

Cynthia Aileen Catton

California Department Fish and Wildlife
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EDUCATION

- 2008 PhD Marine Biology, Scripps Institution of Oceanography, UC San Diego
2008 M.S. Marine Biology, Scripps Institution of Oceanography, UC San Diego
2000 B.S. Zoology, University of Washington
1994 Roosevelt High School, Seattle, Washington

Doctoral Dissertation (2002-2008)

The influence of aggregation characteristics on low-density population dynamics of pink abalone (*Haliotis corrugata*), red abalone (*H. rufescens*), and wavy turban snails (*Megastraea undosa*) in California

RESEARCH EXPERIENCE

- 2017-present Research Associate – Marine invertebrate fisheries and conservation
Bodega Marine Laboratory, University of California, Davis
- 2012-present Environmental Scientist – Marine invertebrate fisheries and conservation
Marine Region, California Department of Fish and Wildlife (CDFW)
- 2012 Staff Research Associate II – Endangered white abalone conservation
Bodega Marine Laboratory, University of California, Davis
- 2010-2011 Research Contractor – Endangered black abalone conservation modeling
Southwest Fisheries Science Center, La Jolla,
National Oceanic and Atmospheric Administration (NOAA)
- 2009-2010 Postdoctoral Associate – Black abalone population dynamics
National Research Council
Southwest Fisheries Science Center, La Jolla, NOAA
- 2002-2008 Doctoral Student Researcher – Fisheries and conservation ecology
Scripps Institution of Oceanography, University of California, San Diego
- 2002 Research Technician – Marine ecology and larval biology
Lincoln Marine Science Center, Flinders University of South Australia
- 2000-2002 Research Technician – Marine ecology
Friday Harbor Laboratories, University of Washington

TEACHING EXPERIENCE

- 2014 Curriculum development committee – CDFW Marine Climate Change College
- 2007-2010 Guest instructor – Marine Invertebrates, University of California, San Diego
- 2007 Teaching assistant – Marine Biology, University of California, San Diego
- 2008 Guest instructor – Marine Invertebrates, University of San Diego
- 2004, 2005 Guest instructor – Scientific Diving, University of California, Davis
- 2001, 2002 Teaching assistant – Marine Invertebrate Zoology and Botany
Friday Harbor Labs, University of Washington

PUBLICATIONS

- Kawana, S.K., **Catton, C.A.**, Hofmeister, J.K.K., Juhasz, C.I., Taniguchi, I.K., Stein, D., and L. Rogers-Bennett (*in review*). Prolonged warm water shifts abalone recruitment and sea urchin density in southern California: Implications for climate-ready abalone restoration planning. *Journal of Shellfish Research*.
- Rogers-Bennett, L., Kashiwada, J.V., Taniguchi, I.K., Kawana, S.K., and C.A. Catton (*in review*). Using density-based fishery management strategies to respond to mass mortality events. *Journal of Shellfish Research*
- Hofmeister, J.K.K., Kawana, S.K., Walker, B.J., **Catton, C.A.**, Taniguchi, I., Stein, D.M., Sowul, K. and L. Rogers-Bennett. (2018) Temporal and spatial patterns in behavioral responses of marine predators to a sudden influx of abalone prey (*Haliotis rufescens*). *Hydrobiologia* 813(1):123-136. DOI: 10.1007/s10750-018-3514-2
- Reid, J., L. Rogers-Bennett, M. Pace, R. Eyler, F. Vasquez, A. Bruner, **C. A. Catton**, J. V. Kashiwada, and I. K. Taniguchi. (2016) The economic value of the recreational red abalone fishery in northern California. *California Fish & Game*. 102(3):119-130.
- Catton, C.A.**, Stierhoff, K., and L. Rogers-Bennett (2016) Population status assessment and restoration modeling of white abalone (*Haliotis sorenseni*) in California. *Journal of Shellfish Research*. 35(3):593-599. DOI: 10.2983/035.035.0304
- Rogers-Bennett, L., Dondanville, R. F., **Catton, C.A.**, Juhasz, C.I., Horii, T., and M. Hamaguchi (2016) Tracking larval, newly-settled, and juvenile red abalone (*Haliotis rufescens*) recruitment in northern California. *Journal of Shellfish Research*. 35(3):601-609. DOI: 10.2983/035.035.0305
- Rogers-Bennett, L., Aquilino, K.M., **Catton, C.A.**, Kawana, S.K., Walker, B.J., Ashlock, L.W., Marshman, B.C., Moore, J.D., Taniguchi, I.K., Gilardi, K.V., and G.N. Cherr (2016) Implementing a restoration program for the endangered white abalone (*Haliotis sorenseni*) in California. *Journal of Shellfish Research*. 35(3):611-618. DOI: 10.2983/035.035.0306
- Braje, T.J., Torben, R.C., Erlandson, J.M., Rogers-Bennett, L., and **C. Catton** (2015) Historical ecology can inform restoration site selection: The case of black abalone (*Haliotis cracherodii*) along California's Channel Islands. *Aquatic Conservation: Marine and Freshwater Ecosystems*. DOI: 10.1002/aqc.2561
- Catton, C.A.** and L. Rogers-Bennett (2013) Assessing the recovery of pink abalone (*Haliotis corrugata*) by incorporating aggregation into a matrix model. *Journal of Shellfish Research*. 32:181-187. DOI: 10.2983/035.032.0124
- Arellano, S., Reitzel, A., and **C. (Catton) Button** (2012). Stage-specific variation in vertical distribution of larvae relative to halocline cues. *Journal of Experimental Marine Biology and Ecology*. 414- 415:28-37. DOI: 10.1016/j.jembe.2012.01.008
- (Catton) Button, C.A.** and L. Rogers-Bennett (2011) Vital rates of pink abalone *Haliotis corrugata* estimated from mark-recapture data to inform recovery. *Marine Ecology Progress Series*. 431:151-161. DOI: 10.3354/meps09094

