**Orr Shapiro**  **August 2019**

**Part I: CURRICULUM VITAE**

1. **Personal**

Department of food quality and safety, Institute for Potharvest and Food Sciences, Volcani Center, ARO.

Phone: +972-3-9683422

Cell: +972-50-6220325

e-mail: orr@agri.gov.il

website: <http://www.agri.gov.il/en/people/1190.aspx>

Google Scholar website: <https://scholar.google.com/citations?user=7chldT8AAAAJ&hl=en>

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| **Dates** | **Description** |
| 1974 | Born in London, UK |
| 1975 | Immigration to Israel |

1. **University Education and Additional Training**

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| **Dates** | **Description** |
| 1998 – 2003 | B.Sc. in biotechnology engineering at Ben Gurion University of the Negev |
| 2003 – 2005 | M.Sc. in in biotechnology engineering at Ben Gurion University of the NegevSupervision by: Ariel Kushmaro/Asher Brenner |
| 2006 – 2011 | Ph.D. in in biotechnology engineering at Ben Gurion University of the Negev Title of thesis: Microbial processes and population dynamic in industrial wastewater treatmentSupervision by: Ariel Kushmaro/Asher Brenner |
|  |  |
| 2011 – 2012 | Postdoctoral position at MIT with Prof. Roman Stocker , Dr. Assaf Vard, Weizmann Institute of ScienceResearch subject: Microfluidic tools for the study of coral-pathogen interactions |
| 2012-2015 | Postdoctoral position at Weizmann Institute of Science with Dr. Assaf Vardi, Prof. Roman Stocker, MIT Research subject: Microfluidic tools for the study of coral-pathogen interactions |

1. **Positions Held and Academic Status**

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| **Dates** | **Description** |
| 2015 to date | Researcher, Volcani Center, ARO. Studying the microbiology of aquaculture environments and postharvest processes in derived products  |

1. **Teaching Experience / Guiding Students**
2. Academic Contribution:

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| --- | --- |
| **Dates** | **Description** |

1. Guidance of M.Sc. Students:

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| --- | --- | --- | --- |
| **Graduation date** | **Name** | **Title of thesis** | **Guidance with** |
| 2019 | Ms. Olubunmi Adejimi\* | Low-resolution Raman spectroscopy for real-time monitoring of harmful cyanobacterial blooms | Prof. Shlomo SelaDr. Zeev Shmilovich |
| 2019 | Ms. Sivan Galai\* | Developing a model system for phage biocontrolof Vibrio pathogens in aquaculture environments  | Prof. Shlomo Sela |

\*under my direct supervision

1. Guidance of Ph.D. Students:

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| --- | --- | --- | --- |
| **Graduation date** | **Name** | **Title of thesis** | **Guidance with** |
| 2022 (Exp.) | Mr. Felix Menash\* | Probiotic approaches for the prevention of farunculusis in aquacultured carp species | Dr. Eddie Cytryn |
| 2023 (Exp.) | Ms. Olubunmi Adejimi\* | Spectral methods for early detection and identification of harmful cyanobacteria in aquaculture environments | Dr. Ittai Herrmann |
| 2022 (Exp.) | Mr. Abraham Ogungbile† | Developing an electro-chemical ELISA essay for detection and quantification of cyanotoxins | Dr. Sefi Vernick Dr. Meni Ben-Hur |

\*under my direct supervision

† Pending approval as thirdco-mentor

1. Post-Docs and Visiting Scientists:

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| --- | --- | --- |
| **Dates** | **Name** | **Research subject** |
| 2016 -to date | Dr. Giji Sadasivam | Secondary metabolites of cyanobacterial origin in fish ponds in the north of Israel Developing a microfluidic system for live-imaging microscopy assessment of nano-algaecides activity |
| 2017-2019 | Dr. Ella Kaplan-Yair | Phage biocontrol of *Aeromonas pathogens* in aquaculture environments |
| 2018-to date | Dr. Sri Rakumar Vijayan | Biodegradable nanoparticles for targeted elimination of cyanobacterial blooms in aquaculture environments  |

