150,000, To Kleiner Lab \$75,000)

2020 – 2023 NSF IOS Collaborative Research (PI, \$440,281)

2019 – 2025 Novo Nordisk Foundation, InROOT (Co-PI, Total: \$9,600,000, To Kleiner Lab: \$300,000)

2019 – 2025 Novo Nordisk Foundation, INTERACT (Co-PI, Total: \$9,600,000, To Kleiner Lab: \$340,000)

2019 – 2021 NSF Growing Convergence Research (Co-PI, Total: \$630,000, To Kleiner Lab: \$140,000)

2019/20 Center for Gastrointestinal Biology and Disease (CGIBD) Pilot Grant (PI, \$30,791)

2019 – 2021 Foundation for Food and Agriculture Research (FFAR) New Innovator Award (PI, \$600,000)

2019 Plant Soil Microbial Community Consortium (PSMCC, Co-PI, \$84,965)

2018 NCSU internal seed funding, NC Agricultural Research Service, (NCARS, \$24,000)

2018 PSMCC (PI, \$60,000)

2015 Banting Postdoctoral Fellowship Award, NSERC (\$140,000; considered the most prestigious postdoctoral fellowship in Canada)

2014 Eyes High Postdoctoral Fellowship Award, University of Calgary (\$100,000)

2014 Friedrich Hirzebruch PhD thesis award of the German National Academic Foundation for outstanding work in the fields of Mathematics, Natural Sciences and Engineering (5000 Euro)

2013 Finalist for the Society in Science Branco Weiss Fellowship

2012 Sequencing grant from the Community Sequencing Program of the US Department of Energy Joint Genome Institute for the sequencing of 20 bacterial genomes and metagenomes (PI): “*Understanding novel pathways for energy and carbon use in bacterial symbionts of gutless marine worms.*”

2011 MarMic (International Max Planck Research School for Marine Microbiology) teaching excellence award (best tutorial)

2009 - 2012 PhD scholarship award from the German National Academic Foundation (Studienstiftung des deutschen Volkes) for academically gifted students

- 2009 Poster Award at the Gordon Research Conference for Applied and Environmental Microbiology
- 2008/09 Hölderlin-scholarship from the German National Academic Foundation for a postgraduate research year in the USA
- 2007 Travel scholarship from the German National Academic Foundation for a research internship in the Laboratory of Gregory Velicer, Indiana University
- 2005 Travel grant of the International Society for the Study of the Origin of Life (ISSOL) to attend its conference in Beijing
- 2005 - 2012 Scholarship from e-fellows.net supplying fast internet access for academically gifted students
- 2001 – 2008 Graduate scholarship award from the German National Academic Foundation (Studienstiftung des deutschen Volkes) for academically gifted students

SERVICE – UNIVERSITY, DEPARTMENT AND GRADUATE PROGRAMS

Only selected, major service contributions are listed:

- 1/2022 – present Chair: Microbiology Graduate Curriculum Committee. Lead complete curriculum re-design.
- 2019 – present Member: Microbiology Graduate Program Steering Committee for Admissions and Recruiting
- 6/2022 – present Director of Microscope Facility for the interdepartmental microbiology program
- 2018 – present Administrator microbiome listserv for NCSU
- 2018 – present Organizer of the Microbiome Monthly Meetup (M³) seminar series at NCSU
- 2017 – present Member of mass spectrometry user committee METRIC (Molecular Education, Technology, and Research Innovation Center) at NCSU

Graduate Programs: Microbiology, Genetics and Genomics, Plant Biology, Comparative Biomedical Sciences, and Biotechnology Minor

Graduate and Postdoc Training Grants: NIH/NCSU Molecular Biotechnology Training Program (MBTP), NIH T32 Chemistry of Life (CLPT) Comparative Medicine Institute, UNC Basic Science GI (gastrointestinal) T32 Fellowship, and NIH T32 Comparative Molecular Medicine Training Program (CMMTP) Comparative Medicine Institute.

Undergraduate Training Grants: NIH T34 Young Scholars Program (YSP) Comparative Medicine Institute, NSF REU Integrative Microbial and Plant Systems, and USDA REEU BeeMORE – Bees and Microbes.