MANAGEMENT AND ACTION PLANS

Marine Invertebrate Management Team (*in prep*) California Red Abalone Fishery Management Plan. California Department of Fish and Wildlife.

The Sea Star Wasting Syndrome Task Force (2018). Research and Management Priorities to Address Sea Star Wasting Syndrome: A Collaborative Strategic Action Plan, Issue 1: Research Priorities. <http://www.piscoweb.org/sea-star-wasting-syndrome-task-force>.

OUTREACH MATERIALS AND TECHNICAL REPORTS

Catton, C.A., Amrhein, A., and L. Rogers-Bennett (2016) “Perfect Storm” Decimates Northern California Kelp Forests. California Department of Fish and Wildlife Marine Management News. <https://cdfwmarine.wordpress.com/2016/03/30/perfect-storm-decimates-kelp/>

Rogers-Bennett, L. and **C. Catton** (2013) *California Red Abalone: A guide to understanding the essentials of abalone biology and their relation to recreational red abalone fishing regulations*. California Department of Fish and Wildlife and California SeaGrant. <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=76527&inline>

Rogers-Bennett, L., **Catton, C.**, and I. Taniguchi (2013) *Estimating red abalone density for managing California’s recreational red abalone fishery*. California Department of Fish and Wildlife.

Catton, C. and I. Taniguchi (2013) Annual Abalone Fisheries Report. *In: 2013 California Legislative Fisheries Forum: Department of Fish and Game Annual Marine Fisheries Report*. California Department of Fish and Game.

(**Catton**) **Button, C.** and I. Taniguchi (2012) Annual Abalone Fisheries Report. *In: 2012 California Legislative Fisheries Forum: Department of Fish and Game Annual Marine Fisheries Report*. California Department of Fish and Game.

(**Catton**) **Button, C.**, Rogers-Bennett, L., Taniguchi, I., Kashiwada, J., and C. Juhasz. (2012) *San Miguel Island Red Abalone Fishery Consideration – Recommendation*. Report to the California Fish and Game Commission. California Department of Fish and Game.

INVITED PROFESSIONAL TALKS

Catton, C. (2018) Recent large-scale kelp loss in northern California. Monterey Bay National Marine Sanctuary. April 2018.

Catton, C. (2017) Causes and consequences of large-scale kelp loss in northern California. California State University Monterey Bay. October 2017.

Catton, C. (2017) Eyes on the Horizon: Examining the Scale of Fisheries Management in a Changing Climate and the Need for Multi-Institutional Collaborations. American Fisheries Society. Eureka, CA. March 2017

Catton, C., Stierhoff, K., and L. Rogers-Bennett (2016) White abalone outplanting strategies: Modeling results. National Marine Fisheries Service Abalone Restoration Workshop. January 2016.

