

# Cole Monnahan

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## Education

University of Washington (**UW**), Seattle, Washington, USA

**Ph.D.**, Quantitative Ecology and Resource Management (2017)

- *Advancing Bayesian methods for fisheries stock assessment*

**M.S.**, Quantitative Ecology and Resource Management (2013)

- *Population trends of the eastern North Pacific blue whale*

Western Washington University, Bellingham, Washington, USA

**B.S.**, Mathematics (2006)

**B.A.**, German Language (2006)

## Professional Experience

Research Engineer (2017-2018). *Estimating risk to humpback whales from shipping: a comparative approach from Glacier Bay National Park, Alaska, and Francisco Coloane Marine Protected Area, Chile*. Joint position: University of Washington and Universidad de Concepción, Concepción, Chile.

Research Assistant (2010-2017). University of Washington, Seattle, Washington

Agricultural Statistician (2006-2010). U.S. Department of Agriculture, Bothell, Washington

## Research Interests

Marine resource management, quantitative fisheries science, Bayesian statistics, population dynamics

## Peer-reviewed Publications ( $n=13$ )

**Monnahan**, C. C. and K. Kristensen. 2018. No-U-turn sampling for fast Bayesian inference in ADMB and TMB: Introducing the adnuts and tmbstan R packages. *Plos One* 13:e0197954.

**Monnahan**, C. C. and I. J. Stewart. 2018. The effect of hook spacing on longline catch rates: Implications for catch rate standardization. *Fisheries Research* **198**:150-158.

**Monnahan**, C. C., J. T. Thorson, and T. A. Branch. 2017. Faster estimation of Bayesian models in ecology using Hamiltonian Monte Carlo. *Methods in Ecology and Evolution* **8**:339-348.

Stewart, I. J. and C. C. **Monnahan**. 2017. Implications of process error in selectivity for approaches to weighting compositional data in fisheries stock assessments. *Fisheries Research* **192**:126-134.

Kuriyama, P. T., K. Ono, F. Hurtado-Ferro, A. C. Hicks, I. G. Taylor, R. R. Licandeo, K. F. Johnson, S. C. Anderson, C. C. **Monnahan**, M. B. Rudd, C. C. Stawitz, and J. L. Valero. 2016. An empirical weight-at-age approach reduces estimation bias compared to modeling parametric growth in

- integrated, statistical stock assessment models when growth is time varying. *Fisheries Research* **180**:119-127.
- Monnahan**, C. C., K. Ono, S. C. Anderson, M. B. Rudd, A. C. Hicks, F. Hurtado-Ferro, K. F. Johnson, P. T. Kuriyama, R. R. Licandeo, C. C. Stawitz, I. G. Taylor, and J. L. Valero. 2016. The effect of length bin width on growth estimation in integrated age-structured stock assessments. *Fisheries Research* **180**:103-112.
- Monnahan**, C. C., T. A. Branch, and A. E. Punt. 2015. Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales? *Marine Mammal Science* **31**:279-297.
- Thorson, J. T., C. C. **Monnahan**, and J. M. Cope. 2015. The potential impact of time-variation in vital rates on fisheries management targets for marine fishes. *Fisheries Research* **169**:8-17.
- Anderson, S. C., C. C. **Monnahan**, K. F. Johnson, K. Ono, and J. L. Valero. 2014. ss3sim: an R package for fisheries Stock Assessment simulation with stock synthesis. *Plos One* **9**:e92725.
- Hurtado-Ferro, F., C. S. Szuwalski, J. L. Valero, S. C. Anderson, C. J. Cunningham, K. F. Johnson, R. Licandeo, C. R. McGilliard, C. C. **Monnahan**, M. L. Muradian, K. Ono, K. A. Vert-Pre, A. R. Whitten, and A. E. Punt. 2014. Looking in the rear-view mirror: bias and retrospective patterns in integrated, age-structured stock assessment models. *ICES Journal of Marine Science* **72**:99-110.
- Johnson, K. F., C. C. **Monnahan**, C. R. McGilliard, K. A. Vert-pre, S. C. Anderson, C. J. Cunningham, F. Hurtado-Ferro, R. R. Licandeo, M. L. Muradian, K. Ono, C. S. Szuwalski, J. L. Valero, A. R. Whitten, and A. E. Punt. 2014. Time-varying natural mortality in fisheries stock assessment models: identifying a default approach. *ICES Journal of Marine Science* **72**:137-150.
- Monnahan**, C. C., T. A. Branch, K. M. Stafford, Y. V. Ivashchenko, and E. M. Oleson. 2014a. Estimating historical eastern North Pacific blue whale catches using spatial calling patterns. *Plos One* **9**:e98974.
- Ono, K., R. Licandeo, M. L. Muradian, C. J. Cunningham, S. C. Anderson, F. Hurtado-Ferro, K. F. Johnson, C. R. McGilliard, C. C. **Monnahan**, C. S. Szuwalski, J. L. Valero, K. A. Vert-Pre, A. R. Whitten, and A. E. Punt. 2014. The importance of length and age composition data in statistical age-structured models for marine species. *ICES Journal of Marine Science* **72**:31-43.