SERVICE - DISCIPLINE

- 4/2015 – 6/2022 **Associate Editor**, Frontiers in Microbiology: Microbial Physiology and Metabolism
- 10/2020 – 12/2023 **Senior Editor**, ISME Communications, Advanced Approaches in Microbial Ecology
- 1/2024 - **Editorial Board**, ISME Communications, Advanced Approaches in Microbial Ecology

Manuscript Reviewer: BMC Microbiome, Bioinformatics, Molecular Systems Biology, mBio, mSystems, Environmental Microbiology, Food & Function, Gut Microbes, Marine Ecology, Microbiomes, Nature Communications, Pedosphere, Proteomes, Trends in Microbiology, PLoS

Genetics, Science, ISME J, Genome Biology, Biological Reviews, PeerJ, Computational Structural Biotechnology Journal, and Symbiosis.

Grant Reviewer: Czech Science Foundation (GACR), National Science Foundation (NSF), German Research Foundation (DFG), National Institutes of Health (NIH), Swiss National Science Foundation (SNSF), US Army DEVCOM, and Austrian Science Fund (FWF).

I am currently a member of **15 PhD Thesis Committees** at NC State University, Duke University, and the Max Planck Institute in Bremen.

CONFERENCES AND INVITED TALKS

- Nov 2023 Invited Virtual Talk, Israeli Association for Aquatic Sciences
Nov 2023 Invited Talk, Microbiome Data Congress, Boston, MA
Jun 2023 Gordon Research Conference Animal-Microbe Symbioses, Lucca, Italy
May 2023 Invited Virtual Talk, Dutch Microbiome Initiative (MiCRop) Seminar Series, Netherlands
Nov 2022 Talk, Plant-Microbe Interactions Conference, Copenhagen, Denmark
Sep 2022 Invited Talk, CGIBD Seminar Series, UNC Chapel Hill, NC
Jun 2022 Invited Virtual Talk, DSMZ (German Collection of Microorganisms)
Mar 2022 Invited Seminar Talk, Marine Biological Laboratories, Woods Hole, MA
Mar 2022 Invited talk, US Human Proteome Organization (HUPO), Charleston, NC
Feb 2022 Invited talk, Microbiome Movement AgBiotech Summit, Durham, NC
Nov 2021 Invited Virtual Talk, Nature Conference on Reshaping the Microbiome Through Nutrition
Jun 2021 Invited Virtual Talk, Collaborative Crop Resilience Program
Jun 2021 Invited Virtual Talk, American Society for Microbiology Conference
Jun 2021 Invited Virtual Talk, International Symbiosis Seminar Series
Apr 2020 Invited Virtual Talk, University of Ottawa, Canada
Dec 2019 Invited Talk, Plants for Human Health Institute, Kannapolis, NC
Nov 2019 Invited Talk, Food Systems, Nutrition and the Microbiome Symposium, Duke, NC
Nov 2019 Invited Talk, METRIC Symposium, NCSU
Nov 2019 Invited Talk, Thermal Biology Institute, Montana State University
Jun 2019 Invited Talk, Gordon Research Conference Animal-Microbe Symbioses, Mt. Snow, VT. “Assessing metabolism and interspecies interactions in microbial symbioses via metaproteomics.”
Apr 2019 Invited Talk, UNC Greensboro, NC
Mar 2019 Invited Talk, AgBiome, Durham, NC
Feb 2019 Invited Talk, 3rd Microbiome AgBioTech Summit, Durham, NC
Dec 2018 Invited Talk, International Metaproteomics Symposium, Leipzig, Germany
Nov 2018 Invited Talk, UT Knoxville Microbiology Seminar
Oct 2018 Invited Talk, Triangle Microbial Interactions Meeting, Cary, NC
Aug 2018 Invited Talk, BASF, Durham, NC
May 2018 Invited Talk, Center for Integrated Fungal Research, NC State
May 2018 Talk on Viral Metagenomics, Microbiome Monthly Meetup, NC State
Apr 2018 Invited talk, Novozymes, Durham, NC
Apr 2018 Invited talk, Microbiome Seminar Series, UNC Chapel Hill, NC
Mar 2018 Talk, DOE JGI Genomics of Energy and Environment Meeting, San Francisco
Feb 2018 Invited talk, Ag Biotech Summit, NC Biotechnology Center, Chapel Hill, NC
Dec 2017 Invited talk, Dangl Lab, UNC Chapel Hill, NC

