

# The Effects of Drought on Recreation and Wilderness

## AUDIO CONNECTION

**1. Phone:** mute your computer speakers and call 1-877-369-5243; access code: 0353212#

OR

**2. Audio through the computer:** Make sure your computer speakers are on and listen with speakers or headphones.

**Note:** Phone audio will allow you to both listen and speak up with questions. *If you listen through the computer, you will not be able to speak up with questions, but will be able to type questions into the Q&A pod which will be answered by the appropriate speaker.*



# a sustainable recreation future

effects of drought on recreation and wilderness resources

Joe Meade, Director - Recreation, Heritage and Volunteer Resources



# The forest service is the largest, most diverse provider of recreation opportunities in the world

Outdoor recreation is by far the single greatest use of the National Forest System, dwarfing every other use. The number of recreation visits on the National Forest System rose from about 5 million in 1925 to about 161 million today. That's a growth rate of over 3,000 percent. Not surprisingly, it is also the single greatest employer, and it provides the single greatest stimulus for local economies.

Visitors today engage in activities such as hiking, camping, picnicking, skiing, hunting, fishing, horseback riding, wildlife watching, visiting cultural sites and visitor centers, or just viewing the scenery and driving for pleasure. But the kinds of recreation the public wants are far more diverse than they were in the early 1900s. Think ziplining and snowboards, OHVs and snowmobiles, rafting trips or guided backcountry trips, with gourmet meals and llamas carrying everything but your daypack.



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5000+  
campgrounds

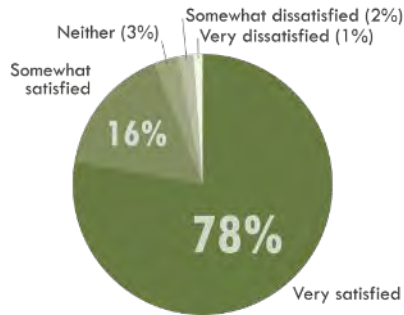
10,000+  
developed sites

30,000+  
recreation areas

- **240 MILLION** Americans live within 100 miles of a National Forest or Grassland
- **115,000** activity locations
- **156,000** miles of trails
- **362,000** heritage sites
- **2 MILLION** acres of lakes
- **200,000** miles of fishable streams
- **36 MILLION** acres of wilderness
- **4.4 MILLION** camping reservations through Recreation.gov
- **119** Wild and Scenic Rivers
- **136** National Scenic Byways covering **9,100** miles



and people seem to like what we do.



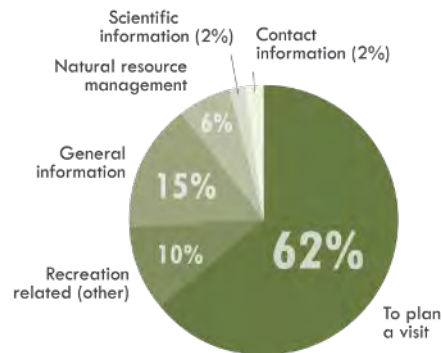
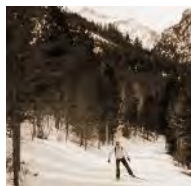
According to 2011 onsite surveys, **95% of visitors are satisfied or highly satisfied** with their National Forest experience.



87% of visitors to the National Forests made the trip **specifically to recreate.**

Over **161 MILLION** visits/year

Over **25 MILLION** ski visits/year



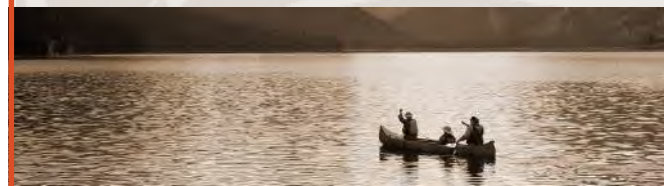
Over 70% of visitors search the Forest Service website **looking for recreation information** to plan a visit.

According to one recent survey, **more than half of American voters have visited a National Forest or Grassland in the past year**, and nearly 90% of avid visitors (those who have gone three or more times in the last year) plan to visit again next year.

We get a lot of repeat visitors. A full 15% of our total visits are from people who enjoy their public lands more than 50 times a year.

Even if they don't directly visit, travelers on scenic byways and similar routes near National Forest lands enjoyed the beautiful scenery 300 million times.

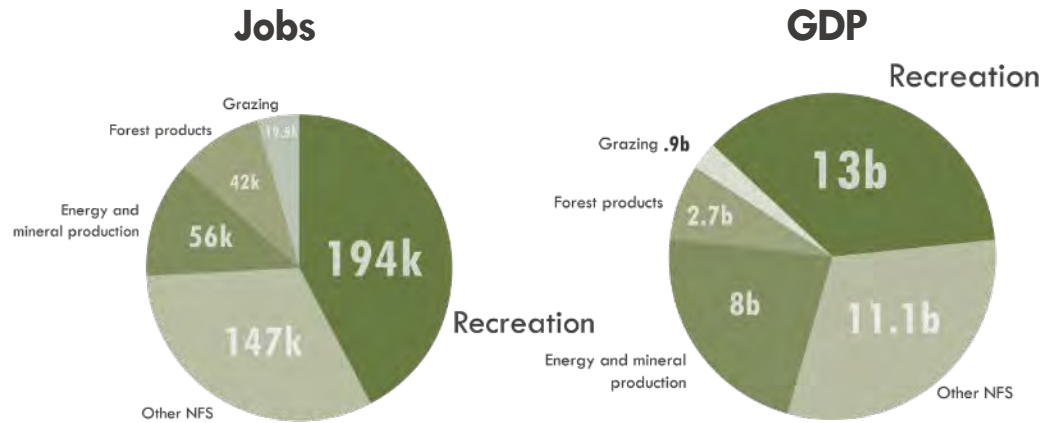
In the same survey, **7 out of 10 Americans agree that protecting our national history and beauty through public lands like National Forests is one of the things we do best.**



# recreation generates economic growth

**Recreation is big business.** In a recent report, the Outdoor Industry Association found the national “outdoor economy” generates **\$646 billion** in direct yearly spending. In 2012, **hundreds of millions** of recreational visits to public lands and waters **supported nearly 900,000 jobs** and **generated over \$50 billion** in direct spending in local communities.

**Outdoor economy spending directly supports 6.1 million American jobs**, from outdoor gear manufacturers and retailers to outfitters and guides. Visitors to our parks and public lands are not only enjoying the bounty of our natural resources, but also promoting jobs and growth.



Recreation produces more jobs and contributes more to GDP than anything else the National Forest System does.



One dollar invested in Forest Service recreation programs becomes a \$33 contribution to GDP.

# recreation supports resilient communities

## National Forest lands support over 5,000 outfitters and guides

many of which are small businesses providing jobs and income. Their continued stability and presence creates tourism-oriented identities for the local areas in which they operate. These permittees provide access to public lands which many people would not otherwise have.

## Rural counties with a land base of more than 30% public lands experienced 345% job growth

over the past 40 years. By comparison, similar counties with no public lands saw jobs increase by only 83% over the same 40-year period.

## 87% of travelers to National Forest lands came for the recreation opportunities.

Over 20% come from more than 200 miles away, and nearly half of U.S. voters are planning on visiting a National Forest in the next year.



>30% public lands 345%

>20% public lands 297%

<10% public lands 108%

No public lands 83%



Forest Service recreation programs support over 190,000 jobs, the vast majority of which are in gateway communities. Outdoor recreation is the single greatest employer in the National Forest System, and provides the single greatest stimulus for local economies. Ski areas on National Forest lands alone contribute \$5 billion to the GDP and represent around 78,000 full and part-time jobs.

Gateway communities provide access to public lands and services to the many millions of Americans who visit them each year. These towns' distinguishing feature is proximity to public lands; the vitality of their social and economic structure often depend on the management decisions being made on and for these public lands.

Outdoor recreation opportunities and amenities are consistently ranked as one of the top reasons people move to rural towns, and is a leading force in many small town revivals, especially in the West.

# recreation improves quality of life

With more and more of America living in urban environments, **the importance of our public lands as natural refuges has never been greater.**

Forest Service lands provide the opportunity to de-stress: about 37% of visitors say they spent time simply just relaxing. Recreation contributes to the overall health of those who visit. Over 90 million visitors of all ages and abilities (over 55%) come to engage in a physically active pursuit, which they usually spend about 7 hours doing.

*Thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wilderness is a necessity and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life. - John Muir*



## **Walks in the woods are good for you.**

Researchers have linked time spent outdoors with decreases in stress, nervousness, blood pressure, and heart rate. It's also associated with greater physical and mental well-being and greater social connectivity.



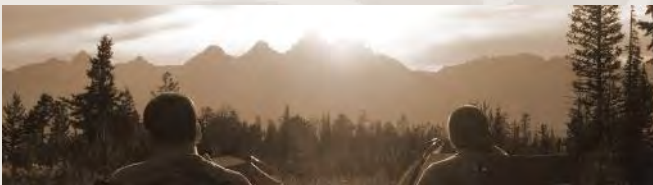
## **Nature makes you more creative.**

After 3 days hiking and camping in the wilderness, study participants improved their scores on tests of creativity by 50%.



## **Time spent outdoors helps children stay healthy.**

Several studies have shown time spent outdoors as the strongest correlate to a child's amount of physical activity, and "green doses" of the outdoors has been shown to reduce the effects of attention deficit syndromes.



# investing in a sustainable future

- **Investments in privately held businesses are leveraged into improved citizen services.**

- The Forest Service planning rule is heavily focused on the integration of economic, social, and ecological sustainability, and increased capacity in the special uses program is key to supporting new outdoor-focused businesses and the resiliency of local communities.



- **Investments in volunteering and youth conservation will reach the next generation.**

- These programs provide outdoor learning experiences for over 4 million people, including 285,000 children. These future recreationists and conservationists are critical to the future of ourselves and our partners.



- **Investments in our nation's trails, scenic byways, and recreation roads are critical to access.**

- Investment in our infrastructure is a fundamental investment in the portfolio of recreation opportunities on National Forest lands.



**Sustainable recreation is a fundamental part of the Forest Service's planning rule.** Sustainable recreation means a range of recreational settings, opportunities, and access that can be sustained over time.

**Managing for sustainable recreation on the forests and grasslands means providing opportunities for small businesses, such as restaurants, motels, and other tourism-related enterprises in gateway communities.** It means sustaining current businesses and jobs and helping new ones get started.

It helps connect people to nature, and it encourages outdoor activities that promote physical and mental health. It helps Americans understand their natural and cultural environments, and it helps engage them in the stewardship of the natural world. It brings the next generation into the fold, giving them opportunities to contribute to their public lands and develop lifelong land ethics.





