

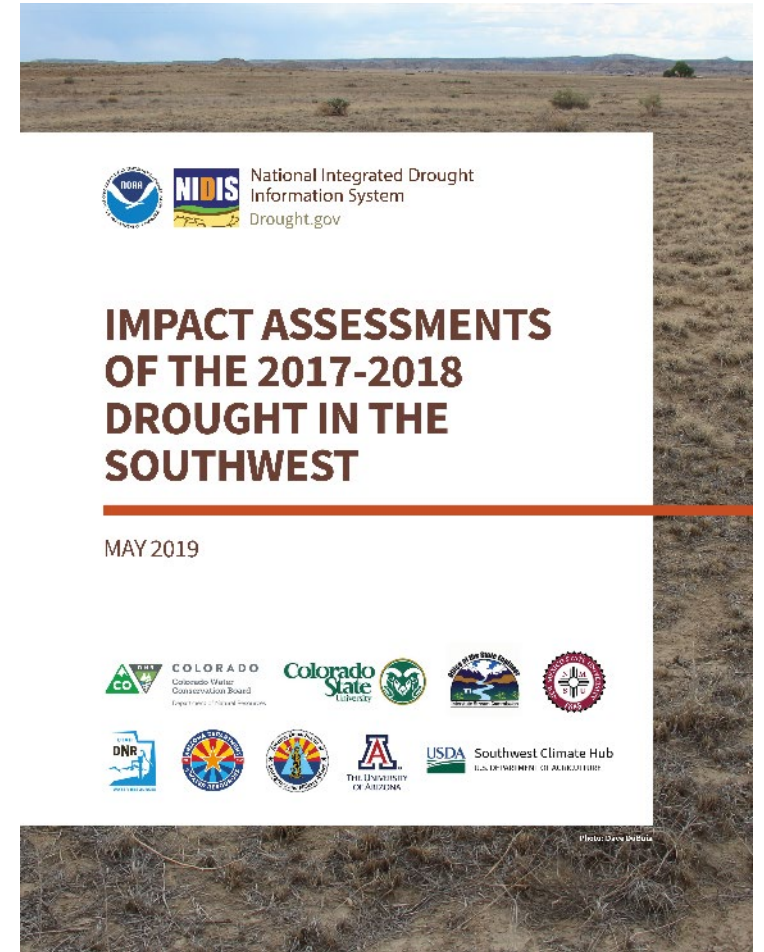
# Effects of Reservoir Levels on Arizona National Recreation Area Visitation, Visitor Spending, and Local Economies

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# Drought Impact Assessment

- Multi-state project assessing economic impacts of drought in Southwest
- AZ portion examined impact of drought on agriculture (crop indemnity payments), forage impacts (livestock disaster payments), outdoor recreation & tourism, & wildland fire



# Effects of Reservoir Levels on Visits, Visitor Spending, & Local Economies

## Previous SSD studies:

- Considered allocation across different uses in basin (ag, municipal, hydropower, recreation)
- Estimated benefits/damages to user groups of alternative policies (Booker, 1995; Booker & Colby, 1995)

