

**Andrea J. Ray, Ph.D.**

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Physical Sciences Division  
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***Professional Preparation***

- Ph.D. Univ. of Colorado, Department of Geography (Environment and Society Interactions) 2004. Dissertation: *Linking climate to multi-purpose reservoir management: Adaptive capacity and needs for climate information in the Gunnison Basin, Colorado*  
Environmental Policy Certificate, Policy Sciences Committee, 1999
- M.S. University of Delaware, Biological Oceanography, 1989
- A.B. University of Chicago, Geophysical Sciences, 1985

***Appointments***

- Physical Scientist (2021- present) NOAA-OAR Physical Sciences Laboratory (PSL, formerly the Climate Diagnostics Center), Boulder, CO. Roles included serving as the PSL Coordinator for the PSL-NWS/Weather Prediction Center Hydrometeorological Testbed, Chairing the cross-NOAA Testbed and Proving Ground Coordinating Committee, serving on the NOAA West Regional Collaboration Team, 2022-present and as the PSL lead for transition plans and planning.
- Physical Scientist (1999-2021) NOAA-OAR Earth Systems Research Lab, Physical Sciences Division (formerly the Climate Diagnostics Center), Boulder, CO. Conduct research on society's needs to plan and respond to weather, water, and climate extremes, across time scales, to better inform natural resource managers about critical environmental vulnerabilities, including published work to understand needs for drought, monsoon, and climate change. This work also has been input to PSL science planning. Stakeholder relationships that I have cultivated over the years that advance PSD's weather, water and climate science and applications priorities, including NWS offices, NOAA Fisheries, western water managers, Dept of Interior Fish and Wildlife Service and Climate Assessment Science Centers.
- Marine Science Policy Analyst (1997-1999), NOAA-OAR Environmental Research Labs, Boulder, CO. I moved to Boulder as part of a long-term training program funded by OAR to take graduate courses in geography and climate and society interactions. I also served as co-Program Manager for the OAR-Office of Global Programs Pan-American Climate Studies Program, a role that started in OAR/PDC in 1995. Participated in the development of the first proposal to OAR/Office of Global Programs for the NOAA-University of Colorado Western Water Assessment. Began dissertation research as a project for the Climate Diagnostics Center (now PSL) on the impacts of climate variability on water managers' ability to meet needs for multiple uses for water including restoring and maintaining ecosystems.
- Marine Science Policy Analyst (1995-1997), NOAA-OAR Program Development & Coordination, Silver Spring, MD. NOAA-OAR Office of Program Development & Coordination (PDC), Silver Spring, MD. As staff in OAR headquarters office with primary responsibility for program development, I was liaison to ocean and Great Lakes labs, including developing

and shepherding budget initiatives, coordination with other NOAA Line Offices (LOs) and other agencies. Coordinator for the 1993 OAR management retreat. In 1996-97 I was the focal point for OAR's participation in an effort to develop a NOAA climate services plan, working extensively with other LOs. I was the primary author of a climate services inventory. For this, I reviewed previous climate services documents, defined several service types, and collected across LOs. Co-Program manager (with CPO) of the Pan American Climate Studies Program.

Climate & Research Programs Specialist (May 1994-Dec 1995), NOAA Office of Policy & Strategic Planning, Washington, DC. Detail to PSP as OAR representative, and also responsible for cross-line office climate portfolio including seasonal to long-term climate. During that time PSP lead the development of the first NOAA Strategic Plan, and I coordinated development of the sections on predicting and assessing decadal to centennial change and implementing seasonal-to-interannual forecasts parts of the plan and was actively involved in writing those sections. Also wrote and reviewed testimony, talking points, and speeches for senior NOAA leadership, worked with Legislative Affairs, and served as the PSP liaison for OAR and climate-related topics.

Marine Science Policy Analyst (1991-1994), NOAA-OAR Program Development & Coordination Office, Silver Spring, MD. As staff in OAR headquarters office with primary responsibility for program development, I was liaison to ocean and Great Lakes labs, including developing and shepherding budget initiatives, coordination with other NOAA Line Offices (LOs) and other agencies. Coordinator for the 1993 OAR management retreat. In 1996-97 I was the focal point for OAR's participation in an effort to develop a NOAA climate services plan, working extensively with other LOs. I was the primary author of a climate services inventory. For this, I reviewed previous climate services documents, defined several service types, and collected across LOs.

John D. Knauss Marine Policy Fellow (1990), Office of the Oceanographer of the Navy, Washington, DC. As staff in the Interagency and International Affairs Division, worked on data declassification policy for submarine under-ice data, collaboration between Navy and NSF-funded scientists for use of acoustic tomography for global ocean temperature, and Navy contributions to the US Global Change Research Program.

### ***Special Assignments***

NOAA/OAR Weather Program Office (Jan-June 2020) Acting Program Manager for U.S. Weather Research Program weather testbeds. Reviewed Research Performance Progress Reports, Transition Plans, and Testbed Plans; developed materials to document & promote the successes of the weather testbeds; participated in WPO internal meetings and responded to management requests; represented WPO at external meetings such as the Tropical Cyclone Research and Operations Forum. Jan-June 2020.