## drought sensitive recreation

Warm-weather (hiking, camping, biking)

Snow-based winter (skiing, snowmobiling)

Wildlife-related (hunting, fishing, viewing)

Forest products gathering (berries, mushrooms)

Water-based, not including fishing (boating, swimming)



# Wilderness and Wild & Scenic Rivers: Recreation and a Changing Climate



Susan Spear, Director  
Wilderness and Wild & Scenic Rivers

© BILL LEA / NBP



## 1964 Wilderness Act

***“A Wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.”***



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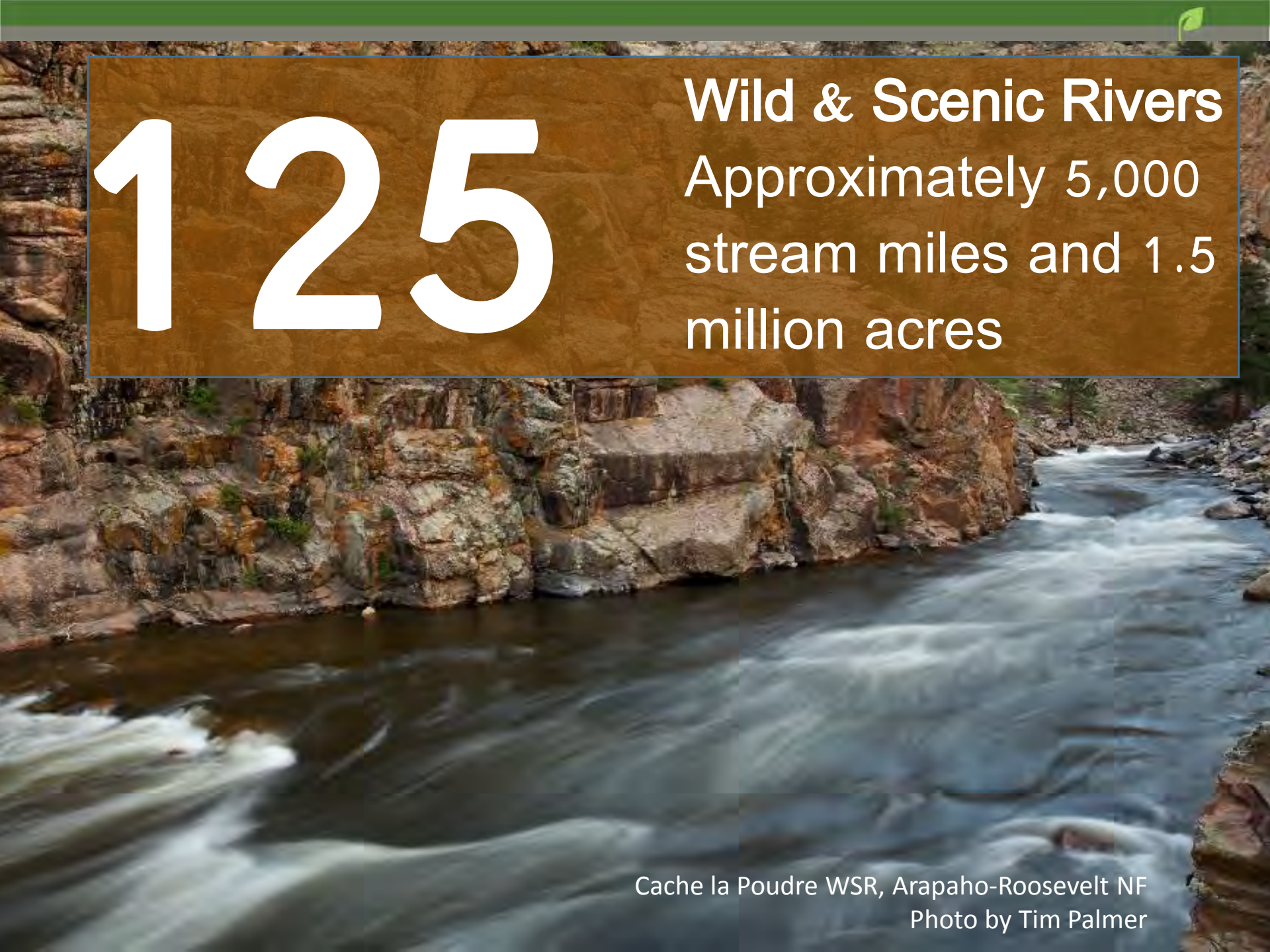
Wildernesses  
36.7 Million Acres



## 1968 Wild and Scenic Rivers Act

***“It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Congress declares that the established national policy of dams and other construction at appropriate sections of the rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes.”***





# 125

**Wild & Scenic Rivers**  
Approximately 5,000  
stream miles and 1.5  
million acres

Cache la Poudre WSR, Arapaho-Roosevelt NF  
Photo by Tim Palmer

# Benefits



- **Natural state, natural processes**
- **Environmental Services**
- **Inherent value**
- **Social**
- **Cultural**
- **Recreational**
- **Habitat and biodiversity**

# Management Considerations



© ETHAN WELTY / NBP



# FSM 2320



“Where a choice must be made between wilderness values and visitor or any other activity, preserving the wilderness resource is the overriding value. Economy, convenience, commercial value, and comfort are not standards of management or use of wilderness. Because uses and values on each area vary, management and administration must be tailored to each area. Even so, all wilderness areas are part of one National Wilderness Preservation System and their management must be consistent with the Wilderness Act and their establishing legislation.”



# Drought and Recreation

- Increased pressure from change
- Importance of free-flowing rivers
- Does the value of these Wilderness areas and rivers increase? (Refugia, natural processes, connectivity)
- Longer shoulder seasons (fire, drought, recreation)
- Ecological Intervention



# WATER

- Drought
- Higher water temperatures
- Changes in precipitation
- Changes in spring flows
- Timing
- Native Fish Conservation in the North Fork of the Flathead (Scapegoat)
- Bob Marshall (Grizzlies and Bull trout)





**Because of the change in climate and the expected change in social values, this makes Wilderness and Wild & Scenic Rivers even more important. These changes create more challenges for meeting the intent of the law.**



# Assessing Vulnerability to Drought of Recreation in National Forests

An example from the Northern Region

Michael Hand

Research Economist

Rocky Mountain Research Station





# How does drought affect recreation?

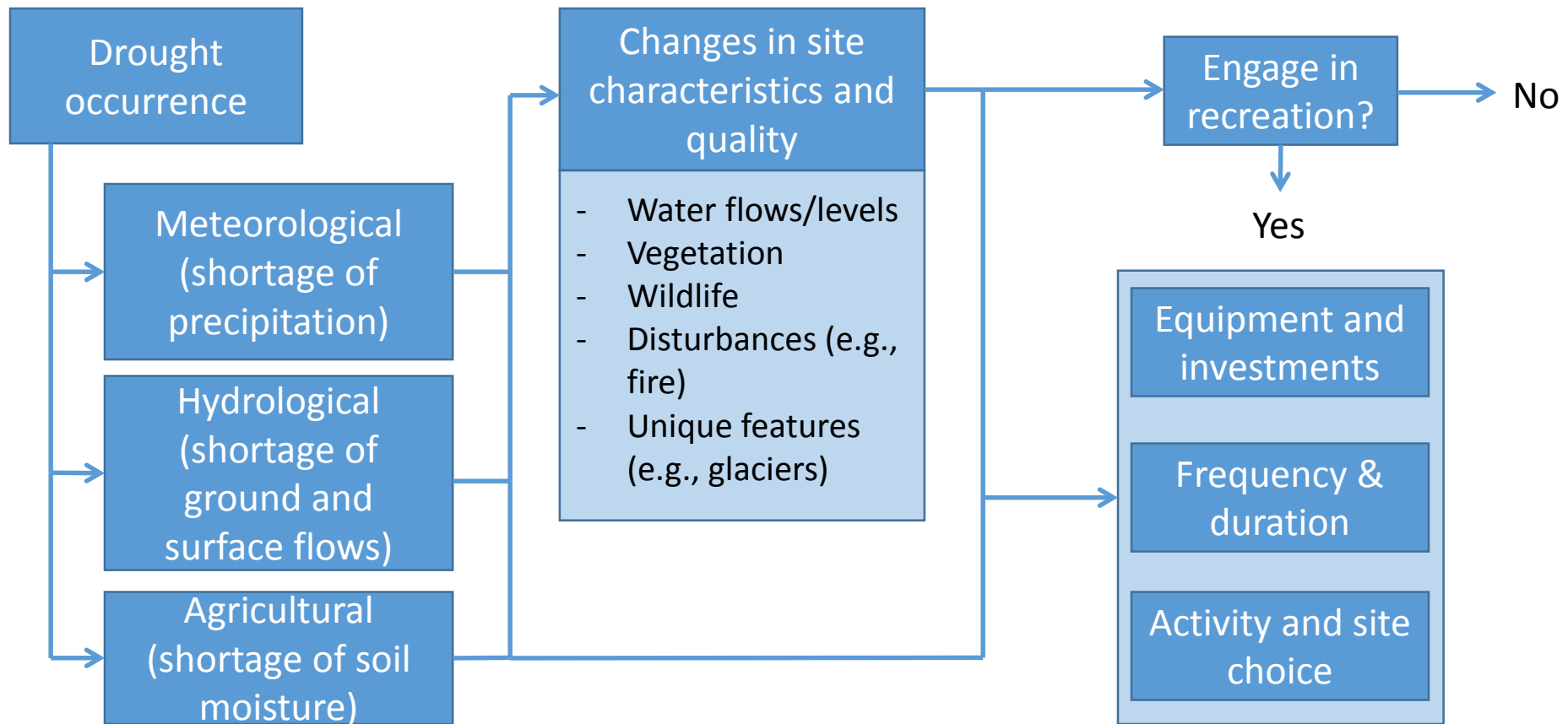
Prolonged shortages of water affect several ecosystem functions that are important for recreation.



Photo credits: Clockwise from bottom right: Friends of Hyalite ([www.hyalite.org](http://www.hyalite.org));  
USDA Forest Service; Michael Hand; Matthew Thompson



# Conceptual model of drought effects on recreation



# Recreation sensitivity to drought

- **Identifying drought-sensitive activities:**
  - **Warm-weather (hiking, camping, biking)**
  - **Snow-based winter (skiing, snowmobiling)**
  - **Wildlife-related (hunting, fishing, viewing)**
  - **Forest products gathering (berries, mushrooms)**
  - **Water-based, not including fishing (boating, swimming)**



# Participation in climate-sensitive recreational activities on Northern Region National Forests

Activity	Percent of visitors who participated in this as their main activity	Annual visitors who participated in this as their main activity
Warm-weather activities	37.1	3,430,637
Hiking/walking	20.8	1,923,376
Viewing natural features	9.2	850,724
Developed camping	2.8	258,916
Bicycling	2.3	212,681
Other non-motorized	2	184,940
Wildlife activities	20.3	1,877,141
Hunting	13	1,202,110
Fishing	5.3	490,091
Viewing wildlife	2	184,940
Winter activities	15.8	1,461,026
Downhill skiing	7	673,372
Snowmobiling	4.9	453,103
Cross-country skiing	3.9	360,633
Forest products gathering	3.6	332,892
Water-based activities, not including fishing	2.2	203,434

Source: USDA Forest Service, National Visitor Use Monitoring (NVUM) survey, round 2, 2014



# Drought effects relevant for recreation

- **Precipitation, hydrology, temperature**
  - Reduced snowpack and runoff
  - Lower stream flows and reservoir/lake levels
  - In combination with climate change:
    - Precip more likely as rain, reduced areas of snow-dominated winter precip
    - Earlier Spring melt

# Drought effects relevant for recreation

- **Vegetation and disturbances:**
  - **Wildfire:** Increase in total area burned, avg. fire size & severity, season length
  - **Forest vegetation:** High risk of vegetative change for many types (e.g., dry Ponderosa pine and Doug fir forests, western larch, whitebark pine)

# Drought effects relevant for recreation

- **Fish and Wildlife:**

- **Cold-water fish (bull & cutthroat trout):** Retreat of suitable habitat due to warmer stream temps and declines in summer flow
- **Warm-water fish:** Expanded opportunities for brook and rainbow trout, smallmouth bass
- **Terrestrial game (white-tail & mule deer, elk):** High climatic plasticity, but depends on pattern of disturbances and forage



# Expected impacts: Warm-weather activities

## Sensitivity to drought

- **Season length:** Snow- and ice-free days, days with suitable temperatures
- **Site characteristics:** Presence/abundance of unique features (e.g., wildflowers), trail conditions, wildfire effects, vegetation and cover

## Expected effects on recreation

- Overall increase in demand (++)
- Shifting seasons: Available “shoulder seasons” (+)
- Shifting site preferences: location choice, response to fire/smoke (+/-)

# Expected impacts: Snow-based winter activities

## Sensitivity to drought

- Overall expected decrease in viable seasons, esp. for lower elevations
- Decrease in snow-dominated areas in early and late winter

## Expected effects on recreation

- Overall decrease in opportunities (--)
- Demand concentrated during shorter seasons at fewer viable sites (+/-)
- Site substitution: Highly mobile visitors may substitute sites that are relatively unaffected (+/-)

# Expected impacts: Wildlife activities (hunting, fishing, viewing)

## Sensitivity to drought

- Reduction in cold-water fish species
- Potential for river closures (in MT) due to high temps/low flows
- Uncertain effects on abundance/distribution of terrestrial game
- Hunting seasons without snow less desirable