- Dec 2017 Invited talk, Computational Biology Seminar Series, Veterinary Medicine, NC State
- Oct 2017 Invited talk, Biology Seminar Series, Georgia Institute of Technology
- Oct 2017 Invited talk, Marine Sciences Seminar Series, UNC Chapel Hill, NC
- Sep 2017 Invited talk, Biochemistry Seminar Series, NC State University
- Sep 2017 Invited talk, Dept. of Symbiosis, Max Planck Institute for Marine Microbiology
- 2017 Invited talk, ASM Microbe conference, New Orleans. “Assessing the metabolism, physiology and interspecies interactions in microbial symbioses via metaproteomics.”
- 2016 Talk, International Society for Microbial Ecology (ISME) conference, Montreal, Canada. “Assessing species biomass contributions in microbial communities via metaproteomics.”
- 2016 Attendee, DOE Joint Genome Institute User Meeting, Walnut Creek, CA
- May 2015 Invited talk, Seminar Series, Bermuda Institute of Ocean Sciences, Bermuda
- 2015 Poster, DOE Joint Genome Institute User Meeting, Walnut Creek, CA
- 2014 Poster, DOE Joint Genome Institute User Meeting, Walnut Creek, CA
- Feb 2014 Invited talk, Biology Seminar Series, Baylor University, TX
- 2013 Talk, American Society for Microbiology (ASM) General Meeting in Denver, Colorado. “Novel metabolic pathway for the massive assimilation of host waste products into carbon storage by the chemolithoautotrophic symbiont of a gutless marine worm.”
- 2012 Poster, Gordon Research Seminar and Conference on the Molecular Basis of Microbial One-Carbon Metabolism at the Bates College, ME, USA. “Proposal of a pyrophosphate-dependent, more energy efficient version of the Calvin cycle.”
- 2012 Poster, EU-US Environmental Biotechnology Workshop on Microbial Community Dynamics: Cooperation and Competition in St. Louis, MO, USA.
- 2011 Invited talk, MIMAS (Microbial interactions in marine systems) Symposium in Greifswald, Germany. “Metaproteomics of a gutless marine worm and its symbiotic microbial community: Discovery of novel pathways for carbon and energy use.”
- 2011 Attendee, NanoSIMS user meeting, Warnemünde, Germany
- 2010 Talk and poster, Symbiotic interactions meeting in Würzburg, Germany
- 2010 Talk, International Society for Microbial Ecology conference in Seattle, Washington, USA. “A symbiosis fueled by carbon monoxide: novel insights in the microbial community of a gutless marine worm.”
- 2009 Poster, Gordon Research Conference on Applied & Environmental Microbiology at the Mount Holyoke College, USA. “Metaproteomics of a gutless marine worm and its symbiotic microbial community.”
- 2009 Talk, International Symbiosis Society Congress in Madison, Wisconsin, USA. “Metaproteomics of a gutless marine worm and its symbiotic microbial community: Novel insights into host and symbiont metabolism and interactions.”

RESEARCH EXPERIENCE AND TRAINING

- Spring 2022 Mentoring Makes a Difference workshop series, (3 sessions), NCSU
- Fall 2018 ALLI – Agricultural Leadership Learning Institute, (8 sessions), NCSU
- Feb 2015 One day communication skills workshop, Mitacs Inc., University of Calgary
- Jan 2014 Two day science communication workshop, Klaus Tschira Foundation, Heidelberg
- Sep 2013 Microbial Genomics & Metagenomics workshop (one week), DOE Joint Genome Institute, Walnut Creek, California
- July 2013 Three day course on the R software environment for statistical computing and graphics