OAR Policy Planning and Evaluation Office (Jan-July 2010) Subject matter expert and liaison to the climate activities in OAR. Led development of the policy section of the PPE office strategic plan; participated in the NOAA planning and budgeting process (PPBES), and routinely briefed senior OAR management. On a team with Climate Program Office staff to initiate a NOAA Climate Projections effort to provide projections at regional scales for decisionmakers.

NOAA Office of Strategic Planning (April 1994-Dec 1995) OAR representative and cross-NOAA Climate & Research Programs Specialist. Contributed to first NOAA Strategic Plan and the White House Ecosystem Management Assessment. Regularly briefed senior NOAA and OAR management, prepared talking points and drafted testimony on a range of issues.

***Publications:***

*Peer-reviewed journal articles, book chapters, and agency reports*

- Dilling, L, Daly, M. Travis, W, **Ray, AJ**, Wilhelmi, O.2023.The role of adaptive capacity in incremental and transformative adaptation in three large U.S. Urban water systems. *Global Environmental Change* 79(11):102649 DOI: 10.1016/j.gloenvcha.2023.102649
- Yocum, HM, Metivier Sassorossi, D, **Ray, AJ**. (2022) Assessing the use of climate change information in State Wildlife Action Plans. *Conservation Science and Practice*, 4: March 2022. DOI: 10.1111/csp2.608.
- Barsugli, JJ, **AJ Ray**, B Livneh, CF Dewes, A Heldmyer, I Rangwala, JM Guinotte, S Torbit. 2020. High-resolution projections of mountain snowpack loss for conservation: the case of the wolverine. *AGU Earth Futures*, <https://doi.org/10.1029/2020EF001537>.
- Abel, B, Rajagopalan, B, **Ray, A.J.** (2020). A predictive model for seasonal pond counts in the United States Prairie Pothole Region using large-scale climate connections, *Environmental Research Letters*, in press.
- Lipschultz, F, Herring, DD., **Ray, A. J.**, Alder, J, Dahlman, L, DeGaetano, A., Fox, J.F., Gardiner, E., Herring, J., Hicks, J, Melton, F, Morefield, P.E., and Sweet, W,V. (2019): Climate Explorer: Improved access to local climate projections. *BAMS*, in press.
- Ray, A. J.** and A. B. White (2019): The Hydrometeorology Testbed–West Legacy Observing Network: Supporting Research to Applications for Atmospheric Rivers and Beyond. *Atmosphere*, 10, 533, <https://doi.org/10.3390/atmos10090533>.
- Yocum, H. M. and **A. J. Ray** (2019): Climate information to support wildlife management in the North Central United States. *Regional Environ. Change*, <https://doi.org/10.1007/s10113-019-01474-y>.
- Dilling, L., M. E. Daly, D. A. Kenney, R. Klein, K. N. Miller, **A. J. Ray**, W. R. Travis, O. Wilhelmi (2019): Drought in urban water systems: Learning lessons for climate adaptive capacity. *Clim. Risk Management.*, 23, 32-42, <https://doi.org/10.1016/j.crm.2018.11.001>.
- Jana, S., B. Rajagopalan, M. A. Alexander, and **A. J. Ray**, 2018: Understanding the Dominant Sources and Tracks of Moisture for Summer Rainfall in the Southwest United States. *J Geophys Res-Atmos*, **123**, 4850-4870.
- Enquist, C. A. F., Jackson, S. T., Garfin, G. M., Davis, F. W., Gerber, L. R., Littell, J. A., . . . **Ray. A.J.**, . . . Shaw, M. R. (2017). Foundations of translational ecology. *Frontiers in Ecology and the Environment*, 15(10), 541-550. doi:10.1002/fee.1733
- Steen, V., Sofaer, H. R., Skagen, S. K., **Ray, A. J.**, & Noon, B. R. (2017). Projecting species' vulnerability to climate change: Which uncertainty sources matter most and extrapolate best? *Ecology and Evolution*, 7(21), 8841-8851. doi:10.1002/ece3.3403
- White, C. J., Carlsen, H., Robertson, A. W., Klein, R. J. T., Lazo, J. K., Kumar, A., . . . **Ray, A.J.**, . . . Zebiak, S. E. (2017). Potential applications of subseasonal-to-seasonal (S2S) predictions. *Meteorological Applications*, 24(3), 315-325. doi:10.1002/met.1654

