

Cheryl-Emiliane T. Chow

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Research Interests

Viral genomics and metagenomics; marine microbial community ecology and network analysis; temporal and depth-dependent variation of marine viral and bacterial communities and their functions.

Education

PhD in Marine Environmental Biology, Aug 2006 – Aug 2012

University of Southern California, Los Angeles, CA

Dana and David Dornsife College of Letters, Arts and Sciences, Dept. of Biological Sciences.

Thesis Advisor: Jed A. Fuhrman

Dissertation: Monthly Microbial Community Dynamics and Interactions in the Surface Ocean

PhD Student in Programs in Biomedical and Biological Sciences, Aug 2005-2006

University of Southern California, Los Angeles, California

Keck School of Medicine

BA in Biology, Aug 2000 – Dec 2003

Oberlin College, Oberlin, Ohio.

Fellowships and Awards

Harrison M. Kurtz Memorial PhD Student Award for 2011/2012, USC Biological Sciences. Apr 2012

National Science Foundation Graduate Research Fellow, Aug 2006 – Aug 2007; Aug 2008-Aug 2010

Wrigley Fellow, USC Wrigley Institute for Environmental Studies, May – Aug 2008 and 2011

Rose Hills Summer Fellow, USC Wrigley Institute for Environmental Studies, May – Aug 2007

John Frederick Oberlin Merit Scholar, Oberlin College, 2000 - 2003

Professional Experience

Center for Microbial Diversity and Evolution (CMDE) Postdoctoral Fellow, Sept 2012– present

University of British Columbia - Department of Earth and Ocean Sciences

PI: Curtis A. Suttle

Investigating viral genetic diversity, biogeography, and influence on biogeochemical cycles through adaptation and optimization of single cell molecular and bioinformatics tools to viruses.

Research Assistant, Aug 2010 – Aug 2012

PhD Student, Marine Environmental Biology

University of Southern California - Department of Biological Sciences

(1) Characterized temporal and depth-dependent changes in marine viral and bacterial communities at the Microbial Observatory at the San Pedro Ocean Time Series station using metagenomics and community fingerprinting.

(2) Conducted field and laboratory experiments to determine effects of ocean acidification on archaeal and bacterial nitrification rates and community composition.

(3) Determined *nifH* gene diversity in bacterial communities from bioturbated sediments.

(4) Completed short-term incubation experiments to determine how altered environmental or nutrient conditions influence prokaryotic communities.

(5) Developed a rapid indicator QPCR test for hepatitis A virus and completed additional QPCR surveys for Bacteroidetes and enteric viruses in coastal seawater.

Teaching Assistant, Aug 2007 - May 2008

University of Southern California - Department of Biological Sciences

Taught undergraduate lab courses in Microbiology and “Molecular Methods in Microbial Ecology.” Responsibilities included lectures, demonstrations, and supervision of biology undergraduates.

Life Science Research Assistant, May 2004 – July 2005

Stanford University – Department of Genetics

Supervisor: Peter Underhill; PI: LL Cavalli-Sforza

Examined Y chromosome single nucleotide polymorphisms (SNPs) and microsatellites (STRs) to investigate ancient human migration patterns.

Field Research Assistant, Feb - Mar 2004

Shark Bay (Monkey Mia, Western Australia)

NSF Research Experience for Undergraduates (REU), June - Aug 2003

University of Hawai'i at Hilo – Life Sciences Department

Topic: Tropical Conservation Biology and Resource Management

Oberlin College Winter Term Research Intern, January 2003

Center for Disease Control and Prevention (CDC) – Viral & Rickettsial Zoonoses Branch

American Heart Association Undergraduate Student Researcher, June - Aug 2002

Children's Hospital Oakland Research Institute

Workshops and Advanced Training Courses

PRIMER Workshop, June 2007

CSU Fullerton, taught by K. Robert Clarke, 1 week

Microbial Genomics and Metagenomics (IMG) Workshop, February 2009

DOE Joint Genome Institute, 1 week

Microbial Oceanography: Genomes to Biomes, Summer 2009

Center for Microbial Oceanography: Research and Education (CMORE),
University of Hawai'i at Manoa, 6 weeks

