

# Frank O. Aylward, PhD

*Curriculum vitae*

Associate Professor  
Department of Biological Sciences  
Virginia Tech  
Blacksburg, VA

Email – [faylward@vt.edu](mailto:faylward@vt.edu)  
Website – <https://aylwardlab.biol.vt.edu>  
Mastodon – [@FOAylward@genomic.social](https://fosstodon.org/@FOAylward@genomic.social)  
GitHub – <https://github.com/faylward>  
ORCID – 0000-0002-1279-4050

## EDUCATION

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- 2008-2013      PhD in *Microbiology*, Microbiology Doctoral Training Program, **University of Wisconsin-Madison**, Madison, WI. Awarded in August 2013.
- 2004-2008      B.Sc., double-major in *Biochemistry and Molecular Biophysics* and *Molecular and Cellular Biology*, **University of Arizona**, Tucson, Arizona.

## ACADEMIC POSITIONS & RESEARCH EXPERIENCE

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- 2023-            **Associate Professor.** Department of Biological Sciences, Virginia Tech, Blacksburg, VA.
- 2017-2023      **Assistant Professor.** Department of Biological Sciences, Virginia Tech, Blacksburg, VA.
- 2014-2017      **Postdoctoral Researcher.** Advisor: Edward F. DeLong, Center for Microbial Oceanography Research and Education, **University of Hawai'i at Mānoa**, Honolulu, HI.
- 2013-2014      **Postdoctoral Researcher.** Advisor: Edward F. DeLong, Department of Civil and Environmental Engineering, **Massachusetts Institute of Technology**, Cambridge, MA.
- 2008-2013      **PhD Candidate.** Advisor: Cameron Currie, Department of Bacteriology & Great Lakes Bioenergy Research Center (GLBRC), **University of Wisconsin-Madison**, Madison, WI.
- 2005-2008      **Undergraduate Researcher.** Department of Ecology and Evolutionary Biology, **University of Arizona**, Tucson, AZ.

## ACADEMIC HONORS, AWARDS, & SCHOLARSHIPS

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- 2024            Virginia Academy of Sciences Life Science Award
- 2022            NIH R35 ESI-MIRA
- 2022            National Science Foundation CAREER award
- 2020            Outstanding Teaching Award, Department of Biological Sciences, Virginia Tech
- 2019            Luther and Alice Hamlett Endowed Junior Faculty Fellowship
- 2019, 2023      Outstanding Research Award, Department of Biological Sciences, Virginia Tech
- 2019            Simons Foundation Early Career Award in Marine Microbial Ecology and Evolution
- 2018            Alfred P. Sloan Research Fellowship in Ocean Sciences
- 2012            International Society for Microbial Ecology Travel Grant (Copenhagen, DK)
- 2012            Wisconsin Distinguished Graduate Fellowship, University of Wisconsin-Madison
- 2011            Hopkins Microbiology Course Fellowship (Pacific Grove, CA)
- 2009            Honorable mention, Graduate Research Fellowship Program, NSF
- 2007            Van de Velde Undergraduate Research Scholarship, University of Arizona
- 2006            Galileo Circle Undergraduate Research Scholarship, University of Arizona

## GRANTS, CONTRACTS, & RESEARCH FELLOWSHIPS

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*Reverse chronological order*

- 2022-2027 Sole-PI, **NIH R35, Early Stage Investigator MIRA** (\$1,861,244). “Coevolutionary Dynamics and Gene Exchange Between Nucleo-Cytoplasmic Large DNA Viruses and Eukaryotes”.
- 2022-2027 Sole-PI, **National Science Foundation CAREER Award** (\$988,984). “Bioinformatic Resources for Promoting Research and Education of Giant Viruses”.
- 2021-2022 Co-PI, **CALS Strategic Plan Advancement 2021 Integrated Internal Competitive Grants Program**, with Biswarup Mukhopadhyay (PI), and co-PIs Reza Ovissipour and Scott Lowman (\$59,800). “Efficient anaerobic digestion of food waste to methane”.
- 2020-2022 Co-PI, **John Lee Pratt Animal Nutrition Program**, with Michael Persia (PI), John Mauer, and Eric Wong (\$125,000). “Nutritional modulation of the microbiome as a strategy for antibiotic-free poultry production using a smart farm approach.”
- 2019-2022 Sole-PI, **Luther and Alice Hamlett Endowed Junior Faculty Fellowship** (\$30,000)
- 2019-2022 PI, **NSF Infrastructure Innovation for Biological Research**, with co-I Liqing Zhang (\$555,496). “Innovative Software and Databases to Leverage RNA Polymerase as a Phylogenetic Marker in Metagenomic Data”.
- 2019-2022 Sole-PI, **Simons Foundation Early Career Award in Marine Microbial Ecology and Evolution** (\$624,000). “Revealing the Tempo and Mode of Prokaryotic Genome Evolution in the Ocean”.
- 2018-2020 Sole-PI, **Alfred P. Sloan Research Fellowship in Ocean Sciences** (\$65,000)
- 2018-2020 PI, **Virginia Tech ICTAS Junior Faculty Award**, with co-I Liqing Zhang (\$80,000). “Leveraging Metagenomic ‘Big Data’ for the Discovery of Novel Microbial Diversity in the Biosphere”.

## PUBLICATIONS

*Full publication information can also be found on [PubMed](#)*

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\* Co-first author; # Graduate or Undergraduate mentee; ± Corresponding author.

