

Nathan B. Spindel, PhD

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Education

2023 – PhD Biological Science, Florida State University

2023 – M.Sc. Biological Science, Florida State University

2009 – B.Sc. Aquatic Biology, University of California Santa Barbara

Publications

2023 – McCoy S.J., Pueschel C.M., Cornwall C.E., Comeau S., Kranz S.A., **Spindel N.B.**, Borowitzka M.A. Calcification in the Coralline Red Algae: A Synthesis. *Phycologia*. 2023. 62, 648-666, DOI:10.1080/00318884.2023.2285673.

2021 – **Spindel N.B.**, Lee L, Okamoto D. Metabolic depression in sea urchin barrens associated with food deprivation. *Ecology*. 2021 August 25; 102(11). Available from: <https://onlinelibrary.wiley.com/doi/10.1002/ecy.3463> DOI: 10.1002/ecy.3463.

2021 – Lee L, Daniel McNeill G, Ridings P, Featherstone M, Okamoto D, **Spindel N.B.**, Galloway A, Saunders G, Adamczyk E, Reshitnyk L, Pontier O, Post M, Irvine R, Wilson G, Bellis S. Chiixuu Tli iinasdli: Indigenous Ethics and Values Lead to Ecological Restoration for People and Place in Gwaii Haanas. *Ecological Restoration*. 2021 June 07; 39(1-2):45-51. Available from: <http://er.uwpress.org/lookup/doi/10.3368/er.39.1-2.45> DOI: 10.3368/er.39.1-2.45

2021 – Elias M, Kandel M, Mansourian S, Meinen-Dick R, Crossland M, Joshi D, Kariuki J, Lee L, McElwee P, Sen A, Sigman E, Singh R, Adamczyk E, Adoah T, Agaba G, Alare R, Anderson W, Arulingam I, Bellis S, Birner R, De Silva S, Dubois M, Duraisami M, Featherstone M, Gallant B, Hakhu A, Irvine R, Kiura E, Magaju C, McDougall C, McNeill G, Nagendra H, Nghi T, Okamoto D, Paez Valencia A, Pagella T, Pontier O, Post M, Saunders G, Schreckenber K, Shelar K, Sinclair F, Gautam R, **Spindel N.B.**, Unnikrishnan H, Wilson G, Winowiecki L. Ten people-centered rules for socially sustainable ecosystem restoration. *Restoration Ecology*. 2021 November 23; 30(4):- . Available from: <https://onlinelibrary.wiley.com/doi/10.1111/rec.13574> DOI: 10.1111/rec.13574

2014 – Comeau S, Edmunds P, **Spindel N.B.**, Carpenter R. Diel pCO₂ oscillations modulate the response of the coral *Acropora hyacinthus* to ocean acidification. *Marine Ecology Progress Series*. 2014 March 31; 501:99-111. Available from: <http://www.int-res.com/abstracts/meps/v501/p99-111/> DOI: 10.3354/

2014 – Comeau S, Edmunds P, **Spindel N.B.**, Carpenter R. Fast coral reef calcifiers are more sensitive

to ocean acidification in short-term laboratory incubations. *Limnology and Oceanography*. 2014 May; 59(3):1081-1091. Available from: <http://doi.wiley.com/10.4319/lo.2014.59.3.1081>

2013 – Comeau S, Edmunds P, **Spindel N.B.**, Carpenter R. The responses of eight coral reef calcifiers to increasing partial pressure of CO₂ do not exhibit a tipping point. *Limnology and Oceanography*. 2013 January; 58(1):388-398. Available from: <http://doi.wiley.com/10.4319/lo.2013.58.1.0388> DOI: 10.4319/lo.2013.58.1.0388

Invited Abstracts

2021 – **Spindel N.B.**, Lee L, Okamoto D. “Zombies of the Nearshore: Metabolic Depression in Sea Urchin Barrens Associated with Food Deprivation”. *The Bulletin of the Ecological Society of America*. 2021 October 1; 102(4). Available from: <https://onlinelibrary.wiley.com/doi/10.1002/bes2.1926> DOI: 10.1002/bes2.1926.

Manuscripts in Review

“Thermal suppression of gametogenesis explains historical collapses in larval recruitment.”. Okamoto D.K., **Spindel N.B.**, Collicutt B., Mustermann M., Karelitz S., Gimenez I., Rolheiser K., Cronmiller E., Foss M., Mahara N., Swezey D., Ferraro R., Rogers-Bennett L., and Schroeter S.

