

# High and Dry

## A comprehensive, high-resolution assessment of Western US instream flow restoration

Tyler Lystash, Michelle Faggert, Emily Powell, & Brian Richter

Flow depletion threatens 367 species in 62% of the sub-basins across the Western US.

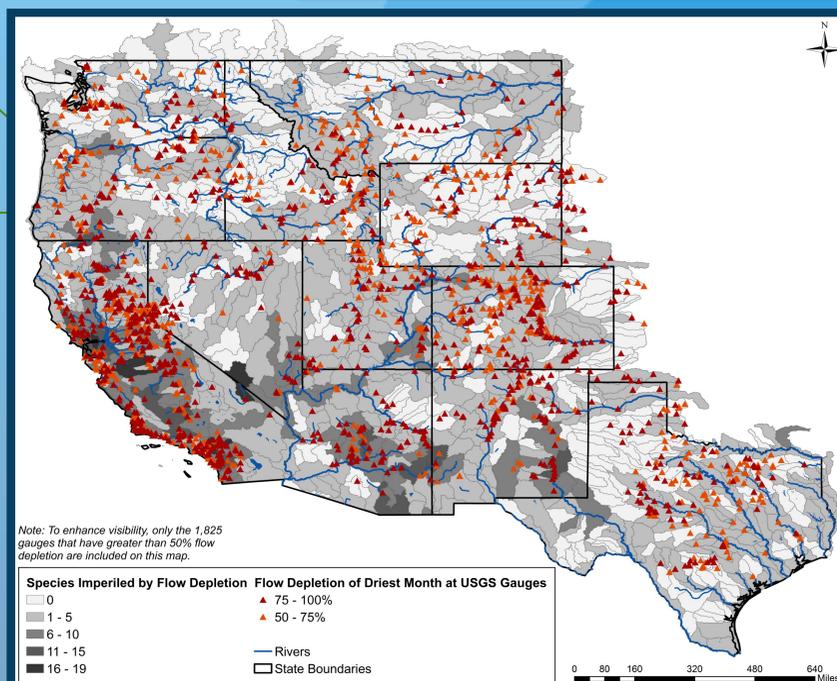
During the driest average month of the year, 53% of gauges have less than half of their natural flow, and 29% have less than one quarter.

4,538 Instream Flow Protections have been documented; the median priority date is 1985.

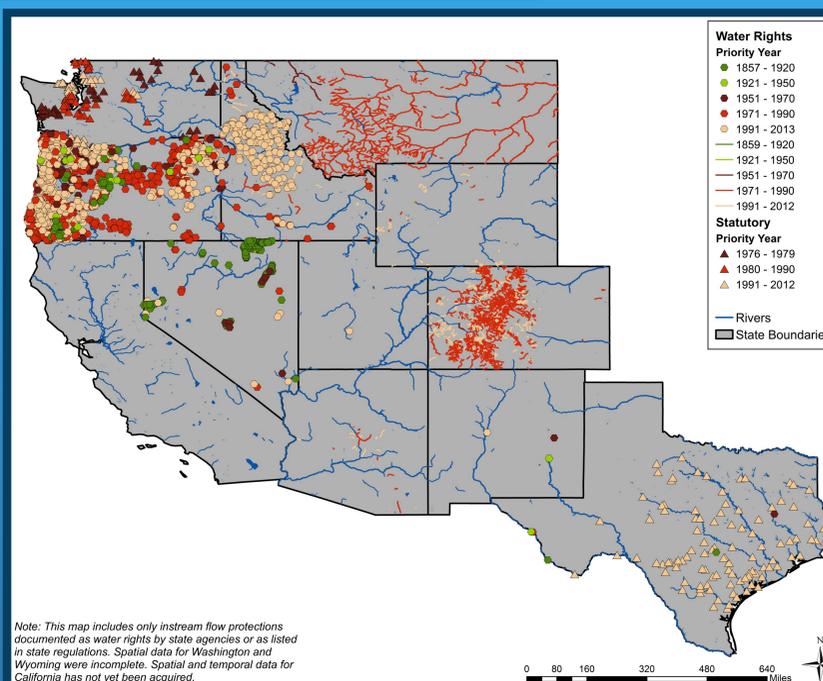
Colorado and Oregon have the most documented instream flow protections.