Strategies and Techniques for Analyzing Microbial Population Structures, August 2011

Marine Biological Laboratory (MBL), 10 days

Software Carpentry

University of British Columbia, 2 days

Environmental Virology Workshop, Jan 2013

Biosphere2, Tucson AZ, 1 week

Publications

Sengupta S, Zhivotovsky LA, King R, Mehdi SQ, Edmonds CA, **Chow CET**, Lin AA, Mitra M, Sil SK, Ramesh A, Usha Rani MV, Thakur CM, Cavalli-Sforza LL, Majumder PP, Underhill PA. (2006). Polarity and Temporality of High-Resolution Y-Chromosome Distributions in India Identify Both Indigenous and Exogenous Expansions and Reveal Minor Genetic Influence of Central Asian Pastoralists. *American Journal of Human Genetics* 78 (2): 202-221.

Martinez L, Underhill PA, Zhivotovsky LA, Gayden T, Moschonas NK, **Chow CET**, Conti S, Mamolini E, Cavalli-Sforza LL, Herrera RJ. (2007) Paleolithic Y-haplogroup heritage predominates in a Cretan highland plateau. *European Journal of Human Genetics* 15(4): 485-493

Underhill PA, Myres NM, Rootsi S, **Chow CET**, Lin AA, Otiillar RP, King, R; Zhivotovsky, LA; Ritchie, KR; Cavalli-Sforza, LL; Kivisild, T; Villems, R; Woodward, SR. New phylogenetic relationships for Y-chromosome haplogroup I: reappraising its phylogeography and prehistory. In: Mellars P, Boyle K, Bar-Yosef O, Stringer C, editors. *Rethinking the human revolution*. Cambridge: McDonald Institute Monographs; 2007. p. 33-42. *Invited book chapter*

King, RJ; Ozcan, SS; Carter, T; Kalfoglu, E; Atasoy, S; Triantaphyllidis, C; Kouvatsi, A; Lin, AA; **Chow, CET**; Zhivotovsky, LA. (2008) Differential Y-chromosome Anatolian Influences on the Greek and Cretan Neolithic. *Annals of Human Genetics* 72 (2): 205-214.

Underhill PA, Myres NM, Rootsi S, Metspalu M, Zhivotovsky LA, King RJ, Lin AA, **Chow CET**, Semino O, Battaglia V, Kutuev I, Järve M, Chaubey G, Ayub Q, Mohyuddin A, Mehdi SQ, Sengupta S, Rogaev EI, Khusnutdinova EK, Pshenichnov A, Balanovsky O, Balanovska E, Jeran N, Augustin DH, Baldovic M, Herrera RJ, Thangaraj K, Singh V, Singh L, Majumder P, Rudan P, Primorac D, Villems R, Kivisild T. (2010) Separating the post-Glacial co-ancestry of European and Asian Y chromosomes within haplogroup R1a. *European Journal of Human Genetics* 18: 479-484

Bertics, VJ; Sohm, JA; Treude, T; **Chow, CET**; Capone, DG; Fuhrman, JA; Ziebis, W. (2010) Burrowing deeper into benthic nitrogen cycling: the impact of bioturbation on nitrogen fixation coupled to sulfate reduction. *Marine Ecology Progress Series* 409:1-15. *Feature Article*.

Hewson, I; **Chow, CET**, Fuhrman, JA. Ecological Role of Viruses in Aquatic Systems. (2010) *Encyclopedia of Life Sciences*.