## This analysis:

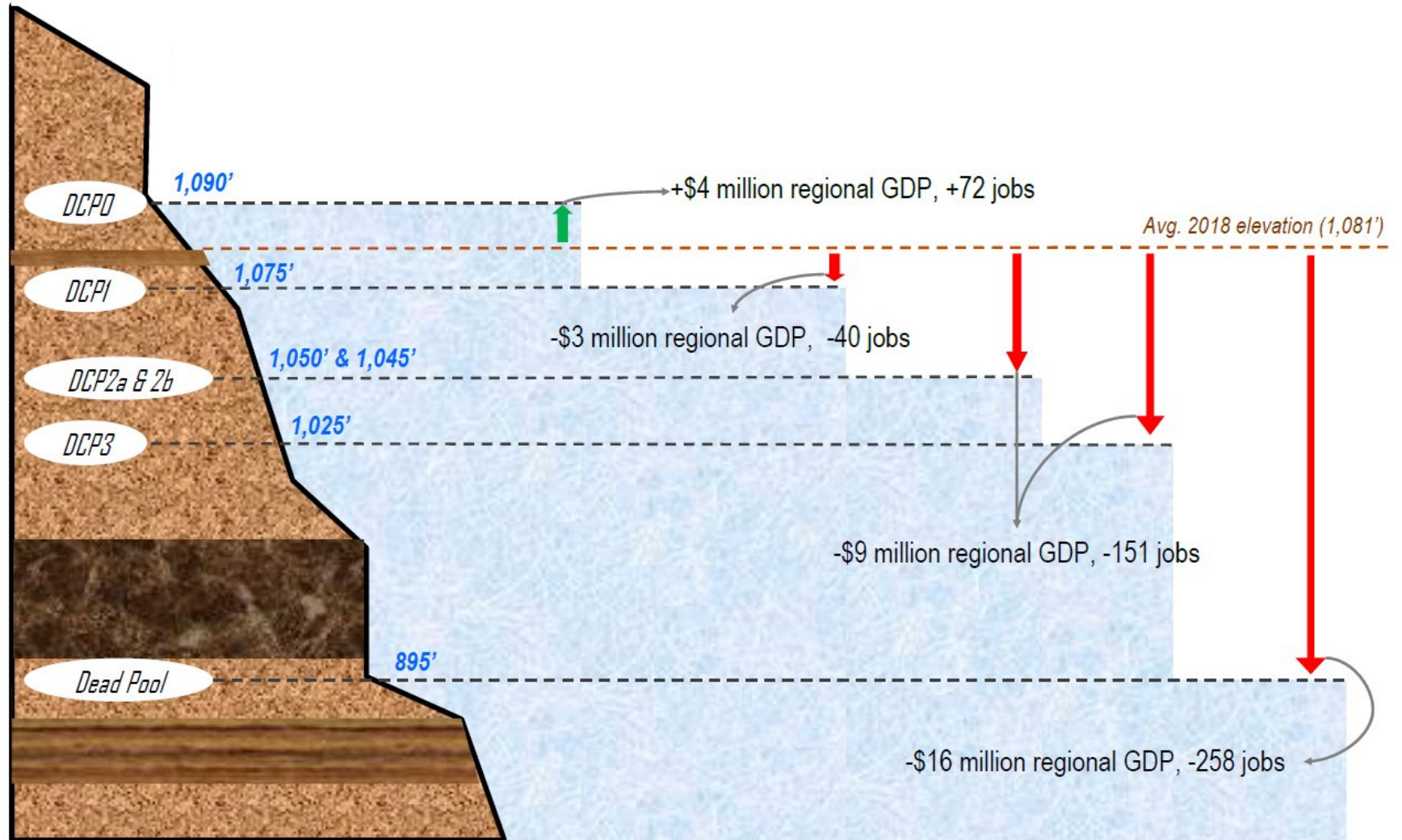
- Estimates effects of changes in reservoir levels on monthly recreation & overnight visits to Lake Mead & Lake Powell from 1979-2018
- Estimates user benefit impacts & regional economic impacts