## Expected effects on recreation

- Potential mis-alignment of hunting season (- short-term, +/- long-term)
- Ambiguous effect on terrestrial catch rates (+/-)
- Decreased opportunities for cold-water angling (-)



# Expected impacts: Gathering forest products

## Sensitivity to drought

- Stress from moisture deficit for some species
- Uncertain effects on vegetative conditions that support target species
- Changing disturbance regimes can alter target species availability

## Expected effects on recreation

- Altered but uncertain changes in abundance and distribution (+/-)
- Increased fire effects may reduce availability of some species (e.g., berries), but encourage productivity in near-term for other species (e.g., mushrooms) (+/-)
- Overall reduction in productivity (-)



# Expected impacts: Water-based activities (not incl. fishing)

## Sensitivity to drought

- Decreased lake and reservoir levels
- Increased surface-water demands may exacerbate low water levels in drought years
- People may seek water-based activities as a climate refuge

## Expected effects on recreation

- Reduced demand due to lower site quality (i.e., lower water levels) (-)

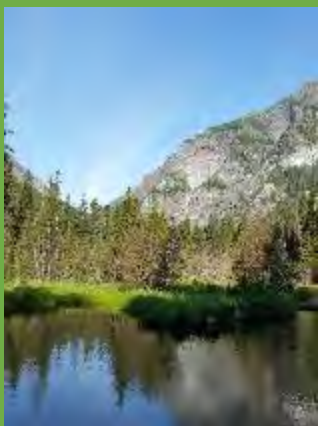


# Summary of expected changes

Activity	Primary drought effect	Expected change
Warm-weather	Longer seasons	++
Snow-based	Less snowfall, shorter seasons	--
Wildlife-related	Low stream flows	+ / -
Forest products gathering	Vegetative change and disturbances	+ / -
Water-based	Less surface water for recreation	-

# A note on adaptation

- **Recreationists are highly adaptable:**
  - Site and activity choices
  - Target species
  - Timing and seasonality
- **Management adaptation may be more constrained**
  - Ecological processes are in charge
  - Infrastructure development is long term, but demand can change with drought conditions



**Thanks!**  
**Michael Hand**  
**[mshand@fs.fed.us](mailto:mshand@fs.fed.us)**



RMRS researchers Matt Thompson and Michael Hand in Pattee Canyon Recreation Area (MT), with two future scientists.



Pickles the mountain dog surveys the trail



Middle Fork Flathead River looking into Glacier NP

Photo credits: Michael Hand



# How the spatial and temporal availability of freshwater affects outdoor recreation in the high deserts of the Intermountain West, USA



INSTITUTE OF  
OUTDOOR  
RECREATION  
AND TOURISM  
UTAH STATE UNIVERSITY

**Jordan W. Smith, Ph.D.**

Director, Institute of Outdoor  
Recreation and Tourism

Assistant Professor, Dept. of  
Environment and Society

Utah State University



FEATURE

# Identifying Alternate Pathways for Climate Change to Impact Inland Recreational Fishers

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**Tyler D. Tunney**

Center for Limnology, University of Wisconsin-Madison, Madison, WI

**Abigail J. Lynch**

U.S. Geological Survey (USGS), National Climate Change and Wildlife Science Center, Reston, VA

**Craig P. Paukert**

USGS, Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia, MO

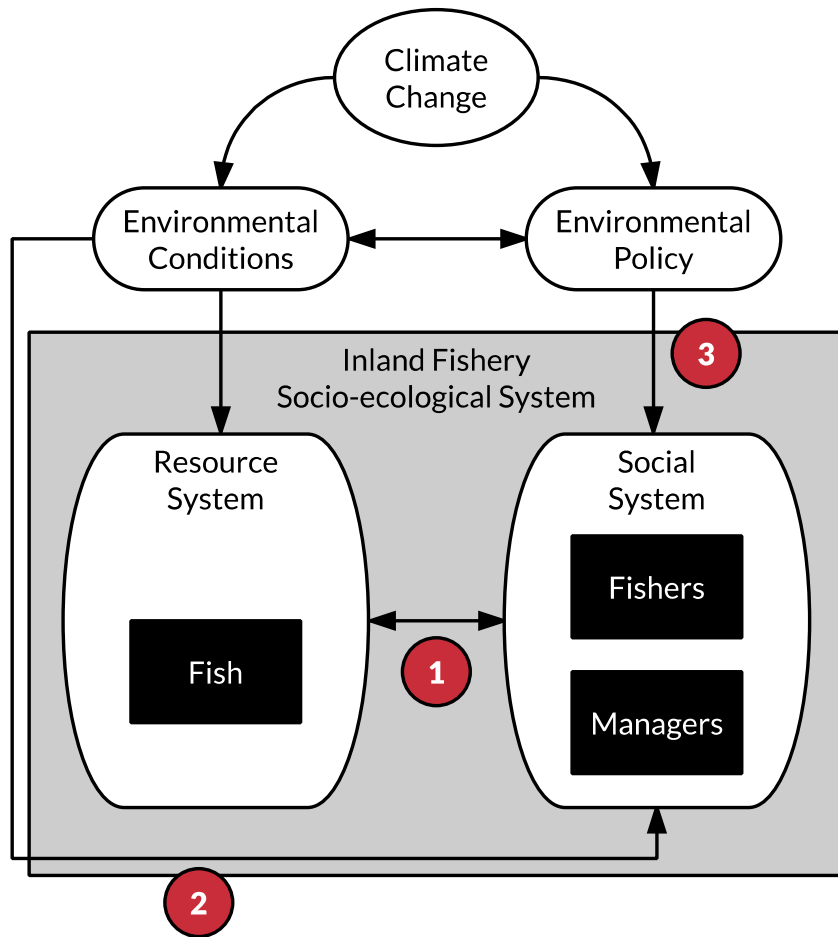
**James E. Whitney\***

Missouri Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO

The fourth through sixth coauthors are listed alphabetically by last name. The final three coauthors are workshop organizers.

\*Present address for James E. Whitney: Department of Biology, Pittsburg State University, Pittsburg, KS





## Pathway 1

- Drought affects the diversity and abundance of fish; subsequently impacting fishers

## Pathway 2

- Drought affects the behavior of fishers directly

## Pathway 3

- Drought adaptation or mitigation policy affects the behaviors of fishers

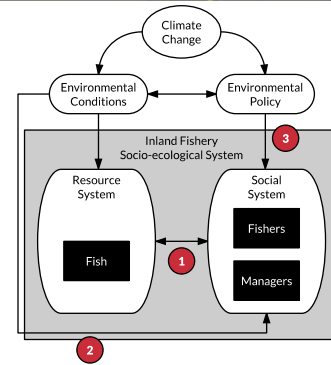
# Pathway 1 Example

## Proliferative Kidney Disease (PKD) in whitefish throughout Washington, Oregon, Idaho and Montana

*Tetracapsuloides bryosalmonae*, the microscopic parasitic spore that attacks the spinal cartilage of young fish, leading to skeletal deformities and nerve damage



Source: theatlantic.com

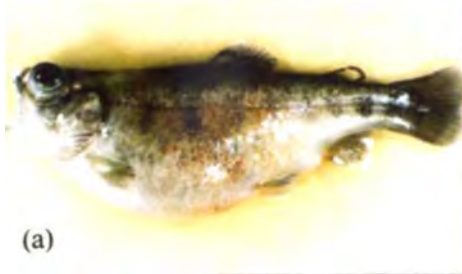




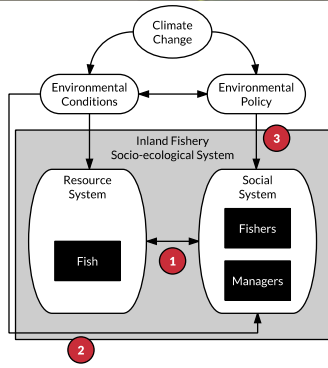
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External signs of PKD include (a) abdominal distention while internal signs (b) include enlarged kidney and spleen. Hedrick *et al.* (1993)



Source: theatlantic.com



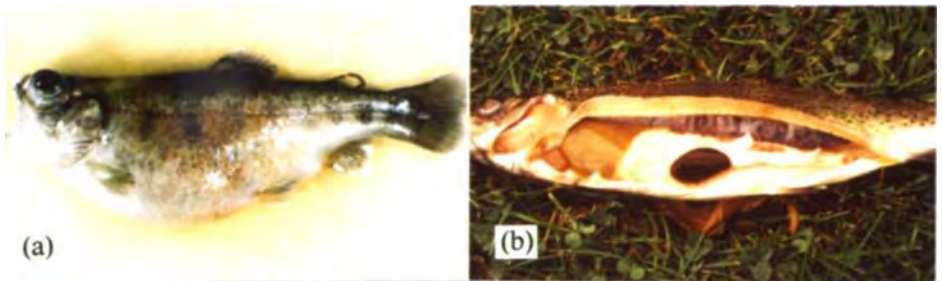
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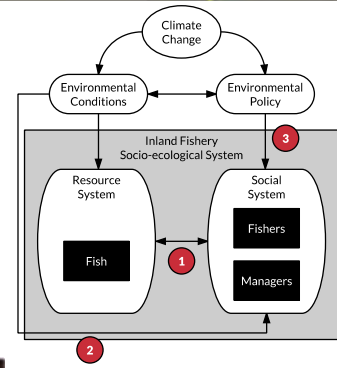


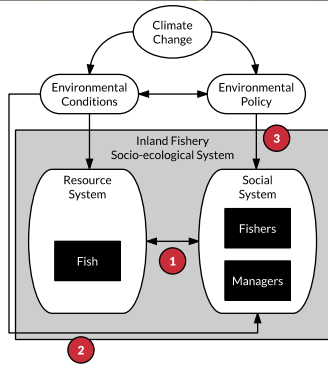
External signs of PKD include (a) abdominal distention while internal signs (b) include enlarged kidney and spleen. Hedrick *et al.* (1993)



Source: hcn.org

In 2016 near-record low water flows, summer high temperatures and recreation activities stressed the fish, which allowed the disease to strike hard and fast. The result, an emergency closure of a 183-mile stretch of the Yellowstone River.

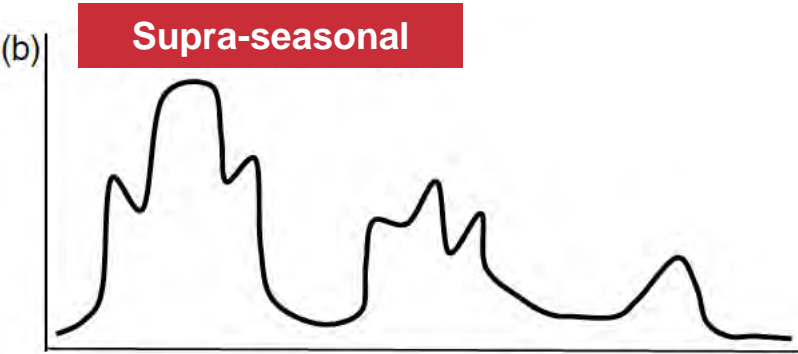
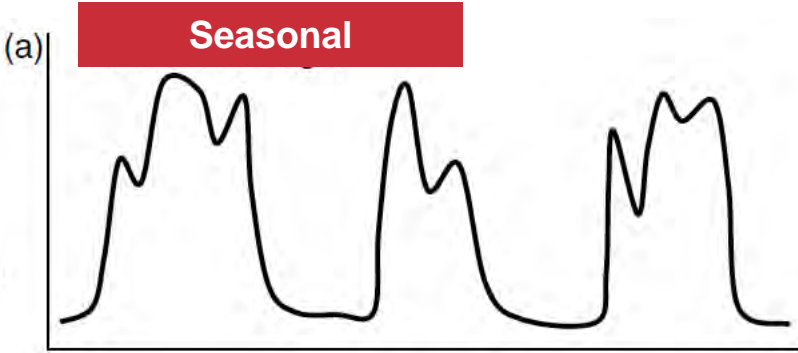