Manuscripts in Preparation

“Consumer resilience suppresses the recovery of overgrazed ecosystems.”. **Spindel N.B.**, Galloway A.W.E, Schram J. B., Pontier O., Lee L.C., Okamoto D.K.

“Contemporary ocean acidification and marine heatwaves shape energetics and rates of herbivory in a dominant ecosystem engineer”. **Spindel N.B.**, Munstermann M.M., Karelitz S., Collicutt B., Rolheiser K., Mahara N., Gimenez I., Evans W., Cronmiller E., Foss M., Pontier O., Rogers-Bennet L., Okamoto D.K.

“Biomarkers of recovery: a case study of how primary consumers assimilate and partition enhanced nutrition following kelp forest restoration”. **Spindel N.B.**, Galloway A.W.E, Schram J. B., Lee L.C., Okamoto D.K.

Academic Awards

2023 – National Science Foundation Ocean Sciences Postdoctoral Research Fellowship (NSF OCE - 2308398) - *Scaling up herbivore holobiont physiology from genes to populations across a temperate upwelling gradient*

2023 – Moss Landing Marine Laboratories Postdoctoral Researcher position

2023 – Smithsonian Institution Anthony Coates Postdoctoral Fellowship – Smithsonian Tropical Research Institute, Panama. **declined**

2022 – Ben and Karen Thrower Award, Florida State University Department of Biological Science

2022 – Horace Loftin Endowment for Research in Neotropical Environments

2021 – Smithsonian Institution Predoctoral Fellowship – Smithsonian Tropical Research Institute, Panama

2018, 2020-2021 – Mote Research Assistantship from the William R. and Lenore Mote Eminent Scholar in Marine Biology Endowment at FSU

2020 – Phycological Society of America Grant-in-Aid of Research

2020 – Lamarr and Edith Trott Endowed Scholarship

2019 – Professional Association of Diving Foundation Research Grant

2018 – Academy of Underwater Arts and Sciences Zale Parry Scholarship

2018 – Florida State University Fellowship in Kelp Forest Ecology and Abalone Population Dynamics

Conferences and Presentations

2023 – Western Society of Naturalists. “Biomarkers of recovery: a case study of how primary consumers assimilate and partition enhanced nutrition following kelp forest restoration.” **Spindel N.B.**, Lee L.C., Galloway A.W.E., Schram J.B., Gwiisihlgaa, McNeill D., Sgiids Kung Bellis V., Guujaaw N., Yakgujanaas J., Thompson M., Saunders G.W., Okamoto D.K.

2023 – Benthic Ecology Meeting. “Quantifying benthic dietary shifts and their consequences for individual herbivore performance and population dynamics in a recovering kelp forest: a hybrid survey-biotracer approach”. **Spindel N.B.**, Galloway A.W.E., Schram J.B., Lee L.D., Okamoto D.K.

2023 – International Temperate Reef Symposium. “Effects of high pCO₂ and oscillation versus static mean exposure on the bioenergetic thermal performance of the model sea urchin, *Strongylocentrotus purpuratus*”. **Spindel N.B.**, Munstermann M.M., Karelitz S., Collicutt B., Rolheiser K., Mahara N., Gimenez I., Evans W., Cronmiller E., Foss M., Pontier O., Rogers-Bennet L., Okamoto D.K.

2023 – International Temperate Reef Symposium. “Chiixuu TII iinasdII: Indigenous and scientific leadership in kelp restoration builds connections and knowledge for people and place in Gwaii Haanas”. Lee L, Daniel McNeill G, Ridings P, Featherstone M, Okamoto D, **Spindel N.B.**, Galloway A, Saunders G, Adamczyk E, Reshitnyk L, Pontier O, Post M, Irvine R, Wilson G, Bellis.

2022 – Western Society of Naturalists. “Effects of high pCO₂ and oscillation versus static mean exposure on the bioenergetic thermal performance of the model sea urchin, *Strongylocentrotus purpuratus*”. **Spindel N.B.**, Munstermann M.M., Karelitz S., Collicutt B., Rolheiser K., Mahara N., Gimenez I., Evans W., Cronmiller E., Foss M., Pontier O., Rogers-Bennet L., Okamoto D.K.

2022 – Southeastern Phycological Colloquy “Building an open-access lipid biomarker library for genetically-verified cryptic algae” **Spindel, N.B.**, Saunders, G., Galloway, A.W., Schram, J.S., Lee, L.C., Okamoto, D.K.