Catton, C., Rogers-Bennett, L., Juhasz, C., Walker, B., Kashiwada, J., Kawana, S., and A. Maguire (2015) Kelp forests pushed beyond a tipping point. California Cooperative Fisheries and Oceanography Investigations El Niño workshop, Monterey, CA. December 2015

- Catton, C.** (2013) Abalone and Allee Effects: Implications for management and conservation. John and Mary Louise Riley Seminar Series, Bodega Marine Laboratory, Bodega Bay, CA. March 2013
- (Catton) Button, C.** (2011) Population viability of the California black abalone. National Oceanic and Atmospheric Administration, La Jolla, CA. March 2011

CONTRIBUTED TALKS

- Catton, C.A.,** Sowul, K., Bray, J.R., Koike, S.S., Kawana, S.K., Winqvist, T.A., Klamt, R.R., Kashiwada, J.V., Moore, J.D., and L. Rogers-Bennett (2018) Widespread starvation of red abalone (*Haliotis rufescens*) following severe ocean warming: Assessing the impacts and recovery potential. International Abalone Symposium. Xiamen, China. May 2018.
- Kawana, S.K., **Catton, C.A.,** Hofmeister, J.K.K., Juhasz, C.I., Taniguchi, I.K., Stein, D.M., and L. Rogers-Bennett (2018) Abalone and sea urchin recruitment during normal and warm-water in southern California: Implications for future abalone recovery. International Abalone Symposium. Xiamen, China. May 2018.
- Rogers-Bennett, L., Kashiwada, J.V., Taniguchi, I.K., Kawana, S.K., and **C.A. Catton** (2018) Using density-based fishery management strategies to respond to unpredictable extreme environmental events. International Abalone Symposium. Xiamen, China. May 2018.
- Catton, C.A.,** Kawana, S.K., Kashiwada, J.K., Winqvist, T., Sowul, K., Genhart-Stiehler, G.R., Grishpan, A., Bray, J., Koike, S., Slatoff, L.G., and L. Rogers-Bennett (2017) Development and persistence of large-scale purple urchin barrens in northern California. Western Society of Naturalists. Pasadena, CA, November 2017.
- Catton, C.A.,** Juhasz, C.I., Stein, D.M., Mireles, C., Coates, J., Buck, T., and L. Rogers-Bennett (2017) The state of benthic marine invertebrate fisheries of the California Current 2016-2017. California Cooperative Fisheries Investigations Annual Meeting. La Jolla, CA. December 2017.
- Rogers-Bennett, L., **Catton, C.A.,** Kawana, S.K., Winqvist, T., Sowul, K., and J. Kashiwada (2017) Catastrophic impacts of a marine heat wave on kelp forests, abalone, and nearshore fisheries in northern California. Western Society of Naturalists. Pasadena, CA, November 2017.
- Sowul, K., Rogers-Bennett, L., Winqvist, T., Bray, J., Genhart-Stiehler, G., Koike, S., and **C.A. Catton** (2017) Assessing the condition of wild red abalone and their potential for recovery following severe ocean warming. Western Society of Naturalists. Pasadena, CA, November 2017.
- Kawana, S.K., **Catton, C.A.,** Hofmeister, J.K.K., Walker, B.J., Taniguchi, I.K., Stein, D.M., Sowul, K., Winqvist, T. and L. Rogers-Bennett (2017) Identifying optimal microhabitat complexity for abalone (*Haliotis* spp.) restoration stocking in southern California. Western Society of Naturalists, Pasadena, CA. November 2017.
- Walker, B.J., **Catton, C.A.,** Moore, J.D., and L. Rogers-Bennett (2017). Planning white abalone restoration considering impacts of ocean warming on reproduction, disease risk, and habitat quality. Western Society of Naturalists, Pasadena, CA. November 2017.
- Hofmeister, J.K.K., Kawana, S.K., Walker, B.J., **Catton, C.A.,** Taniguchi, I.K., Stein, D.M., Maguire,