1. Organization of Courses

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| --- | --- | --- | --- |
| **Dates** | **Duration** | **Place** | **Title** |

1. **Activity in Scientific and Agricultural Committees**
2. International:

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| --- | --- |
| **Dates** | **Description and role** |
| 2017-2019 | European Vibrio-Network, working towards establishing a COST VibrioWeb group; Member |

1. National:

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| **Dates** | **Description and role** |
| 2016-2019 | Board member of the Israeli Association of Aquatic Sciences |
| 2017 | Israeli consortium involving industry and academia focusing on sensing and mitigation of harmful algal blooms; Member |

1. Institutional:

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| **Dates** | **Description and role** |
| 2016-2017 | ARO strategic sub-committee on microbial-associated risks in food; Member |

1. **Contribution to the Scientific Community**
2. International:

|  |  |
| --- | --- |
| **Dates** | **Description** |

1. National:

|  |  |
| --- | --- |
| **Dates** | **Description** |
| 2016-2019 | The annual meeting of the Israeli Association of Aquatic Sciences, Session chair |
| 2017 | Annual meeting of the Israeli Society of Microbiology; Member of organizing committee, Session Chair |

1. Institutional:

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| **Dates** | **Description** |
| 2017 | Organizer of a one day institutional workshop on applications of live imaging microscopy and microfluidics in microbiology research  |

1. Outreach:

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| **Dates** | **Description** |
| 2016 | Contributed a scientific exhibit on coral biology as part of the Ocean Research Exhibition at the Clore Garden of Science, Weizmann Institute of Science  |
| 2017-to date | Participating in the “Scientist On-line” program for advanced high-school science education at the Davidson institute of Science Education  |
| 2019 (Exp) | “Science at the Bar”, Eilat |

1. Editorial responsibilities:

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| **Dates** | **Description** |
| 2015-2017 | Reviewer: Journal of Environmental Microbiology; FEMS microbiology Ecology; ISME journal |
| 2016 | Reviewer: Nature communications; Nature Physics |
| 2016-2017 | Reviewer: Frontiers in Microbiology |
| 2017 | Reviewer: Journal of Microbial Ecology; Advanced Biosystems |
| 2018 | Reviewer: PNAS, JOVE |
| 2019 | Reviewer: Scientific reports; Current biology |

1. Active Participation in Meetings
2. International:

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| --- | --- | --- | --- |
| **Date** | **Title of the Meeting** | **Place** | **Role** |
| 2016 | Gordon research conference on Marine Microbes | Girona, Spain | Electronic Poster |
|  | Microscale interactions in aquatic environments | IUI, Eilat, Israel | Hands-on demonstration |
| 2017 | 1st International Forum on coral reefs | Sanya (Hainan), China | Invited speaker (+expenses) |
|  | Vibrio2017 | Chicago, IL, USA | Speaker |
| 2018 | Gordon research conference on Marine Microbes | Barga, Italy | Poster |
|  | ISME17 | Leipzig, Germany | Invited speaker |
| 2019 | International Conference on Algal Biomass, Biofuels and Bioproducts (AlgalBBB) | Boulder, CO, USA | \*Speaker (travel grant) |
| 2019 (Exp.) | Vibrio2019 | Montreal Canada | Poster |
| 2019 (Exp.) | 2nd International Forum on Coral Reefs | Sanya (Hainan), China | Invited speaker (+expenses) |

\* Lecture/poster presented by student

1. National:

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| --- | --- | --- |
| **Date** | **Title of the Meeting** | **Role** |
| 2017 | Fisheries course organized by Agricultural Extension Service (SHAHAM), Ministry of Agriculture, Emek Hamayanot | Invited speaker |

1. Institutional:

|  |  |  |
| --- | --- | --- |
| **Date** | **Title of the Meeting** | **Role** |
| 2017 | Nano-Agrotechnology  | Invited speaker |

1. **Research Grants**
2. International Peer Reviewed Grants:

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| --- | --- | --- | --- | --- | --- |
| **Year** | **Granting Source** | **Duration (years)** | **Role\*** | **Title (short)** | **Budget**  |
| **Total (US $ / year)** | **Researcher (US $ / year)** |
| 2017 | BSF | 2 | PI |  Genomic adaptations of the marine pathogen *Vibrio vulnificus* facilitating host microbiome invasion during infection of the agriculturally-relevant model host Artemia salina. | 75,000 | 30,000(+15,000 for 2nd year) |

\*PI = Principal Investigator; LPI =Local Principal Investigator; CI = Cooperating Investigator

1. National Peer Reviewed Grants:

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| --- | --- | --- | --- | --- | --- |
| **Year** | **Granting Source** | **Duration (years)** | **Role\*** | **Title (short)** | **Budget**  |
| **Total (US $ / year)** | **Researcher (US $ / year)**  |
| 2017 | Chief Sci. | 2 | PI | A Raman-spectroscopy based system for tracking cyanobacterial blooms in aquaculture ponds | 42,000 | 26,250 |
| 2018 | Chief Sci. | 3 | PI | A biodegradable nano-formulation for the control of toxic cyanobacteial blooms in fish ponds | 56,000 | 37,000 |
| 2018 | Chief Sci. | 3 | PI | Using bacteriophage for biological control of Vibrio pathogens in mariculture | 44,650 | 22,325 |
| 2018 | Chief Sci. | 3 | CI | Development of novel biocontrol-based approach of for reduction of antibiotic use in aquaculture | 56,000 | 22,325 |
| 2019 | Chief Sci. | 3 | CI | Electrochemical biosensor for rapid detection and quantification of Cyanobacteria toxins in water reservoirs | 60,000 | 20,500 |

\*PI = Principal Investigator; LPI =Local Principal Investigator; CI = Cooperating Investigator

1. National Non-Peer Reviewed Grants:

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| --- | --- | --- | --- | --- | --- |
| **Year** | **Granting Source** | **Duration (years)** | **Role\*** | **Title (short)** | **Budget** |
| **Total (US $ / year)** | **Researcher (US $ / year)** |

1. Other Funds:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **Granting Source** | **Duration (years)** | **Role\*** | **Title (short)** | **Budget** |
| **Total (US $ / year)** | **Researcher (US $ / year)** |
| 2016 | ARO strategic funds  | 1 | PI | Advanced microscopy system for microfluidic-based live-imaging studies | 183,500 | 183,500 |

\*PI = Principal Investigator; LPI =Local Principal Investigator; CI = Cooperating Investigator

1. **Awards**

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| --- | --- |
| **Dates** | **Description** |
| 2012 | Outstanding early career scientist, Gordon conference on Marine Microbes |
| 2013 | 1st place in the International Science and Engineering Visualization Challenge, category Photography, for image “Invisible Coral Flows”  |
| 2017 | “Coral on a Chip” paper selected among 6 most important coral-related scientific discoveries for 2016, 1st international coral forum, Sanya, China. |

# Orr Shapiro August 2019

##### Part II: LIST OF PUBLICATIONS

Marks:

X \*                    Equal contribution as the first author

X \*\* Corresponding Author *(in cases where the researcher is the Corresponding Author)*

Marks (only for the first author):

XS                     Student under my supervision

XT                    Technician or research engineer working in my research team

XPD, XVS           Post-Doc or Visiting Scientist working in my research team

1. **Articles in Reviewed Journals**

1.  Oren A, Pri-El N, **Shapiro OH**, Siboni N. (2005).

Gas vesicles isolated from Halobacterium cells by lysis in hypotonic solution are structurally weakened

 FEMS Microbiol. Lett. 252:337-341; IF 2.046 Category: Microbiology; Rank 74/119

2.  Oren A, Pri-el N, **Shapiro OH**, Siboni N (2006).

Buoyancy studies in natural communities of square gas-vacuolate archaea in saltern crystallizer ponds

Saline Systems. 2:4; SJR 0.545 Category: Aquatic Science; Rank 95/195

1. Ben-Dov E, **Shapiro OH**, Siboni N, Kushmaro A. (2006).

Advantage of Using Inosine at the 3’-termini of 16S rRNA Gene Universal Primers for the Study of Microbial Diversity

Appl Environ Microb. 27:6902-6906. IF 4.077; Category: Biotechnology and Applied Microbiology; Rank 33/162

4.  Ben-Dov E\*, **Shapiro OH\*,** Gruber R, Brenner A, Kushmaro A. (2008).

Changes in microbial diversity in industrial wastewater evaporation ponds following artificial salination

FEMS Microbiol Ecol. 66:437-446. IF 3.875; Category: Microbiology; Rank 26/119

5.  **Shapiro OH\*\*,** Kushmaro A, Brenner A. (2010).