2021 – Western Society of Naturalists. “The very hungry urchin: feedbacks between kelp forest change and animal behavior and physiology” O. Rhoades, M. Hessing-Lewis, O. Pontier, J. Phoenix, M. Abele, **N. B. Spindel**, B. Twist, B. Collicutt, N. Mahara, G. Sadler-Brown, F. Manning, K. Hall, M. Foss, P., D.K. Okamoto.

2020 – Western Society of Naturalists “Zombies of the Nearshore: Metabolic Depression in Sea Urchin Barrens

Associated with Food Deprivation” **Spindel, N.B.**, Lee, L.C. Okamoto, D.K.

2020 – Southeast SACNAS Regional Meeting “Metabolic plasticity and resilience in consumptive capacity in sea urchins” **Spindel, N.B.**, Okamoto, D.K.

2020 – Ocean Sciences Meeting “Calcification in the Coralline Algae: A Synthesis and Conceptual Model” McCoy, S.J., Peuschel, C.M., Kranz, S.A., Cornwall, C.E., Comeau, S., **Spindel, N.B.**, Borowitzka, M.A.

2019 – Western Society of Naturalists “Collaborative Coastal Marine Habitat Restoration Within An Indigenous Co-Management Context In Gwaii Haanas, Haida Gwaii, Canada” Lee, L., Bellis, V., McNeill, D., Irvine, R., Wilson, N., Houston, C., Okamoto, D., **Spindel, N.B.**

2017 – Western Society of Naturalists “Determining Long-Term Biological Performance of a Large Artificial Reef in Southern California: The Wheeler North Artificial Reef” **Spindel, N.B.**, Huang, D.Y., Weisman, D., Chamberlain, L., Silbert, M.L., Schroeter, S.C., Reed, D.C., Raimondi, P.T.

2012 – Western Society of Naturalists and MCR LTER All Investigators Meeting “Implications of Using LED Lights to Test the Effects of Ocean Acidification on Coral Calcification”. Smolenski, J.R., **Spindel, N.B.**, and P.J. Edmunds

2010 – Western Society of Naturalists “Independent assessment of mitigation performance: A case study for Wheeler North Reef, the world’s largest artificial kelp reef.” Reed, D.C., Weisman, D., Deza, A., Bentley, E., **Spindel, N.B.**, Huang, D.Y.

2008 – UCSB Student Symposium “Anthropogenic effects on *Acanthaster Planci* outbreaks in French Polynesia, a model for prediction”. **Spindel, N.B.**

Formal Reports

2022 – L.C. Lee, C. Eppers, C. Houston, D.K. Okamoto, **Spindel, N.B.**, C. Brooks, G. Saunders, A.W.E. Galloway, J. Burton, M. Post, need to finalize order and add any others. 2022. Gwaii Haanas Chiixuu Tli iinasdli: Nurturing Seafood to Grow – Restoring the marine health of temperate rocky reef ecosystems in Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site. Final Report. Skidegate, BC.

2010, 2013-2016 – Annual Report of the Status of Condition C: Kelp Reef Mitigation in 2016. San Onofre Nuclear Generating Station (SONGS) Mitigation Program. Submission to California Coastal Commission. (http://marinemitigation.msi.ucsb.edu/documents/artificial_reef/index.html)

Service

Mentoring and Teaching

2023 – Lead Teaching Assistant for Dr. Kevin Dixon - ZOO3141L Animal Diversity, upper division Biology Major course in FSU Department of Biological Science, Teaching Assistant for Dr. Brittany Kraft - BSC2011L Biology 2 Lab

2022 – Mentor for laboratory technician focused on lipid biochemistry, annual growth estimation using mark-recapture, and reproductive capacity assays using histology (technician: Rachele Ferraro).

2018-2021 – Mentor for five students enrolled in Florida State University’s Undergraduate Research Opportunity Program (UROP). Supervised independent UROP research projects involving fatty acid biomarker analysis and annual growth estimation using mark-recapture (students: Sofia Perez Yudin, Isaiah Vsquez, Maria Nunez, Trevor Alspach, Anthony Cappellino).

2020 – Teaching Assistant* for Dr. Kevin Dixon - ZOO3141L Animal Diversity, upper division Biology Major course in FSU Department of Biological Science

2019 – Teaching Assistant* for Dr. Trisha Terebelski - ZOO3141L Animal Diversity, upper division Biology Major course in FSU Department of Biological Science

*Average Supervisor Rating for Teaching Assistant Role: 4.75/5.0

2013-2018 – Mentor for 20 seasonal scientific diver technicians hired for the San Onofre Nuclear Generating Station Mitigation Monitoring Project to evaluate the ecological performance of the world’s largest artificial kelp forest reef in relation to nearby natural reefs. Trained technicians in subtidal benthic survey methodology, research vessel operation, field identification of temperate rocky reef biota, and SQL-based relational database quality control.