- Cherry, J. E., Knapp, C., Trainor, S., **Ray, A. J.**, Tedesche, M., & Walker, S. (2017). Planning for climate change impacts on hydropower in the Far North. *Hydrology and Earth System Sciences*, 21(1), 133-151. doi:10.5194/hess-21-133-2017
- Ray, A.J.** 2016. Providing climate science to real-world policy decisions: a scientist's view from the trenches. pp.141-160 in: *Water Policy and Planning in a Variable and Changing Climate*. Editors: Kathleen Miller, Alan Hamlet, Douglas Kenney, Kelly T. Redmond. CRC Press.
- Ray, A. J.**, & Webb, R. S. (2016). Understanding the user context: decision calendars as frameworks for linking climate to policy, planning and decision-making. In A. Parris, et al (Ed.), *Climate in Context: Lessons learned from the RISA Program*, (pp. 27-50): Wiley & Sons.
- Gordon, E., Dilling, L., McNie, E., & **Ray, A. J.** (2016). Navigating Scales of Knowledge and Decision Making in the Intermountain West: Implications for Science Policy. In A. Parris, M. Garfin Gregg, K. Dow, R. Meyer, & S. L. Close (Eds.), *Climate in Context: Lessons learned from the RISA Program* (pp. 235-253). West Sussex, UK: Wiley & Sons.
- Fisichelli, N., G. Schuurman, A. Symstad, **A. J. Ray**, B. Miller, M. Cross, E. Rowland (2016): Resource management and operations in southwest South Dakota: Climate change scenario planning workshop summary January 20-21, 2016, Rapid City, SD. Natural Resource Report [NPS/NRSS/NRR—2016/1289](#). National Park Service, Fort Collins, Colorado.
- Fisichelli, N., G. Schuurman, A. Symstad, **A. J. Ray**, J. Friedman, B. Miller, E. Rowland (2016): Resource management and operations in central North Dakota: Climate change scenario planning workshop summary November 12-13, 2015, Bismarck, ND. Natural Resource Report [NPS/NRSS/NRR—2016/1262](#). National Park Service, Fort Collins, Colorado.
- Ballard, T., Seager, R., Smerdon, J. E., Cook, B. I., **Ray, A. J.**, Rajagopalan, B., . . . Henderson, N. (2014). Hydroclimate Variability and Change in the Prairie Pothole Region, the "Duck Factory" of North America. *Earth Interactions*, 18. doi:10.1175/Ei-D-14-0004.1
- Ray, A.J.**, Liebmann, Brant, and Allured, D.A. 2015. Climate Analysis, Chapter 7 in Wyoming Basin Rapid Ecoregional Assessment, USGS report to the US Bureau of Land Management, USGS Open-File Report 2015-1155. <http://pubs.er.usgs.gov/publication/ofr20151155>.
- Barsugli, J., J., Guentchev, G., Horton Radley, M., Wood, A., Mearns Linda, O., Liang, X.-Z., . . . **Ray, A.J.**, ...Ammann, C. (2013). The Practitioner's Dilemma: How to Assess the Credibility of Downscaled Climate Projections. *Eos, Transactions American Geophysical Union*, 94(46), 424-425. doi:10.1002/2013EO460005
- Cayan, Daniel, et al. 2013. *Future Climate: Projected Average*. In Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 101–125. A report by the Southwest Climate Alliance. Washington, DC: Island Press.
- Gershunov, A, et al. 2013. *Future Climate: Projected Extremes*. In Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 126–147. A report by the Southwest Climate Alliance. Washington, DC: Island Press.
- Carr, N.B., Garman, S.L., Walters, A, **Ray, A.J**, Melcher, C.P., Wesner, J.S., O'Donnell, M.S., Sherrill, K.R., Babel, N.C., and Bowen, Z.H., 2013: *Wyoming Basin Rapid Ecoregional Assessment work plan*. USGS Open-File Report 2013–1223, 58 p.

- Kenney, D., **A.J. Ray**, B. Harding, R.S. Pulwarty, B. Udall, 2010. Rethinking Vulnerability on the Colorado River. *Journal of Contemporary Water Research and Education*. 40:103-119.
- McWethy, David B. et al. 2010. *Climate and Ecosystem Change in the U.S. Rocky Mountains and Upper Columbia Basin: Historic and Future Perspectives for Natural Resource Management*. USGS Natural Resource Report NPS/GRYN/NRR—2010/260. 97pp.
- Ray, AJ**, JJ Barsugli, Jr., Klaus E Wolter, Jon K. Eischeid. 2010. *Rapid-Response Climate Assessment to Support the FWS Status Review of the American Pika*. NOAA Report to the U.S. Fish and Wildlife Service. 53pp. [www.esrl.noaa.gov/psd/news/2010/020210.html](http://www.esrl.noaa.gov/psd/news/2010/020210.html)
- Rajagopalan, B., Nowak, K., Prairie, J., Hoerling, M., Harding, B., Barsugli, J., **Ray, A.J.**, Udall, B. (2009). Water supply risk on the Colorado River: Can management mitigate? *Water Resources Research*, 45. doi:10.1029/2008wr007652
- Lowrey, J. L., **Ray, A. J.**, & Webb, R. S. (2009). Factors influencing the use of climate information by Colorado municipal water managers. *Climate Research*, 40(1), 103-119. doi:10.3354/cr00827
- Ray, AJ**, JJ Barsugli, KB Averyt, KE Wolter, MP Hoerling, 2008. *Colorado Climate Change: A Synthesis To Support Water Resource Management and Adaptation*, a report for the Colorado Water Conservation Board by the NOAA-CU Western Water Assessment, available at: [http://wwa.colorado.edu/publications/reports/WWA\\_ClimateChangeColoradoReport\\_2008.pdf](http://wwa.colorado.edu/publications/reports/WWA_ClimateChangeColoradoReport_2008.pdf)
- Ray, A. J.**, Garfin, G. M., Wilder, M., Vasquez-Leon, M., Lenart, M., & Comrie, A. C. (2007). Applications of monsoon research: Opportunities to inform decision making and reduce regional vulnerability. *Journal of Climate*, 20(9), 1608-1627. doi:10.1175/Jcl14098.1
- Ray, A. J., Garfin, G. M., Brito-Castillo, L., Cortez-Vásquez, M., Diaz, H. F., Garatuza-Payán, J., Gochis, D., Lobato-Sánchez, R, Varady, R, & Watts, C. (2007). Monsoon Region Climate Applications: Integrating Climate Science with Regional Planning and Policy. *Bulletin of the American Meteorological Society*, 88, 933-935. doi:DOI: 10.1175/BAMS-88-6-933
- Ray, A. J.** (2003). Reservoir management in the Interior West: the influence of climate variability and functional linkages of water. In H. F. Diaz & B. J. Morehouse (Eds.), *Climate and Water: Transboundary challenges in the Americas* (pp. 193-217). Boston: Kluwer Academic Publishers.