- Sep 2011 Two day grant application training workshop, Max Planck Institute
 Mar 2011 Two day scientific writing course, Max Planck Institute
 Feb 2011 Two day course on leadership skills for scientists, Max Planck Institute
 Dec 2010 Two weeks of training to become a NanoSIMS operator, Max Planck Institute
 Nov 2010 RAST workshop at the Argonne National Laboratory. ‘Genome annotation, comparison and metabolic modeling’
 May 2010 Biosand workshop 2010 at the Hydra Institute for Marine Sciences, Elba, Italy
 2008/09 Postgraduate research year, Indiana University and Oak Ridge National Laboratory: Additional training in Proteomics and Mass spectrometry.
 2007 Three months research internship in the group of Gregory Velicer, Indiana University. ‘Developing a mutant screen for *Myxococcus xanthus* showing special fruiting body development’.
 2006/07 Three month research internship in the bioinformatics group at the Max Planck Institute for Marine Microbiology. ‘Developing software for combined analyses of proteome and genome data’.
 2006 Two month research internship in the group of Michael Thomm at the University of Regensburg. ‘Heterologous expression of archaeal proteins in *Escherichia coli*’.
 2006 Five week research internship at the Institute for Marine Biotechnology in Greifswald. ‘Proteomics of the *Riftia pachyptila* symbionts’.

TEACHING EXPERIENCE

- Fall 2023 Taught three credit course on “Microbial Symbiosis & Microbiomes” (MB479/579), NC State University (16 Students)
 Fall 2023 Taught guest lecture in Doctoral Microbial Research Presentations (MB880), NC State University
 Spring 2023 Guest lecture in Cell and Molecular Biology (BIOL 4444/5544), Idaho State Univ.
 Fall 2022 Taught three credit course on “Microbial Symbiosis & Microbiomes” (MB479/579), NC State University (22 Students)
 Fall 2022 Guest lecture on the future of microbiomes (ENG590 – Exploring Mosaic Narrative), NC State University
 Fall 2021 Taught three credit course on “Microbial Symbiosis & Microbiomes” (MB479/579), NC State University
 Fall 2020 Taught three credit course on “Microbial Symbiosis & Microbiomes” (BSC495/MB590), NC State University
 Fall 2020 Taught guest lecture in Symbiosis Seminar Course, Gettysburg College
 Fall 2020 Taught guest lecture in Microbial Community Engineering (CHE 596-037), NC State University
 Fall 2019 Taught three credit course on “Microbial Symbiosis & Microbiomes” (BSC495/MB590), NC State University
 Spring 2019 Taught guest lecture in Aquatic Microbiology (MEA 493/593), NC State University
 Fall 2018 Taught three credit course on “Microbial Symbiosis & Microbiomes” (BSC495/MB590), NC State University
 Spring 2018 Taught guest lectures in Aquatic Microbiology (MEA 493) and Meet Your Microbes (LSC 170), NC State University
 Fall 2016 Taught workshop on Negotiation Skills in Geoscience Graduate Skills course (GLGY 699.56), University of Calgary
 Fall 2016 Taught lectures on the origins of life in a course for geologists on the “Evolution of Earth through Life and Time” (GLGY 493), University of Calgary

- Spring 2016 Taught lectures on the origins of life in a course for geologists on the “Evolution of Earth through Life and Time” (GLGY 493), University of Calgary
- Fall 2015 Taught part of Microbial Physiology course (CMMB 443), University of Calgary
- 2014 Teaching faculty at the SYMBIOMICS field workshop on Elba, Italy. Mix of lectures, seminars and laboratories for a group of 20 international MSc and PhD students (two weeks).
- 2012 Teaching faculty at the SYMBIOMICS field workshop on Elba, Italy (two weeks).
- 2011 Instructor for tutorials accompanying lectures on metagenomics (Group of 20 MSc students)
- 2011 Design of and sole instructor for a two day workshop on ‘Genome annotation, comparison and metabolic modeling using RAST, the SEED and Model-SEED’ for a group of 15 graduate students and postdocs. The workshop consisted of lectures, demonstrations and hands on exercises. I received teaching evaluations above faculty average.
- 2011 Instructor for tutorials accompanying lectures on symbiosis for 20 MSc students. I received the MarMic teaching excellence award for the best tutorial.

