

Research Interests

I am interested in the response of ocean dynamics, ocean biogeochemistry and living marine resources (i.e., coral reefs and fisheries) to CO₂-induced climate change and natural climate variability with implications for conservation.

Education

- Ph.D. 2015 **Climate Variability and Impacts:** Joint Program in Oceanography, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, Cambridge and Woods Hole, MA
Dissertation: Exploring the climate change refugia potential of equatorial Pacific coral reefs
Advisors: Anne Cohen, Daniel McCorkle, and Kristopher Karnauskas
- B.A. 2009 **Biological Sciences and Chemistry:** Cornell University, Ithaca NY.
Advisors: Eric Alani (academic), Drew Harvell (research)

Employment

- 2019-pres. **Research Oceanographer**
Geophysical Fluid Dynamics Laboratory, NOAA, Princeton, NJ
Supervisors: John Dunne, Charlie Stock
- 2016-2019 **Postdoctoral Scholar**
Scripps Institution of Oceanography, UCSD, La Jolla, CA
Advisors: Arthur Miller (SIO) and Sam McClatchie (NOAA, SWFSC)
- 2014-2016 **Postdoctoral Researcher**
Rutgers University, New Brunswick, NJ
Advisor: Enrique Curchitser
- 2009-2014 **Graduate Research Assistant**
Woods Hole Oceanographic Institution, Woods Hole, MA
Advisors: Anne Cohen, Daniel McCorkle, and Kristopher Karnauskas
- 2010-2011 **Assistant Aquarist**
New England Aquarium, Boston, MA
Supervisor: Steve Spina
- 2008-2009 **Undergraduate Lab/Research Assistant**
Harvell Lab (Coral ecology), Cornell University, Ithaca, NY
Supervisor: Drew Harvell
- 2008 **NOAA Ernest F. Hollings Intern**
NOAA NMFS PIFSC Coral Reef Ecosystem Division, Honolulu, HI
Supervisor: Bernardo Vargas-Angel
- 2007 **NSF Research Experience For Undergraduates**
Program in Aquatic Chemical Ecology, Georgia Institute of Technology, Atlanta, GA
Supervisor: Julia Kubanek
- 2006-2007 **Undergraduate Lab /Research Assistant**
Aquadro Lab (Population genetics), Cornell University, Ithaca, NY
Supervisors: Vanessa Bauer DuMont, Charles Aquadro

Publications

- 2019 Mollica N, Cohen AL, Alpert A, Barkley HC, Brainard RE, Carilli J, DeCarlo TM, **Drenkard EJ**, Lohmann GP, Mangubhai S., Pietro K, Rivera HE, Rotjan RD, Scott-Beuchler C, Solow A, Young C. Constraining Thermal Thresholds of Coral Reefs using Skeletal Signatures of Bleaching. *Coral Reefs*,
- 2018 Barkley HC, Cohen AL, Mollica NR, Brainard RE, Rivera HE, DeCarlo TM, Lohmann GP, **Drenkard EJ**, Alpert AE, Young CW, Vargas-Ángel B, Lino KC, Oliver TA, Pietro KR, Luu VH. Repeat bleaching of a central Pacific coral reef over the past six decades (1960–2016). *Communications Biology*, 1:177
- Drenkard EJ**, Cohen AL, McCorkle DC, de Putron SJ, Starczak, VR, Repeta RJ. Juvenile of the Atlantic Coral *Favia fragum* (Esper, 1797) do not invest energy to maintain calcification under ocean acidification. *Journal of Experimental Marine Biology and Ecology*, 507:61-69

- McClatchie S, Gao J, **Drenkard EJ**, Thompson AR, Watson W, Ciannelli L, Bograd S, Thorson JT. Inter-annual and secular variability of larvae of mesopelagic and forage fishes in the southern California Current System. *Journal of Geophysical Research Oceans*, 123: 6277-6295
- 2015 Karnauskas KB, Cohen AL, **Drenkard EJ**. Comment on “Equatorial Pacific coral geochemical records show recent weakening of the Walker circulation” by J. Carilli et al. *Paleoceanography*, 30:570-574
- 2014 **Drenkard EJ** and Karnauskas KB. Strengthening of the Pacific Equatorial Undercurrent in the SODA record: mechanisms, ocean dynamics and implications. *Journal of Climate*, 27:2405-2416
- 2013 **Drenkard EJ**, Cohen AL, McCorkle DC, de Putron SJ, Starczak VR, Zicht AE. Calcification by juvenile corals under heterotrophy and elevated CO₂. *Coral Reefs*, 32: 727-735
- 2010 Lane AL, Mular L, **Drenkard EJ**, Shearer TL, Engel S, Fredericq S, Fairchild CR, Prudhomme J, Le Roch K, Hay ME, Aalbersberg W, Kubanek J. Ecological leads for natural product discovery: novel sesquiterpene hydroquinones from the red macroalga *Peyssonnelia* sp. *Tetrahedron*, 66: 455-461

