

Economic Assessment of Outdoor Water Use Restrictions in South Florida

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GEER Conference (April 22-25, Coral Springs, FL).

Overview

- Background on Outdoor Water Use and Restrictions
- Estimated Outdoor Water Use in South Florida
- Monetary Value of estimated restricted Water
- Study on Valuation of Ecosystem Services
- Outlook



Background: Outdoor Water Use

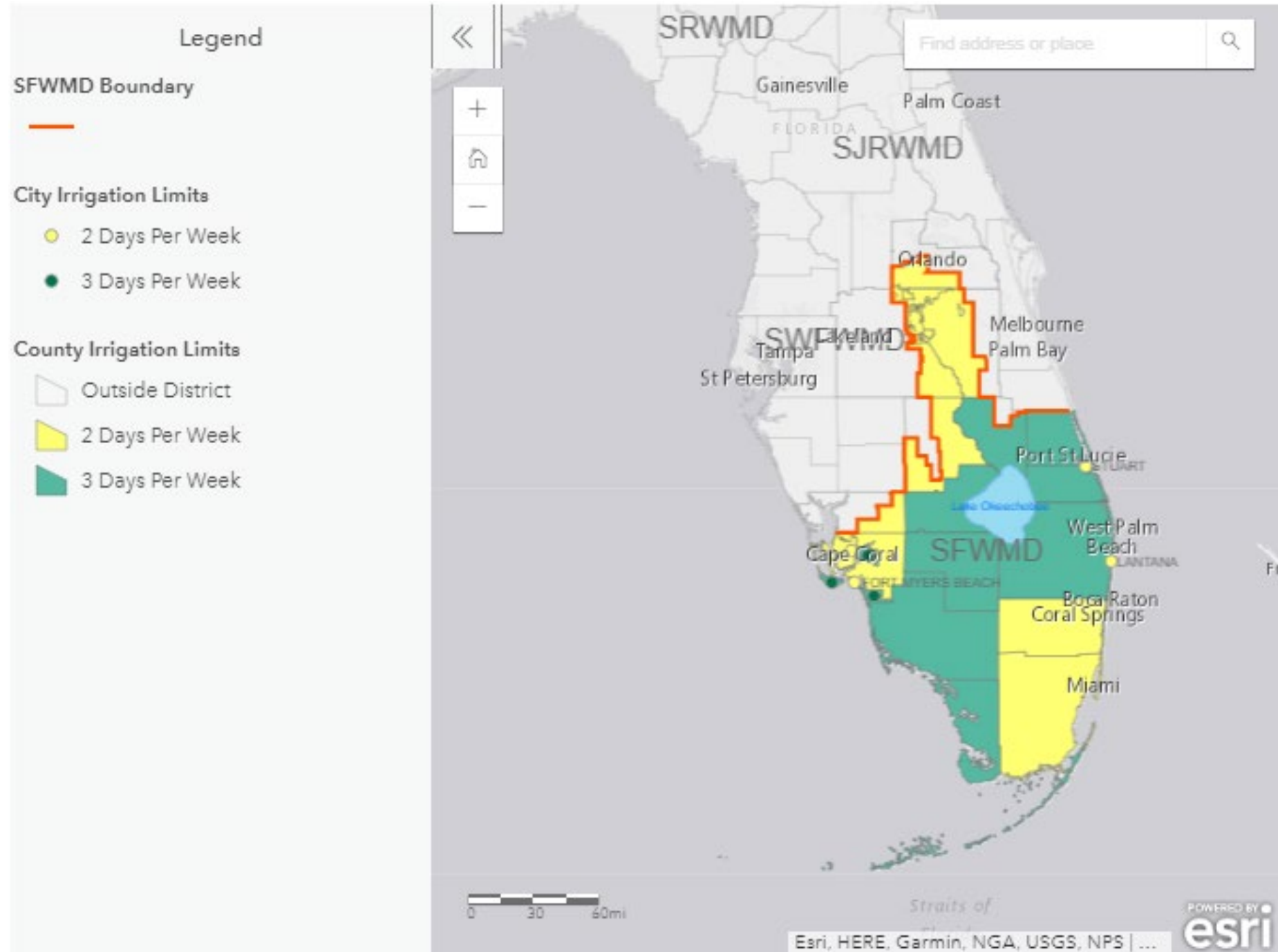
- The average American family uses over 300 gallons of water per day (gpd) (US EPA, 2017)
- About 8.1 million people live in 16 counties rely on public water supply (SFWMD, 2018)
 - A daily consumption of above 2 billion gallons per day
- Growing population in South Florida increases pressure:
 - 10% population increase between 2010 and 2017 (Office of Economic & Demographic Research, 2017)
- 30-50% of total water consumption occurs outdoors (EPA, 2013; SFWMD, 2019; Lee, Tansel & Balbin, 2011)