### *Peer-reviewed original research articles*

1. K Piedl, **FO Aylward**, E Mevers. The microbiota of moon snail egg collars is shaped by host-specific factors. *Microbiology Spectrum*. 2024, e01804-24.
2. BL de Azevedo, VF Queiroz, IL de Aquino, TB Machado, de Assis FL, Reis E... **FO Aylward**... JS Abrahão. The genomic and phylogenetic analysis of *Marseillevirus cajuinensis* raises questions about the evolution of *Marseilleviridae* lineages and their taxonomical organization. *Journal of Virology*. 2024, 98(6):e00513-24.
3. ZK Barth, I Hicklin, J Thézé, J Takatsuka, M Nakai, EA Herniou, AM Brown, and **FO Aylward**<sup>±</sup>. Genomic analysis of hyperparasitic viruses associated with entomopoxviruses. *Virus Evolution*, 2024, 10(1):veae051.
4. A Fromm, G Hevroni, F Vincent, D Schatz, CA Martinez-Gutierrez, **FO Aylward**<sup>±</sup>, A Vardi<sup>±</sup>. Single-cell RNA-seq of the rare virosphere reveals the native hosts of giant viruses in the marine environment. *Nature Microbiology*, 2024, <https://doi.org/10.1038/s41564-024-01669-y>.

5. AD Ha, **FO Aylward**<sup>‡</sup>. Automated classification of giant virus genomes using a random forest model built on trademark protein families. *npj Viruses*, 2 (1), 9
6. CA Martinez-Gutierrez, JC Uyeda, **FO Aylward**<sup>‡</sup>. A timeline of bacterial and archaeal diversification in the ocean. *eLife*, 2023, <https://doi.org/10.7554/eLife.88268.2>.
7. TB Machado, AC Picorelli, BL de Azevedo, IL de Aquino, VF Queiroz, RA Rodrigues, ... **FO Aylward**, LE Del-Bem, JS Abrahão. Gene duplication as a major force driving the genome expansion in some giant viruses. *Journal of Virology*, 2023; e01309-23.
8. **FO Aylward**<sup>‡</sup>, JS Abrahão, CPD Brussaard, MG Fischer, M Moniruzzaman, H Ogata, CA Suttle. Taxonomic update for giant viruses in the order *Imitervirales* (phylum *Nucleocytoviricota*). *Archives of Virology*, 2023; 168(11):283.
9. J Niemeyer, L Fischer, **FO Aylward**, M Schroda. Analysis of Viral Promoters for Transgene Expression and of the Effect of 5'-UTRs on Alternative Translational Start Sites in *Chlamydomonas*. *Genes*, 2023; 14(4):948.
10. AD Ha, M Moniruzzaman, & **FO Aylward**<sup>‡</sup>. Assessing the biogeography of marine giant viruses in four oceanic transects. *ISME communications*, 2023; 3(1), 43.
11. SS Tithi, **FO Aylward**, RV Jensen, L Zhang. FastViromeExplorer-Novel: Recovering Draft Genomes of Novel Viruses and Phages in Metagenomic Data. *Journal of Computational Biology*, 2023; 30(4): 391-408.
12. R Farzad<sup>‡</sup>, AD Ha, **FO Aylward**<sup>‡</sup>. Diversity and genomics of giant viruses in the North Pacific Subtropical Gyre. *Frontiers in Microbiology*, 2022; 13: 1021923.
13. M Moniruzzaman, P Erazo-Garcia<sup>#</sup>, **FO Aylward**<sup>‡</sup>. Giant Endogenous Viruses contribute to intra-strain genomic variability in the unicellular green alga *Chlamydomonas reinhardtii*. *Virus Evolution*, 2022; 8(2): veac102.
14. IS Hines, KD Santiago-Morales, CS Ferguson, J Clarrington, M Thompson, M Rauschenbach, U Levine, D Drahos, **FO Aylward**, SA Smith, DD Kuhn, AM Stevens. Steelhead trout (*Oncorhynchus mykiss*) fed probiotic during the earliest developmental stages have enhanced growth rates and intestinal microbiome bacterial diversity. *Frontiers in Marine Science*, 2022; 9:1021647
15. CA Martinez-Gutierrez<sup>#</sup>, **FO Aylward**<sup>‡</sup>. Genome size distributions in bacteria and archaea are strongly linked to phylogeny at broad phylogenetic scales. *PLoS Genetics*, 2022; 18(5):e1010220.
16. AR Weinheimer<sup>#</sup>, **FO Aylward**. Infection strategy and biogeography distinguish cosmopolitan groups of jumbo bacteriophages. *The ISME Journal*, 2022; 16: 1657–1667.
17. BH Khairunisa, D Susanti, U Loganathan, CD Teutsch, BT Campbell, D Fiske, CA Wilkinson, **FO Aylward**, B Mukhopadhyay. Dominant Remodeling of Cattle Rumen Microbiome by *Schedonorus arundinaceus* (Tall Fescue) KY-31 Carrying a Fungal Endophyte. *Access Microbiology*, 2022; 4(2).
18. D Muratore, AK Boysen, MJ Harke, KW Becker, JR Casey, SN Coesel, DR Mende, ST Wilson, **FO Aylward**, JM Eppley, A Vislova, S Peng, RA Rodriguez-Gonzalez, SJ Beckett, EV Armbrust, EF DeLong, DM Karl, AE White, JP Zehr, BAS Van Mooy, ST Dyhrman, AE Ingalls, JS Weitz. 2021. Complex marine microbial communities partition metabolism of scarce resources over the diel cycle. *Nature Ecology and Evolution*, 2022; 6, 218–229.
19. **FO Aylward**<sup>‡</sup>, M Moniruzzaman, AD Ha, EV Koonin. A phylogenomic framework for charting the diversity and evolution of giant viruses. *PLOS Biology*, 2021; 19(10).
20. ED Osburn, BD Badgley, BD Strahm, **FO Aylward**, JE Barrett. Emergent properties of microbial communities drive accelerated biogeochemical cycling in disturbed temperate forests. *Ecology*, 2021; 102(12).

