

PATRICK R. SECOR

University of Montana
Division of Biological Sciences – CMMB Graduate Program – Center for Translational Medicine
32 Campus Drive – Missoula, Montana – 59812
patrick.secor at umontana.edu
<https://patsecor.wixsite.com/mysite-1>

ACADEMIC APPOINTMENTS

- 2017- present University of Montana
Assistant Professor
Division of Biological Sciences
CMMB Graduate Program
- 2013-2017 University of Washington
Cystic Fibrosis Foundation Postdoctoral Fellow
Advisor: Pradeep K. Singh
- 2011-2013 University of Washington
NIH T32 Postdoctoral Fellow
Advisor: William C. Parks

EDUCATION

- 2006-2011 Montana State University
Center for Biofilm Engineering
Ph.D. in Biological Sciences/Microbiology
Advisor: Garth James
- 2002-2006 Montana State University
B.S. in Biochemistry

PUBLICATIONS ([Google Scholar](#))

*graduate student, **undergraduate student, ***postdoc, #corresponding author

- 2022 (26) Secor, P. R. #, Michaels, L. A., Bublit, D.C., Jennings, L.K., Singh, P.K. (2022). The Depletion Mechanism Actuates Bacterial Aggregation by Exopolysaccharides and Determines Species Distribution & Composition in Bacterial Aggregates. *Front. Cell. Infect. Microbiol.* <https://doi.org/10.3389/fcimb.2022.869736>
- (25) Faith, D*., Kinnersley, M., Schwartzkopf, C.M*., de Mattos, C.D*., Schmidt, A.K*., and Secor, P.R.#. (2022). Complete Genome Sequence of the N4-like *Pseudomonas aeruginosa* Bacteriophage vB_PaeP_CMS1. *Microbiol Resour Announc*, e0023922. 10.1128/mra.00239-22.
- (24) van Rossem, M., Wilks, S., Kaczmarek, M., Secor, P.R., and D'Alessandro, G. (2022). Modelling of filamentous phage-induced antibiotic tolerance of *P. aeruginosa*. *PLoS One* 17, e0261482. 10.1371/journal.pone.0261482.
- (23) A.K. Schmidt*, A.D. Fitzpatrick, C. S. Schwartzkopf*, D.R. Faith*, L.K. Jennings, A. Coluccio, D.J. Hunt**, L.A. Michaels, D.W. Dorward, J. Wachter, P.A. Rosa, K.L. Maxwell, P.R. Secor#. A Filamentous Bacteriophage Protein Inhibits Type IV Pili to Prevent Superinfection of *Pseudomonas aeruginosa*. *mBio*, 2022; <https://doi.org/10.1128/mbio.02441-21>
- 2021 (22) Kirsch JM, Brzozowski RS***, Faith D.R.*, Round JL, Secor PR, Duerkop BA. Bacteriophage-Bacteria Interactions in the Gut: From Invertebrates to Mammals. *Annu Rev Virol.* 2021;8(1):95-113. doi:10.1146/annurev-virology-091919-101238.
- (21) Jennings LK, Dreifus JE, Reichhardt C, Storek KM, Secor PR, Wozniak DJ, Hisert KB, Parsek MR. *Pseudomonas aeruginosa* aggregates in cystic fibrosis sputum produce

exopolysaccharides that likely impede current therapies. *Cell Rep.* 2021;34(8):108782. doi: 10.1016/j.celrep.2021.108782.

2020

(20) E. B. Burgener, **P. R. Secor**, M. C. Tracy, J. M. Sweere, E. M. Bik, C. E. Milla, and P. L. Bollyky. Methods for Extraction and Detection of Pf Bacteriophage DNA from the Sputum of Patients with Cystic Fibrosis, *Phage: Therapy, Applications, and Research*, June 2020, doi.org/10.1089/phage.2020.0003

(19) **P. R. Secor**[#] and A. A. Dandekar, More than Simple Parasites: The Sociobiology of Bacteriophages and Their Bacterial Hosts. *mBio*, March 10, 2020, <https://mbio.asm.org/content/11/2/e00041-20>