Outdoor Water Use Restrictions (OWR)

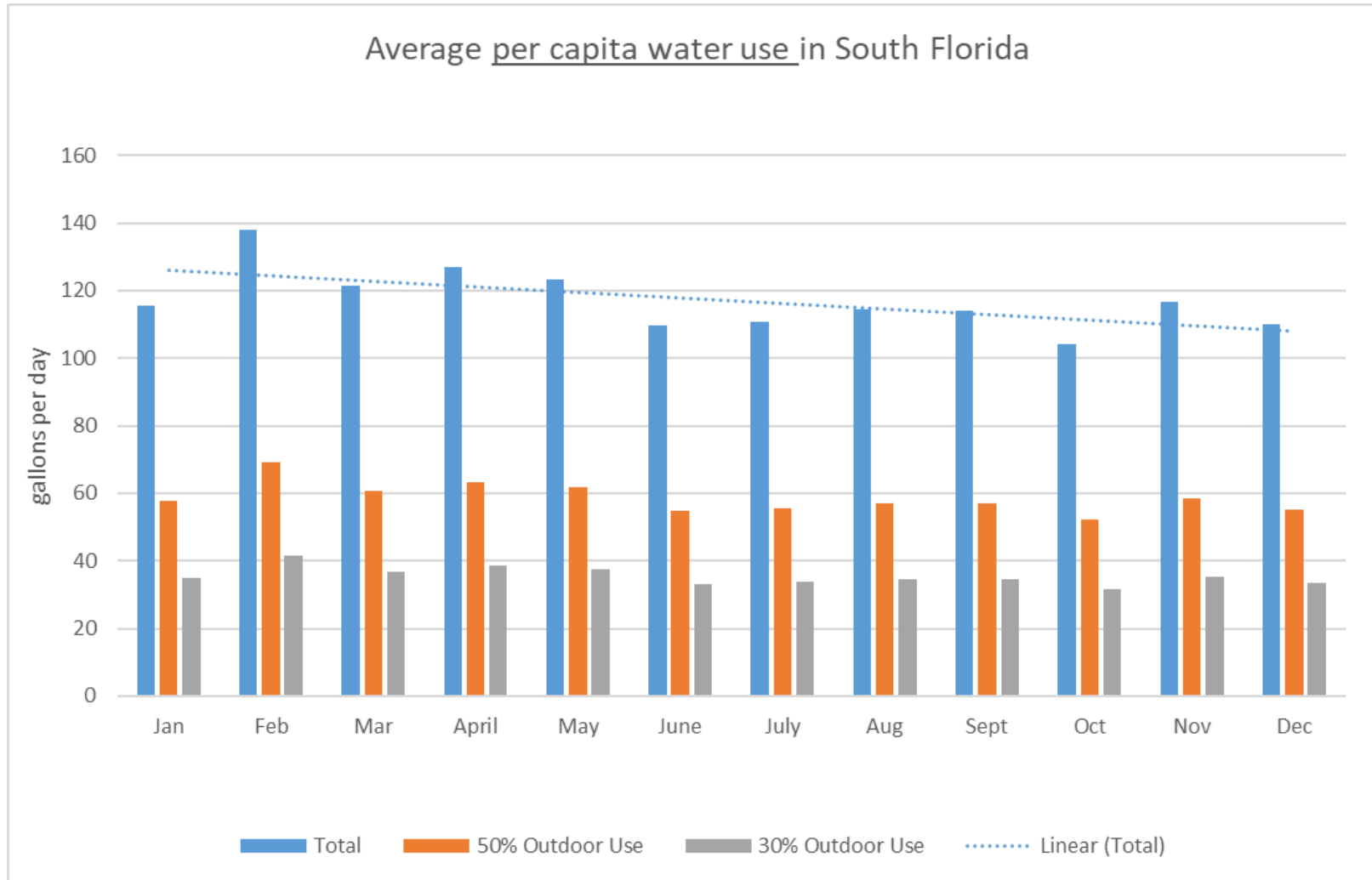
- Common demand-side management policy tool (Survis & Root, 2012)
- 32 U.S. states have policy regulations requiring or recommending Outdoor Water Use Restrictions (Milman & Polsky, 2016)
 - Florida among those with highest number of policies requiring OWR
- Types of Outdoor Water Use Restrictions vary in frequency, time & duration
- Research mainly focused on conservation success
 - Economic effect/efficiency relatively understudied