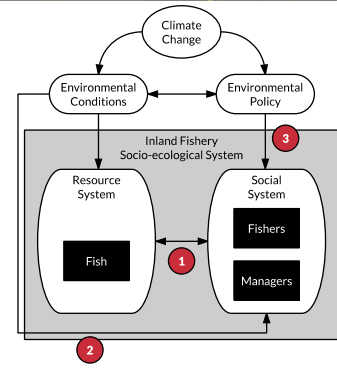


# The Science Behind Pathway 1

- Scientific research into the effects of droughts on river ecology is fragmented

## DROUGHT TYPE

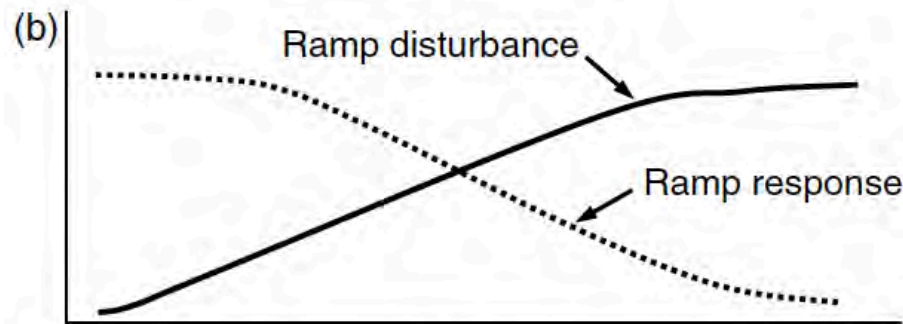
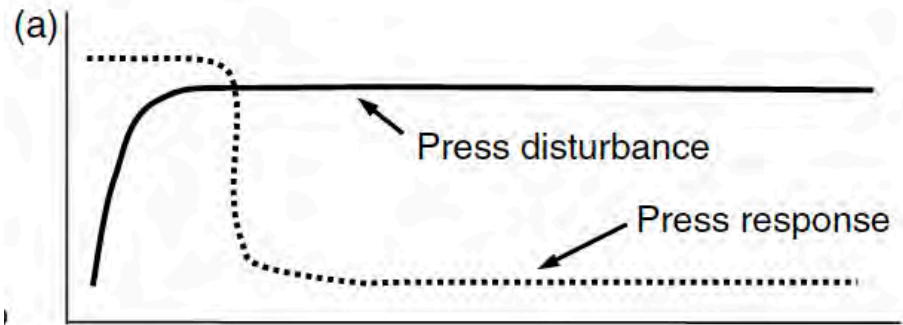
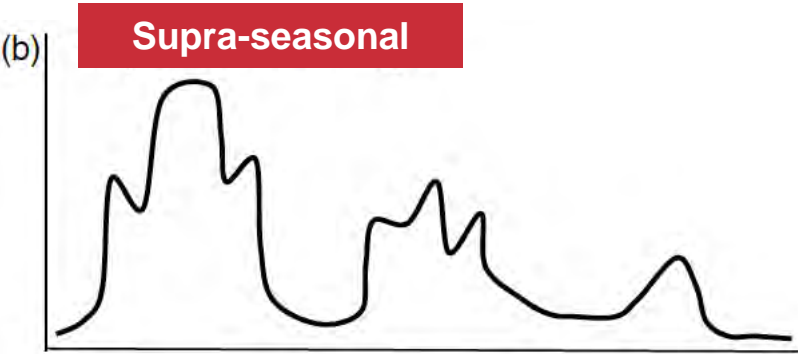
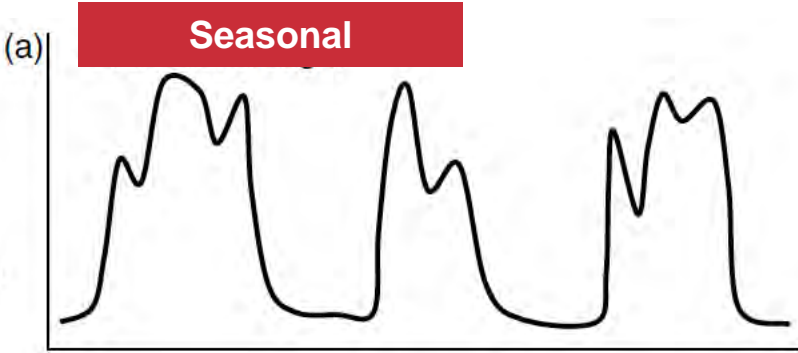




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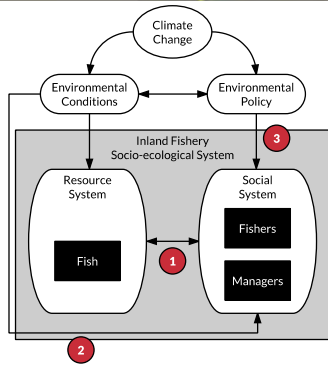
## DROUGHT TYPE



Time

Lake (2003)

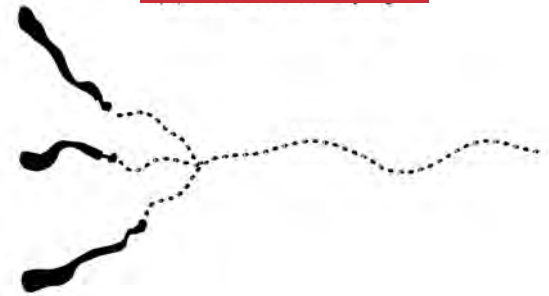




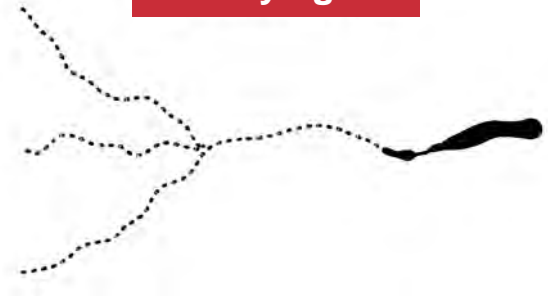
# The Science Behind Pathway 1

## DRYING TYPE

**Downstream Drying**



**Headwater Drying**



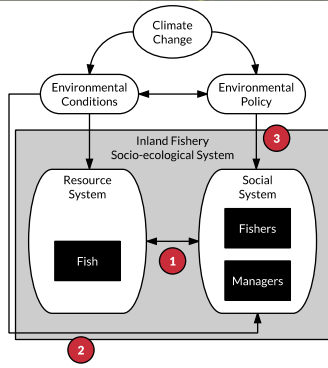
**Mid-reach Drying**





# Pathway 2 Example

## Low-volume reservoirs/low-flow rivers



The old site of the Lake Mead Marina, a popular boat launch since the 1940s. Falling water levels in the reservoir forced the marina to relocate in 2008.



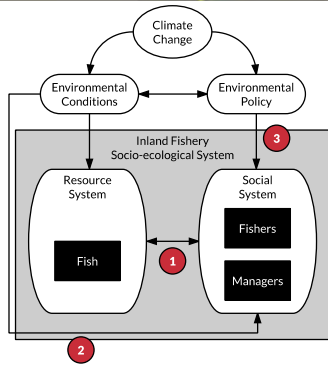
Source: theatlantic.com





# Pathway 2 Example

## Low-volume reservoirs/low-flow rivers

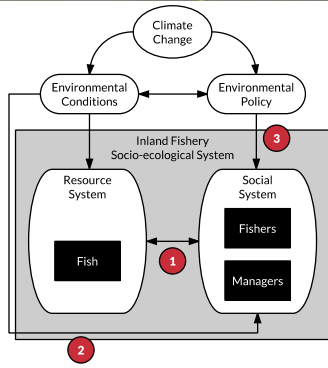


The old site of the Lake Mead Marina, a popular boat launch since the 1940s. Falling water levels in the reservoir forced the marina to relocate in 2008.



Source: theatlantic.com





# Pathway 2 Example

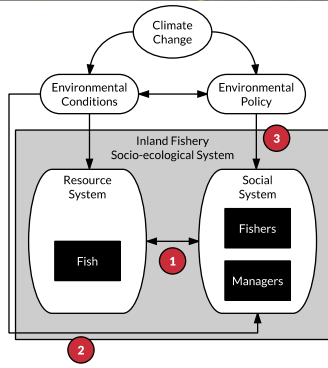
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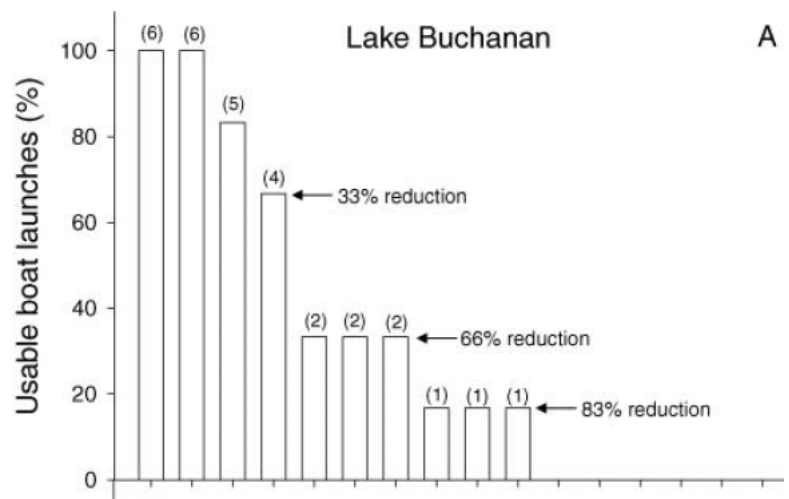




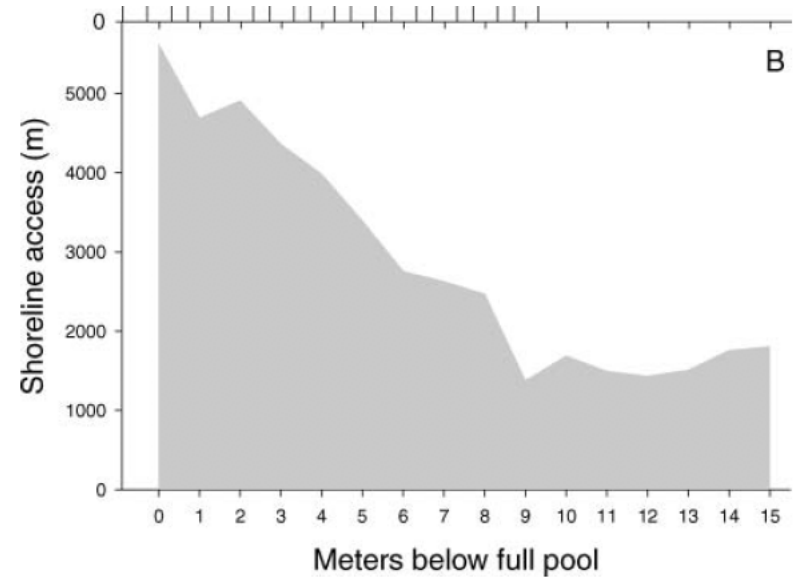
# The Science Behind Pathway 2

## RESERVOIR WATER LEVEL AND...

### PERCENTAGE OF USABLE BOAT LAUNCHES



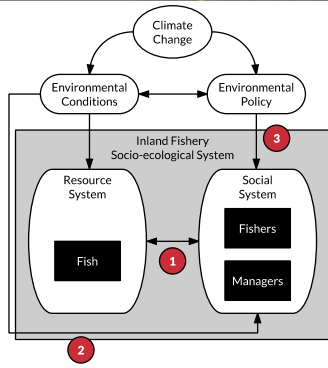
### CUMULATIVE SHORELINE ACCESS





# Pathway 3 Example

Management decisions to switch from stocking cold guild species to stocking warm guild species