In Review/Preparation

Drenkard EJ, Dussin R, Curchitser E, Kleypas JA, Castruccio FS, Dynamical resilience of the Verde Island Passage to thermally stressful ENSO events. (Submitting to *J.G.R. Oceans*)

Conference Abstracts

- 2019 **Drenkard EJ**, Miller A, McClatchie S, Webber E, Burnham T, Ramirez S, Shen S, Neilson D, Hovel K. Modeling climate change impacts on California Current System fisheries. *ASLO, Aquatic Sciences, San Juan*, Puerto Rico (Talk: SS036-12493)
- 2018 **Drenkard EJ**, Miller A, McClatchie S. Modeling climate change impacts on California Current System oceanography and fisheries. *The Effects of Climate Change on the World's Ocean*. Washington, DC
- Drenkard EJ**, Miller A, McClatchie S. Resolving climate change impacts on California Current System oceanography and fisheries. *Ocean Sciences*, Portland, OR
- Mollica N.R., Cohen A.L., Barkley H., **Drenkard E.J.**, Mangubhai S., Rotjan R., Scott-Buechler C. Constraining Thermal Thresholds of Coral Reefs using a Paleo-Bleaching Proxy. *Ocean Sciences*, Portland, OR
- 2017 **Drenkard E.J.**, Miller, A., McClatchie, S. Modeling climate change impacts on California current system oceanography and fisheries. *CalCOFI*, La Jolla, CA
- Drenkard E.J.**, Miller, A., McClatchie, S., Model resolution necessary to study the impact of climate change on fisheries in the California Current System. *EPOC*, South Lake Tahoe, CA
- 2016 **Drenkard E.J.**, Curchitser, E., Kleypas, J.A., Castruccio F.S., Exploring multi-scale ocean and climate drivers of widespread bleaching in the Coral Triangle. *AGU*, San Francisco, CA (Poster: OS13E-07)
- Curchitser, E., Kleypas, J.A., Castruccio F.S., **Drenkard E.J.**, Thompson, D.M., Pinsky, M.L., Climate, bleaching and connectivity in the Coral Triangle. *AGU*, San Francisco, CA (Talk: OS21B-1962)
- Drenkard E.J.** (Modeling Session Co-Chair), Curchitser E.N., Dussin R., Kleypas J. Resolving mechanisms of localized environmental resilience: A closer look at ocean dynamics in the Verde Island Passage during the 1998 bleaching event. *ICRS*, Honolulu, HI
- Drenkard E.J.**, Curchitser E.N., Cohen, A.L. Climate impacts on PIPA’s potential connectivity to resilient reef systems. *Phoenix Islands Protected Area Science Meeting*, Honolulu, HI
- Rivera H.E., Cohen A.L., **Drenkard E.J.**, Alpert A.E., DeCarlo T.M., Young C., Brainard R., Mollica N., Liu V., McCarthy N. Feast and famine: a strategy for surviving ocean warming. *ICRS*, Honolulu, HI
- 2015 **Drenkard, E. J.**, Cohen, A. L., McCorkle, D. C., dePutron, S. J., Starczak, V. R. What’s energetics got to do with it? Coral calcification response to OA under light, feeding and nutrients. *Ocean Acidification PI Meeting*, Woods Hole MA
- 2014 **Drenkard, E. J.**, Cohen, A. L., McCorkle, D. C., dePutron, S. J., Starczak, V. R. How circulation changes in the tropical Pacific could modulate coral calcification response to ocean acidification. *Ocean Sciences*, Honolulu, HI (Talk: 16723)
- 2013 **Drenkard, E. J.** and Karnauskas K. B. Observed strengthening of the Pacific Equatorial Undercurrent: coupled mechanisms, ocean dynamics, and implications. *Graduate Climate Conference*, Woods Hole, MA (Talk)