(18) **P. R. Secor**, E B Burgener, M Kinnersley, L K Jennings, V Roman-Cruz*, M Popescu, J D Van Bellegheem, N Haddock, C Copeland**, L A Michaels, C R De Vries, Q Chen, J Pourtois, T J Wheeler, C E Milla, P L Bollyky, Pf Bacteriophage and Their Impact on *Pseudomonas* Virulence, Mammalian Immunity, and Chronic infections. *Front. Immunol.*, 21 February 2020 doi.org/10.3389/fimmu.2020.00244

2019

(17) J M. Sweere, H Ishak, V Sunkari, M S. Bach, R Manasherob, K Yadava, S. M. Ruppert, C. K. Sen, S Balaji, S. G. Keswani, **P. R. Secor**, and Paul L. Bollyky. (2019) The Immune Response to Chronic *Pseudomonas aeruginosa* Wound Infection in Immunocompetent Mice. *Advances in Wound Care*, Vol. 8.

(16) E. B. Burgener, J. M. Sweere, M. S. Bach, **P. R. Secor**, N Haddock, L. K. Jennings, R. L. Marvig, H. K. Johansen, E. Rossi, X. Cao, L. Tian, L. Nedelec, S. Molin, P. L. Bollyky, and C. E. Milla. (2019) Filamentous bacteriophages are associated with chronic *Pseudomonas* lung infections and antibiotic resistance in cystic fibrosis. *Science Translational Medicine*, Vol. 11, Issue 488, eaau9748

(15) J. M. Sweere, H. Ishak, M. S. Bach, V. Sunkari, G. Kaber, R. Manasherob, G. A. Suh, M. Popescu, P. L. Marshall, M. Birukova, E. Katznelson, D. V. Lazzareschi, S. Balaji, S. Keswani, T. R. Hawn, **P. R. Secor**, and P. L. Bollyky. (2019) Filamentous Bacteriophage Suppress Clearance of Bacterial Infection. *Science*, Vol. 363, Issue 6434, eaat9691.

2018

(14) **P. R. Secor**[#], M., L.A., Ratjen, A., Jennings, L.K., Singh, P.K. Entropically-driven aggregation of bacteria by host polymers promotes antibiotic tolerance in *Pseudomonas aeruginosa*. *PNAS*, Oct 2018, 201806005; DOI:10.1073/pnas.1806005115

2017

(13) Jorth, P.A., McLean, K., Ratjen, A., **Secor, P.R.**, Bautista, G.E., Ravishankar, S., Rezayat, A., Garudathri, J., Harrison, J.J., Harwood, R.A., Penewit, K., Waalkes, A., Singh, P.K., Salipante, S.J. (2017) Evolved aztreonam resistance is multifactorial and can produce hypervirulence in *Pseudomonas aeruginosa*. *mBio*, 8:e00517-17

(12) Nazik, H., Joubert, L.M., **Secor, P.R.**, Sweere, J.M., Bollyky, P.L., Sass, G., Cegelski, L., Stevens, D.A. (2017) *Pseudomonas* Phage Inhibition of *Candida albicans*. *Microbiology*, 163 (11), 1568-1577

(11) **Secor P.R.**[#], Sass G, Nazik H, Stevens DA. (2017) Effect of acute predation with bacteriophage on intermicrobial aggression by *Pseudomonas aeruginosa*. *PLoS One*. 16;12(6):e0179659. doi: 10.1371/journal.pone.0179659

(10) **Secor, P.R.**[#], Michaels, L.A., Smigiel, K.S., Rohani, M.G., Jennings, L.K., Hisert, K.B., Arrigoni, A., Braun, K.R., Birkland, T.P., Hallstrand, T.S., Lai, Y., Bollyky, P.L., Singh, P.K., Parks, W.C. (2017) Filamentous bacteriophage produced by *Pseudomonas aeruginosa* alters the inflammatory response and promotes non-invasive infection *in vivo*. *Infection and Immunity*, vol. 85, issue 1. Featured on journal cover.