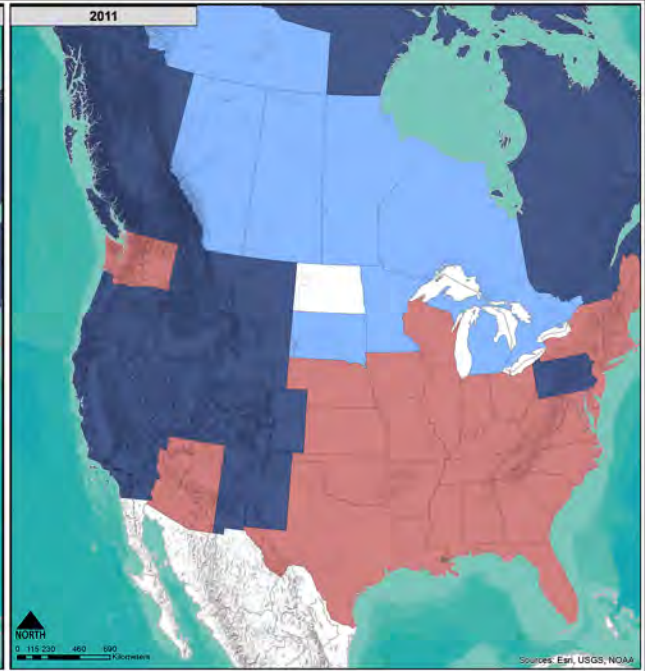
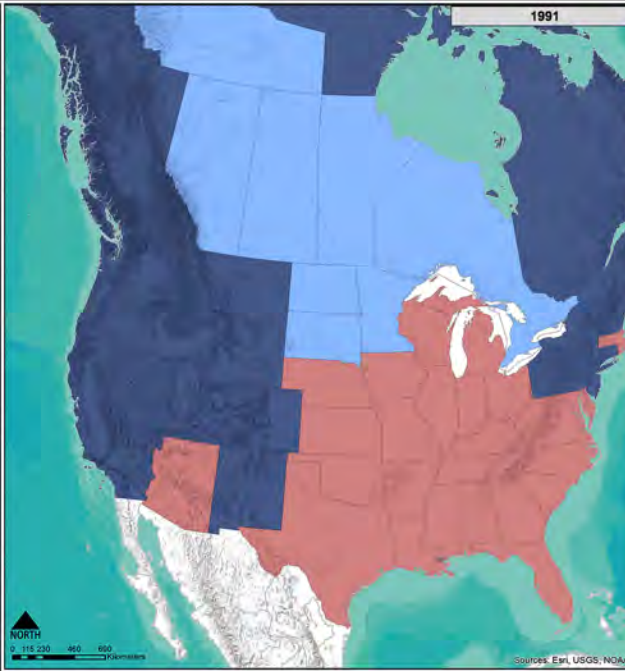




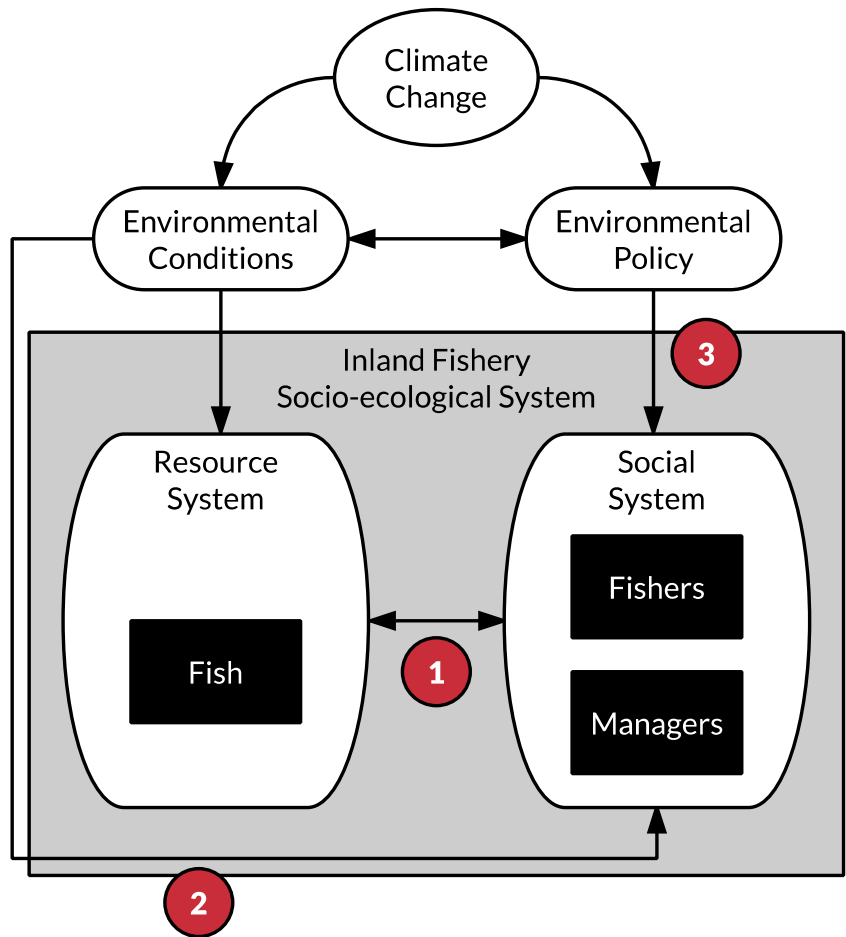
# Pathway 3 Example

## Management decisions to switch from stocking cold guild species to stocking warm guild species

STATE	1991		2011		Switch in thermal guild of most targeted species
	Most Targeted Species	Thermal Guild of Most Targeted Species	Most Targeted Species	Thermal Guild of Most Targeted Species	
Alaska	Salmon	COLD	Salmon	COLD	NO
Alabama	Black Bass	WARM	Black Bass	WARM	NO
Arkansas	Black Bass	WARM	Black Bass	WARM	NO
Arizona	Catfish, bullheads	WARM	Black Bass	WARM	NO
California	Trout	COLD	Trout	COLD	NO
Colorado	Trout	COLD	Trout	COLD	NO
Connecticut	Trout	COLD	White bass, striped	WARM	YES
Delaware	Black Bass	WARM	White bass, striped	WARM	NO
Florida	Black Bass	WARM	Black Bass	WARM	NO
Georgia	Black Bass	WARM	Black Bass	WARM	NO
Iowa	Catfish, bullheads	WARM	Black Bass	WARM	NO
Idaho	Trout	COLD	Trout	COLD	NO
Illinois	Catfish, bullheads	WARM	Panfish	WARM	NO
Indiana	Panfish	WARM	Black Bass	WARM	NO
Kansas	Black Bass	WARM	Catfish, bullheads	WARM	NO
Kentucky	Black Bass	WARM	Black Bass	WARM	NO
Louisiana	Black Bass	WARM	Panfish	WARM	NO
Massachusetts	Black Bass	WARM	Black Bass	WARM	NO
Maryland	Black Bass	WARM	Black Bass	WARM	NO
Maine	Trout	COLD	Catfish, bullheads	WARM	YES
Michigan	Panfish	WARM	Walleye, sauger	COOL	YES
Minnesota	Walleye, sauger	COOL	Walleye, sauger	COOL	NO
Missouri	Black Bass	WARM	Black Bass	WARM	NO
Mississippi	Black Bass	WARM	Black Bass	WARM	NO
Montana	Trout	COLD	Trout	COLD	NO
North Carolina	Black Bass	WARM	Black Bass	WARM	NO
North Dakota	Walleye, sauger	COOL	COOL	N/A	
Nebraska	Catfish, bullheads	WARM	Catfish, bullheads	WARM	NO
New Hampshire	Trout	COLD	Black Bass	WARM	YES
New Jersey	Trout	COLD	Black Bass	WARM	YES
New Mexico	Trout	COLD	Trout	COLD	NO
Nevada	Trout	COLD	Trout	COLD	NO
New York	Trout	COLD	Black Bass	WARM	YES
Ohio	Black Bass	WARM	Black Bass	WARM	NO
Oklahoma	Black Bass	WARM	Black Bass	WARM	NO
Oregon	Trout	COLD	Trout	COLD	NO
Pennsylvania	Trout	COLD	Trout	COLD	NO
Rhode Islands	Black Bass	WARM	Black Bass	WARM	NO
South Carolina	Black Bass	WARM	Black Bass	WARM	NO
South Dakota	Walleye, sauger	COOL	Walleye, sauger	COOL	NO
Tennessee	Black Bass	WARM	Black Bass	WARM	NO
Texas	Black Bass	WARM	Catfish, bullheads	WARM	NO
Utah	Trout	COLD	Trout	COLD	NO
Virginia	Black Bass	WARM	Black Bass	WARM	NO
Vermont	Trout	COLD	Panfish	WARM	YES
Washington	Trout	COLD	Black Bass	WARM	YES
Wisconsin	Panfish	WARM	Panfish	WARM	NO
West Virginia	Black Bass	WARM	Black Bass	WARM	NO
Wyoming	Trout	COLD	Trout	COLD	NO



Between 1991 and 2011, the most targeted species in 8 states switched from a cold to a warm guild species



## Pathway 1

- Drought affects the diversity and abundance of fish; subsequently impacting fishers

## Pathway 2

- Drought affects the behavior of fishers directly

## Pathway 3

- Drought adaptation or mitigation policy affects the behaviors of fishers





## References

**Daugherty, D.J.**, Buckmeier, D.L., Kokkanti, P.K., 2011. Sensitivity of recreational access to reservoir water level variation: An approach to identify future access needs in reservoirs. **North Am. J. Fish. Manag.** 31, 63–69. doi:10.1080/02755947.2011.559846

**Hedrick, R.P.**, MacConnell, E., de Kinkelin, P., 1993. Proliferative kidney disease of salmonid fish. **Annu. Rev. Fish Dis.** 3, 277–290. doi:10.1016/0959-8030(93)90039-E

**Hunt, L.M.**, Fenichel, E.P., Fulton, D.C., Mendelsohn, R., Smith, J.W., Tunney, T.D., Lynch, A.J., Paukert, C.P., Whitney, J.E., 2016. Identifying alternative pathways for climate change to impact inland recreational fishers. **Fisheries** 41, 362–372.

**Lake, P.S.**, 2003. Ecological effects of perturbation by drought in flowing waters. **Freshw. Biol.** 48, 1161–1172. doi:10.1046/j.1365-2427.2003.01086.x





# How the spatial and temporal availability of freshwater affects outdoor recreation in the high deserts of the Intermountain West, USA



INSTITUTE OF  
OUTDOOR  
RECREATION  
AND TOURISM  
UTAH STATE UNIVERSITY

**Jordan W. Smith, Ph.D.**

[jordan.smith@usu.edu](mailto:jordan.smith@usu.edu)