Bacteriophage predation regulates microbial abundance and diversity in a full-scale bioreactor treating industrial wastewater

ISME J. 4:327-336. IF 9.493; Category: Ecology; Rank 5/164.

6.  Ben-Dov E, Siboni N, **Shapiro OH**, Arotzker L, Kushmaro A. (2011).

Substitution by Inosine at the 3'-Ultimate and Penultimate Positions of 16S rRNA Gene Universal Primers

Microb Ecol. 61:1-6. IF 3.611; Category: Marine and Freshwater Biology; Rank 7/106

7.  **Shapiro OH**\*, Hatzenpichler R\*, Buckley DH, Zinder SH, Orphan VJ. (2011).

Multicellular photo-magnetotactic bacteria

Environ. Microbiol. Rep. 3:233-238. IF 2.874; Category: Environmental Sciences; Rank 92/250

9.  Ben Dov E\*, **Shapiro OH\*,** Kushmaro A. (2012).

Next base effect on PCR amplification

Environ. Microbiol. Rep. 4:183-188. 2.874; Category: Environmental Sciences; Rank 92/250

10.  Segev O, **Shapiro OH\*,** Kushmaro A, Brenner A. (2013).

Application of a unique miniature MBR for screening the biodegradation of brominated flame retardants

Desal Wat Treat. 51:5909-5917. IF 1.272; Category: Ocean Sciences; Rank 30/139

11.  Garren M, Son K, Raina JB, Rusconi R, Menolascina F, **Shapiro OH**, Tout J, Bourne DG, Seymour JR, Stocker R. (2013).

A bacterial pathogen uses dimethylsulfoniopropionate as a cue to target heat-stressed corals

ISME J. 8:999-1007. IF 9.493; Category: Ecology; Rank 5/164.

12. **Shapiro OH\*\*,** Fernandez VI\*, Garren MS, Guasto JS, Debaillon-Vesque FP, Kramarsky-Winter E, Vardi A, Stocker R. (2014).

 Vortical Ciliary flows actively enhance mass transport in reef corals P Natl Acad Sci USA. 111:13391-13396. IF 9.809; Category: Multidisciplinary sciences; Rank 4/63

**Since Previous Promotion:**

13. **Shapiro OH\*\*,** Kramarsky-Winter E, Gavish R, Stocker R, Vardi A. (2016).

 A coral on a chip microfluidic platform enabling live-imaging microscopy of reef-building corals Nat Commun. DOI: 10.1038/ncomms10860. IF 12.124; Category: Multidisciplinary; Rank 3/64.

14. Massalha H, Korenblum E, Malitsky E, **Shapiro OH\*\*,** Aharoni A. (2017).

 Live Imaging of Root-Bacteria Interactions in a Microfluidics Set-up

 P Natl Acad Sci USA. 114:4549-4554. IF 9.809; Category: Multidisciplinary sciences; Rank 4/63.

15. Gibbin EM, Gavish AR, Domart-Coulon I, Kramarsky-Winter E, **Shapiro OH**, Meibom A, Vardi A. (2018).

Using NanoSIMS coupled with microfluidics to visualize the early stages of coral infection by Vibrio coralliilyticus

BMC microbiology 18(1), 39. IF 3.287; Category: Microbiology; Rank: 49/133

16. **Shapiro OH\*\*,** Kartvelishvily E, Kramarsky-Winter E, Vardi Ac. (2018).