- A., and L. Rogers-Bennett (2016) Predation and predator response to experimental stocking of red abalone (*Haliotis rufescens*) in southern California. Western Society of Naturalists. Monterey, CA, November 2016.
- Kawana, S.K., **Catton, C.A.**, Juhasz, C.I., Taniguchi, I.K., and L. Rogers-Bennett (2016) Southern California artificial reefs: Monitoring abalone (*Haliotis* spp.) recruitment. Western Society of Naturalists. Monterey, CA, November 2016.
- Walker, B.J., **Catton, C.A.**, and L. Rogers-Bennett (2016) Integrated habitat evaluation for white abalone restoration stocking. Western Society of Naturalists. Monterey, CA, November 2016.
- Catton, C.A.**, Rogers-Bennett, L., Juhasz, C., Kashiwada, J., Kawana, S., and A. Maguire. (2015) Impacts of recent warming events on red abalone (*Haliotis rufescens*) reproduction and recruitment in northern California. Western Society of Naturalists. Sacramento, CA. November, 2015.
- Rogers-Bennett, L., **Catton, C.**, Juhasz, C., Kashiwada, J., Kawana, S., and A. Maguire (2015) Kelp forest monitoring reveals changes from HABs, sea star disease, purple urchin explosions, and El Niño in northern California. Western Society of Naturalists, Sacramento, CA. November, 2015.
- Catton, C.**, Slatoff, L., Huff, S., Gaylord, B., and L. Rogers-Bennett (2015) Impacts of marine bio-eroding species on shell strength of red abalone: Implications for incidental fishing mortality. California Department of Fish and Wildlife Science Symposium. Davis, CA. October, 2015.
- Catton, C.**, Stierhoff, K., and L. Rogers-Bennett (2015) Modeling restoration of the endangered white abalone populations in California. International Abalone Symposium. Yeosu, Korea. October, 2015.
- Catton, C.**, Lessard, J., and L. Rogers-Bennett (2015) At risk or on the rise? Characterizing northern abalone populations across a broad geographic range. International Abalone Symposium, Yeosu, Korea. October, 2015.
- Catton, C.**, Lessard, J., and L. Rogers-Bennett (2015) Characterizing northern abalone populations across a broad geographic range: Perspectives on endangered listing consideration. National Shellfisheries Association, Monterey, CA. March, 2015.
- Catton, C.** (2014) Red abalone recreational fishery. California Cooperative Oceanic Fisheries Investigations, La Jolla, CA. December, 2014.
- Catton, C.**, Lessard, J., and L. Rogers-Bennett (2014) Characterizing northern abalone populations across a broad geographic range: Perspectives on endangered listing consideration. Western Society of Naturalists, Tacoma, CA. November, 2014.
- Catton, C.**, Rogers-Bennett, L., and J. Leichter (2013) Density-dependence of aggregation in abalone populations: Evidence for Allee Effects. Western Society of Naturalists, Oxnard, CA. November, 2013.
- Catton, C.A.** and L. Rogers-Bennett (2012) Assessing the recovery of pink abalone (*Haliotis corrugata*) by incorporating aggregation into a matrix model. Western Society of Naturalists, Monterey, CA. November, 2012.
- (Catton) Button, C.A.** and L. Rogers-Bennett (2012) Assessing the recovery of *Haliotis corrugata* by incorporating aggregation into a matrix model. International Abalone Symposium, Hobart,

Tasmania, Australia. May, 2012.

(Catton) Button, C. and L. Rogers-Bennett (2009) The use of nearest-neighbor distance, aggregation size, and population density estimation methods in developing biological reference points.

International Abalone Symposium, Pattaya, Thailand. July, 2009.

(Catton) Button, C. (2006) Current status of a pink abalone population near San Diego, CA. Western Society of Naturalists. November, 2006.

CONTRIBUTED POSTERS

Catton, C.A., Kawana, S.K., Kashiwada, J.K., Winkquist, T., Maguire, A., and L. Rogers-Bennett (2016) Recent unprecedented purple urchin population boom in northern California razes algal species and exposes bare rock reef. Western Society of Naturalists. Monterey, CA, November 2016.

Koike, S., **Catton, C.A.,** Klamt, R., and L. Rogers-Bennett (2016) Kelp deforestation impacts health and reproduction of red abalone in northern California. Western Society of Naturalists. Pasadena, CA, November 2016.