21. ED Osburn, **FO Aylward**, JE Barrett. Historical land use has long-term effects on microbial community assembly processes in forest soils. *ISME Communications*. 2021; 1(48).
22. CA Martinez-Gutierrez<sup>#</sup> & **FO Aylward**<sup>‡</sup>. Phylogenetic signal, congruence, and uncertainty across bacteria and archaea. *Molecular Biology and Evolution*, 2021; 38(12).
23. ED Osburn, BD Badgley, **FO Aylward**, JE Barrett. Historical forest disturbance mediates soil microbial community responses to drought. *Environmental Microbiology*, 2021; 23(7).
24. AD Ha, M Moniruzzaman, **FO Aylward**<sup>‡</sup>. High transcriptional activity and diverse functional repertoires of hundreds of giant viruses in a coastal marine system. *mSystems*, 2021; 6(4).
25. AK Boysen, LT Carlson, BP Durham, RD Groussman, **FO Aylward**, F Ribalet, KR Heal, AE White, EF DeLong, EV Armbrust, AE Ingalls. Particulate metabolites and transcripts reflect diel oscillations of microbial activity in the surface ocean. *mSystems*, 2021; 6(3).
26. S Karki<sup>#</sup>, M Moniruzzaman, **FO Aylward**<sup>‡</sup>. Comparative genomics and environmental distribution of large dsDNA viruses in the family *Asfarviridae*. *Frontiers in Microbiology*, 2021; 12:657471.
27. **FO Aylward**<sup>‡</sup>, M Moniruzzaman. ViralRecall—a flexible command-line tool for the detection of giant virus signatures in ‘omic data. *Viruses*, 2021; 13(2):150.
28. M Moniruzzaman, AR Weinheimer<sup>#</sup>, CA Martinez-Gutierrez<sup>#</sup>, **FO Aylward**<sup>‡</sup>. Widespread endogenization of giant viruses shapes green algal genomes. *Nature*, 2020; 58:141-145.  
**\*\* Winner of the 2022 Lindeman Award for Best Paper, American Society of Limnology and Oceanography**
29. AR Weinheimer<sup>#</sup> & **FO Aylward**<sup>‡</sup>. A distinct lineage of *Caudovirales* that encodes a deeply-branching multi-subunit RNA Polymerase. *Nature Communications*, 2020; 11(1): 1-9.
30. **FO Aylward**<sup>‡</sup> & AE Santoro AE<sup>‡</sup>. Heterotrophic thaumarchaea with small genomes are widespread in the dark ocean. *mSystems*, 2020; 5:e00415-20.
31. M Moniruzzaman, CA Martinez-Gutierrez<sup>#</sup>, AR Weinheimer<sup>#</sup>, **FO Aylward**<sup>‡</sup>. Dynamic genome evolution and complex virocell metabolism of globally-distributed giant viruses. *Nature Communications*, 2020; 11(1): 1-11.
32. AM Linz, **FO Aylward**, S Bertilsson, KM McMahon. Time-series metatranscriptomes reveal conserved patterns between phototrophic and heterotrophic microbes in diverse freshwater systems. *Limnology and Oceanography*, 2020; 65:101-112.
33. ED Osburn, SG McBride, **FO Aylward**, BD Badgley, BD Strahm, JD Knoepp, JE Barrett. Soil bacterial and fungal communities exhibit distinct long-term responses to disturbance in temperate forests. *Frontiers in Microbiology*, 2019; 10:2872.
34. CA Martinez-Gutierrez<sup>#</sup> & **FO Aylward**<sup>‡</sup>. Strong purifying selection is associated with genome streamlining in epipelagic *Marinimicrobia*. *Genome Biology and Evolution*, 2019; 11 (10), 2887-2894.
35. BC Kolody, JP McCrow, L Zeigler Allen, **FO Aylward**, KM Fontanez, A Moustafa, M Moniruzzaman, FP Chavez, CA Scholin, EE Allen, AZ Worden, EF DeLong, AE Allen. Diel transcriptional response of a California Current plankton microbiome to light, low iron, and enduring viral infection. *The ISME Journal*, 2019; 13(11): 2817-2833.
36. MJ Harke, FR Frischkorn, ST Haley, **FO Aylward**, JP Zehr, ST Dyhrman. Periodic and coordinated gene expression between a diazotroph and its diatom host. *The ISME Journal*, 2019; 13(1):118-131.
37. EW Getz, SS Tithi, L Zhang, **FO Aylward**<sup>‡</sup>. Parallel evolution of genome streamlining and cellular bioenergetics across the marine radiation of a bacterial phylum. *mBio*, 2018; 9(5).