- Cohen, A. L., Barkley, H. C., DeCarlo, T. M., **Drenkard, E. J.**, Shamberger, K. A., McCorkle, D. C., and Lentz, S. The Coral Reef Response to Ocean Acidification: Insights from Laboratory Experiments and Field Data. *Ocean Acidification PI Meeting* (Poster)
- 2012 **Drenkard, E. J.** and Karnauskas K. B. Changes in the equatorial undercurrent from 1871 to present. *AGU*, San Francisco, CA (Poster: OS53B-1972)
- Cohen A. L. and **Drenkard E. J.** Pacific Circulation and the Resilience of its Equatorial Reefs *AGU*, San Francisco, CA (Talk: OS51H-07)
- Drenkard, E. J.**, Cohen, A. L., McCorkle, D. C., de Putron, S. J., Starczak, V. R., and Zicht, A. E. Feeding modulates the impact of ocean acidification on coral calcification. *ICRS*, Cairns Australia (Talk: 8C)
- 2011 **Drenkard, E. J.**, Cohen, A. L., McCorkle, D. C., de Putron, and Zicht, A. E. Feeding enhances skeletal growth and energetic stores of an Atlantic coral under significantly elevated CO₂. *AGU*, San Francisco, CA (Poster: OS33B-1668)
- Drenkard, E. J.**, Cohen, A. L., McCorkle, D. C., de Putron, S. J., Starczak, V. R., Zicht, A. E., and Shamberger, K. E. F., *ASLO Aquatic Sciences Meeting*, Puerto Rico (Talk: 8894)

Field Experience

- 2016 **Scientist, NOAA SE-02-16: Oscar Elton Sette**
Assisted Cohen Lab with collection of coral and water samples at Jarvis Island
- 2015 **Scientist, Phoenix Islands Protected Area: Hanse Explorer**
Assisted with collection of coral and water samples in for monitoring and study of PIPA reef systems
- 2012 **Co-chief scientist, Pangea Explorations: Sea Dragon**
Collection of coral and water samples in the central Pacific Ocean to assess impact of equatorial undercurrent on equatorial Pacific island reefs
- 2010-2012 **Summer Scientist, Bermuda Institute of Ocean Sciences, Bermuda**
Ran experiments assessing the impact of nutrition on coral calcification response to acidification
Supervisors: Samantha de Putron, Anne Cohen, Daniel McCorkle,
- 2011 **Student, MIT/WHOI Field Course in Marine Biology**
Exploration and study of mangrove and reef ecosystems at the Liquid Jungle Lab, Panama
Instructors: Ann Tarrant, Jesús Pineda
- 2010 **Student, Red Sea, Saudi Arabia**
Collection of coral skeleton/tissue and water chemistry samples
Chief Scientists: Neal Cantin, Ann Tarrant

Technical Skills and Certifications

Modeling/Programming – Setting up, running and evaluating ROMS models; Analyzing global climate and ocean model output. Proficient in Matlab and Python; Experience in R, Fortran, IDL, Bash

Analytical Techniques – Seawater analyses: Total Alkalinity and dissolved inorganic carbon using VINDTA 3C, salinity using salinometer; Coral tissue analyses: lipid extraction, quantifying coral symbiont densities, analysis of histology slides; Coral skeletal analyses using: stereoscopic/compound microscopes, SPOT and ImageJ software (photography/measurements), Natural products procedures: bioassay-guided fractionation, column chromatography, TLC, HPLC; Genetic analyses: polymerase chain reaction and gel electrophoresis

Aquarium Care/Maintenance – Proper feeding/cleaning/monitoring/repair procedures for coral and jellyfish exhibits.

SCUBA Certifications – PADI: Open Water, Advanced Open Water, Rescue; NAUI: Master, EANX; AAUS

BLS Certifications – First Aid (AHA), CPR (AHA), O₂-Administration (DAN)

Professional Service

- 2017-p. **International Coral Reef Society:** Recording secretary, communications committee chair
- 2017-18 **Eastern Pacific Ocean Conference:** 2018 meeting Co-chair

Relevant Outreach, Workshop Participation and Awards

- 2017 **Participant, STATMOS workshop on Climate Statistics**
Coordinator: Michael Stein; Location: NCAR, Boulder, CO
- Participant, SCRiM: Summer School on Sustainable Climate Risk Management (competitive)**
Coordinator: Katerina Kostadinova; Location: State College, PA

- 2013 **Participant, NCAR/ASP Colloquium: *Carbon-Climate Connections in the Earth System* (competitive)**
Coordinator: Matthew Long; Location: NCAR, Boulder, CO
- 2011 **Science Interpreter, National Network for Oceans and Climate Change Interpreters**
Worked with national aquarium educators to develop effective climate change communication methods
- 2009 **Participant, NOAA NMFS Marine Resource Population Dynamics Workshop (competitive)**
Coordinator: Jim Berkson; Location: Mote Marine Lab, Summerland Key, FL
- 2007 **Recipient, NOAA Ernest F. Hollings scholarship**

