Eric J. Ward

Statistician & Research Biologist
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Education

University of Washington, Ph.D. Aquatic and Fishery Sciences 2003-2006
- *Committee:* Ray Hilborn (advisor), Andre Punt, Tim Essington

Montana State University, MSc Biology 2000-2003
- *Advisor:* Dan Goodman

University of California San Diego, BSc Ecology and Evolution 1995-1999

Employment

Statistican Northwest Fisheries Science Center, NMFS (NOAA) 2009 - present

Affiliate Associate Professor University of Washington (SAFS) 2013 - present

Post-doctoral researcher National Research Council 2007 - 2008

Stock assessment scientist Wellington, New Zealand Spring 2005

Graduate research assistant University of Washington 2003 - 2006

Journal Articles (peer - reviewed)

70. **Ward, E.J.**, S.C. Anderson, A.O. Shelton, R.E. Brenner, M.D. Adkison, A.H. Beaudreau, J.T. Watson, J.C. Shriver, A.C. Haynie, B.C. Williams. 2018. Effects of increased specialization on revenue of Alaskan salmon fishers over four decades. *Journal of Applied Ecology*, :n/a–n/a. doi:10.1111/1365-2664.13058

69. Chasco, B.E., I.C. Kaplan, A.C. Thomas, A. Acevedo-Gutiérrez, D.P. Noren, M.J. Ford, M.B. Hanson, J.J. Scordino, S.J. Jeffries, K.N. Marshall, A.O. Shelton, C. Matkin, B.J. Burke, **E.J. Ward**. 2017. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. *Scientific Reports*, 7:15439. doi:10.1038/s41598-017-14984-8

68. Deacy, W.W., J.B. Armstrong, W.B. Leacock, C.T. Robbins, D.D. Gustine, **E.J. Ward**, J.A. Erlenbach, J.A. Stanford. 2017. Phenological synchronization disrupts trophic interactions between Kodiak brown bears and salmon. *Proceedings of the National Academy of Sciences*, 114:10432–10437. doi:10.1073/pnas.1705248114

67. Anderson, S.C., **E.J. Ward**, A.O. Shelton, M.D. Adkison, A.H. Beaudreau, R.E. Brenner, A.C. Haynie, J.C. Shriver, J.T. Watson, B.C. Williams. 2017. Benefits and risks of diversification for individual fishers. *Proceedings of the National Academy of Sciences*, 114:10797–10802. doi:10.1073/pnas.1702506114

66. Linder, H.L., J.K. Horne, **E.J. Ward**. 2017. Modeling baseline conditions of ecological indicators: marine renewable energy environmental monitoring. *Ecological Indicators*, 83:178–191. doi:10.1016/j.ecolind.2017.07.015

65. **Ward, E.J.**, M. Adkison, J. Couture, S.C. Dressel, M.A. Litzow, S. Moffitt, T.H. Neher, J. Trochta, R. Brenner. 2017. Evaluating signals of oil spill impacts, climate, and species interactions in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska. *PLOS ONE*, 12:e0172898. doi:10.1371/journal.pone.0172898

64. Hussey, N.E., J.D. DiBattista, J.W. Moore, **E.J. Ward**, A.T. Fisk, S. Kessel, T.L. Guttridge, K.A. Feldheim, B.R. Franks, S.H. Gruber, O.C. Weideli, D.D. Chapman. 2017. Risky business for a juvenile marine predator? Testing the influence of foraging strategies on size and growth rate under natural conditions. *Proceedings. Biological Sciences*, 284:. doi:10.1098/rspb.2017.0166

63. Chasco, B., I.C. Kaplan, A. Thomas, A. Acevedo-Gutiérrez, D. Noren, M.J. Ford, M.B. Hanson, J. Scordino, S. Jeffries, S. Pearson, K.N. Marshall, **E.J. Ward**. 2017. Estimates of Chinook salmon consumption in Washington State inland waters by four marine mammal predators from 1970 to 2015. *Canadian Journal of Fisheries and Aquatic Sciences*, 74:1173–1194. doi:10.1139/cjfas-2016-0203

