

# UNIVERSITY OF HAWAII AT MANOA

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## FRANÇOIS O. SENECA

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### EDUCATION

- 2011 **James Cook University (JCU), Australia**, Ph.D., School of Pharmacy & Molecular Sciences  
Thesis: The Molecular Stress Response in the Indo-Pacific Model Scleractinian Coral:  
*Acropora millepora*
- 2004 **University of Hawaii (UH) at Mānoa**, B.S., Zoology  
Thesis: Abnormal Growth in the Main Hawaiian Reef-Building Coral: *Porites compressa*

### RESEARCH INTERESTS

My main interest as a molecular ecologist is the response of marine organisms to current climate change and anthropogenic pollution stress. To understand the effects and outcomes resulting from environmental variability and change, I combine transcriptomics, proteomics, enzymatic activity, physiology and ecology to study the organismal response and the role of acclimatization and adaptation in natural populations in both field and lab-based investigations.

Reef-building corals are the foundation taxa of an entire ecosystem and are severely impacted by direct human activity as well as climate change. I use the sensitivity of corals to environmental change to investigate the molecular stress response to predicted future climate scenarios and anthropogenic activity, allowing an understanding of the genomic components under selection by climate change and pollution.

### FELLOWSHIP, GRANTS & AWARDS

- 2014-15 NSF-RAPID Senior personnel (Co-PI: Peter Marko, Ruth Gates, Cynthia Hunter, Amy Moran; US\$163,308)
- 2014-15 National Fish & Wildlife Foundation Coral Reef Conservation Fund PI (Co-PI: Robert Richmond; US\$ 89,000)
- 2014 Ecological Genomics Symposium Travel Fellowship
- 2008 Prince Albert 1<sup>st</sup> Exceptional Ph.D. Scholarship (25,000 Euros)
- 2006 – 08 AIMS@JCU Tuition Waiver Scholarship (AU\$ 25,000/yr)

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2006 – 08 AIMS@JCU Research Scholarship (AUS\$ 5,000/yr)  
 2005 – 07 Government of Monaco Ph.D. Scholarship (25,000 Euros/yr)  
 2009 Pacific Science Inter-Congress Travel Award  
 2008 ARC Center of Excellence in Coral Reef Studies Travel Award  
 2007 – 09 AIMS@JCU Travel Awards

## RESEARCH EXPERIENCE

2013 – **Junior researcher**, Kewalo Marine Laboratories, University of Hawaii  
 Proteomics and enzymatic activity of the effects of land-based pollution on coral health  
 Mentor: Prof. Robert Richmond

2011 – 2013 **Postdoctoral scholar**, Hopkins Marine Station, Stanford University  
 Physiology and transcriptomics of coral acclimatization and adaptation to climate change  
 Mentor: Prof. Stephen R. Palumbi

2005 – 2011 **Ph.D.**, Comparative Genomics Centre, JCU, Australia  
 Transcriptomics of the coral stress response to bleaching and pollution stress  
 Mentor: Prof. David J. Miller

2009 – 2010 **Research assistant**, School of Marine and Tropical Biology, JCU  
 Gene expression analysis system on the establishment of coral symbiosis under heat stress  
 Mentor: Prof. Bette Willis

2009 **Research assistant**, ARC Center of Excellence for Coral Reef Studies, JCU  
 Real-time quantitative PCR analysis of the coral bleaching response  
 Mentors: Drs. Tracy Ainsworth and Bill Leggat

2008 **Research assistant**, Australian Institute of Marine Science  
 Coral antioxidant gene expression under heat stress  
 Mentor: Dr. Madeleine van Oppen

2004 – 2005 **Research intern**, Scientific Centre of Monaco  
 Molecular techniques applied to cnidarians  
 Mentor: Dr. Didier Zoccola

2003 – 2004 **Research assistant**, Hawaiian Institute of Marine Biology, UH  
 Techniques in coral propagation and monitoring of fecundity  
 Mentor: Ass. Prof. Cindy Hunter

2002 **Laboratory assistant**, Kewalo Marine Laboratory, UH  
 Multiple tasks in varying projects on tree snails, nudibranchs, corals, barnacles, & biofouling  
 Mentors: Prof. Mike Hadfield, and Dr. Brenden Holland

## REFEREED PUBLICATIONS

### 2014

**Seneca F**, Palumbi S. (Submitted) The role of transcriptome resilience in resistance of corals to bleaching. *Molecular Ecology*

Traylor-Knowles N, **Seneca F**, Palumbi S. (Submitted) Two distinct tumor necrosis factor receptor clusters respond differently to heat stress in reef building corals. *Proceedings of the Royal Society B*

Rose N, **Seneca F**, Palumbi S. (Submitted) Systems genetics of individual variation and plasticity in coral resistance to experimental heat stress. *Genome Biology*

### 2013

Raina J-B, Tapiolas DM, Foret S, Lutz A, Abrego D, Ceh J, **Seneca FO**, Clode PL, Bourne DG, Willis BL, Motti CA (2013) **DMSP biosynthesis by an animal and its role in coral thermal stress response**. *Nature*, 502: 677-680. doi:10.1038/nature12677. [Press coverage by Nature Asia, Nature World News, Science Daily, Phys.org, Life sciences world, and more.]