Teaching and Mentoring Experience

- 2016 **Guest Lecturer:** High school environmental science class on corals, conservation and climate change.
Instructor: Kathleen Gibson (Trumbull High School)
- 2015 **Guest Lecturer:** Undergraduate introductory class on coral ecosystems and climate change.
Instructor: Randye Rutberg (Hunter College)
- 2014 **Guest Lecturer:** Introduction to ocean dynamics lecture for Harvard graduate course in ocean landscape infrastructure. Instructor: Pierre Bélanger (Harvard Graduate School of Design)
- 2014 **Lecturer:** Co-teaching 3-week oceanography course at WHOI for liberal arts undergraduates
- 2010, 2011 **Mentoring:** Teaching Cohen Lab interns techniques for juvenile/larval coral lipid extraction.
Students: Sharmila Giri (University of Pennsylvania), Miriam Geronimus (Princeton)
- 2009 **Teaching Assistant:** Cornell satellite and remote sensing summer course, Cornell University, Ithaca, NY
- 2008 **Teaching Assistant:** Introduction to Oceanography (lab and lecture), Cornell University, Ithaca, NY

Grant Support

- 2012-2014 WHOI Ocean Ventures Fund, support for thesis research, \$10k
- 2009-2013 MIT Bermuda Biological Station for Research Fund, support for thesis research, ~\$15k total
- 2013 MIT Graduate Student Council Travel Grant, \$750
- 2012 MIT Student Research Fund, support for conference attendance, \$500
- 2010 MIT Student Research Fund, support for ocean acidification experiment equipment, \$800

Additional Awards and Recognition

- 2010 Honorable Mention, NSF Graduate Research Fellowship
- 2005-2009 Thomas J. Watson Memorial Scholarship, IBM
- 2008 First Place Presentation Award, NOAA Hollings Scholarship Program, Silver Spring, MA

WHOI Service and Committees

- 2012-2014 **Student Representative:** WHOI G&G safety committee
- 2012-2014 **Student Representative:** WHOI Dive safety control board
- 2013 **Presenter:** WHOI donor promotional event, Woods Hole, MA
- 2013 **Presenter:** Cambridge Science Festival, MIT Science Museum, Cambridge, MA
- 2012 **Presenter:** Falmouth High School: Inspiration for aquatic clay creations, Woods Hole, MA
- 2012 **Student Representative:** WHOI Academic Programs Office hiring committee
- 2012 **Presenter:** Public event: *Ocean Acid Test*, Woods Hole, MA
- 2011-2012 **Student Representative:** MIT/WHOI Joint Program Student Council

Community Service and Outreach

- 2019 **Science Judge:** National Ocean Science Bowl Finals, Washington, DC
- 2018-2019 **Volunteer:** San Diego House Rabbit Society, San Diego, CA
- 2017-2019 **Volunteer:** Diver, Kelp show narrator, Tide Pool Interpreter: Birch Aquarium at Scripps, La Jolla, CA
- 2017-2018 **Volunteer:** Scripps Community Outreach Program for Education, La Jolla, CA
- 2018 **Science Education Mentor:** Ocean Discovery Institute, San Diego, CA
- 2018 **Assistant Precinct Inspector (poll worker):** California General Election, San Diego, CA
- 2018 **Judge:** Greater San Diego Science and Engineering Fair
- 2017-2018 **Science Judge:** Garibaldi Bowl, San Diego, CA
- 2016 **Science Judge:** National Ocean Science Bowl Finals, Moorhead City, NC
- 2016 **Keynote speaker:** Intrepid Museum's GOALS Mentorship Day, New York, NY
- 2016 **Exhibitor:** Intrepid Museum's Girls in Science and Engineering Day, New York, NY
- 2016 **Science Fair Judge:** North Jersey Regional Science Fair, New Brunswick, NJ
- 2015-2016 **Volunteer:** The Raptor Trust (avian rehabilitation center), Millington, NJ
- 2015-2016 **Science Judge:** Shore Bowl, New Brunswick, NJ
- 2013-2014 **Volunteer:** Friends of Falmouth Dogs (shelter), Falmouth, MA

2011-2013 **Presenter:** Women in Science and Engineering Day, Bayview Academy, East Providence, RI
2011-2013 **Science Fair Judge:** Falmouth High School, Falmouth, MA
2010-2013 **Science Judge:** Blue Lobster Bowl, Cambridge, MA
2011 **Assistant Aquarist:** New England Aquarium, Boston, MA
2006-2009 **Cornell Raptor Program:** Individual care, student advisor, and public educator, Ithaca, NY

Leisure Activities

Kite surfing, gardening, home brewing, hiking, rock climbing, needlepoint, pyrography, music (piano, flute, misc.)