***Selected other publications and assessment products:***

- NOAA Fisheries West Coast Region. 2023. *Guidance to improve the Resilience of Fish Passage Facilities to Climate Change*. **Ray** served on the technical committee guiding development of this document and lead sections on climate change and climate change resources for use. Available at: <https://www.fisheries.noaa.gov/resource/document/west-coast-region-guidance-improve-resilience-fish-passage-facilities-climate>
- National Marine Fisheries Service, Alaska Region, 2022. Revised Study Requests for the Nuyakuk Project (FERC No. P14873), *Study 5: Future River Flows and Water Temperatures*. Pp 26-34 in Attachment 2 to NOAA Fisheries Comments on the Pre-Applications Document, Scoping Documents, and Study Requests for P-14873, Nuyakuk. Prepared by **A.J. Ray** and S. Eagan. June 29, 2022. Available at: <https://drive.google.com/drive/folders/1Y7y66UY7IeFU2WKiLFv5RDUTy-TDZHsI>

- Ray, AJ**, J Correia Jr, J Nelson Jr. 2020. *Hydrometeorology Testbed and Extreme Precipitation and Flood Forecasting Improvement*. Report of a Workshop, 15 October, 2019, College, Park, MD. Available at:  
[https://hmt.noaa.gov/about/pdf/NOAA%20HMT\\_EPPIP%20Meeting%20Rpt\\_27May2020.pdf](https://hmt.noaa.gov/about/pdf/NOAA%20HMT_EPPIP%20Meeting%20Rpt_27May2020.pdf)
- National Marine Fisheries Service, Alaska Region, 2020. Study Requests for the Nuyakuk Project (FERC No. P14873), *Study 5: Future River Flows and Water Temperatures*. Pp 26-34 in Attachment 2 to NOAA Fisheries Comments on the Pre-Applications Document, Scoping Documents, and Study Requests for P-14873, Nuyakuk. Prepared by **A.J. Ray** and S. Eagan. February 4, 2020. Available at:  
[https://elibrary.ferc.gov/idmws/file\\_list.asp?accession\\_num=20200204-5068](https://elibrary.ferc.gov/idmws/file_list.asp?accession_num=20200204-5068)
- Ray, A.J.**, J.J. Barsugli, B. Livneh, C.F. Dewes, I. Rangwala, A.Heldmyer, J.Stewart. 2017. Wolverine Snow Refugia Study: An analysis of future climate risks: A Report to the U.S. Fish and Wildlife Service Region 6. 7 September 2017, 94 pp.
- Ray, AJ**, Stokes, M, Yocum, HM, Nielson, A, Goodman, C, Hartman, RK, Intermill III, JA, Kruk, MC, Vose, R, Miskus, D. 2017. *The National Water Resources Monitoring and Outlook: a new national scale product for timely water intelligence*. AMS 88th Annual Meeting, Extended Abstract 5A.4, <https://ams.confex.com/ams/97Annual/webprogram/Paper314921.html>
- National Marine Fisheries Service, West Coast Region, *Proposed New Information Gathering Or Study Not Currently In The Commission-Approved Study Plan for the La Grange Hydroelectric Project (P-14581)*. **Ray** led preparation of this “climate study request” for NMFS with J.J. Barsugli, April 2016, 36 pp.
- National Marine Fisheries Service, Alaska Region, *Study Modification Request for Study 7.7: Glacier and Runoff Changes for the Susitna-Watana Hydropower Project*. **Ray** led preparation of this “climate study request” for NMFS with J.J. Barsugli June 2016, 40 pp.
- Ray, AJ**. 2005-2009. Lead editor of the “Intermountain West Climate Summary,” a product of the Western Water Assessment (WWA) RISA; wrote/co-authored numerous feature articles, focus pages, and technical discussions.  
<http://wwa.colorado.edu/climate/iwcs/archives>
- Ray, AJ**, 2008. Water Resources Decision-Makers and their needs for Decadal Climate Prediction, US CLIVAR Variations Newsletter, Oct 2008.
- Ray, AJ**, JJ Barsugli, and T Hamill. 2007. *Integrating assessments of user needs with weather research: Developing user-centric tools for reservoir management*. AMS 16<sup>th</sup> Conf on Applied Climatology: Extended Abstracts. Boston: AMS.
- Ray, AJ**, N Schmidt, BJ Morehouse, and RS Webb, 2003: Report on Research Opportunities for Climate and Society Interactions in the North American Monsoon Region. Workshop on Applications and Human Dimensions of Monsoon Research 18-20 June 2001, Tucson, AZ, Institute for the Study of Planet Earth, University of Arizona, 42 pp.
- Interagency Ecosystem Management Task Force, 1995: *Science and Information Issues Chapter*, Prince William Sound Ecosystem Management Case Study, for the White House Ecosystem Management Assessment
- Interagency Ecosystem Management Task Force, 1995: *Institutional and Management Issues Chapter*, Great Lakes Ecosystem Management Case Study for the White House Ecosystem Management Assessment