Outdoor Water Use Restrictions in South Florida

- Year-Round Landscape Irrigation Rule
- In effect since 2010
- Prohibited between 10am and 4pm

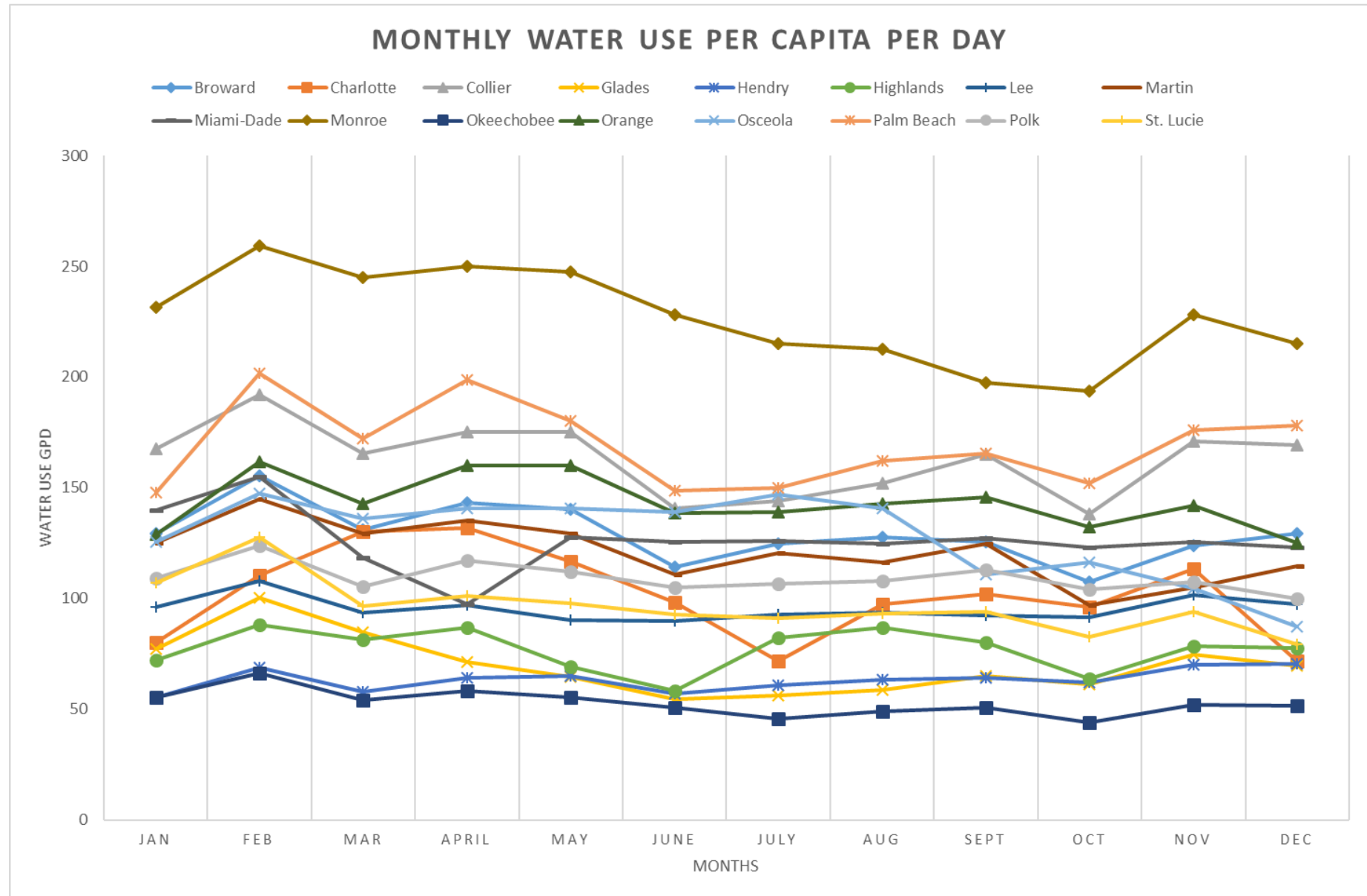


Average monthly total water use, per capita in South Florida