38. SS Tithi, **FO Aylward**, RJ Jensen, L Zhang. FastViromeExplorer: a pipeline for virus and phage identification and abundance profiling in metagenomics data. *PeerJ*, 2018; 12;6:e4227.
39. Luo E, **FO Aylward**, DR Mende, EF DeLong. Bacteriophage distributions and temporal variability in the ocean's interior. *mBio*, 2017; 8(6):e01903-17.
40. **FO Aylward**, D Boeuf, DR Mende, EM Wood-Charlson, A Vislova, JM Eppley, AE Romano, EF DeLong. Diel cycling and long-term persistence of viruses in the ocean's euphotic zone. *Proceedings of the National Academy of Sciences, USA*, 2017; 114(43): 11446-11451.
41. DR Mende\*, J Bryant\*, **FO Aylward\***, JM Eppley, TN Nielsen, DM Karl, EF DeLong. Environmental drivers of a microbial genomic transition zone in the ocean's interior. *Nature Microbiology*, 2017; 2(10): 1367.
42. ST Wilson\*, **FO Aylward\***, F Ribalet, B Barone, JR Casey, PE Connell, JM Eppley, S Ferrón, JN Fitzsimmons, CT Hayes, AE Romano, KA Turk-Kubo, A Vislova, EV Armbrust, DA Caron, MJ Church, JP Zehr, DM Karl, EF DeLong. Coordinated regulation of growth, activity and transcription in natural populations of the unicellular nitrogen-fixing cyanobacterium *Crocospaera*. *Nature Microbiology*, 2017; 2(9): 118.
43. EA Gontang, **FO Aylward**, C Carlos, TG del Rio, M Chovatia, A Fern, C-C Lo, SA Malfatti, SG Tringe, CR Currie, R Kolter. Major changes in microbial diversity and community composition across gut sections of a juvenile *Panchlora* cockroach. *PLOS ONE*, 2017; 12(5): e0177189.
44. DR Mende\*, **FO Aylward\***, JM Eppley, TN Nielsen, EF DeLong. Improving environmental genomes via integration of metagenomic and single-cell assemblies. *Frontiers in Microbiology*, 2016; 7:e143.
45. JA Bryant, **FO Aylward**, JM Eppley, DM Karl, MJ Church, EF DeLong. The influence of wind and solar radiation on microbial community diversity in the North Pacific Subtropical Gyre. *The ISME Journal*, 2016; 10(6):1308-1322.
46. **FO Aylward**, JM Eppley, JM Smith, FP Chavez, CA Scholin, EF DeLong. Microbial community transcriptional network dynamics are conserved across all three domains of life at ocean basin scales. *Proceedings of the National Academy of Sciences, USA*, 2015; 112(17): 5443-5448.
47. MA Spero, **FO Aylward**, CR Currie, TJ Donohue. Phylogenomic analysis and predicted physiological role of the proton-translocating NADH:quinone oxidoreductase (complex I) across Bacteria. *mBio*, 2015; 5(6): e02077-14.
48. **FO Aylward\***, L Khadempour, DM Tremmel#, BR McDonald, CD Nicora, S Wu, RJ Moore, DJ Orton, ME Monroe, PD Piehowski, SO Purvine, RD Smith, MS Lipton, KE Burnum-Johnson, CR Currie. Enrichment and broad representation of plant biomass-degrading enzymes in the specialized hyphal swellings of *Leucoagaricus gongylophorus*, the fungal symbiont of leaf-cutter ants. *PLOS ONE*, 2015; 10(8): e0134752.
49. **FO Aylward\***, G Suen, PHW Biedermann, AS Adams, JJ Scott, SA Malfatti, T Glavina del Rio, SG Tringe, M Poulsen, KF Raffa, KD Klepzig, CR Currie. Convergent bacterial microbiotas in the fungal agricultural systems of insects. *mBio*, 2014; 5(6): e02077-14.
50. EL Huang\*, **FO Aylward\***, Y-M Kim, B-JM Webb-Robertson, CD Nicora, Z Hu, T Metz, MS Lipton, RD Smith, CR Currie, KE Burnum-Johnson. The fungus gardens of leaf-cutter ants undergo a distinct physiological transition during biomass degradation. *Environmental Microbiology Reports*, 2014; 6(4): 389-395.
51. **FO Aylward**, KE Burnum, SG Tringe, C Teiling, DM Tremmel#, J Moeller, JJ Scott, KW Barry, CD Nicora, PD Piehowski, S Malfatti, SO Purvine, LA Goodwin, RD Smith, GM Weinstock, NM Gerardo, G Suen, MS Lipton, CR Currie. *Leucoagaricus gongylophorus* produces diverse lignocellulases for the degradation of recalcitrant plant polymers in the fungus gardens of leaf-cutter ants. *Applied and Environmental Microbiology*, 2013; 79(12): 3770-3778.