Magnesium-rich nano-layer underlies fibrous aragonite deposition in Pocillopora damicornis Front Mar Sci 4, 246. IF 3.086; Category: Marine and Freshwater Biology; Rank 13/108

17. Gibbin EM, Gavish AR, Krueger T, Domart-Coulon I, Kramarsky-Winter E, **Shapiro OH**, Guiet R, Jensen L, Vardi A, Meibom A. (2019).

Vibrio coralliilyticus infection triggers a behavioral response and perturbs nutritional exchange and tissue integrity in a symbiotic coral

 ISMEJ13, 989–1003. IF 9.493; Category: Ecology; Rank 5/164

18. López Pérez M, Jayakumar J, Haro-Moreno J, Zaragoza-Solas A, Reddi G, Rodriguez-Valera F, **Shapiro OH**, Alam M, Almagro-Moreno S (2019).

 Evolutionary model of cluster divergence of the emergent marine pathogen Vibrio vulnificus: From genotype to ecotype

 mBio **DOI:** 10.1128/mBio.02852-18. IF 6.747; Category: Microbiology; Rank 14/133

19. Massalha H, Korenblum E, **Shapiro OH**, Aharoni A (2019)

 [Tracking Root Interactions System (TRIS) Experiment and Quality Control](https://bio-protocol.org/e3211)

 Bio-protocol 9(8) DOI:   [10.21769/BioProtoc.3211](https://doi.org/10.21769/BioProtoc.3211)

20. Mizrachi A, van Creveld SG, **Shapiro OH**, Rosenwasser S, Vardi A. (2019).

 Single-cell heterogeneity in the chloroplast redox state mediates acclimation to stress in a marine diatom.

 eLife. IF 7.551; Category: Biological Sciences; Rank: 4/85 (Accepted for publication).

21. Sadhasivam GPD, Gelber C, Zakin V, Margel S, **Shapiro OH\*\*** (2019).

### N-halamine derivatized nanoparticles with selective cyanocidal activity: Potential for targeted elimination of harmful cyanobacterial blooms.

 Env Sci Tech IF 7.149; Category: Environmental Sciences; Rank: 14/250 (Accepted for publication)

22. Manivannan B, Eltzov E, Veltman B, **Shapiro OH**, Sadhasivam G, Borisover M (2019)

 Toxicity of chlorinated and ozonized wastewater effluents probed by genetically modified bioluminescent bacteria and cyanobacteria Spirulina sp.

 Water Research IF 7.913 Category: Environmental Sciences; Rank: 1/91 (Accepted for publication).

23. Sadhasivam S, **Shapiro OH**, Ziv C, Zakin V, Sionov E (2019)

 Synergistic effect of pomegranate peel extract in combination with azole antifungals against mycotoxigenic fungi

 Front Microb IF 4.259 Category: Microbiology; Rank 32/133 (minor revision).

**Five selected publications since previous promotion:**

Publication 13: <https://www.nature.com/articles/ncomms10860>

Publication 14: <http://www.pnas.org/content/114/17/4549>

Publication 18: <https://mbio.asm.org/content/10/1/e02852-18.abstract>

Publication 20: <https://elifesciences.org/articles/47732>

Publication 21: <https://pubs.acs.org/doi/10.1021/acs.est.9b01368>

1. **Books and Invited Reviews**

1.  **Shapiro OH** and Kushmaro A.(2011)

 Bacteriophage ecology in environmental biotechnology processes

 Current opinion Biotech. 22:1-7. IF 9.294; Category: Biochemical research methods; Rank 3/77

1. **Book Chapters**
2. **Articles in Reviewed Journals in Hebrew**
3. **Articles in Non-Reviewed Journals in Hebrew and English**
4. **Shapiro OH** and Sadasivam G. (2017)

Nano-algaecides as an alternative treatment against toxic cyanobacterial blooms in freshwater aquaculture.

Volcani Voice.

1. **Articles in Symposia Proceedings (including Acta Horticulturae)**
2. Fernandez V\*, **Shapiro OH\***, Brumley D, Garren M, Guasto J, Kramarsky-Winter E, Vardi A,

 Stocker R (2014). [Mixing it up: Corals take an active role in mass transport](https://scholar.google.com/citations?view_op=view_citation&hl=en&user=7chldT8AAAAJ&citation_for_view=7chldT8AAAAJ:r_AWSJRzSzQC)

 Proceeding of APS meeting, Nov 2014, San Francisco, CA, USA.