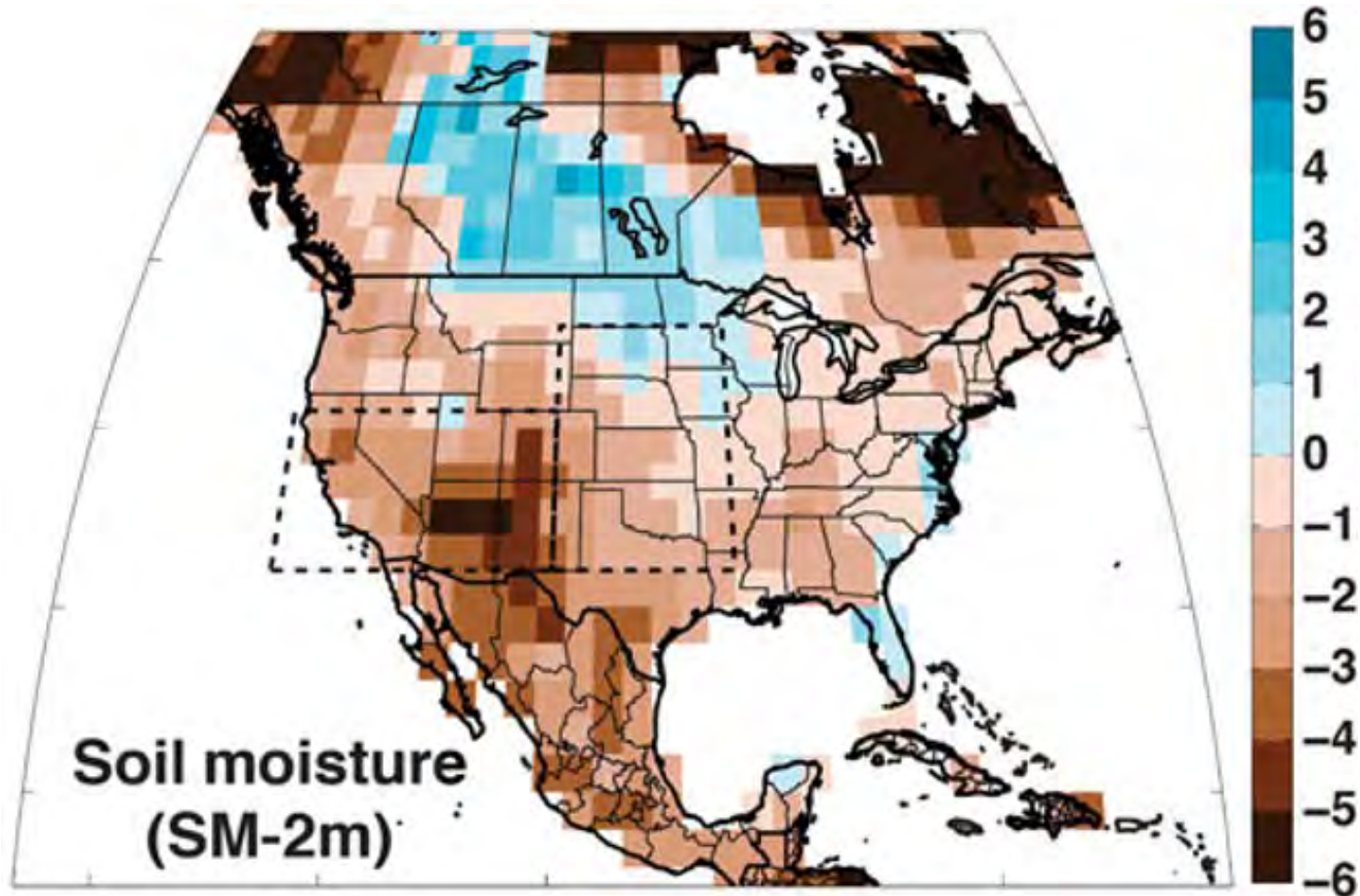
# Recreation Impacts in Forest Service Wilderness Areas: Considering Effects of Urbanization and Drought (2010-2060)

Rebecca Rasch, PhD  
Regional Social Scientist  
US Forest Service, Region 1  
Missoula, MT



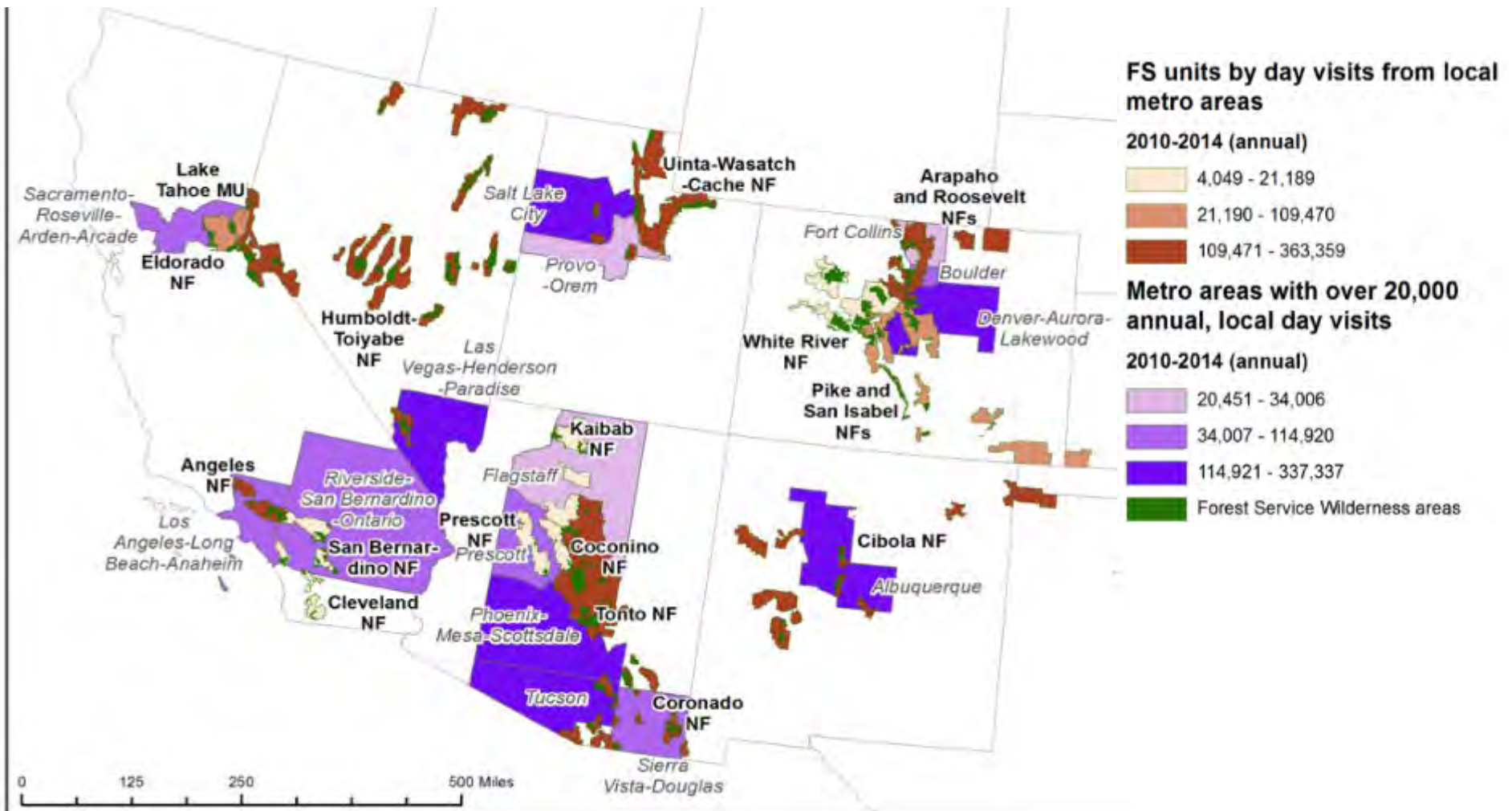
# Drought Projections

CMIP5 Drought Projections (RCP 8.5, 2050-2099 CE)

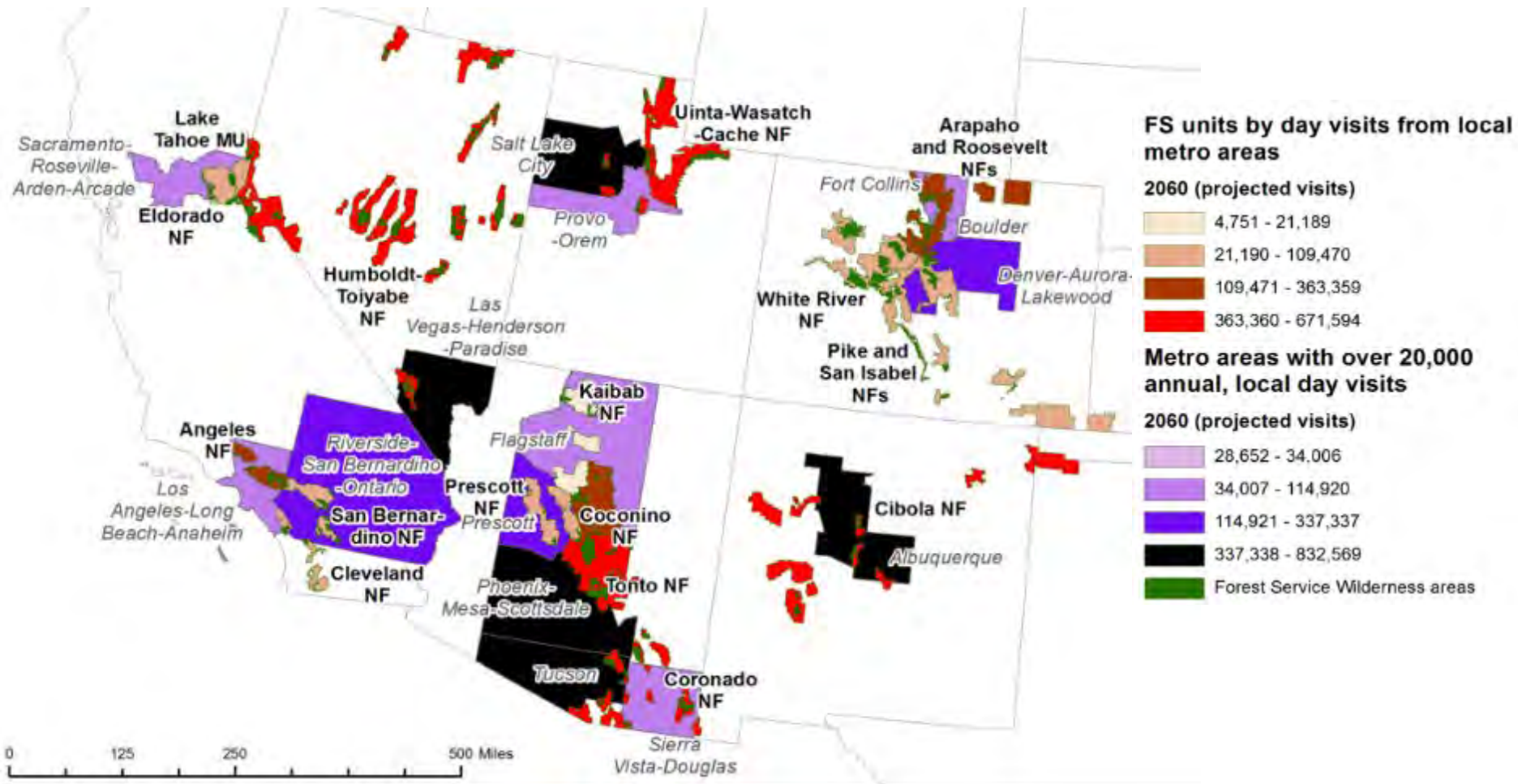


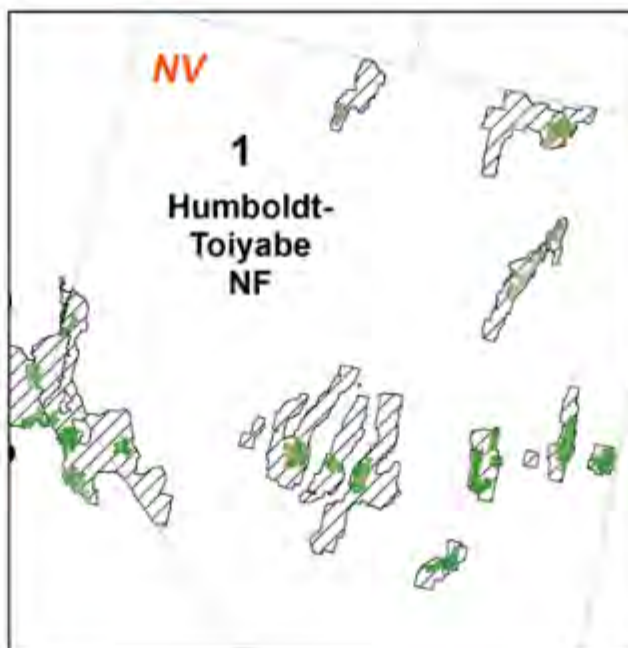
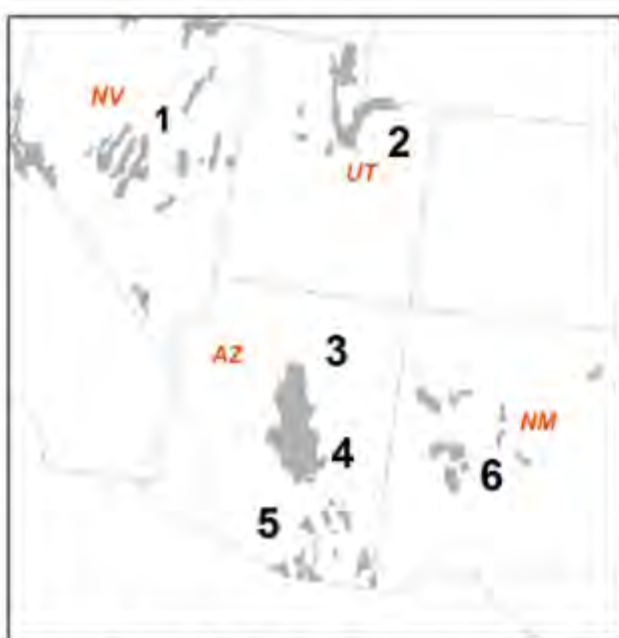
Cook, Benjamin I., Toby R. Ault, and Jason E. Smerdon. 2015. Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Science Advances* 1(1): E1400082. DOI: [10.1126/sciadv.1400082](https://doi.org/10.1126/sciadv.1400082)