### Background

Water resource development in the Western US has drastically altered natural flow regimes: the damming and diversion of rivers has devastated freshwater ecosystems. State and federal agencies, non-profits, and other organizations have taken steps to improve altered flow regimes of individual rivers, but comprehensive studies assessing their success have been largely absent. The project presented here seeks to fill this glaring gap, and provides a tool unique in scope and scale for use by all actors with an interest in flow restoration.



Flow Depletion and Species Imperilment



Documented Permanent Instream Flow Protections

### Methods

- 1) Monthly average flow depletion was calculated for over 3400 USGS gauges based on mean monthly historic observed and modeled natural streamflow.
- 2) Presence of imperiled species affected by flow depletion summarized by sub-basin (HUC8).
- 3) Location, type, priority date, and volume of streamflow protected was characterized as either "permanent instream flow water rights" or "state regulations".
- 4) Actual measured flow was compared to intended instream flow protections for a subset of locations.

### Sources

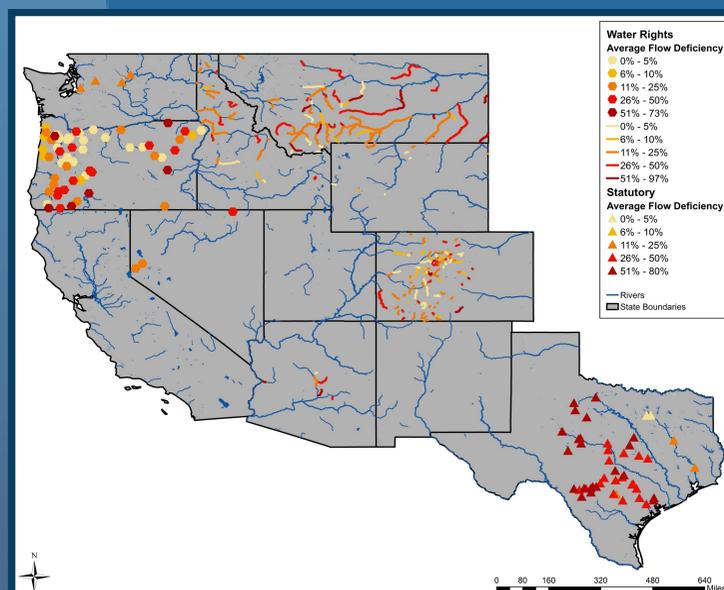
Caldwell, P.V., G. Sun, S.G. McNulty, E.C. Cohen, and J.A. Moore Myers, 2012, Impacts of impervious cover, water withdrawals, and climate change on river flows in the conterminous U.S., Hydrol. Earth Syst. Sc., 16:2839-2857.

Daren Carlisle, USGS Ecological National Synthesis Team.

NatureServe. 2014, March. NatureServe's Central Databases. Arlington, VA. U.S.A.

NHDPlus Version 2, Horizon Systems.

State data acquired from water management agencies.



Comparison of Instream Flow Targets with Measured Monthly Streamflow

### Instream Flow Deficiencies

State	Documented Instream Flows	Oldest Priority Date	Median Priority Date	Percent Matched to a USGS gauge	Average Flow Deficiency	Average Annual Percent of Months with Flow Deficiency
Arizona	38	1979	1990	15.8%	39.5%	36.3%
Colorado	1653	1859	1982	9.5%	14.7%	17.6%
Idaho	288	1976	2005	9.4%	17.3%	25.6%
Montana	422	1965	1985	18.7%	24.1%	30.4%
Nevada	239	1859	1906	7.9%	10.3%	4.4%
New Mexico	21	1883	1935	0.0%	N/A	N/A
Oregon	1532	1857	1990	4.7%	16.7%	16.9%
Texas	108	1895	2011	42.6%	46.7%	29.8%
Utah	1	2012	2012	0.0%	N/A	N/A
Washington	150	1976	1985	2.7%	17.8%	22.3%
Wyoming	86	1949	1995	8.1%	5.0%	10.3%
Total	4538	1857 - Oregon	1985	9.2%	20.5%	21.4%

### Acknowledgements

The Nature Conservancy  
National Fish and Wildlife Foundation  
The University of Virginia