1. **Allowed Patents and Registered Cultivars**

**Orr Shapiro August 2019**

Part III: DESCRIPTION OF MAJOR ACHIEVEMENTS

1. **Contribution to Agricultural and/or Environmental Sciences**

**Harmful cyanobacteria in aquaculture environments** – A large part of my activity over the past 3 years was devoted to understanding the problems associated with harmful cyanobacterial blooms in aquaculture ponds, and to raising awareness among both scientists and professionals to the risks posed by such blooms to both the workers and the consumers. As part of this effort I have participated and presented information in several professional and scientific meetings, including with delegations from china where this problem is well known and recognized.

I have formed several collaborations with researchers from Volcani and additional Institutes in Israel. Together with my collaborators I have raised substantial research funds, in excess of USD 450,000, towards three projects aimed at introducing technologies from different fields in agricultural science and engineering into cyanobacterial research. These include the early detection of developing cyanobacterial blooms using Low Resolution Raman Spectroscopy (LRRS; collaboration with Dr. Zeev Schmilovich), biocidal nanoparticles with selective activity towards cyanobacteria (collaboration with Prof. Shlomo Margel, BIU), and more recently electrochemical biosensors for improved detection of cyanotoxins (collaboration with Dr. Sefi Vernick).

Initial results from the nano-particles project have now been published in a major journal in the field (**1-21**), and an additional paper is expected in the coming year. We are currently working towards protection of the LRRS-based technology with a provisional patent, and a manuscript describing initial results from this system will be submitted following a decision on that matter. This system has now been expanded towards monitoring of invasive cyanobacterial species in micro-algal bioreactors, a collaboration with Dr. Ittai Hermann at HUJI, and a 2nd manuscript describing results from this effort is expected in the coming year. Results from these projects have also been presented by my students in the form of lectures or posters in several scientific meetings in the fields of microbiology, chemistry and nano-technology, both in Israel and abroad. The electro-chemical sensor project is in its early days, there are currently two post-docs working on two different aspects of the problem and we expect to have preliminary results by the of the year.

**Bacteriophage and probiotics as alternatives to antibiotics in aquaculture** – Limitations on the use of antibiotics in aquaculture is a central concern for growers in Israel and abroad. Currently the prophylactic administration of antibiotics is an important measure for preventing outbreaks of bacterial pathogens in aquaculture systems. However, the growing concern regarding the evolution of antibiotic-resistant pathogens, and particularly the possible transmission of this resistance to human pathogens, resulted in severe restrictions on both the type of antibiotics allowed for use in aquaculture and the frequency of their use. I am currently collaborating in two separate efforts aiming to develop alternative approaches to reduce the prophylactic use of antibiotics in aquaculture.

One project, conducted in collaboration with Dr Galit Sharon at NCM, IOLR, Eilat, is focused on the isolation of bacteriophage for *Vibrio* speciesinfecting cultured Seabream. Particularly we are targeting phages that are able to adhere to the fish epithelial mucus layer, as a means to ensure their survival in the immediate vicinity of the fish. For that purpose we have established a model system using the brine shrimp *Artemia salina* as a model host, and *Vibrio* isolatesfrom the strain collection at NCM as model pathogens. We are testing the ability of phages isolated from different systems at the NCM experimental mariculture facility, including from mucus collected from Seabream, to attenuate or prevent *Vibrio* infection in brine shrimp. Ultimately we intend to test the ability of a cocktail of the more efficient phages to prevent infection in Seabream fingerlings at the containment unit at the NCM.