52. **FO Aylward**, BR McDonald, SM Adams, A Valenzuela, RA Schmidt, LA Goodwin, T Woyke, CR Currie, G Suen, M Poulsen. Comparison of 26 sphingomonad genomes reveals diverse environmental adaptations and biodegradative capabilities. *Applied and Environmental Microbiology*, 2013; 79(12): 3724-3733.
53. AS Adams\*, **FO Aylward\***, SM Adams, N Erbilgin, BH Aukema, CR Currie, G Suen, and KF Raffa. Mountain pine beetles colonizing historical, transitional, and naïve host trees are associated with a community of terpenoid-degrading bacteria. *Applied and Environmental Microbiology*, 2013; 79(11): 3468-3475.
54. MR Christopherson, G Suen, S Bramhacharya, KA Jewell, **FO Aylward**, D Mead, PJ Brumm. The genome sequences of *Cellulomonas fimi* and “*Cellvibrio gilvus*” reveal the cellulolytic strategies of two facultative anaerobes, transfer of “*Cellvibrio gilvus*” to the genus *Cellulomonas*, and proposal of *Cellulomonas gilvus* sp. nov. *PLOS ONE*, 2013; 8(1): e53954.
55. **FO Aylward**, KE Burnum, JJ Scott, G Suen, SG Tringe, SM Adams, GJ Starrett<sup>#</sup>, KJ Berry, LA Goodwin, MS Lipton, CR Currie. Metagenomic and proteomic insights into the fungus gardens of leaf-cutter ants. *The ISME Journal*, 2012; 6(9): 1688-1702.
56. G Suen, PJ Weimer, DM Stevenson, **FO Aylward**, J Boyum, J Deneke, C Drinkwater, NN Ivanova, N Mikhailova, O Chertkov, LA Goodwin, CR Currie, D Mead, PJ Brumm. The complete genome sequence of the *Fibrobacter succinogenes* S85 reveals a cellulolytic and metabolic specialist. *PLOS ONE*, 2011; 6(4): e18814.
57. G Suen, JJ Scott, **FO Aylward**, SM Adams, SG Tringe, A Pinto-Tomás, CE Foster, M Pauly, PJ Weimer, K Barry, LA Goodwin, P Bouffard, L Li, J Osterberger, TT Harkins, SC Slater, TJ Donohue, CR Currie. An insect herbivore microbiome with high plant biomass-degrading capacity. *PLOS Genetics*, 2010; 6(9): e1001129.
58. MD Herron, JD Hackett, **FO Aylward**, RE Michod. Triassic origin and early radiation of multicellular volvocine algae. *Proceedings of the National Academy Sciences, USA*, 2009; 106(9): 3254-8.

### *Review and perspective articles*

1. ZK Barth, **FO Aylward**<sup>‡</sup>. March of the Proviruses. *Proceedings of the National Academy Sciences, USA*, 2023; 121(14): e2402541121.
2. M Moniruzzaman, MP Erazo Garcia, R Farzad, AD Ha, A Jivaji, S Karki, U Sheyn, J Stanton, B Minch, D Stephens, DC Hancks, RAL Rodrigues, JS Abrahao, A Vardi, **FO Aylward**<sup>‡</sup>. Virologs, viral mimicry, and virocell metabolism: the expanding scale of cellular functions encoded in the complex genomes of giant viruses. *FEMS Microbiology Reviews*, 2023; 5;47(5):fuad053.
3. M Moniruzzaman & **FO Aylward**<sup>‡</sup>. Endogenous DNA viruses take center stage in eukaryotic genome evolution. *Proceedings of the National Academy Sciences, USA*, 2023; 120 (21) e2305212120.
4. **FO Aylward**<sup>‡</sup> & M Moniruzzaman. Viral Complexity. *Biomolecules*, 2022; 12(8), 1061.
5. **FO Aylward**<sup>‡</sup>. The coevolutionary history of the microbial planet. Invited Crystal Ball review for *Environmental Microbiology Reports*, 2021; 13(1):12-14
6. **FO Aylward**, CR Currie, G Suen. The evolutionary innovation of nutritional symbioses in fungus-growing ants. *Insects*, 2012; 3(1): 41-61.

### *Genome announcements (editorial review only)*

1. **FO Aylward**, DM Tremmel<sup>#</sup>, GJ Starrett<sup>#</sup>, DC Bruce, P Chain, A Chen, KW Davenport, C Detter, CS Han, J Han, M Huntemann, NN Ivanova, NC Kyrpides, V Markowitz, K Mavrommatis, M Nolan, I Pagani, A Pati, S

Pitluck, C-L Wei, LA Goodwin, T Woyke, CR Currie. Complete genome of *Serratia* sp. strain FGI 57, a strain associated with leaf-cutter ant fungus gardens. *Genome Announcements*, 2013; 1(2): e00239-12.

2. **FO Aylward**, DM Tremmel<sup>‡</sup>, DC Bruce, P Chain, A Chen, KW Davenport, C Detter, CS Han, J Han, M Huntemann, NN Ivanova, NC Kyrpides, V Markowitz, K Mavrommatis, M Nolan, I Pagani, A Pati, S Pitluck, C-L Wei, LA Goodwin, T Woyke, CR Currie. Complete genome of *Enterobacteriaceae* bacterium strain FGI 57, a strain associated with leaf-cutter ant fungus gardens. *Genome Announcements*, 2013; 1(1): e00238-12.

### *Book chapters*

1. CA Martinez-Gutierrez & **FO Aylward**. Evolutionary Genomics of Marine Bacteria and Archaea. In: **The Marine Microbiome**, edited by LJ Stal and MS Cretoiu. 2022. Springer, New York, NY.
2. **FO Aylward**. Identifying virus-like regions in microbial genomes using Hidden Markov Models. In: **Case Studies in Systems Biology**, 2021, pp. 263-270. Springer, New York, NY.
3. G Suen, JJ Scott, **FO Aylward**, CR Currie. The Microbiome of Leaf-cutter Ant Fungus Gardens. In: de Bruin, F.J. ed., *Handbook of Molecular Microbial Ecology, Volume 2: Metagenomics in Different Habitats*, 2011, pp. 367-380. John Wiley and Sons, Inc., Hoboken, NJ, USA.
4. G Suen, **FO Aylward**, SC Slater, BS Goldman. From Genetics to Genomics. In: Maloy, S., Hughes, K.T., Casadesus, J. eds., *The Lure of Bacterial Genetics: A Tribute to John Roth*, 2010, pp. 257-266. American Society for Microbiology Press, Washington, D.C., USA.