62. Moriarty, P.E., T.E. Essington, **E.J. Ward**. 2016. A novel method to estimate prey contributions to predator diets. *Canadian Journal of Fisheries and Aquatic Sciences*, 74:168–177. doi:10.1139/cjfas-2016-0149

61. Armstrong, J.B., **E.J. Ward**, D.E. Schindler, P.J. Lisi. 2016. Adaptive capacity at the northern front: sockeye salmon behaviourally thermoregulate during novel exposure to warm temperatures. *Conservation Physiology*, 4:. doi:10.1093/conphys/cow039

60. Boyd, C., D.P. DeMaster, R.S. Waples, **E.J. Ward**, B.L. Taylor. 2017. Consistent extinction risk assessment under the U.S. Endangered Species Act. *Conservation Letters*, 10:328–336. doi:10.1111/conl.12269

59. Stier, A.C., J.F. Samhouri, M. Novak, K.N. Marshall, **E.J. Ward**, R.D. Holt, P.S. Levin. 2016. Ecosystem context and historical contingency in apex predator recoveries. *Science Advances*, 2:e1501769. doi:10.1126/sciadv.1501769

58. Adams, J., I.C. Kaplan, B. Chasco, K.N. Marshall, A. Acevedo-Gutiérrez, **E.J. Ward**. 2016. A century of Chinook salmon consumption by marine mammal predators in the Northeast Pacific Ocean. *Ecological Informatics*, 34:44–51. doi:10.1016/j.ecoinf.2016.04.010

57. Thorson, J.T., M.L. Pinsky, **E.J. Ward**. 2016. Model-based inference for estimating shifts in species distribution, area occupied and centre of gravity. *Methods in Ecology and Evolution*, 7:990–1002. doi:10.1111/2041-210X.12567

56. Jorgensen, J.C., **E.J. Ward**, M.D. Scheuerell, R.W. Zabel. 2016. Assessing spatial covariance among time series of abundance. *Ecology and Evolution*, 6:2472–2485. doi:10.1002/ece3.2031

55. **Ward, E.J.**, M.E. Dahlheim, J.M. Waite, C.K. Emmons, K.N. Marshall, B.E. Chasco, K.C. Balcomb. 2016. Long-distance migration of prey synchronizes demographic rates of top predators across broad spatial scales. *Ecosphere*, 7:n/a–n/a. doi:10.1002/ecs2.1276

54. Ono, K., A.O. Shelton, **E.J. Ward**, J.T. Thorson, B.E. Feist, R. Hilborn. 2016. Space-time investigation of the effects of fishing on fish populations. *Ecological Applications*, 26:392–406. doi:10.1890/14-1874

53. Marshall, K.N., A.C. Stier, J.F. Samhouri, R.P. Kelly, **E.J. Ward**. 2016. Conservation challenges of predator recovery. *Conservation Letters*, 9:70–78. doi:10.1111/conl.12186

52. Galloway, A.W.E., M.T. Brett, G.W. Holtgrieve, **E.J. Ward**, A.P. Ballantyne, C.W. Burns, M.J. Kainz, D.C. Müller-Navarra, J. Persson, J.L. Ravet, U. Strandberg, S.J. Taipale, G. Alhgren. 2015. A fatty acid based Bayesian approach for inferring diet in aquatic consumers. *PLOS ONE*, 10:e0129723. doi:10.1371/journal.pone.0129723

51. Westley, P.A.H., A.H. Dittman, **E.J. Ward**, T.P. Quinn. 2015. Signals of climate, conspecific density, and watershed features in patterns of homing and dispersal by Pacific salmon. *Ecology*, 96:2823–2833. doi:10.1890/14-1630.1