## Technical Reports (n=6)

- Branch, T. A., D. M. Palacios, and C. C. **Monnahan**. 2016. Overview of the North Pacific blue whale distribution, and the need for an assessment of the western and central Pacific. Scientific Committee of the International Whaling Commission. SC/66b/IA/15.
- Stewart, I. J. and C. C. **Monnahan**. 2016. Overview of data sources for the Pacific halibut stock assessment and related analyses., IPHC Report of Assessment and Research Activities. [http://www.iphc.int/publications/rara/2015/RARA2015\\_11Assessmenddatasources.pdf](http://www.iphc.int/publications/rara/2015/RARA2015_11Assessmenddatasources.pdf).
- Stewart, I. J., C. C. **Monnahan**, and S. Martell. 2016. Assessment of the Pacific halibut stock at the end of 2015. . IPHC Report of Assessment and Research Activities. [http://www.iphc.int/publications/rara/2015/RARA2015\\_12Assessment.pdf](http://www.iphc.int/publications/rara/2015/RARA2015_12Assessment.pdf).
- Monnahan**, C. C. and T. A. Branch. 2015. Sensitivity analyses for the eastern North Pacific blue whale assessment. Scientific Committee of the International Whaling Commission. SC/66a/IA15.
- Monnahan**, C. C., M. L. Muradian, and P. T. Kuriyama. 2014b. A guide for Bayesian analysis in AD Model Builder. <http://www.admb-project.org/developers/mcmc/mcmc-guide-for-admb.pdf>.
- Monnahan**, C. C. and I. J. Stewart. 2014. Evaluation of commercial logbook records: 1991-2013. IPHC Report of Assessment and Research Activities. [http://www.iphc.int/publications/rara/2014/rara2014\\_14commlog\\_revision.pdf](http://www.iphc.int/publications/rara/2014/rara2014_14commlog_revision.pdf).

## Teaching Experience

### Instruction

*Fitting hierarchical models in Template Model Builder.* University of Concepción, Concepción, Chile. Lead 1-week workshop in English/Spanish (2018).

*Introduction to R programming for natural scientists.* UW FISH 552 (2016).

*Advanced R programming for natural scientists.* UW FISH 553 (2016).

Co-creator of *Super-Advanced R Programming*. UW FISH 512 (2014).

### Guest Lectures

*Non-linear function minimization.* UW FISH 458 (2016).

*Mixed effects models.* UW StatR 201 (2015).

*Non-parametric, additive, and generalized additive models.* UW QERM 514 (2014 & 2013).

*Object-Oriented programming in R: S3, S4 and reference classes.* UW FISH 512 (2014).

*Non-parametric, additive, and generalized additive models.* UW QERM 514 (2013).

*Generalized Additive Models in R.* UW QERM 514 (2012).

### Teaching Assistant

*Modeling and Estimation in Conservation Resource Management.* UW FISH/Q SCI 458 (2012).

*Analysis of ecological and environmental data.* UW QERM 514 (2012 & 2014).

## Scientific Presentations

*Revisiting the effect of hook spacing on halibut catch rates and the implications of catch per unit effort (CPUE) standardization in the central Gulf of Alaska.* International Pacific Halibut Commission Seminar. Seattle, WA. 4/19/2017.

*Introducing the no-U-turn MCMC sampler in ADMB and TMB: faster run times for large, complex fisheries models.* UW School of Aquatic and Fisheries Science: Fisheries Think Tank. Seattle, WA. 2/7/2017

*Faster estimation of Bayesian models in ecology using Hamiltonian Monte Carlo.* NOAA Fisheries Sea Grant Fellowship Meeting. Southwest Fisheries Science Center. Santa Cruz, CA. 6/28/2016.