### ***Selected Presentations***

Presentations at professional meetings

- Ray, AJ** et al. 2024. The NOAA Testbeds and Proving Grounds: Role in Advancing Hazards Forecasting for Decision Support. Presentation at the 2024 American Meteorological Society meeting. <https://ams.confex.com/ams/104ANNUAL/meetingapp.cgi/Paper/430965>
- Ray A.J.** R2X Collaboration Plans at the Physical Sciences Laboratory. Presentation at the 2024 American Meteorological Society meeting. <https://ams.confex.com/ams/104ANNUAL/meetingapp.cgi/Paper/431094>
- Ray, AJ**, Castillo, J, et al. 2022. Improving Resilience of Fish Passage to Climate Change: NMFS West Coast Guidance (ID#661), In session: Linking Aquatic Organism Passage and Climate Resiliency. Presentation at the American Fisheries Society Meeting, August 2022.
- Ray, AJ.** 2021. Service to Research and Back Again at the NOAA Physical Sciences Laboratory: Challenges and Lessons Learned. Presentation at the 2021 American Meteorological Society meeting. <https://ams.confex.com/ams/101ANNUAL/meetingapp.cgi/Paper/381254>
- Ray, AJ** and Lynn Johnston. 2020. Fishing for Applications of S2S Forecasting. In joint session on Challenges in Communication and Decision Support throughout the Research-to-Operations Nexus. Presentation at the 2020 American Meteorological Society meeting. <https://ams.confex.com/ams/2020Annual/meetingapp.cgi/Paper/366909>
- Ray, AJ**, Barsugli, JJ, and Walker, Susan, Integrating Climate Resiliency into Hydropower Licensing and Design of Fish Passage, Presentation at the 2019 joint American Fisheries Society-The Wildlife Society Annual Meeting, Reno, NV. <https://afs.confex.com/afs/2019/poster/papers/index.cgi?username=37627&password=374257> (click “view submission”)
- Barsugli, JJ, **Ray, AJ** (presenter), Livneh, B. Dewes, CF, Heldmyer, A, Rangwala, I, Guinotte, JM, Torbit, S. High-Resolution Projections of Snowpack Persistence in Occupied and Potential Wolverine Habitat in the Rocky Mountains, Presentation at the 2019 joint American Fisheries Society-The Wildlife Society Annual Meeting, Reno, NV. <https://afs.confex.com/afs/2019/twsccontributed/papers/index.cgi?username=36837&password=597821>
- Ray, AJ**, Barsugli, JJ, et al. 2019. Improving Ecological Vulnerability Assessments Through Deliberate Collaboration between Ecologists and Climate Scientists. Presentation at AGU 2018 Annual Meeting, Washington, D.C. <https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/436943>
- Ray, AJ** and HM Yocum. 2017. Stakeholder engagement at different stages in the research to applications (R2A) pathway. Presentation at the 2017 NOAA Climate Prediction Assessment Workshop, May 2017, Anchorage, AK.
- Ray, AJ**, Barsugli, JJ, Walker, S, Gange, J, McDermott, S, Lagron, S (Hollings Scholar). *Hydropower Licensing as a Bridge between Climate Science and Applications: Creating Actionable Science for Regulatory Decisionmaking*, AGU 2016, San Francisco, CA. <https://agu.confex.com/agu/fm16/meetingapp.cgi/Paper/189401>