### *Articles with mentees published in non-refereed undergraduate research compilations*

1. DP Declat<sup>‡</sup>, **FO Aylward**, CR Currie. Interactions Between Actinobacteria and Other Microorganisms Present in the Fungus Gardens of Leaf-cutter Ants. Integrated Biological Sciences Summer Research Program (IBS-SRP) Research Journal, 2010
2. JA Montalvo<sup>‡</sup>, **FO Aylward**, G Suen, A Valenzuela, CR Currie. Characterizing Lignocellulose-Degrading Microbes from the Fungus Gardens of Leaf-Cutting Ants. Integrated Biological Sciences Summer Research Program (IBS-SRP) Research Journal, 2009.

## **SERVICE**

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### *Service at the International Committee for the Taxonomy of Viruses (ICTV)*

2021-Present Study group chair, *Imitervirales*  
2024-Present Study group member, *Pimascovirales*  
2024-Present Executive committee member

### *Ad Hoc Academic Reviewing*

**Journals:** *Aquaculture, Applied and Environmental Microbiology, Applied Microbiology and Biotechnology, Archives of Virology, Bioinformatics, BMC Genomics, Cell, Cell Reports, Communications Biology, Current Biology, Current Opinion in Virology, Diversity, Ecological Entomology, The EMBO Journal, Environmental Microbiology, Environmental Microbiology Reports, Epigenetics & Chromatin, Frontiers in Microbiology, Genome, Genome Biology, Genome Biology and Evolution, Gut Microbes, The ISME Journal, Journal of Agricultural and Food Chemistry, Journal of Genetic Engineering and Biotechnology, Journal of Virology, Limnology and Oceanography Methods, mBio, Microbial Ecology, Microbiology and Molecular Biology Reviews, Microbiome, Microorganisms, Molecular Biology and Evolution, Molecular Ecology, mSystems, Nature, Nature Communications, Nature Methods, Nature Microbiology, Nature Protocols, Nature*

*Reviews Microbiology, npj Viruses, Phage: Therapy, Applications, and Research, PLOS Biology, PLOS Genetics, PLOS Computational Biology, PLOS ONE, Proceedings of the National Academy of Sciences USA, Science Advances, Science Bulletin, Scientific Reports, Viruses, Virus Evolution, Virus Research, Water Science and Technology.*

**Funding Agencies:** Austrian Science Fund; French National Research Agency; Czech Science Foundation; German Research Foundation; Israel Science Foundation; Kansas EPSCOR (NSF); National Science Foundation of China; Natural Sciences and Engineering Research Council (Canada); Nature Environment Research Council (UK); Singapore National Research Foundation; Stazione Zoologica Anton Dohrn (Italy); Villum foundation (Denmark); United States Army Research Office; USDA Agriculture and Food Research Initiative; US Department of Energy Graduate Student Research Program; US National Science Foundation, Division of Environmental Biology; US National Science Foundation, Biological Oceanography Program.

### **Grant Panels**

2024 Panelist, NIH Fellowships: Genes, Genomes and Genetics (F08)  
2023 Panelist, NSF Directorate for Biological Sciences

### **Editorial Service**

**Editorial Board Member, Applied and Environmental Microbiology (2022-), Environmental Microbiology & Environmental Microbiology Reports (2018-).**

**Past Editorial Board Service, International Society of Microbial Ecology Journal (ISMEJ) (2021-2024)**

**Ad hoc Editor:** *PLOS Biology, PLOS Genetics, PLOS Pathogens, mBio, Frontiers in Microbiology*

**Associate Editor:** *Frontiers in Microbiology- Viral Evolution and Diversification specialty section.*

### **Conference Organization**

**Flash talk coordinator,** ASM Microbe, 2018.

**Graduate Student Coordinator:** Great Lakes Bioenergy Research Center annual retreat planning committee (May 2011).

### **University Service at Virginia Tech**

2022-Present Committee member, Biological Sciences Awards Committee  
2018-Present Committee member, Systems Biology Curriculum Committee  
2023 Research Day poster judge  
2019, 2023 Committee member, Biological Sciences assistant professor search committee  
2021-2022 Committee member, Biological Sciences Executive Committee  
2021 Committee member, for the review of Academy of Integrated Science Collegiate Faculty.  
2020 Reviewer, Institute for Critical Technology and Applied Science (ICTAS) Junior Faculty Award Program (13 4-page grants)  
2019 Committee chair, Global Change Center Seed Grant Program (4 2-page grants)  
2019 Committee member, Luther and Alice Hamlett College of Science Fellowship review committee (14 applications)  
2019 Outreach presentations at Blacksburg Community High School to promote the Systems Biology program at Virginia Tech  
2018 Oral presentation judge for Virginia Tech Research Day  
2018 Guest Presenter, Biological Sciences Alumni Advisory Board Meeting



## PRESENTATIONS

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*External seminars are bolded*