# FINDINGS

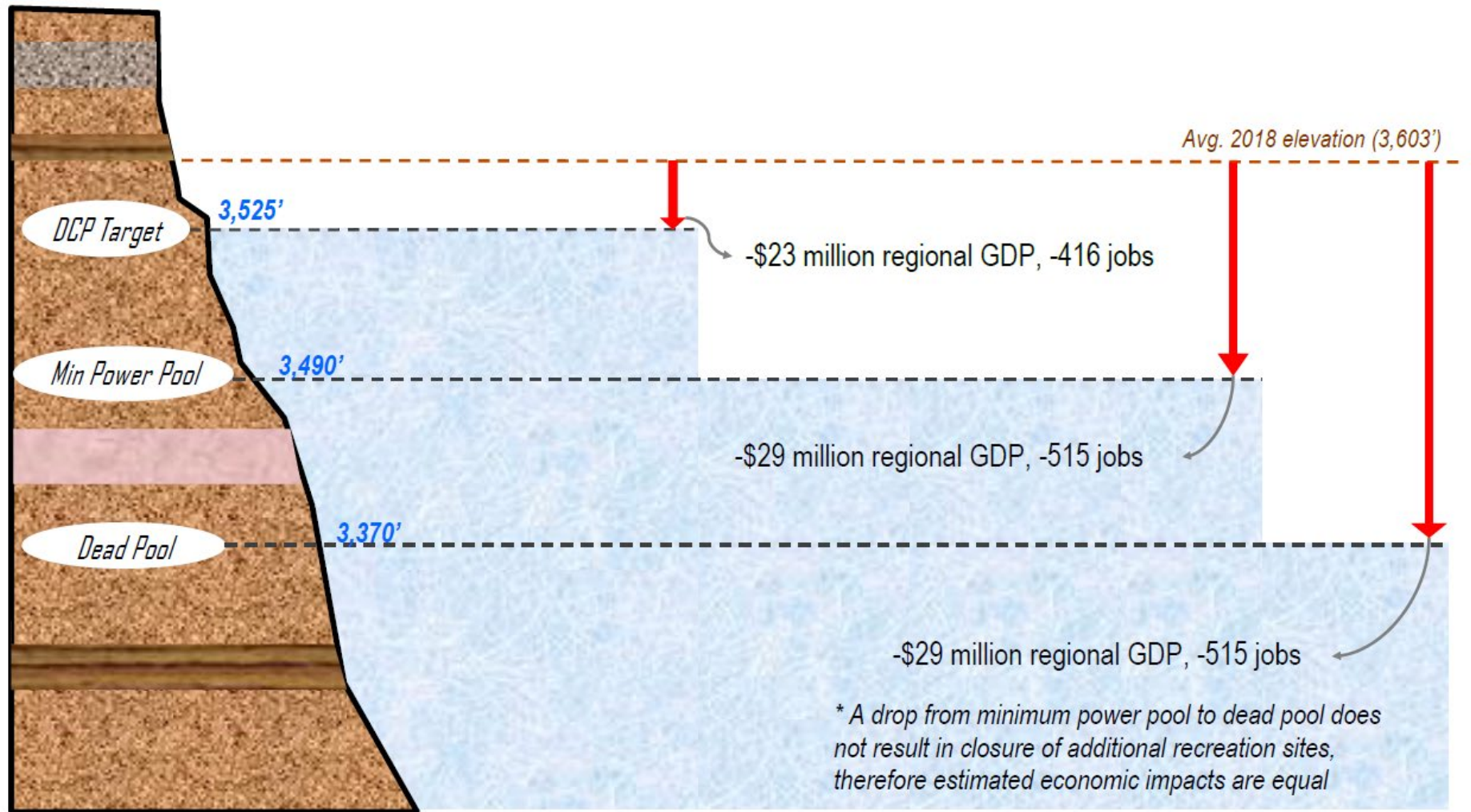
## Estimated Regional Economic Impacts

### Lake Mead



# FINDINGS

## Estimated Regional Economic Impacts Lake Powell



# Findings: User Benefit Impacts

Changes in visitor spending, value added, and user benefits with reductions in reservoir elevations below the 2018 baseline.