INDIVIDUAL GUIDANCE AND MENTORSHIP

Current

- 2023 – pres. Research Technician (Rachel Moser), Kleiner Lab, NCSU
- 2022 – pres. Research Technician (Molly DuBois), Kleiner Lab, NCSU
- 2020 – pres. Senior Research Scientist & Laboratory Manager (Simina Vintila), Kleiner Lab, NCSU
- 2024 – pres. Postdoc (Samiksha Saxena), Kleiner Lab, NCSU
- 2023 – pres. Postdoc (Solomon Samuel), Kleiner Lab, NCSU
- 2022 – pres. Postdoc (Gaurav Pal), Kleiner Lab, NCSU
- 2020 – pres. Postdoc (J. Alfredo Blakeley-Ruiz), Kleiner Lab, NCSU
- 2024 – pres. MS student (Matteo Rios), Kleiner Lab, NCSU
- 2022 – pres. PhD student (Molly Vanhoy), Kleiner Lab, NCSU
- 2022 – pres. PhD student (Ayesha Awan), Kleiner Lab, NCSU
- 2021 – pres. PhD student (Olivia Mathieson), Kleiner Lab, NCSU
- 2021 – pres. PhD student (Jessie Maier), Kleiner Lab, NCSU
- 2020 – pres. PhD student (Anna Garrell), Kleiner Lab, NCSU
- 2020 – pres. PhD student (Clara Tang), Kleiner Lab, NCSU
- 2023 – pres. Undergraduate research student (Julian Perez Velasquez), Kleiner Lab, NCSU
- 2023 – pres. Undergraduate research student (Namita Deshmukh), Kleiner Lab, NCSU
- 2022 – pres. Undergraduate research student (Porter Richardson), Kleiner Lab, NCSU
- 2022 – pres. Undergraduate research student (Aisha Mahmood), Kleiner Lab, NCSU
- 2021 – pres. Undergraduate research student (Nicole Rideout), Kleiner Lab, NCSU
- 2023 – pres. Twelve months, visiting student (Laura Winkler) from Germany, Kleiner Lab, NCSU

Past

- 2021 – 2023 Research Scholar (Jacob Parnell), Kleiner Lab, NCSU
- 2021 – 2022 Postdoc (Lisa David), Kleiner Lab, NCSU
- 2020 – 2021 Postdoc (Nicole Parsley), Kleiner Lab, NCSU

- 2019 – 2021 Postdoc (Gitanjali Nanda Kafle), Kleiner Lab, NCSU
 2018 – 2021 Postdoc (Fernanda Salvato), Kleiner Lab, NCSU
- 2020 – 2023 MS student (Marlene Jensen), Kleiner Lab, NCSU (MS received 2023)
 2016 – 2021 PhD student (Jackie Zorz), Energy Bioengineering Group, University of Calgary
 2018 – 2021 MS student (Angie Mordant), Kleiner Lab, NCSU (MS received 2021)
 2020 – 2021 Research Assistant (Alexandria Bartlett), Kleiner Lab, NCSU
 2018 – 2020 MS student (Alexandria Bartlett), Kleiner Lab, NCSU (MS received 2020)
 2018 – 2020 MS student (Natalia Marino), Kleiner Lab, NCSU
 2018 – 2019 PhD student (Nick Taylor), Kleiner Lab, NCSU
 2011 - 2016 PhD student (Juliane Wippler), Department of Symbiosis, Max Planck Institute for Marine Microbiology (PhD received in 2016)
 2010/11 MSc student (Juliane Wippler), Symbiosis Group, Max Planck Institute for Marine Microbiology
- 2022 – 2023 Undergraduate research student (Nathan Ring), Kleiner Lab, NCSU
 2023 Undergraduate USDA REEU BeeMORE student (Micah Lohr), Kleiner Lab, NCSU
 2020 – 2023 Undergraduate research student (Abigail Korenek), Kleiner Lab, NCSU
 2021 – 2023 Undergraduate research student (Alissa Meyerhoffer), Kleiner Lab, NCSU
 2021 – 2023 Undergraduate research student (Andrea Ward), Kleiner Lab, NCSU
 2022 Undergraduate research student (Mary May), Kleiner Lab, NCSU
 2021 – 2022 Undergraduate research student (Maggie Cook), Kleiner Lab, NCSU
 2020 – 2021 Undergraduate research student (Ty Grewell), Kleiner Lab, NCSU
 2017 – 2021 Undergraduate research student (Jessie Maier), Kleiner Lab, NCSU
 2020 Undergraduate research student (Rowan Roskam), Kleiner Lab, NCSU
 2019 – 2020 Undergraduate research student (Tanner Russ), Kleiner Lab, NCSU
 2019 – 2020 Undergraduate research student (Sophia Miller), Kleiner Lab, NCSU
 2019 Undergraduate research student (Mariska Thayagan), Kleiner Lab, NCSU
 2018 – 2019 Undergraduate research student (Rebekah Lim), Kleiner Lab, NCSU
 2018 – 2019 Undergraduate research student (Amani Albrecht), Kleiner Lab, NCSU
- 2023 Eight months, visiting PhD student (Yejin Son) from Cornell University, Kleiner Lab, NCSU
 2022 Six months, visiting Postdoc (Benoit Kunath) from the University of Luxembourg, Kleiner Lab, NCSU
 2022 Six months, visiting student (Tariq Shah), Kleiner Lab, NCSU
 2021 Six months, visiting PhD student (Grace D'Angelo) from the Max Planck Institute for Marine Microbiology, Kleiner Lab, NCSU
 2021 Three months, visiting MS student (Amit Barkai) from the Israel Limonological and Oceanographic Research Institute, Kleiner Lab, NCSU
 2021 Four months, visiting PhD student (Marie Aggerbeck) from Aarhus University, Kleiner Lab, NCSU
 2019 Summer NSF-REU undergraduate researcher (Jameson Ehret), Kleiner Lab, NCSU
 Feb – Jul 2019 Visiting Student from the Hochschule Bremen, Germany (Marlene Jensen), Kleiner Lab, NCSU. Official member of Bachelor Thesis Committee.
 2017 Six months, visiting PhD student (Tjorven Hinzke), Energy Bioengineering Group, University of Calgary
 2016/17 Project student (Erin Thorson), Energy Bioengineering Group, University of Calgary