- Ray, AJ**, and HM Yocum. 2015. *User studies: integrating social science to create usable weather knowledge*. Annual Meeting of the Association of American Geographers. 24 April 1015, Chicago, IL.
- Ray, AJ**, McNie, E, Averyt, KB, Morisette, J, Derner, J, Ojima, D, Dilling, L, and Barsugli, J. 2014. *Interagency collaboration in the Rocky Mountains and Great Plains: Federal-university climate service networks for producing actionable information for climate change adaptation*. AGU 2014 Annual Meeting, <https://agu.confex.com/agu/fm14/meetingapp.cgi - Paper/23747>
- Ray, AJ**, R Means, BL Liebmann, N Carr, 2013. *Management and Wyoming Basin Rapid Ecoregional Assessment: A Science--Management Partnership to Inform Public Land Management under Changing Climate Conditions*, in AGU Public Affairs session “The Policy-Science Interface for Land Management in a Changing Climate,” [http://www.esrl.noaa.gov/psd/people/andrea.ray/Ray\\_AGU2013\\_poster\\_GC11B\\_0984\\_final](http://www.esrl.noaa.gov/psd/people/andrea.ray/Ray_AGU2013_poster_GC11B_0984_final)
- Ray, AJ**, Anderson, DM, Rood, R, and Barsugli, JJ. 2011. Delivering climate projections at regional scales to support adaptation planning: a new NOAA effort. AMS Practical Solutions for a Warming World: AMS Conference on Climate Adaptation, July 2011, Asheville, NC <https://ams.confex.com/ams/19Applied/webprogram/Paper190496.html>
- Barsugli, J.J. A.J. Ray, K.E. Wolter, J, Eischeid. 2010. *Climate Projections for Ecological Applications: The Case of the American Pika*. Presentation at The Wildlife Society annual meeting, Snowbird UT.
- Ray, A.J. 2008. *Lessons learned from the 2000s Western drought: Evolving linkages between research and services*. Invited presentation at the NOAA Climate Diagnostics & Prediction Workshop/CLIVAR drought meeting in Oct 2008 in Lincoln, NE.
- Ray, AJ**, et al. 2008. Climate Change in Colorado: Creating a Synthesis to Support Water Resources Management and Adaptation. NOAA Climate Prediction Assessment workshop (CPASW), Norman, OK, March 2009.
- Ray, AJ**, DL Lettenmaier, and R Lobato Sanchez. 2007. Intraseasonal to Interannual hydrologic forecasting for Mexico: new products and forecasts and their potential uses. Proceedings of the 2006 North American Drought Monitor Meeting, Mexico City, MX, NOAA National Climatic Data Center
- Ray, AJ**. 2004. The North American Monsoon: an opportunity for regional science to serve society, in session on *Drought, Water Supply, Fire: How Does Regional Science Serve society?* 2004 Annual Meeting of the Association of American Geographers, Philadelphia, PA, March 14-19, 2004

*Selected seminars/presentations, including to stakeholder groups & their professional societies*  
NOAA/NMFS National Hydropower meeting

**Ray, A.J.**, Barsugli, J.J., and Walker, Susan, Integrating Climate Resiliency into Hydropower Licensing and Design of Fish Passage, Presentation at the 2019 joint American Fisheries Society-The Wildlife Society Annual Meeting, Reno, NV.  
<https://afs.confex.com/afs/2019/poster/papers/index.cgi?username=37627&password=374257> (click “view submission”)

Barsugli, Joseph J., **Ray, A.J. (presenter)**, Livneh, B. Dewes, C.F., Heldmyer, A., Rangwala, I., Guinotte, J.M., Torbit, S. High-Resolution Projections of Snowpack Persistence in Occupied and Potential Wolverine Habitat in the Rocky Mountains,



Presentation at the 2019 joint American Fisheries Society-The Wildlife Society Annual Meeting, Reno, NV.

<https://afs.confex.com/afs/2019/twscontributed/papers/index.cgi?username=36837&password=597821>

- Ray, AJ, L Johnson.** 2019. PSD water science for NOAA resource management missions: Opportunities for research to applications. Invited presentation at the Physical Sciences Division (now Laboratory) Water Workshop, March 7, 2019.
- Ray, AJ.** 2018. Opportunities to connect climate science to marine resources and an example: NMFS climate needs for hydropower licensing. Invited presentation at the PSD Marine Resources Workshop, 4 Dec 2018.
- Ray, AJ.** 2017. Hydropower licensing and fisheries: The importance of incorporating uncertain climate projections into regulatory decisionmaking. Invited presentation at NMFS National Hydropower Coordinators meeting, Nov 30, 2017, Portland, OR.
- Ray, AJ.** Panel discussion on Communicating Forecasts, Nov 2016. Invited speaker in California Dept of Water Resources Winter Outlook Forum. Nov 2016.
- Ray, AJ, and M Stokes,** 2016. NOAA Water Resources Monitor and Outlook. NIDIS workshop, 19-21 October 2016, Oracle, AZ.
- Ray, AJ.** User perspectives and Social Science, invited presentation to the NOAA Climate Testbed meeting, Nov 10, 2015, College Park, MD (presented remotely).
- Ray, AJ.** 2015. Negotiating the divide between science and users, invited presentation to the National Research Council Panel on Social Sciences and Decision Support, 15 March 2015, Boulder, CO.
- Ray, AJ.** Application of downscaled climate data and scenarios, Gulf of Mexico Climate Data and Scenarios Workshop, hosted by the four USFWS Landscape Conservation Cooperatives (LCCs) on the Gulf of Mexico, 21-23 March, 2012, Baton Rouge, LA
- Ray, AJ.** 2011. Assessing user needs for weather and climate extremes: NOAA's ongoing efforts, invited presentation to the Western States Water Council, 21-23 March 2011, San Diego, CA.
- Ray, AJ.** *Challenges for managing water resources in mountainous regions*, Invited presentation at the Mountain Hydroclimate & Water Resources Workshop, NASA, NOAA, Boulder, CO, Oct. 17-19, 2007.
- Ray, AJ.** 2007. [IPCC Fourth Assessment Report: Physical Basis of Climate Change and Adaptation, Impacts and Vulnerability](#) invited presentations to the Colorado River Water Conservation District: State of the River meeting, May 16, 2007, Frisco, CO; and to the Utah Water Users Association, Salt Lake City, UT, December 3, 2007.
- Ray, A.J., D.L. Lettenmaier, and R. Lobato Sanchez.** 2007. *Intraseasonal to Interannual hydrologic forecasting for Mexico: new products and forecasts and their potential uses.* Proceedings of the 2006 North American Drought Monitor Meeting, Mexico City, MX, NOAA National Climatic Data Center.
- Ray, AJ.** 2006. [Climate Products and Forecasts: Resources for Understanding Climate and How They Can be Utilized.](#) Presentation at the "Water, Drought, and Wyoming's Climate Workshop," October 5, 2006, Laramie, WY.
- Ray, A.J.** 1998-2004, Multiple presentations to the 3x/year Bureau of Reclamation Aspinall Unit Operations meeting on seasonal climate prediction, drought and climate change. These presentations were both a service to the interagency group, and part of engagement for my work on reservoir management needs for my dissertation.