<b>September 24<sup>th</sup>, 2024</b>	<b>Invited seminar, Biodesign Institute, Arizona State University</b>
<b>May 1<sup>st</sup>, 2024</b>	<b>Invited seminar, National Center for Biotechnology Information, Bethesda, MD.</b>
<b>September 26<sup>th</sup>, 2023</b>	<b>Invited keynote speaker, Brazilian Congress of Virology, Ouro Preto, Brazil.</b>
<b>May 25<sup>th</sup>, 2023</b>	<b>Invited keynote speaker, Aquatic Virus Workshop, Quebec City, Canada.</b>
<b>April 18<sup>th</sup>, 2023</b>	<b>Department of Biological Sciences seminar series, North Carolina State University.</b>
<b>March 1<sup>st</sup>, 2023</b>	<b>Department of Immunology seminar series, University of Texas Southwestern Medical Center.</b>
<b>November 30<sup>th</sup>, 2022</b>	<b>Department of Oceanography seminar series, University of Rhode Island.</b>
<b>October 14<sup>th</sup>, 2022</b>	<b>Invited keynote speaker, Symposium of Virology, University of Nebraska-Lincoln.</b>
<b>February 22<sup>nd</sup>, 2022</b>	<b>Viruses of Microbes 2022 webinar series [Virtual Presentation]</b>
<b>October 21<sup>st</sup>, 2021</b>	<b>Keynote Speaker, ASM Ambassadors Early Career Program [Virtual Presentation].</b>
<b>February 24<sup>th</sup>, 2021</b>	<b>Genetics, Bioinformatics, and Computational Biology seminar series, Virginia Tech [Virtual Presentation].</b>
<b>February 12<sup>th</sup>, 2021</b>	<b>Virginia Tech Life Sciences Seminar Series [Virtual Presentation].</b>
<b>January 15<sup>th</sup>, 2021</b>	<b>Metagenomics Forum [Virtual Presentation], hosted by Francisco Rodriguez-Velera, Universidad Miguel Hernandez, Spain.</b>
<b>November 4<sup>th</sup>, 2019</b>	<b>Department of Microbiology seminar series, University of Tennessee at Knoxville</b>
<b>October 2<sup>nd</sup>, 2019</b>	<b>Department of Biological Sciences seminar series, University of North Carolina-Greensboro</b>
<b>September 24<sup>th</sup>, 2019</b>	<b>Department of Biological Sciences seminar series, University of Virginia.</b>
<b>July 18<sup>th</sup>, 2018</b>	<b>Computer and Information Sciences Research Colloquium, Virginia Military Academy.</b>
<b>November 28<sup>th</sup>, 2017</b>	<b>Microbiology Seminar series, Virginia Tech.</b>
<b>November 13<sup>th</sup>, 2017</b>	<b>Biochemistry Department seminar series, Virginia Tech.</b>
<b>March 3<sup>rd</sup>, 2017</b>	<b>American Society for Limnology and Oceanography (ASLO), Honolulu, HI.</b>
<b>December 1<sup>st</sup>, 2016</b>	<b>Department of Biological Sciences, Virginia Tech.</b>
<b>September 12<sup>th</sup>, 2016</b>	<b>Agricultural and Biosystems Engineering, University of Arizona.</b>
<b>June 18<sup>th</sup>, 2016</b>	<b>ASM Microbe, Boston, MA.</b>
<b>April 20<sup>th</sup>, 2016</b>	<b>Ecosystem Genomics Initiative, University of Arizona.</b>
<b>April 6<sup>th</sup>, 2016</b>	<b>Molecular, Cellular, and Biomedical Sciences, University of New Hampshire.</b>
<b>March 3<sup>rd</sup>, 2016</b>	<b>Department of Oceanography, University of Hawaii at Manoa.</b>
<b>February 9<sup>th</sup>, 2016</b>	<b>Biology Department, Utah State University.</b>
<b>January 12<sup>th</sup>, 2016</b>	<b>Marine, Earth, and Atmospheric Sciences, NC State University.</b>
<b>August 19<sup>th</sup>, 2012</b>	<b>International Society for Microbial Ecology meeting, Copenhagen, Denmark.</b>
<b>May 17<sup>th</sup>, 2011</b>	<b>Great Lakes Bioenergy Research Center annual retreat, South Bend, IN.</b>

## TEACHING

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*University Courses Taught at Virginia Tech*

*As primary instructor*

Systems Biology 2025, Introduction to Systems Biology I (3 CR)	Fall 2017
Systems Biology 3035, Systems Biology of Genes and Proteins I (4 CR)	Fall 2019
Systems Biology 3036, Systems Biology of Genes and Proteins II (4 CR)	Spring 2018, 2019, 2020, 2022

*As co-instructor*

Microbial Community Analysis GRAD6895, Analysis of Microbiome Data	Spring 2019
Systems Biology 2025, Introduction to Systems Biology I	Fall 2018, 2019
Systems Biology 2026, Introduction to Systems Biology II	Spring 2019, 2020

**Workshops**

2016 *Instructor*, Oceanography and Geobiology Environmental ‘Omics workshop sponsored by the NSF-funded EarthCube program. Topic: Introduction to metagenome assembly and analysis. Hosted by the University of Hawaii at Manoa.

**Guest lectures**

2018 Population Genomics, FREC 5164. Topic: Microbial Genomics.  
 2017 Quantitative Ecology, BIOL 6004. Topic: Microbial Ecology.  
 2016 Oceanography 750. Topic: Marine Microbiology. UH Manoa.  
 2011 Microbiology 551. Topic: Ecological genomics. UW-Madison.  
 2010 Agronomy 375. Topic: Microbial genomics. UW-Madison.