2016

(9) Penner, J.C., Ferreira, J.A.G., **Secor, P.R.**, Sweere, J.M., Birukova, M.K., Joubert, L.M., Haagensen, J.A.J., Garcia, O., Malkovskiy, A.V., Kaber, G., Nazik, H.,

- Manasherob, R., Spormann, A.M., Clemons, K.V., Stevens, D.A., Bollyky, P.L. (2016) Pf4 Bacteriophage Produced by *Pseudomonas aeruginosa* Inhibits *Aspergillus fumigatus* Metabolism via Iron Sequestration. **Microbiology**, 162, 1583-1594
- (8) **Secor, P.R.** #, Jennings, L.K., Michaels, L.A., Sweere, J.M., Singh, P.K., Parks, W.C., Bollyky, P.L. (2016) Biofilm assembly becomes crystal clear – filamentous bacteriophage organize the *Pseudomonas aeruginosa* biofilm matrix into a liquid crystal. **Microbial Cell**, 3(1): 49-52. Featured on journal cover
- 2015 (7) **Secor, P.R.** #, Sweere, J.M., Michaels, L.A., Malkovskiy, A.V., Lazzareschi, D., Katznelson, E., Rajadas, J., Birnbaum, M.E., Arrigoni, A., Braun, K.R., Evanko, S.P., Stevens, D.A., Kaminsky, W., Singh, P.K., Parks, W.C., Bollyky, P.L. (2015) Filamentous Bacteriophage Promote Biofilm Assembly and Function. **Cell Host & Microbe**, 18(5): 549-59
- (6) Jennings L.K., Storek K.M., Ledvina H.E., Coulon C., Marmont L.S., Sadovskaya I., **Secor, P.R.**, Tseng B.S., Scian M., Filloux A., Wozniak D.J., Howell P.L., Parsek M.R. (2015) Pel is a cationic exopolysaccharide that cross-links extracellular DNA in the *Pseudomonas aeruginosa* biofilm matrix. **PNAS**, 112(36): 11353-8
- 2012 (5) **Secor, P. R.** #, Jennings, L. K., James, G. A., Kirker, K. R., Pulcini, E. D., McInnerney, K., Gerlach, R., Livinghouse, T., Hilmer, J. K., Bothner, B., Fleckman, P., Olerud, J. E., Stewart, P. S. (2012) Phevalin (aureusimine B) production by *Staphylococcus aureus* biofilm and impacts on human keratinocyte gene expression, **PLoS One** 7(7) e40973
- 2011 (4) **Secor, P. R.** #, James, G. A., Fleckman, P., Olerud, J. E., McInnerney, K., and Stewart, P.S. (2011) *Staphylococcus aureus* Biofilm and Planktonic cultures differentially impact gene expression, MAPK phosphorylation, and cytokine production in human keratinocytes. **BMC Microbiol**, 11:143
- 2009 (3) Kirker, K.R., **Secor, P.R.**, James, G.A., Fleckman, P., Olerud, J.E., Stewart, P.S., (2009) Loss of viability and induction of apoptosis in human keratinocytes exposed to *Staphylococcus aureus* biofilms in vitro. **Wound Repair Regen**, 17(5): 690-9
- 2008 (2) Dowd, S.E., Sun, Y., **Secor, P.R.**, Rhoads, D.D., Wolcott, B.M., James, G.A., Wolcott, R.D. (2008) Survey of bacterial diversity in chronic wounds using pyrosequencing, DGGE, and full ribosome shotgun sequencing. **BMC Microbiol**, 8: 43
- (1) James, G.A., Swogger, E., Wolcott, R., Pulcini, E., **Secor, P.R.**, Sestrich, J., Costerton, J.W., Stewart, P.S. (2008) Biofilms in chronic wounds. **Wound Repair Regen**, 16(1): 37-44