Comparison of per capita total water use in South Florida counties

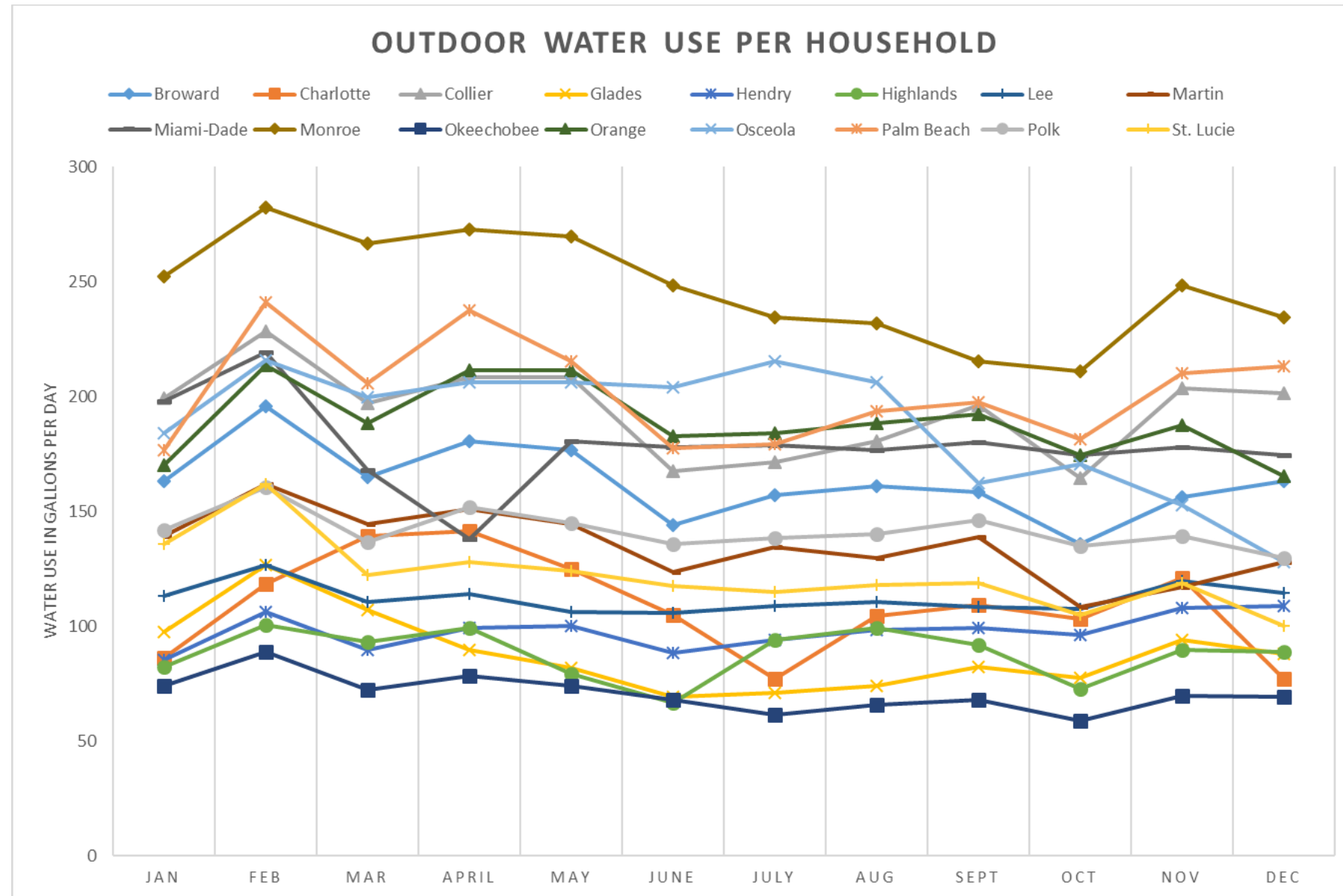
- **Highest** consumption: **Monroe** with average use of 227 gallons per day
- **Lowest** consumption: **Okeechobee** with average use of 53 gallons per day