Tolleter D<sup>#</sup>, **Seneca F<sup>#</sup>**, DeNofrio JC, Palumbi SR, Pringle JR, Grossman AR. (2013) **Coral bleaching independent of photosynthetic activity**. *Current Biology*, 23: 1782-1786. <sup>#</sup>These authors contributed equally. (Cover) [Press coverage by Science Daily, Wildlife Disease News Digest, Health Advisor.]

Barshis DJ, Ladner JT, Oliver TA, **Seneca FO**, Traylor-Knowles N and Palumbi SR. (2013) **A genomic basis for coral resilience to climate change**. *Proceedings of the National Academy of Sciences*, 110(4): 1387-1392. (Cover) [Press coverage by Nature, Science, The Washington Post, Mother Jones, Consortium for Ocean Leadership, and more.]

### 2012

De Wit P, Pespeni MH, Ladner JT, Barshis DJ, **Seneca F**, Jaris H, Overgaard Therkildsen N, Morikawa M, Palumbi SR. (2012) **The simple fool's guide to population genomics via RNA-Seq: an introduction to high-throughput sequencing data analysis**. *Molecular Ecology Resources*, 12(6): 1058-67. doi: 10.1111/1755-0998.12003.

Siboni N, Abrego D, **Seneca F**, Motti CA, Andreakis N, et al. (2012) **Using bacterial extract along with differential gene expression in *Acropora millepora* larvae to decouple the processes of attachment and metamorphosis**. *PLoS ONE*, 7(5): e37774. doi:10.1371/journal.pone.0037774.

Puill-Stephan E, **Seneca FO**, Miller DJ, van Oppen MJH, Willis BL (2012) **Expression of putative immune response genes during early ontogeny in the coral *Acropora millepora***. *PLoS ONE*, 7(7): e39099. doi:10.1371/journal.pone.0039099.

### 2011

Ainsworth TD, Wasmund K, Ukani L, **Seneca F**, Yellowlees D, Miller D, and Leggat W (2011) **Defining the tipping point: A complex cellular life/death balance in corals in response to stress**. *Scientific Reports*, 1:160 DOI: 10.1038/srep00160.

Leggat WP, **Seneca F**, Wasmund K, Ukani L, Yellowlees D, Ainsworth TD. (2011) **Differential responses of the coral host and their algal symbiont to thermal stress.** *PLoS ONE*, 6(10): e26687.

Forêt S<sup>#</sup>, **Seneca F**<sup>#</sup>, de Jong D, Bieller A, Hemmrich G, Augustin R, Hayward DC, Ball EE, Bosch TCG, Agata K, Hassel M and Miller DJ (2011) **Phylogenomics reveals an anomalous distribution of USP genes in metazoans.** *Molecular Biology and Evolution*, 28(1): 153-161.  
<sup>#</sup>These authors contributed equally.

Souter P<sup>#</sup>, Bay LK<sup>#</sup>, Andreakis N<sup>#</sup>, Császár N, **Seneca F** and van Oppen MJH. (2011) **A multi-locus, temperature stress related gene expression profile assay in *Acropora millepora*, a dominant reef-building coral.** *Molecular Ecology Resources*, 11: 328-334. <sup>#</sup>These authors contributed equally.

## 2010

**Seneca F**, Forêt S, Ball E, Smith-Keune C, Miller D J and van Oppen M. (2010) **Patterns of Gene expression in a Scleractinian coral undergoing natural bleaching.** *Marine Biotechnology*, 12(5): 594-604.

## 2009

Császár N, **Seneca F**, and van Oppen M. (2009) **Variation in expression levels of antioxidant genes in the scleractinian coral *Acropora millepora* under laboratory thermal stress conditions.** *Marine Ecology Progress Series*, 392: 93-102.

Bay L, Nielsen B, Jarmer H, **Seneca F**, van Oppen M. (2009) **Transcriptomic variation in a coral reveals pathways of clonal organization.** *Marine Genomics*, 2: 119-125.

## PUBLICATIONS IN PREPARATION

**Seneca F**, Palumbi S. (In prep) The role of acclimatization and adaptation in the bleaching response of resilient corals.

**Seneca F**, Barshis D, Palumbi S. (In prep) Apoptosis control of coral bleaching is not a general phenomenon.

Ainsworth TD, Knack B, Ukani L, **Seneca F**, Weiss Y, Leggat WP & Miller D. (In prep) Cell and tissue specific gene expression patterns associated with the coral disease 'white syndrome'. PLoSOne.

## ONGOING RESEARCH

**Seneca F**, vanOppen M, Willis B. (In prep) The effect of elevated temperature on the innate immunity response during the onset of symbiosis in scleractinian coral larvae.

**Seneca F**, vanOppen M, Willis B. (In prep) Patterns of gene expression involved in the mechanisms of the establishment of coral-algae symbiosis in *Acropora millepora* larvae.