50. **Ward, E.J.**, J.E. Jannot, Y. Lee, K. Ono, A.O. Shelton, J.T. Thorson. 2015. Using spatiotemporal species distribution models to identify temporally evolving hotspots of species co-occurrence. *Ecological Applications*, 25:2198–2209. doi:10.1890/15-0051.1

49. Bjorkland, R.H., S.F. Pearson, S.J. Jeffries, M.M. Lance, A. Acevedo-Gutiérrez, **E.J. Ward**. 2015. Stable isotope mixing models elucidate sex and size effects on the diet of a generalist marine predator. *Marine Ecology Progress Series*, 526:213–225. doi:10.3354/meps11230

48. **Ward, E.J.**, J.H. Anderson, T.J. Beechie, G.R. Pess, M.J. Ford. 2015. Increasing hydrologic variability threatens depleted anadromous fish populations. *Global Change Biology*, 21:2500–2509. doi:10.1111/gcb.12847

47. Sergeant, C.J., J.B. Armstrong, **E.J. Ward**. 2015. Predator-prey migration phenologies remain synchronised in a warming catchment. *Freshwater Biology*, 60:724–732. doi:10.1111/fwb.12524

46. Thorson, J.T., A.O. Shelton, **E.J. Ward**, H.J. Skaug. 2015. Geostatistical delta-generalized linear mixed models improve precision for estimated abundance indices for West Coast groundfishes. *ICES Journal of Marine Science*, 72:1297–1310. doi:10.1093/icesjms/fsu243

45. **Ward, E.J.**, K.N. Marshall, T. Ross, A. Sedgley, T. Hass, S.F. Pearson, G. Joyce, N.J. Hamel, P.J. Hodum, R. Faucett. 2015. Using citizen-science data to identify local hotspots of seabird occurrence. *PeerJ*, 3:e704. doi:10.7717/peerj.704

44. Thorson, J.T., H.J. Skaug, K. Kristensen, A.O. Shelton, **E.J. Ward**, J.H. Harms, J.A. Benante. 2015. The importance of spatial models for estimating the strength of density dependence. *Ecology*, 96:1202–1212. doi:10.1890/14-0739.1

43. Thorson, J.T., J.M. Cope, K.M. Kleisner, J.F. Samhouri, A.O. Shelton, **E.J. Ward**. 2015. Giants' shoulders 15 years later: lessons, challenges and guidelines in fisheries meta-analysis. *Fish and Fisheries*, 16:342–361. doi:10.1111/faf.12061

42. Phillips, D.L., R. Inger, S. Bearhop, A.L. Jackson, J.W. Moore, A.C. Parnell, B.X. Semmens, **E.J. Ward**. 2014. Best practices for use of stable isotope mixing models in food-web studies. *Canadian Journal of Zoology*, 92:823–835. doi:10.1139/cjz-2014-0127

41. Anlauf-Dunn, K.J., **E.J. Ward**, M. Strickland, K. Jones. 2014. Habitat connectivity, complexity, and quality: predicting adult coho salmon occupancy and abundance. *Canadian Journal of Fisheries and Aquatic Sciences*, 71:1864–1876. doi:10.1139/cjfas-2014-0162

40. Chasco, B.E., **E.J. Ward**, J.A. Hesse, C. Rabe, R. Kinzer, J.L. Vogel, R. Orme. 2014. Evaluating the accuracy and precision of multiple abundance estimators using state-space models: a case study for a threatened population of Chinook salmon in Johnson Creek, Idaho. *North American Journal of Fisheries Management*, 34:945–954. doi:10.1080/02755947.2014.926302

39. Shelton, A.O., J.T. Thorson, **E.J. Ward**, B.E. Feist. 2014. Spatial semiparametric models improve estimates of species abundance and distribution. *Canadian Journal of Fisheries and Aquatic Sciences*, 71:1655–1666. doi:10.1139/cjfas-2013-0508