OTHER PUBLICATIONS

- 2022 Camilla D. de Mattos*, Artem A. Nemudryi, Dominick Faith*, DeAnna C. Bublitz, Lauren Hammond, Margie A. Kinnersley, Caleb M. Schwartzkopf*, Autumn J. Robinson**, Alex Joyce**, Lia A. Michaels, Robert S. Brzozowski***, Alison Coluccio, Denghui David Xing, Jumpei Uchiyama, Laura K. Jennings, Prahathees Eswara, Blake Wiedenheft, **Patrick R. Secor**. *bioArxiv*. 2022, <https://doi.org/10.1101/2022.04.01.486733>
- 2021 **Secor, P. R.**, Michaels, LA, Bublitz, DC, Jennings, LK, Singh, PK. The depletion mechanism can actuate bacterial aggregation by self-produced exopolysaccharides and determine species distribution and composition in bacterial aggregates. *bioArxiv*. 2021, doi.org/10.1101/2021.05.11.443568
- 2020 Bach MS, Vries CRd, Sweere JM, Popescu M, Belleghem JDV, Kaber G, Burgener EB, Liu D, Tran Q-L, Dharmaraj T, Birukova M, Sunkari V, Balaji S, Keswani S, Banaei N, Khona DK, Nedelec L, Sen CK, Chandra V, **Secor P. R.**, Suh GA, Bollyky PL. Filamentous Bacteriophage Delay Healing of *Pseudomonas*-Infected Wounds. *bioArxiv*. 2020, doi.org/10.1101/2020.03.10.985663

2019 Bollyky, P.L. and Secor, P.R. (2019) The Innate Sense of Bacteriophages. *Cell Host & Microbe*, 25(2).

FUNDING

2022 – 2024 NIH/NIAID Administrative Supplement (PI: Evans, JT), Adjuvanted Lyme disease vaccine

2022 – 2023 NIH/NIGMS CBSD COBRE Pilot Award (PI: Secor, PR), Structural variation of small phage proteins

2020 – 2024 NIH/NIDDK **R01DK124317** (PI: Round, J.L.), Bacteriophage pathobiology of inflammatory bowel disease.

2020 – 2022 NIH/NIAID **R21AI151597** (PI: Secor, PR), Targeting a ubiquitous spirochete bacteriophage to prevent Lyme disease

2018 – 2023 NIH/NIAID **R01AI138981** (PI: Secor, PR), Immunization against filamentous bacteriophages to prevent bacterial infection

2018 University of Montana Genomics Core–Illumina Mini-Grant (PI, Secor, P.R.)

2017 – 2021 NIH/NIGMS CBSD COBRE **P20GM103546** (PI: Sprang, S, Subaward PI: Secor, PR) Young Investigator Award

2017 – 2020 NIH/NIAID Career Transition Award **K22AI125282** (PI: Secor, PR) Understanding polymer-induced bacterial aggregation and antimicrobial tolerance

2017 – 2019 Dr. Ralph and Marian Falk Medical Research Trust – Catalyst Award (PI Bollyky, P.L.).

2016 The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research, \$10,000 direct.

2015 – 2017 Cystic Fibrosis Foundation (National) Postdoctoral Fellowship

2013 – 2014 Cystic Fibrosis Foundation Fellowship, Seattle Chapter, Postdoctoral Fellowship

2013 Stanford University Immunology Postdoctoral Training Grant, awarded, but declined 5T32AI007290-29 (NIH/NIAID)

2011 University of Washington Pulmonary Postdoctoral Training Grant 5T32HL007287-33 (NIH/NHLBI)

OTHER AWARDS

2021 Faculty Merit Award for outstanding research productivity, University of Montana

2020 Faculty Merit Award for outstanding research productivity, University of Montana

2020 Co-moderator, Life at the Cutting Edge, ASM Microbe, Chicago, IL (canceled, COVID-19)

2020 US Patent App. 63/078,777; Compositions and Methods Targeting Filamentous Bacteriophage.

2019 US Patent 10,835,607 - Monoclonal antibody and vaccine targeting filamentous bacteriophage.

2018 Searle Scholar Nominee, University of Montana

2018 Young Investigator Award, Center for Biofilm Engineering, Montana State University

2017 Young Investigator Award, Center for Biomolecular Structure and Design, University of Montana

2016 NIH/NIAID Career Transition Award (K22)

2016 The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research

2015-2017 Cystic Fibrosis Foundation (National) Postdoctoral Fellowship

2013-2014 Cystic Fibrosis Foundation Postdoctoral Fellowship, Seattle Chapter

2009 W.G. Characklis Scholarship for Outstanding Ph.D. Student

TEACHING EXPERIENCE

<i>Fall 2018-present</i>	Instructor, Microbial Physiology (plus lab), University of Montana
<i>Spring 2020</i>	Co-instructor, The Diversity of Life, University of Montana
<i>Summer 2018</i>	HHMI Summer Institute on Scientific Teaching
<i>Spring 2010</i>	Co-instructor, Microbes in the Environment, Montana State University
<i>2007-2008</i>	Teaching Assistant, Molecules to Cells, Montana State University