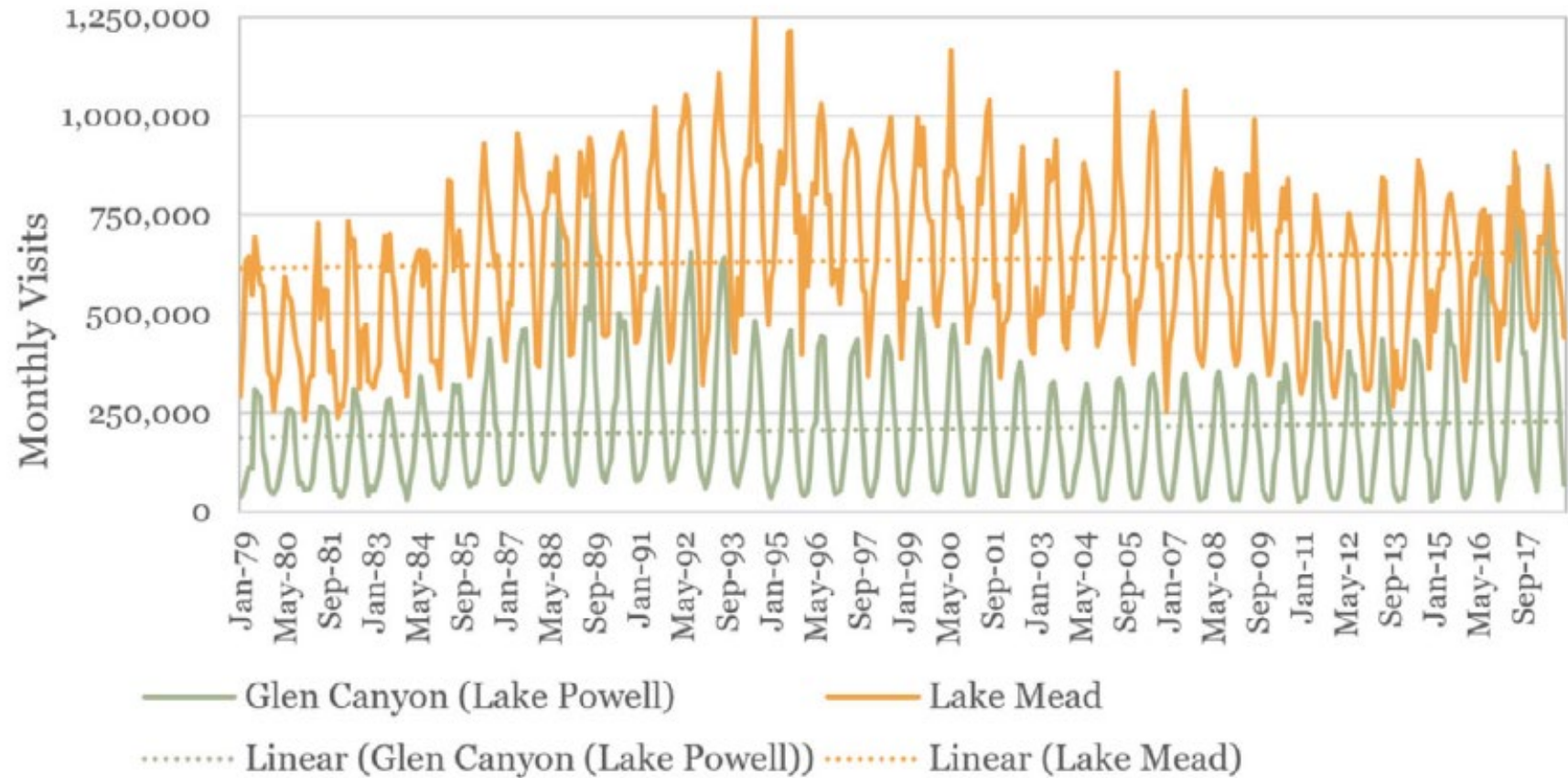
Elevation, ft	DCP threshold	Visitor spending change Local value added change <sup>1</sup> Millions of 2019 constant dollars	Estimated change in user benefits				
			Low	Middle	High	Very high	
Lake Mead							
1,081	Predicted 2018 visits						
1,075	DCP Tier 1 threshold	-3.4	-2.5	-4.5	-5.8	-8.6	
1,050	DCP Tier 2a threshold	-12.7	-9.3	-17.1	-22.0	-32.9	
Lake Powell							
3,603	Predicted 2018 visits						
3,525	DCP target elevation	-34.0	-23.1	-11.8	-21.0	-31.3	-67.3
3,490	Minimum power pool	-42.1	-28.6	-14.6	-26.1	-39.0	-83.6

<sup>1</sup>Estimates of the changes in local value added include multiplier effects.