38. **Ward, E.J.**, E.E. Holmes, J.T. Thorson, B. Collen. 2014. Complexity is costly: a meta-analysis of parametric and non-parametric methods for short-term population forecasting. *Oikos*, 123:652–661. doi:10.1111/j.1600-0706.2014.00916.x

37. Thorson, J.T., **E.J. Ward**. 2014. Accounting for vessel effects when standardizing catch rates from cooperative surveys. *Fisheries Research*, 155:168–176. doi:10.1016/j.fishres.2014.02.036

36. Nosrati, K., G. Govers, B.X. Semmens, **E.J. Ward**. 2014. A mixing model to incorporate uncertainty in sediment fingerprinting. *Geoderma*, 217-218:173–180. doi:10.1016/j.geoderma.2013.12.002

35. Bodey, T.W., **E.J. Ward**, R.A. Phillips, R.A.R. McGill, S. Bearhop. 2014. Species versus guild level differentiation revealed across the annual cycle by isotopic niche examination. *Journal of Animal Ecology*, 83:470–478. doi:10.1111/1365-2656.12156

34. Hampton, S.E., E.E. Holmes, L.P. Scheef, M.D. Scheuerell, S.L. Katz, D.E. Pendleton, **E.J. Ward**. 2013. Quantifying effects of abiotic and biotic drivers on community dynamics with multivariate autoregressive (MAR) models. *Ecology*, 94:2663–2669. doi:10.1890/13-0996.1

33. Semmens, B.X., **E.J. Ward**, A.C. Parnell, D.L. Phillips, S. Bearhop, R. Inger, A. Jackson, J.W. Moore. 2013. Statistical basis and outputs of stable isotope mixing models: comment on Fry (2013). *Marine Ecology Progress Series*, 490:285–289. doi:10.3354/meps10535

32. Hanson, M.B., C.K. Emmons, **E.J. Ward**, J.A. Nystuen, M.O. Lammers. 2013. Assessing the coastal occurrence of endangered killer whales using autonomous

passive acoustic recorders. *The Journal of the Acoustical Society of America*, 134:3486–3495. doi:10.1121/1.4821206

31. Parnell, A.C., D.L. Phillips, S. Bearhop, B.X. Semmens, **E.J. Ward**, J.W. Moore, A.L. Jackson, J. Grey, D.J. Kelly, R. Inger. 2013. Bayesian stable isotope mixing models. *Environmetrics*, 24:387–399. doi:10.1002/env.2221

30. Thorson, J.T., **E.J. Ward**. 2013. Accounting for space–time interactions in index standardization models. *Fisheries Research*, 147:426–433. doi:10.1016/j.fishres.2013.03.012

29. Holtgrieve, G.W., M.E. Arias, K.N. Irvine, D. Lamberts, **E.J. Ward**, M. Kummu, J. Koponen, J. Sarkkula, J.E. Richey. 2013. Patterns of ecosystem metabolism in the Tonle Sap Lake, Cambodia with links to capture fisheries. *PLOS ONE*, 8:e71395. doi:10.1371/journal.pone.0071395

28. Daele, M.V., C. Robbins, B. Semmens, **E. Ward**, L.V. Daele, W. Leacock. 2013. Salmon consumption by Kodiak brown bears (Ursus arctos middendorffi) with ecosystem management implications. *Canadian Journal of Zoology*, 91:164–174. doi:10.1139/cjz-2012-0221

27. Westley, P.A.H., **E.J. Ward**, I.A. Fleming. 2013. Fine-scale local adaptation in an invasive freshwater fish has evolved in contemporary time. *Proceedings of the Royal Society of London B: Biological Sciences*, 280:20122327. doi:10.1098/rspb.2012.2327

26. **Ward, E.J.**, G.R. Pess, K. Anlauf-Dunn, C.E. Jordan. 2012. Applying time series models with spatial correlation to identify the scale of variation in habitat metrics related to threatened coho salmon (Oncorhynchus Kisutch) in the Pacific Northwest. *Canadian Journal of Fisheries and Aquatic Sciences*, 69:1773–1782. doi:10.1139/f2012-096