Based on U.S. Geological Survey, Scientific Investigation Report 2014-5088

Comparison of Household 50% Outdoor Water Use of Counties

- Average family size: **2.5**
- Calculation of outdoor water use: **50%** of total use
- Between \approx **250** gpd (Monroe) and \approx **75** gpd (Okeechobee)



Estimated average additional outdoor water use without restrictions

- Possible additional outdoor water use is estimated based on average current daily outdoor water consumption which is extrapolated to the amount of restricted days
- Example:

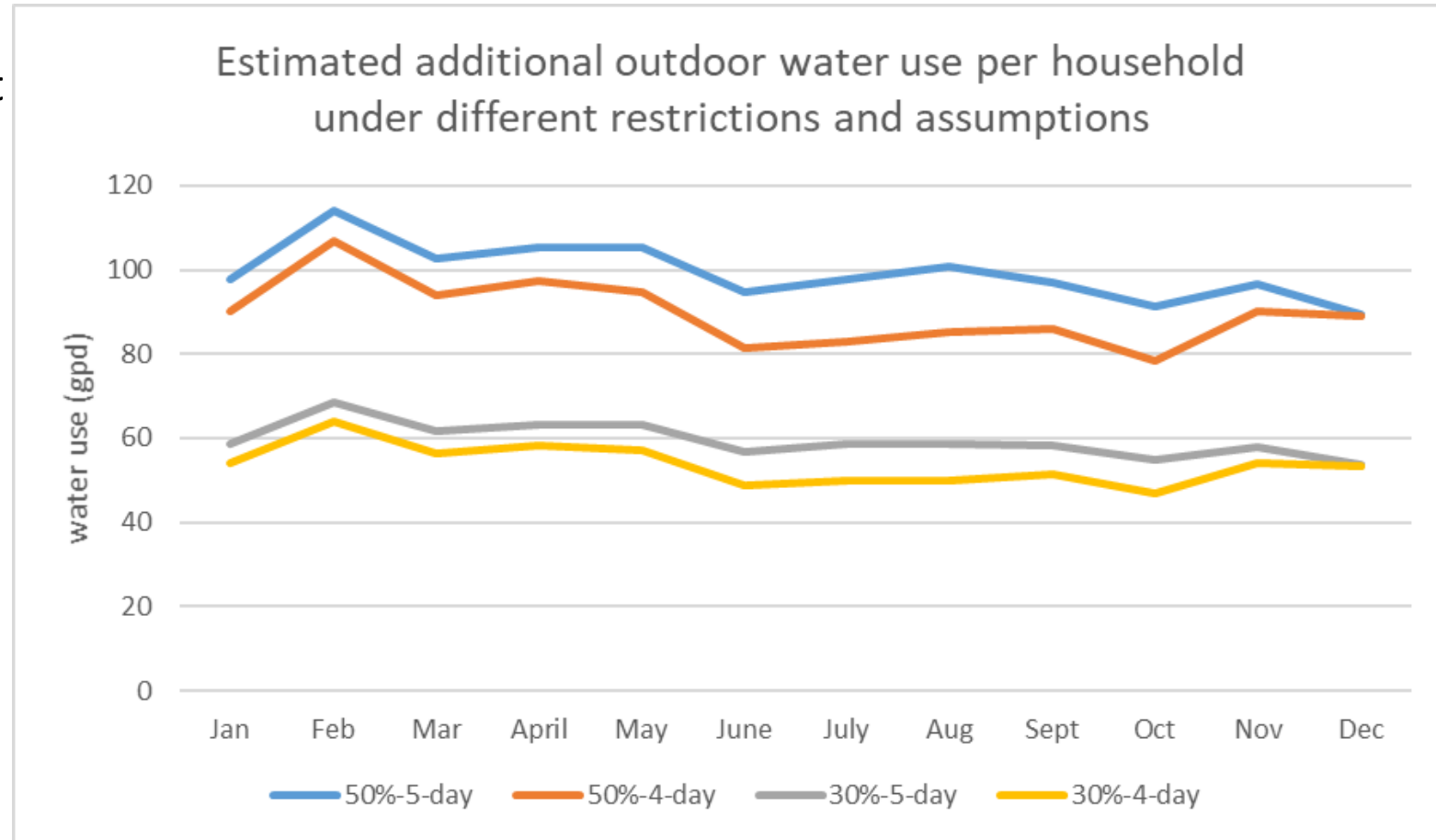