*\*\*Using benefits transfer method*

# Recreation Visits (1979-2018)

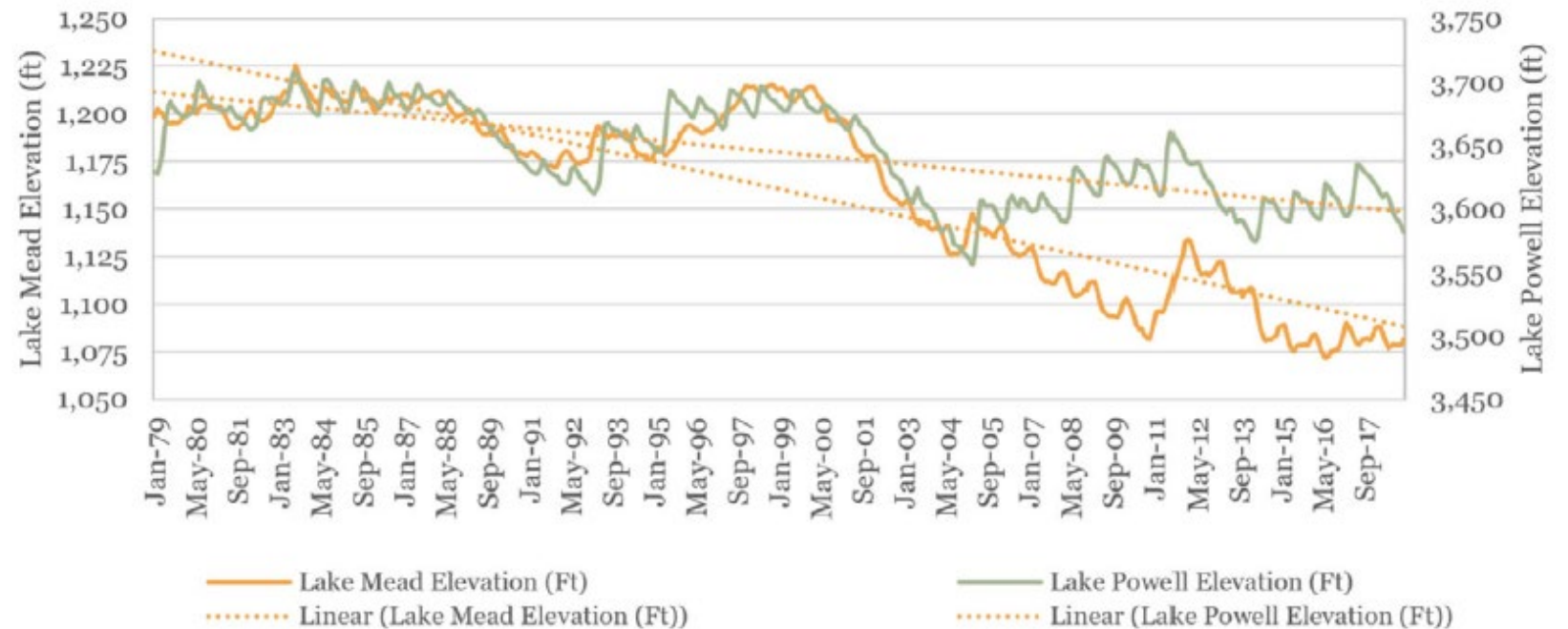
Monthly recreation visits to Glen Canyon NRA (Lake Powell) & Lake Mead NRA, with linear trend lines, 1979-2018. Source: National Park Service



# Reservoir Levels (1979-2018)

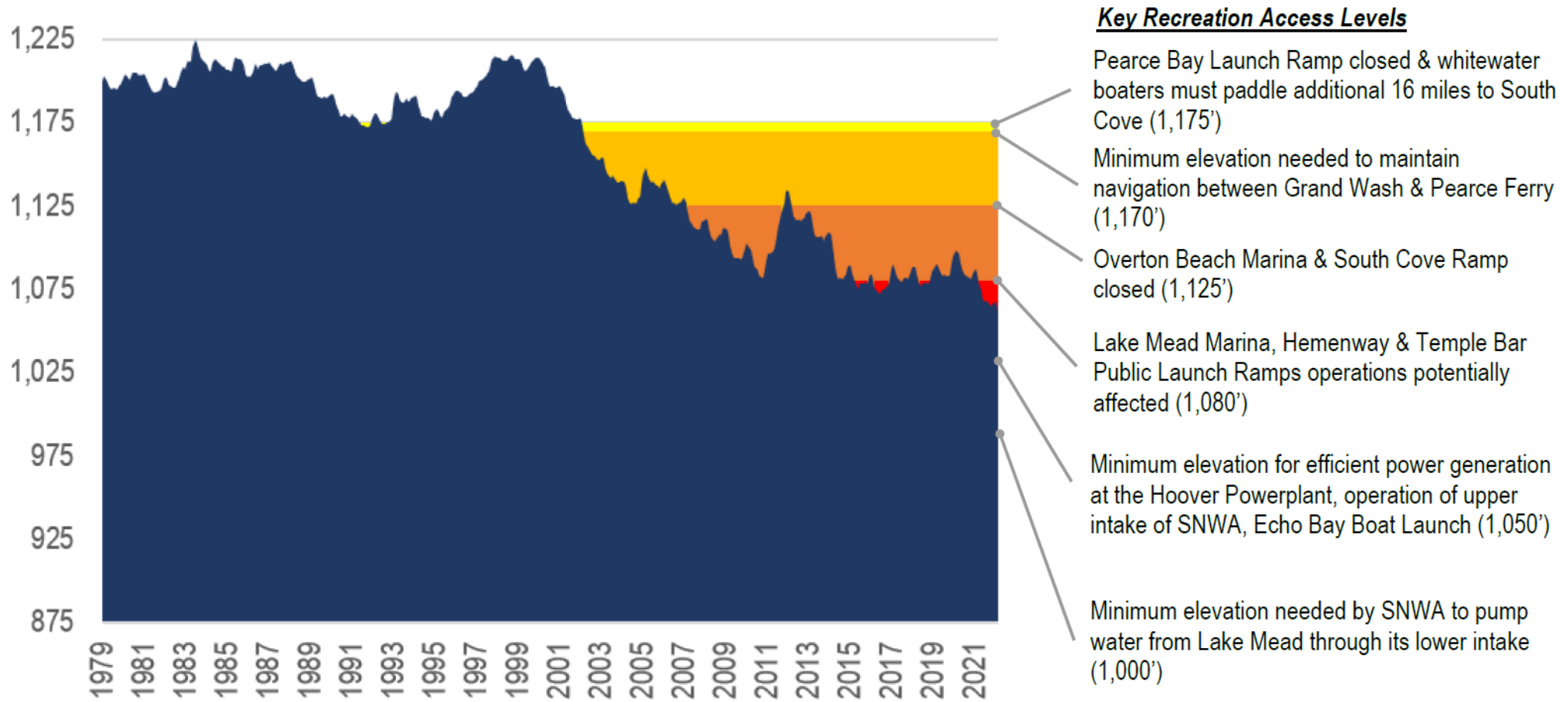
Study examines reservoir elevation & number of key recreation access levels inaccessible due to reservoir levels (marinas, boat ramps, etc.) as explanatory variables