25. **Ward, E.J.**, P.S. Levin, M.M. Lance, S.J. Jeffries, A. Acevedo-Gutiérrez. 2012. Integrating diet and movement data to identify hot spots of predation risk and areas of conservation concern for endangered species. *Conservation Letters*, 5:37–47. doi:10.1111/j.1755-263X.2011.00210.x

24. Pattengill-Semmens, C., B. Semmens, E. Holmes, **E.J. Ward**, B. Ruttenberg. 2011. Integrating time-series of community monitoring data. *Proceedings of the 63rd Gulf and Caribbean Fisheries Institute*, 63:214–216. doi:

23. Holmes, E., **E.J. Ward**, K. Wills. 2012. MARSS: Multivariate autoregressive state-space models for analyzing time-series data. *R Journal*, 4:11–19. doi:

22. Anderson, J.H., **E.J. Ward**, S.M. Carlson. 2011. A model for estimating the minimum number of offspring to sample in studies of reproductive success. *Journal of Heredity*, 102:567–576. doi:10.1093/jhered/esr060

21. Holtgrieve, G.W., D.E. Schindler, W.O. Hobbs, P.R. Leavitt, **E.J. Ward**, L. Bunting, G. Chen, B.P. Finney, I. Gregory-Eaves, S. Holmgren, M.J. Lisac, P.J. Lisi, K. Nydick, L.A. Rogers, J.E. Saros, D.T. Selbie, M.D. Shapley, P.B. Walsh, A.P. Wolfe. 2011. A coherent signature of anthropogenic nitrogen deposition to remote watersheds of the Northern Hemisphere. *Science*, 334:1545–1548. doi:10.1126/science.1212267

20. Yeakel, J.D., M. Novak, P.R.G. Jr, N.J. Dominy, P.L. Koch, **E.J. Ward**, J.W. Moore, B.X. Semmens. 2011. Merging resource availability with isotope mixing models: the role of neutral interaction assumptions. *PLOS ONE*, 6:e22015. doi:10.1371/journal.pone.0022015

19. Berntson, E.A., R.W. Carmichael, M.W. Flesher, **E.J. Ward**, P. Moran. 2011. Diminished reproductive success of steelhead from a hatchery supplementation program (Little Sheep Creek, Imnaha Basin, Oregon). *Transactions of the American Fisheries Society*, 140:685–698. doi:10.1080/00028487.2011.584489

18. Francis, T.B., D.E. Schindler, G.W. Holtgrieve, E.R. Larson, M.D. Scheuerell, B.X. Semmens, **E.J. Ward**. 2011. Habitat structure determines resource use by zooplankton in temperate lakes. *Ecology Letters*, 14:364–372. doi:10.1111/j.1461-0248.2011.01597.x

17. **Ward, E.J.**, B.X. Semmens, D.L. Phillips, J.W. Moore, N. Bouwes. 2011. A quantitative approach to combine sources in stable isotope mixing models. *Ecosphere*, 2:1–11. doi:10.1890/ES10-00190.1

16. **Ward, E.J.**, B.X. Semmens, E.E. Holmes, K.C.B. Iii. 2011. Effects of multiple levels of social organization on survival and abundance. *Conservation Biology*, 25:350–355. doi:10.1111/j.1523-1739.2010.01600.x

15. **Ward, E.**, A. Zerbini, P. Kinas, M. H.Engel, A. Andriolo. 2011. Estimates of population growth rates of humpback whales (Megaptera Novaeangliae) in the wintering grounds off the coast of Brazil (Breeding Stock A). *Journal of Cetacean Research and Management*, Special Issue:145–149. doi:

14. Zerbini, A., **E.J. Ward**, P. Kinas, M. H.Engel, A. Andriolo. 2011. A Bayesian assessment of the conservation status of humpback whales (Megaptera Novaeangliae) in the Western Atlantic Ocean (Breeding Stock A). *Journal of Cetacean Research and Management*, Special Issue:131–144. doi:

13. **Ward, E.J.**, B.X. Semmens, D.E. Schindler. 2010. Including source uncertainty and prior information in the analysis of stable isotope mixing models. *Environmental Science & Technology*, 44:4645–4650. doi:10.1021/es100053v

12. Williamson, K.S., A.R. Murdoch, T.N. Pearsons, **E.J. Ward**, M.J. Ford. 2010. Factors influencing the relative fitness of hatchery and wild spring Chinook salmon (Oncorhynchus Tshawytscha) in the Wenatchee River, Washington, USA. *Canadian Journal of Fisheries and Aquatic Sciences*, 67:1840–1851. doi:10.1139/F10-099

11. Warren, D.R., M.M. Mineau, **E.J. Ward**, C.E. Kraft. 2010. Relating fish biomass to habitat and chemistry in headwater streams of the Northeastern United States. *Environmental Biology of Fishes*, 88:51–62. doi:10.1007/s10641-010-9617-x

10. **Ward, E.J.**, H. Chirakkal, M. González-Suárez, D. Aurioles-Gamboa, E.E. Holmes, L. Gerber. 2010. Inferring spatial structure from time-series data: using multivariate state-space models to detect metapopulation structure of California sea lions in the Gulf of California, Mexico. *Journal of Applied Ecology*, 47:47–56. doi:10.1111/j.1365-2664.2009.01745.x

9. Semmens, B.X., **E.J. Ward**, J.W. Moore, C.T. Darimont. 2009. Quantifying inter- and intra-population niche variability using hierarchical Bayesian stable isotope mixing models. *PLOS ONE*, 4:e6187. doi:10.1371/journal.pone.0006187

8. **Ward, E.J.**, E.E. Holmes, K.C. Balcomb. 2009. Quantifying the effects of prey abundance on killer whale reproduction. *Journal of Applied Ecology*, 46:632–640. doi:10.1111/j.1365-2664.2009.01647.x

7. Semmens, B.X., J.W. Moore, **E.J. Ward**. 2009. Improving Bayesian isotope mixing models: a response to Jackson et al. (2009). *Ecology Letters*, 12:E6–E8. doi:10.1111/j.1461-0248.2009.01283.x

6. **Ward, E.J.**, K. Parsons, E.E. Holmes, K.C. Balcomb, J.K. Ford. 2009. The role of menopause and reproductive senescence in a long-lived social mammal. *Frontiers in Zoology*, 6:4. doi:10.1186/1742-9994-6-4

5. **Ward, E.J.**. 2008. A review and comparison of four commonly used Bayesian and maximum likelihood model selection tools. *Ecological Modelling*, 211:1–10. doi:10.1016/j.ecolmodel.2007.10.030

4. **Ward, E.J.**, R. Hilborn, R.G. Towell, L. Gerber. 2007. A state–space mixture approach for estimating catastrophic events in time series data. *Canadian Journal of Fisheries and Aquatic Sciences*, 64:899–910. doi:10.1139/f07-060

3. **Ward, E.J.**. 2006. A new BEAST: Bayesian software tools for ecological trend analysis. *Wildlife Society Bulletin*, 34:1420–1424. doi:10.2193/0091-7648(2006)34%5B1420:ANBBST%5D2.0.CO;2

2. Branch, T.A., R. Hilborn, A.C. Haynie, G. Fay, L. Flynn, J. Griffiths, K.N. Marshall, J.K. Randall, J.M. Scheuerell, **E.J. Ward**, M. Young. 2006. Fleet dynamics and fishermen behavior: lessons for fisheries managers. *Canadian Journal of Fisheries and Aquatic Sciences*, 63:1647–1668. doi:10.1139/f06-072