Invited Lectures

2021 – “Individuality in ecosystems: scaling up present day and legacy environmental effects on individual level physiology and ecology in the sea”. FSU Fellows Society

2019-2021 – Guest lecture: “Adventures in Marine Biology” FSU Marine Biology Honors Program

Campus Service

2020-present – Elected Student Representative to FSU Diving Control Board

2020-present – Member of Diversity Equity and Inclusion Committee at Florida State University. Leading an initiative to evaluate and reform undergraduate compensation for research in the FSU Biology Department as a means of promoting equity.

2020 – Elected Liaison to Faculty for Ecology and Evolution graduate students in the FSU Biology Department.

2020 – Member of FSU Graduate Fellows Society Forum Committee

2019-present – Assisted with instruction of FSU Scientific Diving Course

2019 – FSU Coastal & Marine Lab Open House presenter for McCoy/Okamoto Lab research

2010-2018 – Marine Biologist/Collector at Agua Hedionda Lagoon Foundation Discovery Center in Carlsbad, California (see details under Research Experience below)

Research Experience

2023 – Postdoctoral Researcher, California Collaborative Fisheries Research Program, Moss Landing Marine Laboratories at San Jose State University

Research focus: Data analysis, manuscript preparation, and dissemination of results for a community-based science program spanning the California coast involving six CA universities, the crew and captains of 36 sportfishing vessels, more than 1,800 volunteer anglers, and partners in resource and conservation management agencies (<https://www.ccfpr.org/>). The program aims to evaluate the effectiveness of CA's network of marine protected areas as a tool for fisheries management and conservation.

Additional duties: Mentorship and teaching of M.S. students at Moss Landing Marine Laboratories. Education and outreach for angling community.

2018-2023 – Department of Biological Sciences at Florida State University PhD Candidate, Major Professor: Dr. Dan Okamoto.

Research focus: I'm curious about how the physiology of individuals constrains the way global change affects ecological interactions, population dynamics, and community structure in marine ecosystems. I study invertebrate model organisms that have strong grazing impacts on macroalgal productivity and represent important fisheries, such as sea urchins and abalone. I am interested in improving understanding of how individuality can modulate ecological projections by considering the roles of processes such as local adaptation, phenotypic plasticity, and epigenetic effects. I aim to build process-based models of the effects of multiple abiotic drivers including ocean temperature, acidity, and nutrient loading on the energy budgets of individuals to provide a quantitative framework for scaling up inferences to higher orders of biological organization and improve managers' capacity for strategic conservation. My research spans from coastal British Columbia, Canada to the Tropical Eastern Pacific along the coast of Panamá and integrates field surveys, field and laboratory experiments, statistical analysis, quantitative theory, and simulation modeling.

2013-2018 – San Onofre Nuclear Generating Station Mitigation Monitoring Project,

Staff Research Associate II Website: <http://marinemitigation.msi.ucsb.edu/>

General duties: Field: Biological and geophysical surveys of an artificial mitigation reef and two natural reference reefs off the southern California coast. Laboratory: Routine and emergency maintenance and monitoring of the project's information management and technology system, including hardware and software components. Processing of performance and operation data and logs, identification of security threats, vulnerabilities, and performance bottlenecks. Data entry, QA/QC, assist in compilation of project documentation and annual report. Processing, sorting, and classification of invertebrate and algal samples collected from the field. Fabrication and repair of sampling equipment.

2011-2013 – National Science Foundation Research Technician - Ocean acidification and coral reefs

Website: <http://www.crco2.org>, <http://mcr.lternet.edu/>

General duties: Support for research on the effects of ocean acidification (OA) on coral reefs in Moorea, French Polynesia and Oahu, Hawaii USA. Research focused on the ecophysiology of corals and algae, and spanned investigative scales from organisms to assemblages of species, and natural communities. Experiments conducted involved microcosms and in situ analyses. Responsibilities included management of research logistics, design, construction, maintenance, and husbandry of experimental aquaria, management of field and diving operations for a small research team, carbonate chemistry analysis, a range of physiological assays, data collection, QA/QC, and analysis, and collaboration on manuscript preparation.

2010 – SONGS Mitigation and Monitoring Project, Laboratory Assistant III

General duties: Field and laboratory support for a long-term study investigating the performance of the world's largest temperate artificial reefs used to mitigate the loss of kelp forest habitat caused by the operation of the San Onofre Nuclear Generating Station (SONGS). Database management and web integration. Fabrication and repair of sampling equipment. Project presentation at symposia.