Beman, JM; **Chow, CET**; King, AL; Feng, Y; Fuhrman, JA; Andersson, A; Bates, NR; Popp, BN; Hutchins, DA. (2011) Global declines in oceanic nitrification rates as a consequence of ocean acidification. *PNAS* 108 (1): 208-213

Steele, JA; Countway, PD; Xia, L; Vigil, P; Beman, JM; Kim, D; **Chow, CET**; Sachdeva, R; Jones, AC; Schwalbach, MS; Rose, J; Hewson, I; Patel, A; Sun, F; Caron, DA; Fuhrman, JA. (2011) Marine bacterial, archaeal, and protistan association networks reveal ecological linkages. *The ISME Journal* 5: 1414-1425

Chow, CET and JA Fuhrman. (2012) Seasonality and Monthly Dynamics of Marine Myovirus Communities. *Environmental Microbiology*. 14(8): 2171-2183. *Special Issue: Ecology, Evolution and Population Genetics of Pathogenic Microbes*.

Needham, DM; **Chow, CET**; Cram, JA; Sachdeva, R; Parada, A; Fuhrman, JA (accepted) Short-term observations of marine bacterial and viral communities: patterns, connections and resilience.

Manuscripts in progress

Chow, CET, Sachdeva, R; Cram, JA; Steele, JA; Needham, DN; Patel, A; Parada, AE; Caron, DA and Fuhrman, JA. (submitted) Temporal variability and coherence of euphotic zone bacterial communities over a decade in the Southern California Bight.

Pagarete, A; **Chow, CET**; Johannessen, T; Thingstad, TF; Fuhrman, JA; Sandaa, RA (submitted) Marine myovirus communities shift seasonally and support “killing the winner.”

Chow, CET; Kim, D; Sachdeva, R; Caron, DA and Fuhrman, JA. (in prep) Ecological networks reveal interactions between top-down controls of marine bacterial community structure.

Chow, CET and JA Fuhrman. (in prep) Depth-differentiated viral metagenomics at the San Pedro Ocean Time-series.

Presentations

Steele, JA; Countway, PD; Schwalbach, MS; Rose, JM; Vigil, PD; O'Brien, SG; Hewson, I; Brown, MV; Jones, AC; Patel, A; Kakajiwala, MZ; **Chow, CET**; Ruan, Q; Huang, J; Sun, F; Caron, DA, Fuhrman, JA. Bacterial and protistan interactions at the USC Microbial Observatory. Poster presented by JA Fuhrman at NSF Microbial Observatory Workshop, Washington DC March 2007.

Steele, JA; Countway, PD; Schwalbach, MS; Rose, JM; Vigil, PD; O'Brien, SG; Hewson, I; Brown, MV; Jones, AC; Patel, A; Ruan, Q; Huang, J; Kakajiwala, MZ; **Chow, CET**; Sun, F; Naeem, S; Caron, DA; Fuhrman, JA. Bacterial and protistan interactions at the USC Microbial Observatory. Poster presented by JA Fuhrman at the "Sequencing the Seas" Symposium, Royal Society, London April, 2007.

Chow, CET; Steele, JA; Patel, A; Kakajiwala, M; Sachdeva, R; Fuhrman, JA. Connecting bacterial identity with function by response to enrichment. Poster at ASLO Ocean Sciences Meeting, Orlando FL March 2008.

Bertics, VJ; Sohm, JA; Treude, T; **Chow, CET**; Fuhrman, JA; Capone, DG; Ziebis, W. Linked nitrogen fixation and sulfate reduction in a benthic system heavily influenced by bioturbation. Talk presented by VJ Bertics at ASLO Ocean Sciences Meeting, Orlando FL, March 2008.

Chow, CET; Patel, A; Beman, JM; Fuhrman, JA. Bacterial and Archaeal community shifts as a response to ammonium and nitrite enrichments in seawater. Poster presented at ISME 12, Cairns, Australia, August 2008.

Beman, JM; **Chow, CET**; Popp, BN; Fuhrman, JA; Feng, Y; Hutchins, DA; Alteration of oceanic nitrification under elevated carbon dioxide concentrations. Poster presented by JM Beman at AGU Fall Meeting, San Francisco CA, December 2008.

Beman, JM; **Chow, CET**; Popp, BN; Fuhrman, JA; Feng, Y; Hutchins, DA. Alteration of oceanic nitrification under elevated carbon dioxide concentrations. Talk presented by JM Beman at ASLO Ocean Sciences Meeting, Nice, France, February 2009.