Number of restricted days

Average additional outdoor water use

$$100\text{gpd} * 18 \text{ days} / 30 \text{ days} = 60\text{gpd}$$

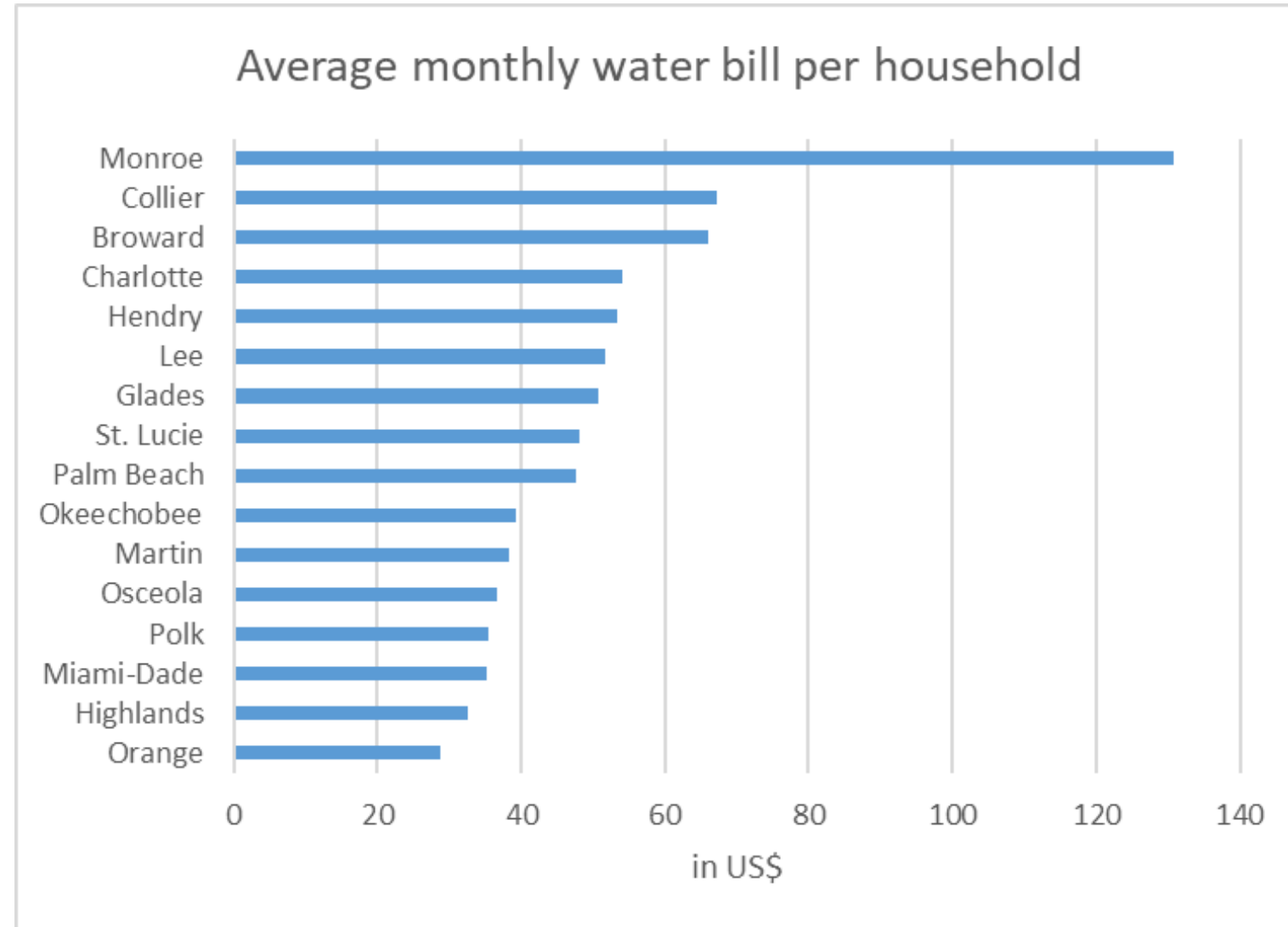
Average outdoor water use

Days in a given month



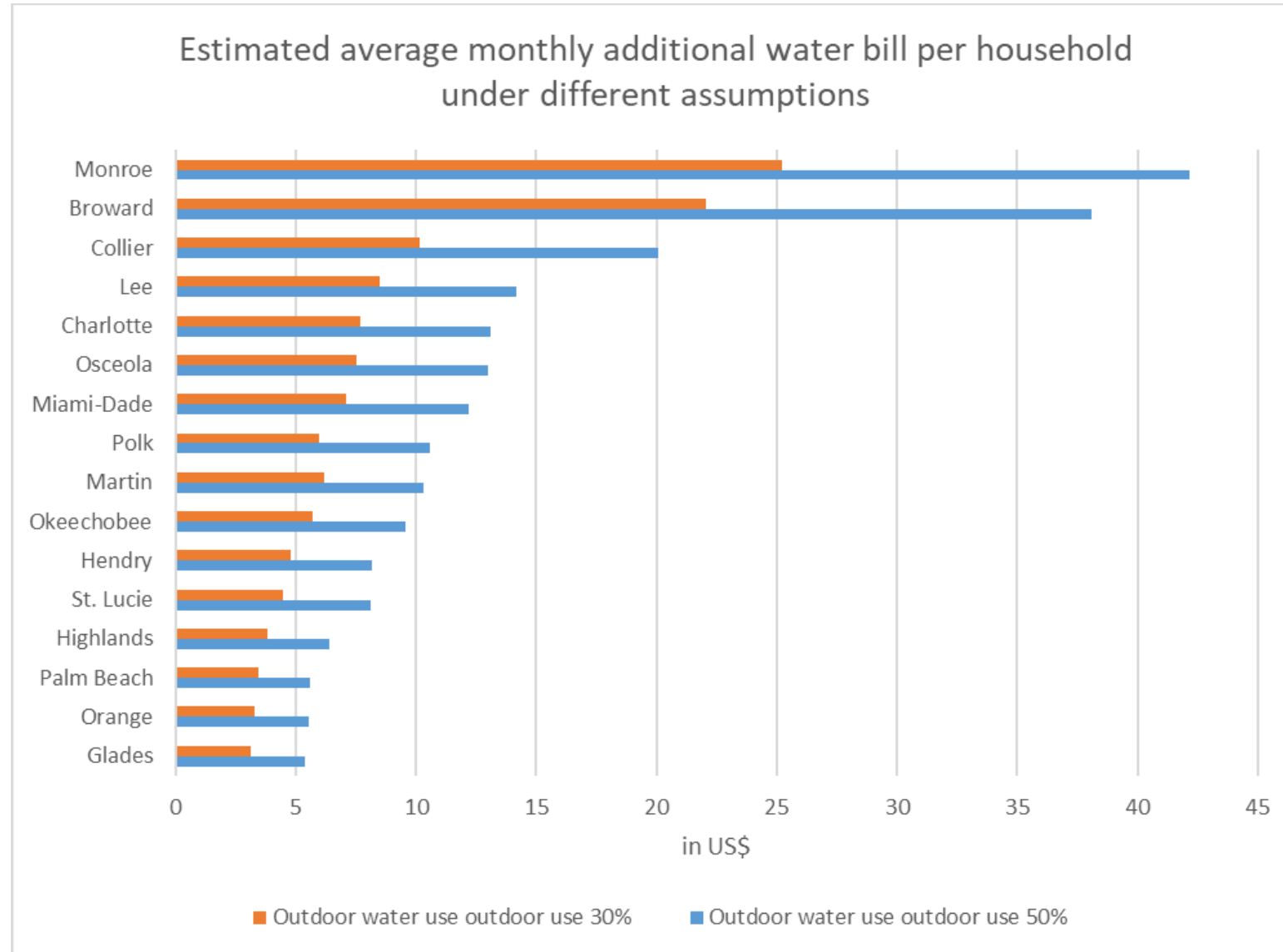
Average monthly water bill per household