Walker, B.J., **Catton, C.A.** and L. Rogers-Bennett (2015) Critical temperature thresholds can be used to select optimal white abalone outplanting sites. National Shellfisheries Association, Monterey, CA. March 2015

Walker, B.J., **Catton, C.A.** and L. Rogers-Bennett (2015) Critical temperature thresholds can be used to select optimal white abalone outplanting sites. Western Society of Naturalists, Tacoma, CA. November 2014

Makukhov, A.D., Rogers-Bennett, L., **Catton, C.A.,** Micheli, F., and J.K. O'Leary (2014) Initial assessment of larval settlement in low density abalone populations in Monterey Bay, California. Ecological Society of America, Sacramento, CA. August 2014

Kawana, S.K., **Catton, C.A.,** and L. Rogers-Bennett (2013) Distribution of the boring sponge, *Cliona celata*, infecting the red abalone fishery in northern California. Western Society of Naturalists, Oxnard, CA. November, 2013

(Catton) Button, C.A., Rogers-Bennett, L., Juhasz, C., and I. Taniguchi (2013) Modeling restoration of endangered white abalone (*Haliotis sorenseni*) populations. California Department of Fish and Wildlife Science Symposium, Sacramento, CA. October, 2013

Catton, C.A., Rogers-Bennett, L., Juhasz, C., and I. Taniguchi (2012) Modeling restoration of endangered white abalone (*Haliotis sorenseni*) populations. Western Society of Naturalists, Monterey, CA. November, 2012

Aquilino, K.M., McGinn, N.A., **Catton, C.A.,** Rogers-Bennett, L., Moore, J.D., and G.N. Cherr (2012) White abalone (*Haliotis sorenseni*) captive breeding program. Western Society of Naturalists, Monterey, CA. November, 2012

Catton, C. (2005) Temperature effects on the larval duration of the Wavy Turban Snail, *Megastraea undosa* (Wood, 1828) (Gastropoda: Turbinidae). Society of Integrative and Comparative Biology, San Diego, CA. January, 2005.

Catton, C., Haaker, P., and I. Taniguchi (2004) Is density an effective population evaluation criterion for aggregative species? A Case study of a pink abalone, *Haliotis corrugata*, population near

San Diego, California. Western Society of Naturalists, November, 2004.

- Catton, C.** (2003) Exploited invertebrates from southern California kelp forests: Considerations for management and conservation. Center for Marine Biodiversity and Conservation, December, 2003.
- Catton, C.** (2002) Life history stages of *Eusyllis habeii* Imajima, 1966 with notes on epitoky in the family Syllidae (Annelida: Polychaeta). Society of Integrative and Comparative Biology, Anaheim, CA. January, 2002.

SERVICE

- Program Director – Kelp Ecosystem and Landscape Partnership for Research on Resilience (KELPRR), 2017-present
- Co-Chair – Kelp Recovery Working Group, CDFW and Greater Farallones National Marine Sanctuary, 2018
- Lead Editor, Red Abalone Fishery Management Plan – CDFW, 2015-present
- Representative for US and Canada – International Abalone Society, 2015-present
- CDFW climate change working group, 2013-present
- Scheduler and Chair – Seminar Committee, Bodega Marine Laboratory, 2012-2014
- Diving Control Board Student Representative – Scripps Institution of Oceanography, 2003-2007

REFEREE SERVICE

- North Pacific Research Board
- Journal of Shellfish Research
- Bulletin of Marine Science
- CalCOFI Reports
- Seafood Watch
- California SeaGrant

STUDENT COMMITTEES

- Kate Melanson, University of California Santa Cruz

HONORS / AWARDS

- National Research Council Postdoctoral Fellowship 2009-2010
- Wyer Fellowship 2007-2008
- Halliday Field Research Grant 2007
- Hicks Fellowship 2007-2008
- Coastal Environmental Quality Initiative Graduate Fellowship 2006
- California Sea Grant Trainee 2002-2005
- Western Society of Naturalists, Best Student Poster Award 2004
- Dr. Mia J. Tegner Fund Research Grant 2003, 2004
- Edna B. Sussman Internship Funding 2002-2005

- NSF Research Experience for Undergraduates Fellowship 1999

CERTIFICATIONS

- California Boating Safety – 2015
- Washington Boating Safety – 2014
- CDFW Scientific Diver – 2013
- Standard 1st Aid – 2016
- Adult and child CPR – 2016
- CDFW Scuba Compressor Operator – 2012
- AAUS Scientific Diver – 1999
- PADI Rescue Diver #9804081456 – 1997
- PADI Advanced Open Water #9509294676 – 1995
- NAUI Open Water I – 1993

PROFESSIONAL MEMBERSHIPS

American Academy of Underwater Sciences
International Abalone Society
National Shellfisheries Association
Western Society of Naturalists

RECENT GRANTS

2016-2018 NOAA Section 6 “Next Steps in White Abalone Recovery: A Partnership for Wild Population Restoration Stocking” PIs Taniguchi, Rogers-Bennett, Moore, **Catton**, Gilardi, and Burton.