A 2nd project, conducted in collaboration with Dr. Eddie Cytrin and collaborators at the Dor station for aquaculture research and the fish health laboratory at Nir-David, aims to understand the ecology of the fish pathogen *Aeromonas salmonicida* and to develop porobiotics and phage-based approaches against it. *A. salmonicida* in Israel is known particularly as a pathogen of aquacultured cyprinids, particularly carp and koi. Globally it is better known as a pathogen of aquacultured salmon, trout, and eels, with major economic impacts. Similar to the vibrio project we are concentrating on understanding the microbial ecology of the fish epithelial mucus, and isolating specific bacteriophage against the pathogen as well as potentially beneficial bacteria that can reduce its infectivity. Here we use the systems at Dor, and fish brought for analysis to Nir David, to isolate bacteria and phage from water and mucus sample. We further established an infection system in carp in the containment facility at Nir-David, where we test the infectivity of *A. salmonicida* isolates, and later the ability of bacteriophage and probiotics to reduce infection rates. At the same time we are characterizing the growth of the pathogen at different temperatures, and particularly its ability to revive following prolonged incubation at different temperatures, a subject that is likely highly relevant to the characteristic appearance of farunculusis in Israel at winter. We further explore the genomes of several *A. salmonicida* isolates, how they change and evolve between different clusters and between isolates from consecutive years, and how they are related to genomes of similar pathogens isolated from different countries and different fish species.

**Ecology and evolution of the emergent zoonotic pathogen *Vibrio vulnificus*** – Together with my collaborator, Prof. Almagro-Moreno at UCF, I have established an experimental system similar to that developed for the *Vibrio* phage project, and use it to characterize the virulence of different *V. vulniifucs* isolates against artemia, as well as the effect of different mutations (induced at the lab of Prof. Almagro-Moreno) on their virulence. We have further performed a genomic analysis of multiple *v. vulnificus* strains to try and understand the difference between different clades of this important human and fish pathogen. That part of the work has been published recently at mBio (1-18).

**Developing live imaging microscopy and microfluidic-based systems for agricultural sciences** - In addition to the work carried by my own team, I am collaborating with several researchers in Volcani in the development of various experimental systems utilizing live-imaging microscopy and microfluidics, as well as additional systems in my lab. These allow the us to observe biological and physical phenomena at particularly high spatio-temporal resolutions, while manipulating the microenvironment experienced by microorganisms. We are thus able to interrogate micro-scale effects that are difficult to observe and explore with more traditional methods. Examples for such collaborations include the work with Eddie Sionov on characterizing the effects of pomegranate peel extract of mycotoxigenic fungi (1-23), a collaboration with Mikhail Borisover on characterizing the toxicity of oxidized wastewater effluents (1-22), and additional ongoing projects with Shlomo Sela, Shmuel Assouline, Eddie Cytrin, Carmit Ziv, and more.

1. **Achievements in Applied Research**I have contributed to raising the awareness of field researchers in freshwater aquaculture to the problems posed by harmful cyanobacterial blooms in aquaculture ponds, and have established myself as a contact person for questions related to this problem. This has also led to an invitation by the department of fisheries to introduce and explain the subject during a professional development day for workers in freshwater aquaculture. I have recently initiated a preliminary field experiment at the Dor research station testing a new approach for the management of freshwater aquaculture ponds to reduce the development of cyanobacterial blooms during the summer months.

The LRRS project, which was initiated as a means to detect cyanobacterial blooms in aquaculture ponds, has now been expanded to detect harmful cyanobacteria in bioreactors for the production of algal biomass. We are currently working towards a patent application covering this aspect of the project. This work has attracted interest from several companies, and two of those expressed interest in a collaboration, including meetings with Kidum. I hope and believe that such collaborations can indeed be established in the coming year.

My joint work with Eddie Cytrin on the pathogen *A. salmonicida* has already led to several important insights into the ecology and possible reservoirs of the pathogen in aquaculture environments in Israel. If successful this project can have several applicative outcomes that will ultimately allow better management of aquaculture ponds and fish stocks in regards to this pathogen, and reduce the prophylactic use of antibiotics for its control.

From a wider perspective, while my work is often focused on basic scientific questions, I have made it a point to anchor these in applicative, real life question and problems, often arising from meetings and discussion with people in the field. I thus believe that any of my contributions to basic science may ultimately be translated to applicative advancements that will improve the productivity and sustainability of aquaculture operations in Israel and abroad.