Average monthly water level elevation for Lakes Mead & Powell, 1979–2018, with linear trend lines. Source: USBR.

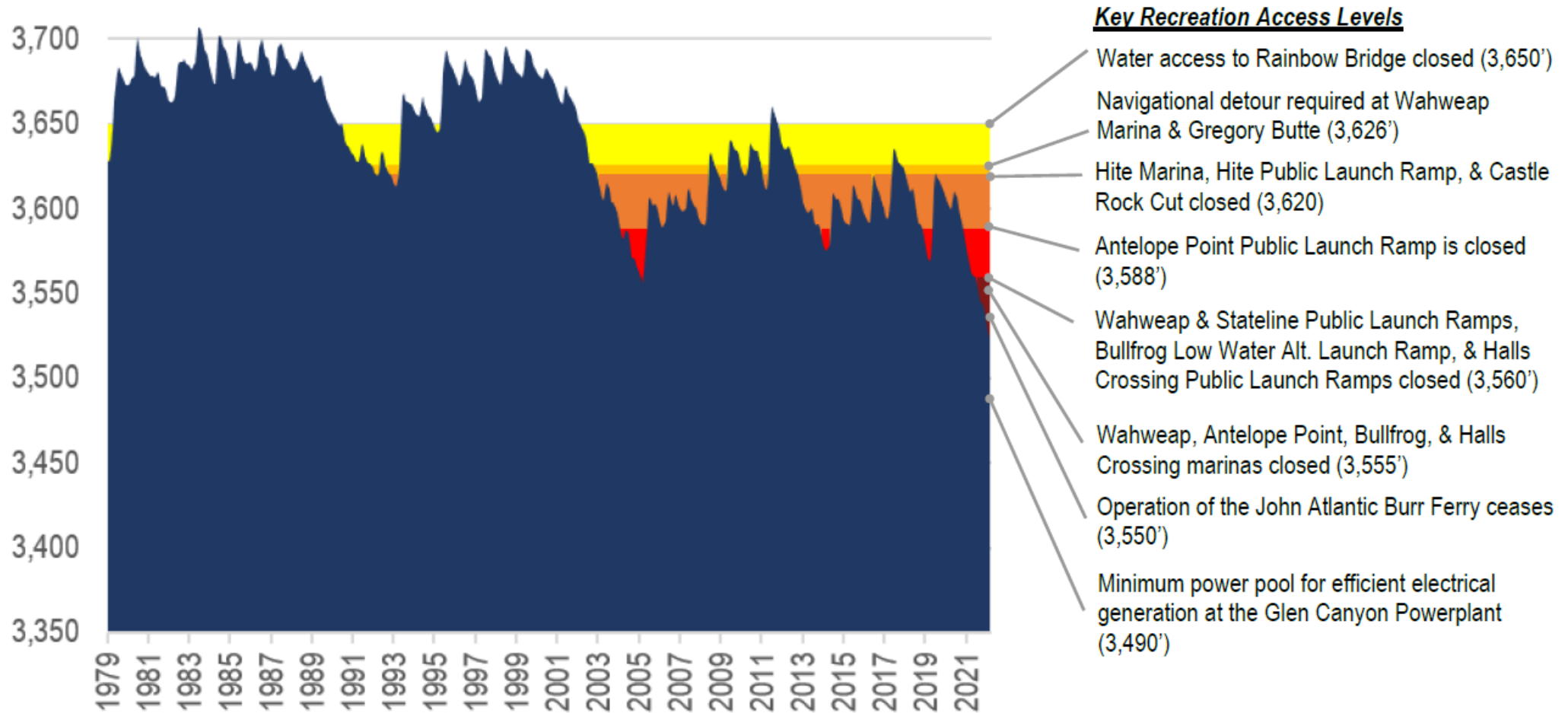




## Lake Mead Monthly Surface Elevation 1979-2021 & Key Recreation Access Levels



## Lake Powell Monthly Surface Elevation 1979-2021 & Key Recreation Access Levels



# Results – Recreation Visits

Total recreation visitor model results (dependent variable: log of total recreation visitors).

	Lake Powell		Lake Mead	
Log reservoir elevation	2.774 (1.443)*	—	0.375 (0.367)	—
Recreation access points closed	—	-0.018 (0.010)*	—	-0.024 (0.010)**
12-Month lag log visitors	0.753 (0.038)***	0.747 (0.038)***	0.416 (0.040)***	0.400 (0.041)***
SPI (one-month)	-0.007 (0.011)	-0.006 (0.011)	-0.002 (0.007)	-0.001 (0.007)
Average monthly temperature	0.017 (0.009)**	0.018 (0.009)**	0.039 (0.008)***	0.039 (0.008)***
Average monthly temperature squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)***	0.000 (0.000)***
Spring month dummy	0.092 (0.059)	0.094 (0.059)	0.088 (0.029)***	0.092 (0.029)***
Summer month dummy	0.089 (0.069)	0.095 (0.069)	0.065 (0.036)*	0.068 (0.036)*
Fall month dummy	0.051 (0.062)	0.052 (0.062)	-0.023 (0.027)	-0.022 (0.027)
Log population	0.108 (0.085)	0.091 (0.083)	0.313 (0.083)***	0.398 (0.084)***
Unemployment rate, West	-0.010 (0.006)	-0.011 (0.006)*	-0.001 (0.004)	0.000 (0.004)
Log gas price, West	-0.091 (0.045)**	-0.094 (0.044)**	-0.372 (0.037)***	-0.351 (0.037)***
Post 9–11 dummy	-0.179 (0.025)***	-0.186 (0.025)***	-0.177 (0.031)***	-0.173 (0.031)***
Federal government shutdown dummy	-0.406 (0.105)***	-0.401 (0.108)***	-0.274 (0.147)*	-0.279 (0.147)*