# Day Visits to Forest Service Wilderness Areas (2010-2014)



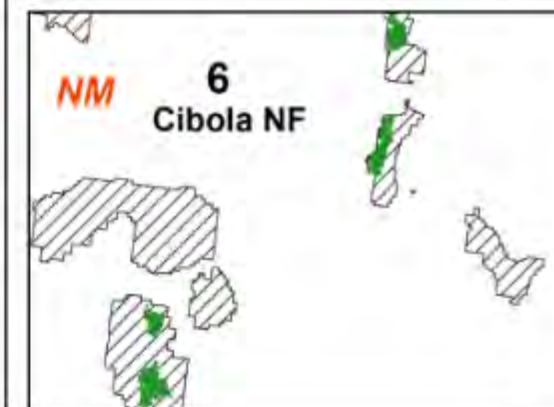
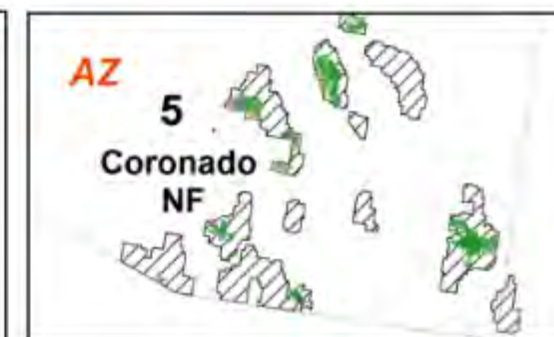
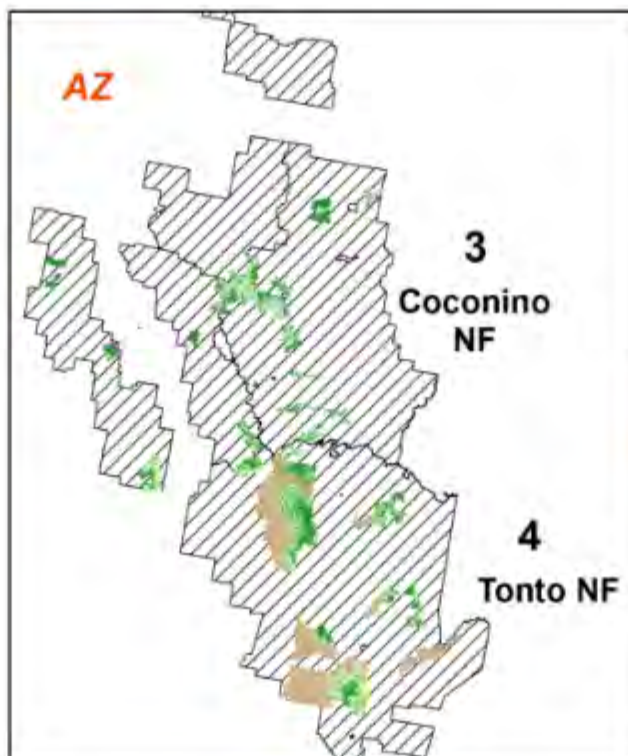
# Forecast Day Visits to Forest Service Wilderness Areas(2060)





## USGS GAP Land cover data

### Wilderness Ecosystem Type



# Management Implications

➤ **Tailor  
stewardship  
messaging  
to urban  
day users.**



Red Rock-Secret Mountain Wilderness,  
Coconino National Forest  
Less than 30 miles from Flagstaff, Arizona

# Management Implications

➤ **Forests in the Southwest and Central plains need to plan carefully for simultaneous uptick in day visits and drought in the coming decades.**



Pusch Ridge Wilderness Area,  
Coronado National Forest  
Less than 15 miles from Tucson, Arizona



# Thank you!



# Questions & Answers

- By phone: **Dial #2** to enter the queue.
- On your computer: **Type your question into the Q & A pod on the left side of your screen.**

# Drought and a Changing Ski Industry

**Scott Fitzwilliams**

**Forest Supervisor, White River National Forest**

**Rick Cables**

**Vice President for Natural Resources and Conservation, Vail Resorts**



# What is Changing?

- **Significant investments in resort infrastructure**
- **Changing demographics and visitor expectations**
- **Unpredictability of snowfall**
- **Need to diversify recreational offerings**

# Ski Area Recreational Opportunity and Enhancement Act

- **Authorizes more “year round” use of NFS lands for enhanced recreation**
- **Congress recognized the unpredictability of weather/precipitation/ climate into the future**
- **Helps protect resorts investments**





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**VAIL RESORTS**

VAIL | BEAVER CREEK | BRECKENRIDGE | KEYSTONE | PARK CITY | HEAVENLY  
NORTHSTAR | KIRKWOOD | WILMOT | AFTON ALPS | MT. BRIGHTON | PERISHER

# Form 10 K

## Risk Factors

- Economic conditions
- Vulnerable to unfavorable weather and the impact of natural disasters
- Business is highly seasonable
- Significant competition
- We rely on government permits and landlord approvals

# Vail Resorts

- Global mountain resort operator with
- Strategic portfolio of **14 mountain resorts**
  - Over **12 million skier visits** annually
  - **Largest ski resort** in North America with Whistler Blackcomb
  - **Three of the four largest US ski resorts** by acreage with Park City, Vail, Heavenly
  - **Largest ski resort in Australia** with Perisher
- **Fully integrated and proven business model**
  - Geographically diverse
  - Economies of scale
  - Excellent product

# Recent Awards & Recognition

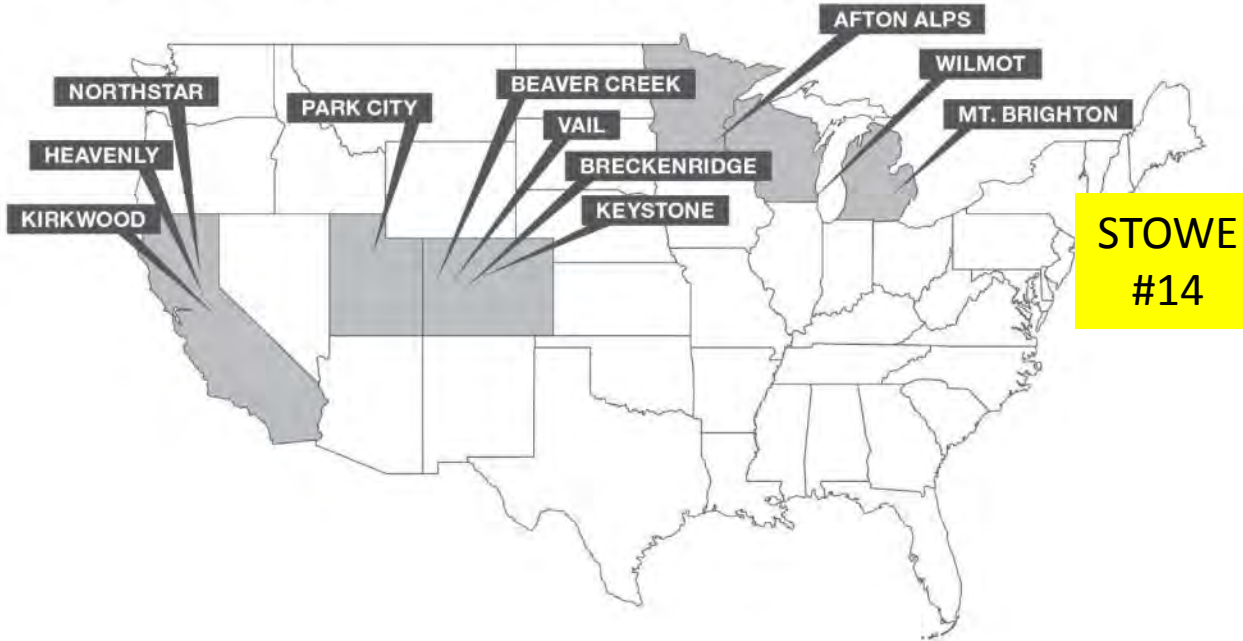
- ***Fast Company***: 50 Most Innovative Companies
- ***Travel and Leisure Magazine***: Global Vision Award for social responsibility
- ***Conde Nast Traveler Magazine***: “World Saver” for leadership in environmental protection
- ***Forbes Best Employers***: Top 25% of employers based on employee survey
- ***Harvard Business Review***: “Vail Resorts recognizes that cultivating joy among employees helps customers have fun too...”



# Vail Resorts Network

## UNITED STATES

TAHOE      UTAH      COLORADO      MIDWEST



## INTERNATIONAL

CANADA



AUSTRALIA



LIFT TICKET — LODGING — SKI SCHOOL — DINING — RETAIL — URBAN — REAL ESTATE

**VAIL RESORTS**

VAIL | BEAVER CREEK | BRECKENRIDGE | KEYSTONE | PARK CITY | HEAVENLY  
NORTHSTAR | KIRKWOOD | WILMOT | AFTON ALPS | MT. BRIGHTON | PERISHER

# Stowe Mountain Resort



VAIL RESORTS

VAIL | BEAVER CREEK | BRECKENRIDGE | KEYSTONE | PARK CITY | HEAVENLY  
NORTHSTAR | KIRKWOOD | WILMOT | AFTON ALPS | MT. BRIGHTON | PERISHER