**Teaching Assistantships**

2010-11, ‘13 *Teaching Assistant*. Microbiology 450, UW-Madison  
 2009 *Teaching Assistant*. Microbiology 301 Laboratory, UW-Madison

**STUDENTS, POSTDOCS, AND PERSONNEL ADVISED**

<i>Postdocs</i>	<i>Tenure</i>	<i>Current position</i>
Victoria Queiroz	2024-Present	-
Zachary Barth	2023-Present	-
Uri Sheyn	2022-Present	-
Anh D Ha	2020-2024	Bioinformatics Data Scientist, Black Canyon Consulting
Mohammad Moniruzzaman	2018-2022	Asst. Prof., University of Miami

<i>Graduate Students (program)</i>	<i>Tenure</i>	<i>Current position</i>
Alaina Weinheimer (PhD, Biological Sciences)	2018-2023	Postdoc, Bigelow Labs
Carolina Martinez-Gutierrez (PhD, Biological Sciences)	2018-2022	Postdoc, UNC Greensboro
Claudia Perez (MS, Biological Sciences)	2021-2022	PhD student, UMass Worcester
Nitin Nair (MS, Biological Sciences)	2018-2020	DeepSig, Inc
Sangita Karki (PhD, Biological Sciences)	2020-2024	Postdoc, Aylward lab
Robin Cesur (PhD, Biological Sciences)	2024-Present	-
Jude Aldaroub (PhD, Biological Sciences)	2024-Present	-
Paula Erazo-Garcia (PhD, Biological Sciences)	2022-Present	-
Abdeali Jivaji (PhD, Biological Sciences)	2022-Present	-
Roxanna Farzad (MS, Biological Sciences)	2021-Present	-

**Undergraduate Students**      *Major, year*

Lily Saad	Biochemistry, '25
Emma Franken	Systems Biology, '25
Tyler Harris	Biological Sciences, '24
Gillian Murphy	Systems Bioloy, '24
Menglei Wu	Biological Sciences, '23
Josh Stanton	Biological Sciences, '23
Tiffany McCoy	Biological Sciences, '22
Nick Anderson	Systems Biology, '22
Riley Wilson	Systems Biology, '22
Meagan Todd	Systems Biology, '20
Ashleen Harris	Systems Biology, '20
Gavin Mucker	Systems Biology, '20
Eric Getz	Biological Sciences, '18

### *Graduate Committee Membership*

<b>Student</b>	<b>Advisor</b>	<b>Dates</b>	<b>Program</b>	
Ernie Osburn	Jeb Barret	2017-2021	Bio Sci	PhD
Reem Aldaihani	Lenwood Heath	2020-2022	Comp Sci	PhD
Jeffrey Marano	James Weger	2019-2023	TBMH	PhD
Guadalupe Reynoso	Ann Stevens	2018-2020	Bio Sci	MS
Bela Khairunisa	Biswarup Mukhopadhyay	2017-2023	GBDB	PhD
Paul Risteca	Jeb Barret	2020-2023	Bio Sci	MS
Korin Jones	Lisa Belden	2018-	Bio Sci	PhD
Ramya Nandigam	Lenwood Heath	2019-	Comp Sci	MS
Hollyn Franklin	Bryan Hsu	2021-	Bio Sci	PhD
Isaiah Jordan	Jeremy Draghi	2022-	Bio Sci	PhD
Wilson Farthing	Ann Stevens	2022-	Bio Sci	MS
Rayne Wilson	Ann Stevens	2022-	Bio Sci	MS
Meredith Snyder	Jeb Barret	2023-	Bio Sci	PhD
Shreya Choudhary	David Popham	2022-	Bio Sci	PhD
Rita Makhoul	Bryan Hsu	2024-	MCB	PhD
Chandra Sarkar	Julie Allen	2023-	Bio Sci	PhD

## **OTHER OUTREACH & MENTORSHIP**

### Mentorship

- 2010-2013 Mentor to three undergraduate Microbiology majors (Daniel Tremmel, Gabriel Starrett, and Austin Lynch), as well as a visiting MS student (Thiruvankadam Shanmugam). Several of these students subsequently appeared as co-authors on peer-reviewed journal articles.
- 2009, 2010 Mentor for David Pagan-Declet and Jorge Montalvo ('09 and '10, respectively), students in the Integrated Biological Science Summer Research Program (IBS-SRP), Great Lakes Bioenergy Research Center. Both students were undergraduates at the University of Puerto Rico and subsequently published their work in undergraduate research journals (*see Publications section*).

2009 Mentor to a participant in the Research Experience for Teachers Program hosted by the Great Lakes Bioenergy Research Center. This program provided research experience to elementary school teachers in the greater Madison area. I assisted in developing a bioenergy-related research project and the design of curricula for middle-school science classes.

2007, 2008 Peer Mentors Program, Department of Biochemistry, University of Arizona, Tucson, Arizona. In this program I mentored freshmen Biochemistry majors for one year.

### Outreach

2018 Guest speaker at the Blacksburg High School College Research event. Topic: The Systems Biology program at Virginia Tech.

2017- Open-access bioinformatics tutorials available on the Protocols.IO.  
Link: <https://www.protocols.io/researchers/frank-aylward>

2010 Speaker for the Monona Grove Energy Fair, UW-Madison People Program, UW-Madison Microbiology Club, and the UW-Madison Biological Sciences Preview Weekend, which are all programs focused on broadening participation in biological sciences from high school or undergraduate students.

2006-2008 Ambassadors program, Department of Biochemistry, University of Arizona, Tucson, Arizona. In this program I participated in outreach activities spreading awareness of scientific careers and opportunities to high school students.

## **SOFTWARE AND COMPUTATIONAL RESOURCES**

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**ViralRecall** Tool for identifying signatures of giant viruses in genomic data  
<https://github.com/faylward/viralrecall>

**ncldv\_markersearch** Tool for generating multi-locus phylogenies of giant viruses  
[https://github.com/faylward/ncldv\\_markersearch](https://github.com/faylward/ncldv_markersearch)

**Giant Virus Database** Database with genomic, phylogenetic, and taxonomic resources for giant viruses  
<https://faylward.github.io/GVDB/>

**markerfinder** Tool for identifying phylogenetic marker genes and producing multi-locus phylogenies of bacteria and archaea  
<https://github.com/faylward/markerfinder>