2010-2018 – Marine Biologist/Collector at Agua Hedionda Lagoon Foundation Discovery Center

General duties: Design and construction of aquaria and exhibits for display of local temperate marine organisms. Presentation of interactive marine educational programs for special events. Collection and husbandry of local marine organisms.

2009 – Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO), Laboratory Assistant II

General duties: Larval fish otolith and larval squid statolith extraction and preparation using microtools and dissecting microscopy coupled with digital imaging equipment. Subtidal benthic and fish surveys in the Southern California Bight and associated laboratory support.

2008 – Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO), Laboratory Assistant I

General duties: Subtidal benthic and fish surveys in the Southern California Bight and associated laboratory support.

2008 – Reef Check California, Volunteer Research Diver

General duties: Volunteer subtidal fish and benthic survey diving.

2008 – UCSB Recreation Department, Instructor/Lifeguard

General duties: Surveillance of pool patrons and facilities for safety assurance. Swim, surf, kayak lesson instruction for all ages and ability levels. Enforcement and education of rules and regulations of the Recreation Center. Maintenance of facilities.

2007 – Holbrook/Schmitt Moorea Coral Reef/LTER Lab, Volunteer Intern

General duties: Processing of marine microbenthic samples using dissecting microscopy. Laboratory organization and schedule management.

Skills

Laboratory Proficiencies

- ❖ Lipid and fatty acid (FA) extraction and quantitative analysis using data from a gas chromatograph – mass spectrometer. Emphasis on the application of FA biomarkers to make inferences about food web dynamics as well as to better understand biochemical modification of FAs during the process of tissue building.
- ❖ Aquatic respirometry.
- ❖ Acoustic telemetry technology for tracking invertebrate movement.
- ❖ Carbonate chemistry analysis and manipulation. Emphasis on the role of carbonate chemistry in global change biology.
- ❖ Marine calcification assays including buoyant weight and alkalinity anomaly.
- ❖ Demonstrated working knowledge of reef fish, invertebrate, and algal taxonomy.

- ❖ Dissection, general anatomy, and taxonomic classification of various aquatic animal phyla.
- ❖ Experimental aquarium design, construction, and husbandry.
- ❖ Operation of machine shop tools and custom fabrication.
- ❖ Otolith and statolith processing and analysis as it applies to assessing age.
- ❖ Advanced microscopy.

Scientific Diving

- ❖ Graduate Student Representative to Florida State University Diving Control Board
- ❖ 2018-present – Assisted with training of students enrolled in AAUS Scientific Diving course at Florida State University
- ❖ American Academy of Underwater Sciences (AAUS): 1000+ Scientific Dives logged; 100 ft depth rating; Lead Diver on multiple temperate and tropical dive plans; high proficiency in range of challenging conditions including low visibility, high current, high surge, cold water.
- ❖ SSI Specialty Diver: NITROX
- ❖ NAUI Specialty Diver: Reef Check California
- ❖ PADI Open Water Certification
- ❖ DAN Diving First Aid/CPR/O2 Administration for Professional Divers Certified
- ❖ PADI Master Diver in progress
- ❖ High proficiency with *in situ* identification of temperate and tropical invertebrates, fish, and algae.
- ❖ Experience with SCUBA gear repair and maintenance and compressor operation and maintenance.
- ❖ Experience with underwater photography and videography.

Software Proficiencies

- ❖ Statistics, procedural programming, and data visualization: R, JMP, SAS, and Matlab.
- ❖ Productivity: Microsoft Office and comparable Mac software.
- ❖ Collaborative data visualization: SigmaPlot
- ❖ Dynamic OOP-style web application development: PHP, MySQL, HTML, CSS, JS
- ❖ Static web design: iWeb, Wordpress, Weebly
- ❖ Collaborative programming: Subversion, Eclipse IDE, GitHub
- ❖ Relational database management: MySQL
- ❖ Automation: PHP-based unit testing for granular QA/QC for millions of rows of data
- ❖ Geographic Information System: QGIS, ArcGIS, Google Earth Pro
- ❖ 3D modeling: Autodesk Fusion 360, Google Sketchup, David Laserscanner Gmbh, Blender
- ❖ Graphic design and video editing: Adobe Premier Pro, Adobe InDesign, Adobe Photoshop

Boating

- ❖ Extensive field operations using small research craft (19-26ft) and skiffs (15ft) working in both temperate and tropical environments.
- ❖ Experience with boat maintenance, troubleshooting, and repairs.