**Ray, A.J.** and K.T. Redmond. 1999. *1999-2000 winter season outlook and interpretation*. Poster presentation at the U.S. Bureau of Reclamation River Systems Management Workshop, October 19-21, 1999, Reno, NV

***Transitions of research and knowledge to applications*** : Examples of knowledge transfer into applications, citations refer to peer-reviewed or other reports listed above.

Develop NOAA Transition plans: Transition plan, signed 2022, Wide Swath Radar Altimeter; In signature process for: Evaporative Demand Drought Index, Next Generation of the PSL 20<sup>th</sup> Century Reanalysis, Transition of the Coupled Arctic Forecast System to a UFS Framework

Fish passage guidance (NOAA Fisheries West Coast Region, 2022) to incorporate Climate Change into the design of fish passage

Barsugli et al. (2020) and Ray et al. (2017) on how future snow might change under climate change for wolverine habitat analysis. This effort informed the U.S. Fish and Wildlife Service decision on whether the wolverine might be protected under the Endangered Species Act (ESA), <https://psl.noaa.gov/news/2020/101520.html>

Provided analysis of the climate information needed to support NMFS analysis of risks to its trust resources, as study requests that NMFS submits to the Federal Energy Regulatory Commission. Five study requests since 2012 (National Marine Fisheries Service 2020, 2016a, b; 2012; Lagron et al. 2018).

Understanding of climate risks for two National Park Service (NPS) units for NPS scenario planning, as the climate subject matter expert on scenario planning team (Fisichelli et al 2016a, b)

Ray et al. (2010) work on changing climate and habitat for the American pika informed the U.S. Fish and Wildlife Service decision on determine whether it warranted for protection under the ESA, <https://psl.noaa.gov/news/2010/020210.html>

Ray et al (2008) work commissioned by the State of Colorado to synthesize the best available science on most reliable data available on temperature, precipitation, snowmelt, and runoff for Colorado. This work was among the first statewide climate assessments. And informed state and local governments and water providers to assess drought risk, impacts, and preparedness in Colorado and the potential changes that might be needed for managing under climate change. This work was a finalist for the Colorado Governor's Award for Research, sparked demand for follow-on efforts to better assess risks of drought and water supply in Colorado, and has over 100 citations in the published literature.

<https://psl.noaa.gov/news/2008/100908.html>: The impacts of this effort has been significant enough that two subsequent editions have been commissioned, most recently in 2024, available here: <https://engr.source.colostate.edu/2024-climate-change-in-colorado-report-takeaways-context-and-details/>

Authored/co-authored articles on understanding user needs and developing the right science to meet them, **selected**: Yocum et al (2022), Yocum and Ray (2019), Ray (2016), Ray and Webb (2016), Gordon et al. (2016), Barsugli et al. (2013), Lowrey et al. (2008), Ray et al. (2007)

### ***Consultation/advising to government bodies***

Ray has been interacting for 15 years with Department of Interior and NOAA Fisheries colleagues to connect climate science with agency missions, including serving on the Steering Committee of the DOI Great Northern Landscape Conservation Cooperative. She works to connect climate science and applications across the country, with funding from NOAA, the US Fish and Wildlife Service and Bureau of Reclamation, and the State of Colorado, and serves on the Interagency Climate Projections Team for the Climate Explorer of the USGCRP Resilience Toolkit. Currently, she is working with NOAA/National Marine Fisheries Service to support their need to incorporate risks of climate change into the Federal Energy Regulatory Commission planning process for licensing or re-licensing dams, and with the DOI North Central-Climate Science Center to connect climate science to ecological modeling to support management decisions. Prior efforts include successfully leading work to synthesize climate science for applications for water and endangered species (Ray et al. 2008 and 2010). The PI also has used institutional and decision analyses tools in work studying USBR and stakeholders in its reservoir management decisions (Ray 2003, 2004, 2016; Ray and Webb, 2016) and this work has guided efforts by NOAA/ESRL and the Western Water Assessment RISA to connect climate science with water managers.