- 2016 Four months summer student (Erin Thorson), Energy Bioengineering Group, University of Calgary
- 2011 Guest PhD student (Ruby Ponnudurai) doing a 4 week project, Symbiosis Group, Max Planck Institute for Marine Microbiology
- 2011 Six week Lab Rotation MSc student (Lizbeth Sayavedra), Symbiosis Group, Max Planck Institute for Marine Microbiology
- 2010 Research intern for 8 weeks (MSc student Johannes Boetschi from the University of Greifswald), Symbiosis Group, Max Planck Institute for Marine Microbiology

FIELD EXPERIENCE

- 2018 NCSU Center for Marine Sciences and Technology, North Carolina. Collection of chemosynthetic symbioses from marine sediments (multiple trips).
- 2015 Bermuda Institute of Ocean Sciences, Bermuda. Collection of marine sediments and symbionts from gutless marine oligochaetes for metagenomics, metatranscriptomics and metaproteomics.
- 2013 Little Darby Island, Bahamas. Collection of marine sediment and symbiotic Meiofauna for metagenomics and metaproteomics.
- 2012* Heron Island Research Station, Australia. Collection of symbiotic Meiofauna for metagenomics and metaproteomics.
- 2012 Hydra Institute for Marine Sciences, Elba, Italy. Collection of gutless oligochaetes, *in situ* measurements and physiological incubation experiments.
- 2011* Hydra Institute for Marine Sciences, Elba, Italy. Collection of gutless oligochaetes.
- 2010* Hydra Institute for Marine Sciences, Elba, Italy (Two Trips). Collection of gutless oligochaetes, *in situ* measurements and physiological incubation experiments.
- 2009* Bermuda Institute of Ocean Sciences, Bermuda. Collection of marine sediment and symbionts from gutless marine oligochaetes for metaproteomics and metagenomics.
- 2007* Hydra Institute for Marine Sciences, Elba, Italy. Collection of symbionts from gutless marine oligochaetes for metaproteomics.

*For these sampling trips I was the main coordinator of the research team - consisting of three to five scientists - and was in charge of equipment and sample logistics.

PROFESSIONAL MEMBERSHIPS

- 2009 - International Symbiosis Society
- 2010 - International Society for Microbial Ecology
- 2013 - American Society for Microbiology (ASM)
- 2020 - American Society for Mass Spectrometry (ASMS)
- 2021 - International Society for Molecular Plant-Microbe Interactions (IS-MPMI)