## TEACHING EXPERIENCE

### **Course development and instruction**

- 2014 Science communication, University of Hawaii at Manoa (guest lecturer)
- 2014 Practical Computing and bioinformatics for RNASeq, Kewalo Marine Laboratory, University of Hawaii at Manoa
- 2012 Bioinformatics for RNASeq data, Pan-Pacific Advanced Studies Institute, Dumaguete, Philippines
- 2012 Population genomics using next-generation sequencing, Intensive graduate course, Stanford University, USA

### **Laboratory mentoring/ training**

- 2014 Narissa Spies, James Murphy, Aleka Lyman, Tiani Naholowaa; RNASeq and ecotoxicology, Kewalo Marine Laboratory
- 2010 Lubna Ukani: qRT-PCR, ARC Centre of Excellence for Coral Reef Studies, AUS
- 2009 Jeroen Van De Water, Dr. Nachshon Siboni, Dr. Adrian Lutz: Gene Analysis System, AIMS, AUS
- 2008 Dr. Eneour Puill-Stephan: qRT-PCR, AIMS, AUS
- 2007 Dr. Nikolaus Csaszar: qRT-PCR, AIMS, AUS
- 2006 Dr. Line Bay: cDNA microarray, Australian Institute of Marine Science (AIMS), Townsville, Australia

### **Teaching assistant**

- 2007 Coral Biology, James Cook University, Townsville, Australia
- 2003 Biology 101, University of Hawaii, USA
- 1999 Botany, Field science educator, Nice, France

## **ACADEMIC SERVICES**

**Reviewing for:** PLOS One, BMC Genomics, Journal of Experimental Biology, Marine Biology, Marine Environmental Research

**Society memberships and volunteering:** International Society for Reef Studies, Society for Advancement of Chicanos and Native Americans in Science (Mentor), American Genetics Association

## **SCIENCE COMMUNICATION**

### **Invited**

- 2012 Genomic Applications to Marine Science and Resource Management in SE Asia Workshop, Pan-Pacific Advanced Studies Institute, Dumaguete, Philippines
- 2007 Development of coral specific internal control genes for quantitative real time PCR experiment. In: The 1<sup>st</sup> Symbiosis Cell biology Workshop, Heron Island, Australia.

### Contributed

- 2013 3<sup>rd</sup> Annual Yosemite Symbiosis Workshop, Sierra Nevada Research Institute, Wawona, USA.  
2012 Environmental Biomechanics, Physiology, and Genomics of Marine Species, PISCO at Hopkins Marine Station, Pacific Grove, USA.  
2010 'Talking science with the media' Workshop, ARC Centre of Excellence for Coral Reef Studies, Brisbane, Australia.

### Presented

- 2014 Seneca F, Palumbi S. **Evidence for both a fixed response and acclimatization potential for thermotolerance in natural coral populations.** In: 12th Annual Ecological Genomics Symposium, Kansas State University  
2012 Seneca F, Tolleter D, Barshis D, Grossman A, Palumbi S. **Caspase-controlled coral bleaching: is it common?** In: The 12<sup>th</sup> International Coral Reef Symposium, Cairns, Australia.  
2009 Seneca F, Foret S, Goffard N, Smith C, Grasso L, Hayward D, Saint R, van Oppen M, Ball E and Miller D J. **An Ecological Microarray Study of Coral Bleaching.** In: The 11<sup>th</sup> Pacific Science Inter-Congress, Tahiti, French Polynesia.  
2008 Seneca F, Foret S, Goffard N, Smith C, Grasso L, Hayward D, Saint R, van Oppen M, Ball E and Miller D J. **An Ecological Microarray Study of Coral Bleaching.** In: the 11<sup>th</sup> International Coral Reef Symposium, Fort Lauderdale, USA.  
2006 Seneca F, van Oppen M and Miller D J. **Microarray analysis of gene expression in *Acropora millepora* during a natural bleaching event.** In: the Australian Coral Reef Society 82<sup>nd</sup> Annual Conference, Mission Beach, Australia.

## PROFESSIONAL SKILLS AND EXPERIENCE

**Molecular Biology:** DNA/RNA/protein extraction; cDNA synthesis; PCR, RACE-PCR, qRT-PCR; microarray; GeXP; RNA-Seq; *in situ* hybridization; ELISA; Western Bolt; enzymatic activity; spectrophotometry; cloning; denaturing gradient-gel electrophoresis

**Cellular Biology:** Microscopy (fluorescent); histology; cell isolation; cell count (flow cytometry)

**Physiology:** Photosynthesis efficiency (PAM); respirometry (oxygraphy); linear, surface and buoyant weight growth; pigment extraction

**Marine Husbandry:** *Symbiodinium*, anemone, and coral propagation techniques; coral spawning; coral and coral larvae rearing; zoo- and phytoplankton culture; aquaria design, maintenance and plumbing

**Computer Skills:** Bioinformatics; Python and regular expression scripting; various R packages; PC and Mac, including word processing and graphics; Adobe Illustrator and Photoshop; Microsoft Office

**Fieldwork:** Scientific diving (UH, JCU, Stanford, PADI Assistant Instructor, NITROX, Rescue Diver); sample collection; GPS; marine invertebrate species identification; benthic survey; mapping; underwater photography and videography; extensive boat handling