1. **Ward, E.J.**. 2005. Differences between fishery-dependent and fishery-independent estimates of single-and mixed-species dolphin schools: implications for single-species stock assessments. *Marine Mammal Science*, 21:189–203. doi:10.1111/j.1748-7692.2005.tb01223.x

Technical Reports

12. Ferguson, L., M. Srinivasan, E. Oleson, S. Hayes, S.K. Brown, R. Angliss, J. Carretta, E. Holmes, **E.J. Ward**, J. Kocik, K. Mullin, R. Dean, and J. Davis (eds.). 2017. Proceedings of the First National Protected Species Assessment Workshop. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-F/SPO-172, 92 p. link

11. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2016 Elwha River Steelhead Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

10. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2016 Elwha River Chinook Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

9. Gustafson, R.G., L. Weitkamp, Y.W. Lee, **E.J. Ward**, K. Somers, V. Tuttle, and J. Jannot. 2016. Status Review Update of Eulachon (Thaleichthys pacificus) Listed under the Endangered Species Act: Southern Distinct Population Segment. link

8. Gerrodette, T., **E.J. Ward**, R.L. Taylor, L.K. Schwarz, T. Eguchi, P.R. Wade, and G.K. Himes-Boor. 2016. Daniel Goodman's empirical approach to Bayesian statistics. Pre-print at PeerJ link

7. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2015 Elwha River Steelhead Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

6. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2015 Elwha River Chinook Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

5. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2014 Elwha River Steelhead Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

4. Denton, K., M. McHenry, R. Moses, **E.J. Ward**, M. Liermann, O. Stefankiv, W. Wells and G. Pess. 2014 Elwha River Chinook Escapement Estimate Based on DIDSON/ARIS Multi-Beam SONAR Data.

3. **E.J. Ward**, M.J. Ford, R.G. Kope, J.K.B. Ford, A. Velez-Espino, C.K. Parken, L. LaVoy, M.B. Hanson, K.C. Balcomb. Estimating the impacts of Chinook salmon abundance and prey removal by ocean fishing on Southern Resident killer whale population dynamics. 2013. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-123, 71 p. link

2. Stout, H.A., P.W. Lawson, D.L. Bottom, T.D. Cooney, M.J. Ford, C.E. Jordan, R.G. Kope, L.M. Kruzic, G.R. Pess, G.H. Reeves, M.D. Scheuerell, T.C. Wainwright, R.S. Waples, **E.J. Ward**, L.A. Weitkamp, J.G. Williams, and T.H. Williams. 2012. Scientific conclusions of the status review for Oregon coast coho salmon (Oncorhynchus kisutch). U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-118, 242 p. link

1. Northwest Fisheries Science Center. 2011. Risk assessment of U.S. West Coast groundfish fisheries to threatened and endangered marine species. NWFSC, NMFS. 2725 Montlake Blvd E, Seattle, WA. link

Book Chapters

E.J. Ward 2012. Population Dynamics. In *Grzimek's Animal Life Encyclopedia*. pp. 195- 208.

Teaching Experience

FISH 507: Applied Time Series Analysis, University of Washington 2012 - present
Co-taught course with Eli Holmes and Mark Scheuerell webpage

Ecological Society of America (ESA) 2008 - 2011
Co-taught Analysis of Multivariate Time-Series Data Using State-Space Models, and Introduction to MARSS

NWFSC R workshop (organized & taught) 2010 - 2011

Visiting lecturer University of Washington 2007 - 2009
Taught FSH 497 Introductory modeling and programming course

External Funding

2018-2020 G. Holtgrieve, C. Harvey, and E.J. Ward. *Reconstructing a Century of Coastal Productivity and Predator Trophic Dynamics using Compound-specific Stable Isotopes from Archival Bone Specimens*. Washington Sea Grant, $192K.