*Hamiltonian Monte Carlo in ADMB and TMB: current status and future directions.* ADMB/TMB Developers' Workshop. Seattle, WA. 6/23/2016.

*Hamiltonian MCMC in TMB (and ADMB)*. Introductory TMB (and ADMB comparison) workshop. Seattle, WA. 2/8/2016.

*Advantages of gradient-based MCMC algorithms for difficult-to-fit Bayesian models in fisheries and ecology*. UW School of Aquatic and Fishery Sciences Quantitative Seminar. Seattle, WA. 12/4/2015.

*Hands-on workshop for ss3sim*. Center for the Advancement of Population Assessment Methodology: Workshop on data conflict and weighting, likelihood functions, and process error. La Jolla, CA. 11/19/2015.

*The effect of hook spacing in the standardization of Pacific halibut CPUE*. NOAA Fisheries Sea Grant Fellowship Meeting. Remote presentation. 6/9/2015.

*Sensitivity analyses for the eastern North Pacific blue whale assessment (SC/66a/IA/15)*. Invited speaker, Scientific Committee of the International Whaling Commission. San Diego, CA. 5/21/2015.

*An evaluation of alternative binning approaches for composition data in integrated stock assessments*. Center for the Advancement of Population Assessment Methodology. Workshop on growth: theory, estimation, and application in fishery stock assessment models. La Jolla, CA. 11/5/2014.

*Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales?* Marine Mammal Laboratory, Alaska Fishery Science Center, NOAA. Seattle, WA. 10/22/2014.

*IPHC Logbook Standardization Project Summary*. International Pacific Halibut Commission. Seattle, WA. 5/12/2014.

*ss3sim: An R package for stock assessment simulation with SS3*. UW School of Aquatic and Fisheries Science: Fisheries Think Tank. Seattle, WA. 3/26/2014

*ss3sim: An R package for stock assessment simulation with SS3*. Stock synthesis development workshop, Northwest Fisheries Science Center, NOAA. Seattle, WA. 12/10/2013.

*Population trends of the eastern North Pacific blue whale*. Northwest Student Chapter of the Society for Marine Mammalogy. Seattle, WA. 5/18/2013.

*Next-generation MCMC: theory, options, and practice for Bayesian inference in ADMB*. University of Washington, Fisheries Think Tank. Seattle, WA. 2/27/2013

*Splitting historical blue whale catches using spatial GAMs*. UW School of Aquatic and Fishery Sciences Quantitative Seminar. 11/2/2012.

*Utilizing historical data to infer cetacean biology*. Northwest Student Chapter of the Society for Marine Mammalogy. University of British Columbia. 5/5/2012.

## Modeling Skills

**Software:** R, ADMB, TMB, Stan, JAGS, Stock Synthesis, git, LaTeX.

**Modeling:** Non-linear, GLM, GAM, mixed effects, and geospatial (spatiotemporal) models; fisheries stock assessment with Stock Synthesis; comfortable with frequentist and Bayesian paradigms.

**R Packages:** adnuts (creator), ss3sim (developer), r4ss (contributor)

**Developer:** ADMB and TMB; contributed new MCMC capabilities to source code and documentation.

## Outreach

For my study demonstrating the recovery of a blue whale population, we conducted outreach to spread the positive results to the broader public. Specifically, we:

- Created a blog and multiple posts explaining whaling and its effect on blue whales ([www.bluewhalenews.org](http://www.bluewhalenews.org)).
- Conducted phone interviews for a variety of news organizations including National Public Radio, BBC News, New York Times, Nature News, and National Geographic.

Our efforts lead to dozens of news stories and over 100 tweets from around the world. The resulting Altmetric score of 342 is in the 99th percentile of all scores to date (see <https://wiley.altmetric.com/details/2658240>).

## Scholarships and Awards

National Marine Fisheries Service/Washington Sea Grant Fellowship in Population Dynamics: *Optimizing Bayesian analysis in data-rich stock assessments and management resources in data-limited fisheries* (2013).

Dean's Visualization Prize. UW College of the Environment (2011).

Graduate School Fund for Excellence and Innovation Top Scholar Award, UW (2010).

## Journal Reviews ( $n=15$ )

Behavioral Ecology and Sociobiology (1), Endangered Species Research (1), Fisheries Research (6), Methods in Ecology and Evolution (2), Natural Resource Monitoring (1), North American Journal of Fisheries Management (1), PLoS One (1), Theoretical Population Biology (1), Proceedings of the Royal Irish Academy (1)