Constant	-22.061 (12.787)*	1.037 (1.326)	-1.181 (3.758)	0.272 (1.230)
$R^2$	0.9443	0.9443	0.8624	0.8636

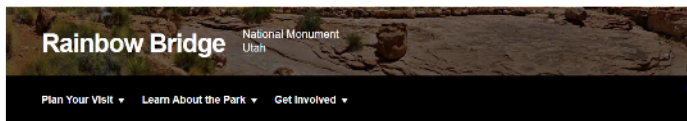
Note: Statistically significant at the: \*10% level; \*\*5% level; \*\*\*1% level.

# Results – Overnight Visits

Overnight visitor model results (dependent variable: log of overnight visitors).

	Lake Powell		Lake Mead	
Log reservoir elevation	2.744 (2.147)	—	0.758 (0.429)*	—
Recreation access points closed	—	-0.031 (0.014)**	—	-0.025 (0.012)**
12-Month lag log visitors	0.683 (0.041)***	0.674 (0.040)	0.703 (0.033)***	0.699 (0.033)***
SPI (one-month)	-0.020 (0.018)	-0.017 (0.018)	-0.009 (0.006)	-0.009 (0.006)
Average monthly temperature	0.029 (0.014)**	0.030 (0.014)**	0.026 (0.008)***	0.027 (0.008)***
Average monthly temperature squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)***	0.000 (0.000)***
Spring month dummy	0.283 (0.080)***	0.292 (0.079)***	0.033 (0.030)	0.034 (0.030)
Summer month dummy	0.204 (0.097)**	0.213 (0.098)**	0.053 (0.039)	0.055 (0.039)
Fall month dummy	0.281 (0.084)***	0.287 (0.084)***	-0.006 (0.029)	-0.004 (0.029)
Log population	-0.326 (0.128)**	-0.290 (0.119)**	-0.346 (0.080)***	-0.340 (0.076)***
Unemployment rate, West	0.019 (0.010)*	0.017 (0.010)*	0.009 (0.004)	0.009 (0.004)**
Log gas price, West	-0.141 (0.070)**	-0.127 (0.070)*	-0.144 (0.034)***	-0.134 (0.036)***
Post 9–11 dummy	-0.161 (0.052)***	-0.169 (0.053)***	-0.022 (0.035)	-0.016 (0.035)
Federal government shutdown dummy	-0.105 (0.039)***	-0.100 (0.041)**	-0.401 (0.076)***	-0.407 (0.076)***
Constant	-15.589 (19.027)	6.439 (1.887)***	2.913 (4.033)	8.230 (1.350)***
$R^2$	0.9653	0.9655	0.8972	0.8974