2018-2020 L. Hauser, B. Vadopalas, R. Childer, B. Hudson, B. Eudeline, and E.J. Ward. *Development of genetic risk assessment tools and Management Strategy Evaluation for Aquaculture of Native Shellfish*. Saltonstall-Kennedy Grant, $299K.

2017-2018 E.J. Ward, G. Holtgrieve, C. Harvey. *Reconstructing a ecosystem productivity and marine mammal trophic dynamics using compound-specific stable isotopes from bone specimens*. NWFSC Internal Grants Program

2016-2018 T.E. Essington, T.B. Francis, C. Greene, L. Kuehne, D. Lowry, E.J. Ward. *Recovering historical baselines in Puget Sound*. Washington Sea Grant, $243K.

2016 E.J. Ward *Improving bycatch estimation through spatial statistics* $100K.

2015 E.J. Ward, A.O. Shelton and M.J. Ford. *Portfolio Effects in Historic Chinook Hatchery Practices on Prey Availability for Southern Resident Killer Whales* National Fish and Wildlife Foundation, $110K.

2014-2015 I. Kaplan, E.J. Ward, et al. *A spatially explicit ecosystem model for quantifying marine mammal impacts on Chinook salmon* Pacific Salmon Commission Southern Fund, $206K.

2013-2014 T. Eguchi, E.J. Ward, and E.E. Holmes. *Developing risk assessment tools for marine sea turtles* $100K.

2013-2014 Holmes, E.E. and E.J. Ward. *Developing web based computing tools for protected species*. $200K.

2013 M.B. Hanson, E.J. Ward. et al. *Modeling the distribution of endangered killer whales in Pacific Northwest Navy ranges using acoustic recorder detections and satellite tagged whales*, US Navy.

2013 Shelton, A.O., E.J. Ward, J.T. Thorson, M. Bellman, B. Feist. *Integrating spatial habitat and fisheries effort data to improve abundance estimates of west coast groundfish*. $56K.

2011 E.J. Ward et al., *Incorporating multiple data sources into a unified framework to improve estimates of adult salmon returns and population productivity*. $33K.

2009 *NSF Comparative Analysis of Marine Ecosystem Organization: New statistical tools for analyzing community dynamics with applications to marine zooplankton*, $347K (141K from NCEAS). Associate Investigator (Principal Investigator - E.E. Holmes)

Fellowships and Awards

2006 *Cumulative Risk Assessment for Endangered Species* 2 year NRC post-doc awarded $92K.

2003 *National Marine Fisheries Service / Washington Sea Grant Fellowship in Population Dynamics*: Incorporating model selection and decision analysis into population dynamics modeling. Grant awarded for $120K.

Post-docs

2012 Jim Thorson (NRC Research Post-doc). With Michelle McClure, Eli Holmes, and Mark Scheuerell

2012-2013 Guillaume Bal (NRC Research Post-doc). Co-supervised with Eli Holmes and Mark Scheuerell

2015-2017 Sean Anderson (Smith Fellow). Co-supervised with Trevor Branch

2017– Ben Nelson (NWFSC). Co-supervised with Ole Shelton

2017– Lewis Barnett (NWFSC)

Supervised Graduate Students or Committees

2017– Natalie Lowell (L. Hauser), SAFS, University of Washington

2017– Megan Feddern (G. Holtgrieve), SAFS, University of Washington

2012-2017 Pam Moriarty (T. Essington), SAFS, University of Washington

2013-2016 Brandon Chasco (S. Heppell) Oregon State University

2014-2015 Brian Stock (B. Semmens) SIO, with Tomo Eguchi

2015-2016 Hannah Linder (J. Horne) UW

Service and Outreach

Subject Editor, Ecological Applications 2013 - present

Puget Sound Seabird Survey 2005-present
Developed survey methodology for Puget Sound's first land-based citizen science seabird survey and oversaw data analysis

Orca Bowl Washington State Sea Grant / University of Washington

Secretary & Treasurer, Statistical Ecology Section, Ecological Society of America 2010-2012