# Adapting Recreation to a Changing Climate



**Nancy Brunswick**

**USFS Intermountain Region**

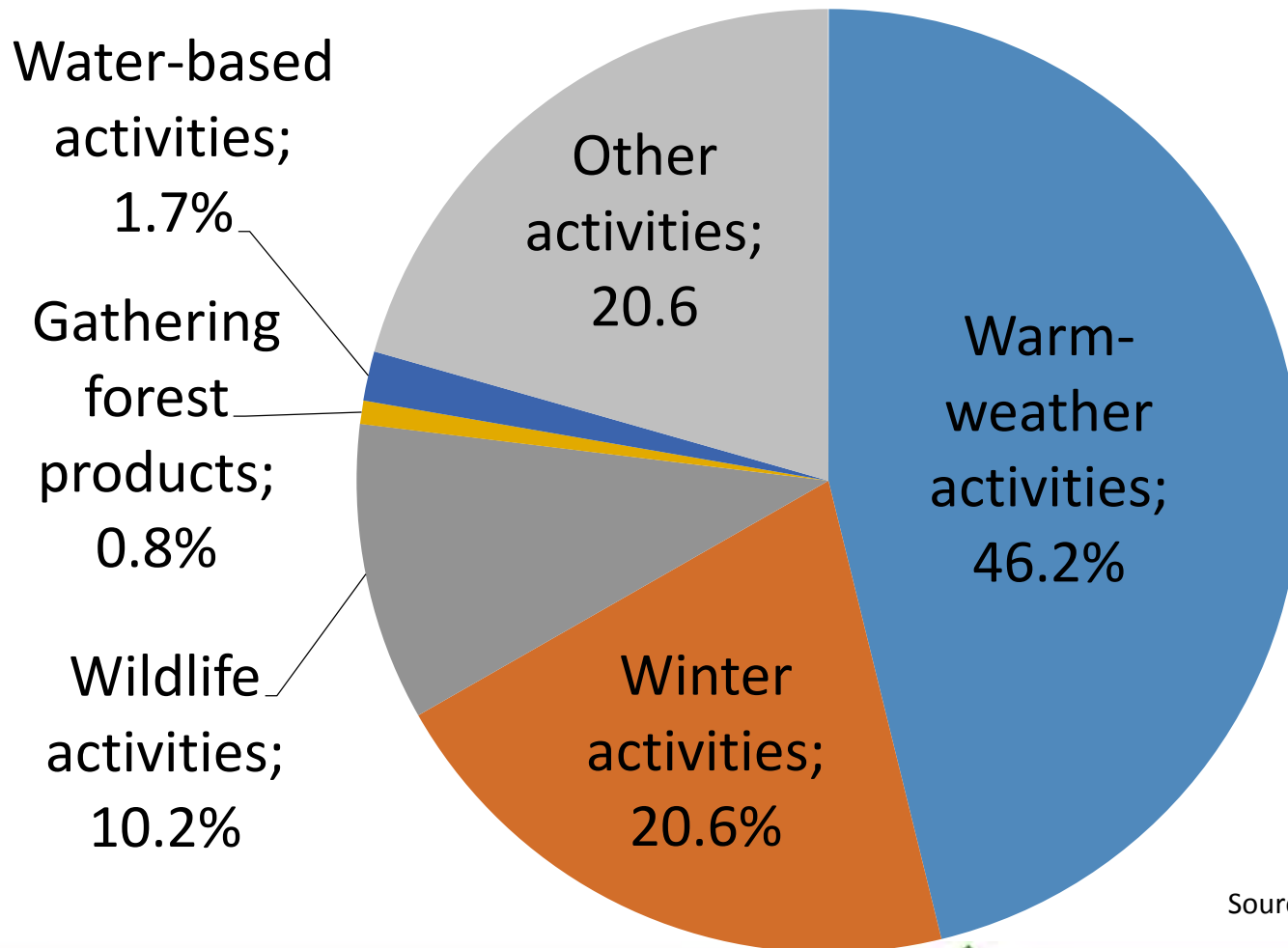


# Recreation in the Intermountain Region

- Round 3 of the National Visitor Use Monitoring Survey estimates that there were 17,174,000 annual recreation visits to the R4 Forests.
- The Outdoor Industry Association estimates that \$38 billion in direct yearly spending to support outdoor recreation in the four R4 states, supporting nearly 397,000 jobs.



# Recreation Activities in R4



Source: USDA FS (n.d.)



# Adapting to change

## Warm-weather activities



# Warm-weather activities

- **Challenges:**

- Warmer and drier weather patterns at lower elevations often leads to increased visitation at higher elevations
- When recreationists are generally from the local area, even greater variation based on weather.
- Increased use could lead to conflicts between types of uses.
- Use restrictions based on road and trail conditions may be incompatible in drier and warmer spring and fall seasons.

# Warm-weather activities

- **Adaptation strategies:**

- Use predictive modeling that incorporates changing climate conditions to develop recreation plans
- Track trends through surveys such as the National Visitor Use Monitoring survey (NVUM)
- Provide information about changing recreation opportunities, and the impacts from climate change.
- Consider if flexibility based on dry conditions can be incorporated into travel management decisions.

# Developed Facilities Management

- **Shoulder seasons:**

- Forests are already experiencing spring and fall shoulder seasons that are beginning earlier, lasting later, and experiencing increased visitor demand for warm weather activities.

- **Challenges:**

- Difficult to predict suitable opening and closing dates
- Seasonal work force is not in place to manage recreation sites
- Sites with flush toilets can not be opened due to freezing concerns
- Contracts for dumpsters not active
- REA fees cannot be adjusted for reduced services

# Developed Facilities Management

- **Adaptation Strategies**

- **Explore creative staffing and partnership opportunities.**

- Develop partnerships with local governments, other agencies, tribes or other user or volunteer groups to help manage sites in shoulder seasons.
- Use fire crews or other employees for site management that are traditionally in other roles.
- Provide temporary trash containers and trash collection until dumpsters contracts begin.
- Invest in one or two vault toilets for key sites with flush toilets.

## Developed Facilities Management

- **Considerations for Concession operated sites**
  - Shoulder season management is often optional in prospectuses.
  - Conflict with concessionaires if FS wants to open a facility before the concession permit specifies site opening.
- **Adaptation Strategies:**
  - Include requirements for shoulder season management in the prospectus.
  - Provide provisions in the prospectus for Forest Service management during shoulder seasons.

# Adapting to change: Snow-based winter activities



# Snow-based winter activities

- **Ski areas:**

- Ski season more variable, may have years when the resort has less terrain available.
- Greater temperature variability increases avalanche danger and rain on snow events.
- Greatest impact to “mom and pop” smaller resorts – fewer resources to utilize improved snowmaking technologies and four season opportunities

- **Adaptation strategies:**

- Recognize the need for four season opportunities in operating plans.
- Partner with ski areas to integrate their opportunities into Forest recreation master plans.
- When evaluating water resources, consider the needs and impacts from snow making.



# Snow-based winter activities

- **Trail based activities (snowmobiling, cross country skiing, etc.):**
  - Snow base appropriate to the various activities may have a shorter season, or occur at higher elevations.
  - When this occurs, developed trailheads and staging areas may be located at lower elevations with no access to snow.
  - Damage can occur to trails and vehicles without sufficient snow depth
  - Snowplowing contracts and agreements may not be sufficient to reach higher elevations

# Snow-based winter activities

- **Adaptation strategies:**
  - Analyze location of trailheads and staging areas, locate alternative temporary or permanent parking areas at higher elevations
  - Identify potential partnerships and grant opportunities for multiple use trailheads at higher elevations that can serve needs for both winter and summer use
  - Work with partners and volunteers to monitor snow conditions, and post information about suitable locations for snowmobiling and other snow based activities
  - Identify funding opportunities or partnerships for increased plowing.

# Wildlife-related activities



# Wildlife-related activities

- **Need for close coordination with the state agencies that manage hunting and fishing.**
- **Challenges:**
  - **Hunting and fishing patterns may change in response to decreases and increases of wildlife and fish populations and their location.**
- **Adaptation strategies:**
  - **Provide responsive information on the impacts of the changing climate and camping availability.**
  - **Flexibility in moving recreation patrols.**
  - **Working with partners to share information.**
  - **Encourage wildlife viewing and bird watching opportunities.**



# Adapting to change: Water-based activities



# Water-based activities

- **Challenges:**

- During periods of warmer and drier weather, popularity of water based recreation increases.
- Lakes and streams may become less accessible due to dropping water levels, reduced water quality, toxic algal blooms, etc. Impacts to marinas, boat ramps, etc.

- **Adaptation Strategies:**

- Plan for management strategies needed for increased use.
- Develop a communication plan for sharing information about water levels and quality
- Analyze developed recreation facilities and identify impacts from dropping water levels. Explore solutions for extending boat ramps, fishing piers, and beach access.



# Large Wildfires & Forest Insect and Disease Epidemics



# Large Wildfires & Forest Insect and Disease Epidemics

- **Challenges:**

- During or after an event use may increase due to media attention
- Access reduced due to hazard trees or flooding events
- With declining budgets, often difficult to respond to damaged or destroyed infrastructure
- Long term, there is less impact on use in travel activities, such as trail use, but may be displacement where people spend an extended period of time such as campgrounds.

# Expected effects: Large Wildfires & Forest Insect and Disease Epidemics

- **Adaptation Strategies**
  - Develop a communication plan to communicate closures, impacts and detours.
  - In developed sites incorporate a vegetation management plan that includes planting new trees and using methods that promote success in high use areas (planting more mature trees, temporary watering systems, etc.)
  - Have a hazard tree plan for developed recreation site.

# What we learned in 2014-15 (the winter without snow)

## Recreationists are highly adaptable

- They found snow
- They switched to summer activities

## Capacity of agencies to adapt was minimal

- But they understand how climate affects recreation patterns
- They have ideas for adapting to a warmer climate in the future





*Southern Idaho*



*Utah*



*Western Wyoming*

# Thank you

**Nancy Brunswick**  
**[nbrunswick@fs.fed.us](mailto:nbrunswick@fs.fed.us)**



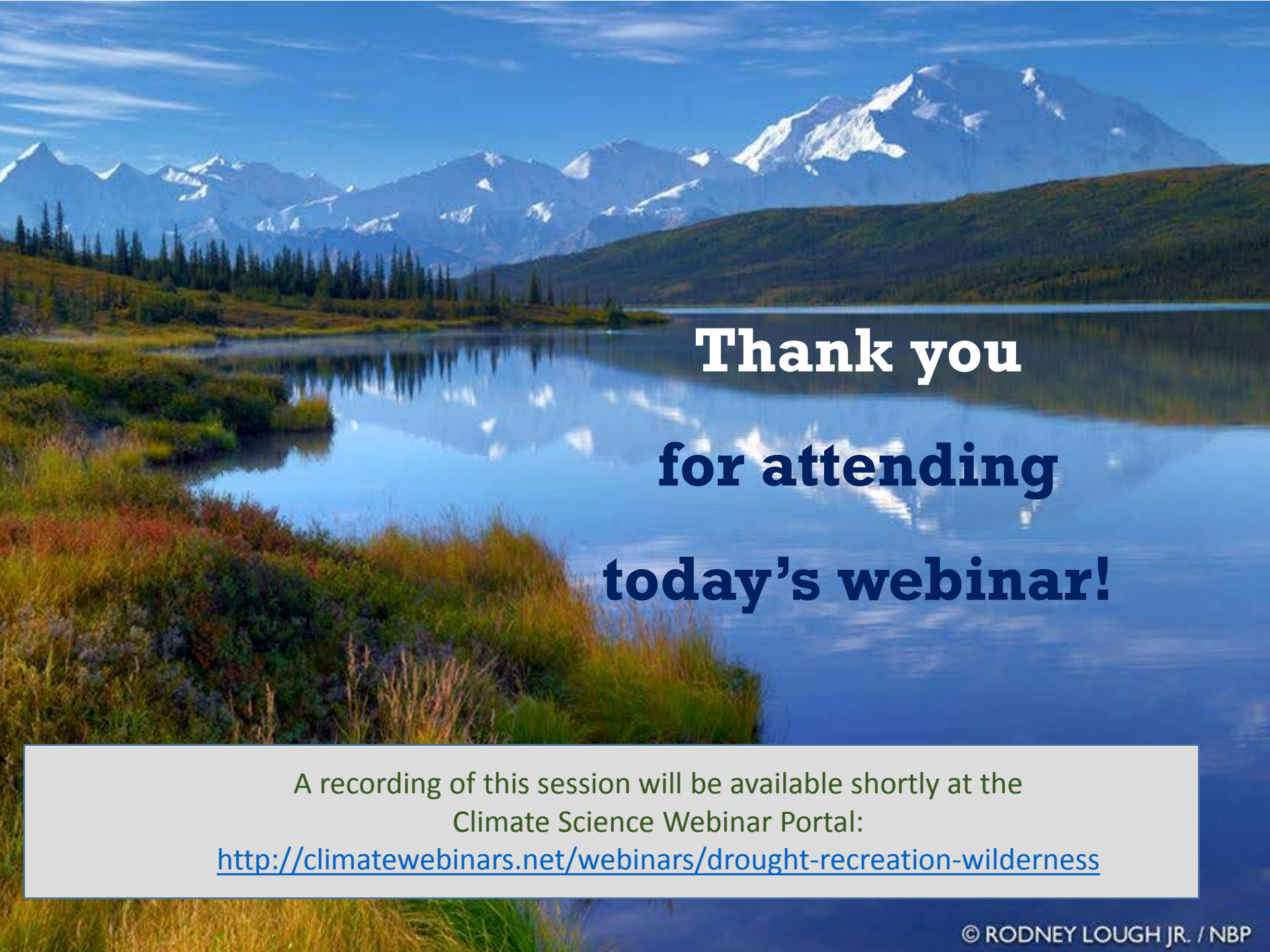
*Nevada*





## Questions & Answers

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Climate Science Webinar Portal:

<http://climatewebinars.net/webinars/drought-recreation-wilderness>