PRESENTATIONS

<i>Upcoming</i>	Departmental Seminar, Department of Plant and Microbial Biology at UC Berkeley, host Kimberley Seed, PhD
<i>Upcoming</i>	Thinking like a microbe: a tribute to Stanley Falkow symposium, NIH Division of Intramural Research, NIAID Rocky Mountain Laboratories, Hamilton, MT
2022	18th International Conference on <i>Pseudomonas</i> , Atlanta, Georgia
2021	Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana
2020	University of Denver Anschutz Microbiology Seminar Series
2020*	American Society for Microbiology 2020 Microbe Meeting, Co-moderator with Sophie Darch, in-depth symposium Life at the Cutting Edge *cancelled, covid
2020	<i>Pseudomonas</i> Seminar Series, online seminar series organized by Urvis Trivedi (University of Copenhagen) and Cassandra Nelson (University of Maryland).
2019	NIH Rocky Mountain Laboratories Summer Research Symposium, Hamilton, MT
2019	University of Utah Department of Pathology Seminar Series, University of Utah
2019	Division of Biological Sciences Seminar Series, University of California, San Diego
2019	Department of Microbiology and Immunology Seminar Series, Montana State University
2019	Integrative Microbiology Seminar Series, University of California, San Francisco
2019	Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana
2019	Institute for Infection, Immunology, and Inflammation Seminar Series, Vanderbilt University
2018	Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana
2018	Organismal Biology, Ecology, and Evolution Brewery Chalk Talk Series, University of Montana
2018	Montana Biofilm Meeting, Center for Biofilm Engineering, Montana State University
2017	Harkins High School Science Fusion Lecture, University of Montana
2016	Pacific Northwest Epithelial Biology Meeting, University of Washington
2016	Cystic Fibrosis Foundation Retreat, University of Washington
2015	North American Cystic Fibrosis Conference, Phoenix, AZ
2014	North American Cystic Fibrosis Conference, Atlanta, GA
2012	Cystic Fibrosis Foundation Retreat, University of Washington
2008	Invited Speaker, Molecular Probes, Invitrogen, Eugene, OR
2006-2010	Montana Biofilm Meeting, Center for Biofilm Engineering, Montana State University

PROFESSIONAL ACTIVITIES

Referee for Professional Publications –

Cell Host & Microbe, Cell Reports, iScience, Science Advances, eLife, EMBO Journal, Virulence, Nature Biofilms and Microbiomes, Frontiers in Microbiology, Genome Evolution, Virus Evolution, mBio, Journal of Bacteriology, Applied and Environmental Microbiology, mSphere, Journal of Virology, Soft Matter, PLoS ONE, Spectrum, Viruses.

Grant review –

2022 *ad hoc* member, NIAID P01 Study Section, 2021 *ad hoc* member, NIH DDR Study Section, 2020 *ad hoc* member, NIH Special Emphasis Study Section, 2021 *ad hoc* reviewer, Cystic Fibrosis Foundation

Postdoctoral Fellows Mentored –

Robert Brzozowski, PhD

Graduate Students Mentored –

Camilla de Mattos, Caleb Schwartzkopf, Amelia Schmidt, Dominick Faith, Valery Roman-Cruz

Graduate Student Committees –

Camilla de Mattos, Caleb Schwartzkopf, Amelia Schmidt, Dominick Faith, Shaun Wachter, Kelley Van Vaerenberghe, Christopher Pierpont, John Statz

Professional Society Affiliations –

American Society for Microbiology

Departmental Service –

Neuroscience Faculty Search Committee, Center for Translational Medicine Faculty Advisory Council, Graduate Admissions Committee, Microbiology Curriculum Advisory Committee

College Service –

Undergraduate Award and Scholarship Committee, DBS Curriculum Committee

University Service –

Institutional Biosafety Committee