Chow, CET; Gilhooley, W; Bertics, VJ; Carney, R; Ziebis, W; Fuhrman JA. Diving for Microbes in a Brine Pool: Investigating Microbial Communities in a Methane-charged Brine Pool in the Gulf of Mexico. CMORE Microbial Oceanography Student Symposium, June 12, 2009.

Chow, CET; Steele, JA; Sachdeva, R; Cram, J; Fuhrman, JA. Viral Connections in a Diverse Microbial Community (Abstract BO15E-15). Poster presented at the ASLO Ocean Sciences Meeting, Portland OR, February 2010.

Meyer, K; Antunes, A; Calil, PH; **Chow, CET**; Gaerdes, A; Regaudie de Gioux, A; Ruiz Gonzales, C; Jones, C; Kashtan, N; Olson, E; Pedler, B; Pham, C; Samo, T; Wright, J; Young, J; Leon Zayas, R. 2009 Microbial Oceanography: Genomes to Biomes; Nutrient influences on plankton community structure and production in oligotrophic regions of the North Pacific Subtropical Gyre. Poster presented by K Meyer at ASLO Ocean Sciences Meeting, Portland OR. February 2010.

Wright, J; Antunes, A; Calil, PH; **Chow, CET**; Gaerdes, A; Regaudie de Gioux, A; Ruiz Gonzales, C; Jones, C; Kashtan, N; Meyer, K; Olson, E; Pedler, B; Pham, C; Samo, T; Young, J; Leon Zayas, R. 2009 Microbial Oceanography: Genomes to Biomes; A transect study of the North Pacific Subtropical Gyre and Front. Poster presented by J Wright at ASLO Ocean Sciences Meeting, Portland OR. February 2010.

Carney R; Ziebis W; Bertics VJ; **Chow CET**. A Report at Year 6 for Long-term Colonization of Artificial Sulfidic Substrate by Chemosynthetic Fauna. Talk presented by R Carney at the 12th Deep-Sea Biology Symposium, Reykjavík, Iceland. June 2010.

Chow, CET; Fuhrman, JA. Virus-Bacteria Relationships at San Pedro Ocean Time Series. University of Bergen (Bergen, Norway), May 18, 2010 (invited talk)

Chow, CET; Sachdeva, R; Fuhrman, JA. Monthly Variation of Viral Communities at the San Pedro Ocean Time-Series Station (SPOT). Poster presented at ISME-13, Seattle WA, August 2010.

Needham, DM; **Chow, CET**; Sachdeva, R; Cram, JA; Parada, A; Fuhrman, JA. Day-to-day Dynamics of Bacterial and Myoviral Communities of the Surface Ocean. Poster presented by D Needham at the 111th General Meeting of American Society for Microbiology, New Orleans LA, May 2011.

Chow, CET; **Fuhrman, JA**. Seasonality and Monthly Dynamics of Marine Myovirus Communities by Capsid Gene Sequences at the San Pedro Ocean Time-Series. Talk presented at the 6th Aquatic Virus Workshop. November 2011.

Needham, DM; **Chow, CET**; Sachdeva, R; Cram, JA; Parada, A; Fuhrman, JA. Day-to-day Dynamics of Bacterial and Myoviral Communities of the Surface Ocean. Talk presented by D Needham at the 6th Aquatic Virus Workshop. November 2011.

Chow, CET; Sachdeva, R; Cram, JA; Fuhrman, JA. Viral Control of Autotrophic vs. Heterotrophic Bacteria in the Surface Ocean: Ecological Networks Linking Viruses and Bacteria. Talk presented at the 2012 Ocean Sciences Meeting, Salt Lake City UT, February 2012.

Chow, CET; Sachdeva, R; Cram, JA; Steele, JA; Needham, DM ; Patel, A; Parada, A; Fuhrman, JA. Temporal Variability and Coherence of Bacterial Communities in the Photic Zone from a Ten-year Time-series in the Southern California Bight. Poster presented at the Gordon Research Seminar/Conference: Marine Microbes, Barga, Italy, June 2012.