### ***Synergistic Activities***

1. **TBPG Chair**
2. Co-Coordinator of the NOAA Hydrometeorological Test Bed (beginning 2019), a collaboration between NOAA Research and the National Weather Service, to improve forecasts of extreme precipitation and forcings for hydrologic prediction, by testing outputs from research.
3. Member, Climate Projections Team, for the Climate Explorer of the USGCRP Resilience Toolkit (<https://toolkit.climate.gov/climate-explorer2/>, March 2015-present)
4. Mentor for eight NOAA Hollings Undergraduate Scholars and UNAVCO Research Experiences in Earth Sciences Scholars (RESESS) since 2007.
5. Dissertation Committees: Ben Abel and Srijita Jana, Univ of Colorado Civil and Environmental Engineering
6. Post-Doc Advisor: Heather M. Yocum, now at the USGS North Central Climate Adaptation Science Center and University of Colorado CIRES, and Angela Boag, now Policy Advisor in the Colorado Department of Natural Resources.
7. Participant, NOAA/CIRES Western Water Assessment RISA, funded by NOAA/CPO, (1998-present) worked on the interaction climate and multi-purpose reservoir management in several western reservoir systems, municipal water management and climate, and edited a regularly issued “Intermountain West Climate Summary” from 2005-2009. Organized numerous WWA-sponsored workshops for water and other natural resource managers for two-way communication about climate and weather products and research.
8. Former member of the CLIVAR Predictions, Predictability and Applications Interface Panel, 2013-2016; the American Meteorological Society Committee on Climate Services 2012-2017; and the Science Working Group for the North American Monsoon Experiment (NAME), 2000-08.
9. Co-Program Manager for NOAA Pan American Climate Studies (PACS) from 1995-2000, \$5.3M research program to improve predictions for seasonal climate over the Americas.

### ***Conferences, Workshops and Symposia Convened***

- Lead organizer, NOAA Testbed and Proving Grounds Coordinating Committee annual meetings, 2021 (virtual) and 2023 (hybrid)
- Organizer, NOAA Hydromet Testbed and Extreme Precipitation Improvement Workshop, October 2019, College Park, MD.
- Organizing Committee for workshops: 40<sup>th</sup> Climate Diagnostics and Prediction Workshop, Oct 2015, Boulder, CO; USGS-NOAA Gulf of Mexico Climate Data and Scenarios Workshop, Baton Rouge, LA, May 2012; NCAR Community Earth System Model Societal Dimensions Workshop, May 2011; AMS Summer Community Meeting, August 2011; 2011 and 2013 Climate Prediction Applications Science Workshops (CPASW)
- Co-convenor of professional society sessions connecting climate science and other disciplines: i) Symposium on Understanding and Responding to Climate Change Impacts on Marine and Coastal Fisheries, at the American Fisheries Society Annual Meeting, Seattle, WA, Sept 2011; ii) Advancing Climate Science for Wildlife Management: From Impacts And Uncertainty To Decisions, The Wildlife Society Annual Meeting, October 2010, Snowbird, UT, iii) Human Dimensions of Climate Variations in the Americas, AGU-Mexican Geophysical Union Joint Assembly, May 2007, Acapulco, MX.
- Co-organized two binational workshops on Monsoon Region (2001 and 2006), the "Regional Climate Forum for Northwest Mexico and the Southwest U. S.," Ensenada, MX, April, 2008, and the Workshop on Applications and Human Dimensions of Monsoon Research, Tucson, AZ, 18-20 June 2001.
- Numerous sessions at AGU, AMS, the NOAA Climate Prediction Assessment Workshops, e.g. at the 2013 CPASW, organized a panel discussion of ecosystem and public lands managers to discuss their needs for climate information across time scales; and at the 2014 AGU, "Coming Attractions: Climate Services in the Western U.S"
- As part of the Western Water Assessment RISA, organized numerous WWA-sponsored workshops for water and other natural resource managers for two-way communication about climate and weather products and research, including: WWA Climate workshops for water managers, Golden, Colorado and Cheyenne, Wyoming (Fall 2005), and Colorado River Basin Outlook briefing for water managers, decision makers, and planning groups in the region in Salt Lake City, UT (November 2004)

### ***Professional Development***

- NOAA/OAR Mentoring Program, Mentee, 2018-2019
- Mentor for Hollings, SOARS, RESESS and CIRES mentoring programs
- Detail to OAR Policy Planning and Evaluation Office, Jan-July 2010
- NOAA/OAR Leadership Effectiveness and Advancement (LEAP) program, 2010-11
- NOAA Leadership Seminar, Airlie, VA, Summer 2008
- WAS\*IS, Weather and Society Integrated Studies workshop participant, Summer 2006
- Inter-Americas Institute for Global Change Research Summer Institute in Interdisciplinary Global Change Science, 11-30 July, 1999, Miami, FL