Note: Statistically significant at the: \*10% level; \*\*5% level; \*\*\*1% level.



## Rainbow Bridge

National Monument  
Utah

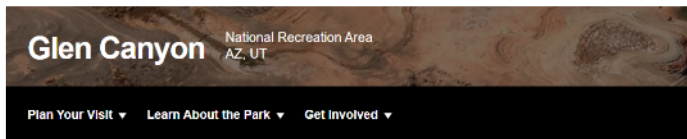
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### ALERTS IN EFFECT

#### PARK CLOSURES

- No dock access to Rainbow Bridge Trail**  
No dock access to the shoreline at Rainbow Bridge due to low water. Boats and small vessels beach at your own risk. There are no services on the dock, which has been moved out of the way.  
[more >](#)

- Dangling Rope Marina Closed Indefinitely**  
Due to significant wind damage and low water conditions, Dangling Rope Marina will not reopen in the immediate future for visitors or employees. There is no estimated date for reopening.  
[more >](#)



## Glen Canyon

National Recreation Area  
AZ, UT

[Plan Your Visit](#) ▾ [Learn About the Park](#) ▾ [Get Involved](#) ▾

### ALERTS IN EFFECT

#### PARK CLOSURES

- Multiple Lake Powell Launch Ramps Closed Due to Low Water**  
Closed to all access: Wahweap Stateline, Wahweap Auxiliary, Bullfrog Main, and Bullfrog Spu Point Public, Wahweap Main.  
[more >](#)
- No Dock Access to Rainbow Bridge**  
The docks/restroom are now upstream, not connected to the Rainbow Bridge trail shoreline. ⚠️ Take sufficient fuel for your vessel to get there and back.

+ [3 more non-emergency alert notifications...](#)



Photo: National Park Service

# Modeling Drought Impacts

- Modeled estimated effects of reservoirs falling to levels outlined in Colorado River Basin Drought Contingency Plan on NRA visitation
- Effects of most declines range in hundreds of thousands of fewer visits annually

Estimated difference in Lake Powell 2018 annual visitation by elevation scenario compared with predicted 2018 visits.

Elevation, ft	Description	Total recreation	Overnight
3,603	Predicted 2018 visits	N/A	N/A
3,525	DCP target elevation	-279,862	-156,036
3,490	Minimum power pool level	-347,813	-192,236
3,370	Dead pool	-347,813	-192,236

Estimated difference in Lake Mead 2018 annual visitation by elevation scenario compared with predicted 2018 visits.

Elevation, ft	Description	Total recreation	Overnight
1,090	DCP Tier 0 threshold	144,955	11,885
1,081	Predicted 2018 visits	N/A	N/A
1,075	DCP Tier 1 threshold	-77,023	-8,069
1,050	DCP Tier 2a threshold	-293,752	-27,537
1,045	DCP Tier 2b threshold	-293,752	-27,537
1,025	DCP Tier 3 threshold	-293,752	-27,537
895	Dead pool	-505,355	-46,531

# Summary

- Cutoff elevations for access to key recreation sites was stronger predictor of visits than reservoir elevation levels
- Lost user benefits & regional economic impacts range into tens of millions of dollars & hundreds of fewer jobs for reservoirs falling to levels associated with Drought Contingency Plan (DCP) thresholds
- Recreation-dependent gateway communities face challenge of adjusting to changing demand as recreation access becomes more limited
- Policies & programs to maintain reservoirs at levels that avoid cutbacks under the DCP have co-benefits via recreation with implications for recreation-dependent gateway communities