Pagarete, A; **Chow, CET**; Johannessen, T; Fuhrman, JA; Thingstad, F; Sandaa, R. Raunefjord Myovirus Communities Shift Seasonally and Support “Killing The Winner.” Poster presented by A. Pagarete at “Viruses of Microbes,” Brussels, Belgium, July 2012.

Cram, JA; Sachdeva, R; **Chow, CET**; Xia, L; Steele, JA; Needham, DM; Parada, A; Fuhrman, JA. Bacterial community variability across ten years and five depths at the San Pedro Ocean Time Series (SPOTS). Poster presented by J Cram at ISME14, Copenhagen, Denmark, August 2012.

Chow, CET; Kim, DY; Sachdeva, R; Caron, DA; Fuhrman, JA. Top-down controls on bacterial community structure: Evaluating links to viral and protistan communities. Poster presented at the Environmental Virology workshop, Tucson AZ, January 2013.

Funding Awarded

USC Graduate Professionalism Initiative, June 2008

Co-organized a one-day workshop on effective science communication for fellow students.
 USC College International Field Research Award, April – May 2010
 for a collaborative project investigating virus community composition at Raunefjord time-series.
 Host: Dr. Ruth-Anne Sandaa, University of Bergen (Norway)

Travel Grants

USC MEB Travel Grant, ASLO Ocean Sciences Meeting, Feb 2008
 Women in Science and Engineering Travel Grant (USC), ISME12 meeting, Aug 2008.
 USC MEB Travel Grant, ISME12 meeting, Aug 2008
 USC MEB Travel Grant, DOE/JGI IMG and IMG/M Workshop, Feb 2009
 Women in Science and Engineering Travel Grant (USC), ASLO Ocean Sciences Meeting, Feb 2010.
 USC MEB Travel Grant, Ocean Sciences Meeting, Feb 2010
 Women in Science and Engineering Travel Grant (USC), 6th Aquatic Virus Workshop. Nov 2011
 Gordon and Betty Moore Foundation Travel Grant. 6th Aquatic Virus Workshop. Nov 2011.
 Gordon Research Conferences Travel Grant, Marine Microbes, June 2012.

Research Skills and Experience

Molecular methods:

DNA extraction, PCR, clone library construction, viral metagenomic library preparation for pyrosequencing, community fingerprinting by fragment analysis (ARISA, TRFLP, microsatellites), SNP analysis (by denaturing high-performance liquid chromatography), microsatellites, DNA hybridization assays, rapid indicator tests for Bacteroidetes, hepatitis A virus and enteric viruses from seawater by QPCR and RT-QPCR

Bioinformatics:

Gene sequence analysis with mothur, QIIME, and ARB; viral metagenomic analysis with CAMERA and VIROME platforms; MG-RAST; 454 gsAssembler; Genbank, BLAST, IMG and IMG/M

Network Analysis:

Cytoscape and plugins (Network Analyzer, AllegroMCODE); Local Similarity Analysis (LSA)

Multivariate Statistics Software:

PRIMER 6 + PERMANOVA (and analyses within), Systat11

Data Visualization:

Tableau (business intelligence platform), Sigmaplot

Fieldwork:

Bacterial productivity by 3H-thymidine and leucine incorporation, epifluorescence microscopy, seawater sampling for microbial DNA, sediment coring and sample collection

Service and Outreach

Stanford @ The Tech Internship, Tech Museum. April – June 2005.

Communicating Ocean Science to Informal Audiences. Aquarium of the Pacific. Spring 2007.

Outreach Intern. USC Wrigley Institute (Catalina Island, CA). Summers 2007, 2008, 2011.

USC Plankton Exhibit Development Team Aquarium of the Pacific (Long Beach, CA). 2007-2008.

Student Organizer for Marine Environmental Biology Seminar Series at USC. 2009-2010

Associate Chair. Marine Microbes – Microbial Ecology in the Era of ‘omics’

Gordon Research Seminar, Barga Italy, June 2012.