- Different price rate structures among and within counties
- Average household water consumption was used to calculate water bill under lowest and highest rate structure for each county, then average was calculated
- Monroe highest water bill with \$130
- Orange and Highlands lowest water bills around \$30









Estimated average additional monthly water bill per household without restrictions

- Monroe and Broward highest additional bill with around \$40/\$25
- Lowest additional bills Glades, Orange and Palm Beach with \$5/\$3



Valuation of Ecosystem Services

- Choice Experiment to understand public preferences for Everglades Ecosystem Service Attributes & associated Trade-offs (work based on several Master Thesis of Nadia Seeteram, Abu HM Sikder, Mehrnoosh Asadi)
- Survey to elicit randomly selected households' preferences (willingness to pay) for management/restoration alternatives accompanied by water restrictions

| Restoration Attributes | Restoration Plan A | Restoration Plan B |
|--|--|--|
|  Lake Okeechobee | 60% of the time, lake levels are similar to historic, pre-drainage conditions | 60% of the time, lake levels are similar to historic, pre-drainage conditions |
|  Water Conservation Area | 50% of the time, water levels are similar to historic, pre-drainage conditions | 75% of the time, water levels are similar to historic, pre-drainage conditions |
|  Everglades National Park | 50% of the time, water levels are similar to historic, pre-drainage conditions | 90% of the time, water levels are similar to historic, pre-drainage conditions |
|  Farmland Acreage | No change in farmland acreage | 100,000 farmland acre reduction |
|  Restrictions on Water Use | 1 days per week outdoor use and 40% reduction in indoor use | 2 day per week outdoor use and 25% reduction in indoor use |
|  Annual Cost per Household | \$0 increase per year in water utility bill | \$35 increase per year in water utility bill |

Estimated Willingness To Pay (WTP)

- Highest WTP for restrictions on water usage
- Marginal WTP of South Florida residents for one unit increase of OWR \$11.95-13.35
- Large disconnect between respondents' desire to maintain conveniences and how to achieve that through restoration

| General Public- Willingness to Pay | | | | | |
|--|------------------|---------------------|----------------------|---|---|
| Attributes | B | mWTP | Avg. WTP | South Fl. Population WTP n= 2,044,741 households | Fl. Population WTP n= 7,147,013 households |
| Water Conservation Areas | | \$1.27- \$2.57 | \$89.66- \$160.26 | \$2,596,821.00- \$ 5,254,984.00 | \$ 9,076,707.00- \$18,367,823.00 |
| Wetland Species | | \$0.16- \$0.32 | \$8.11- \$16.22 | \$327,158.60- \$654,317.10 | \$1,143,522.00- \$2,287,044.00 |
| Dry land Species | | \$0.30- \$0.32 | \$18.54- \$19.78 | \$613,422.30- \$654,317.10 | \$2,144,104.00- \$2,287,044.00 |
| Florida Bay Species | | \$0.30- \$0.31 | \$22.47- \$23.22 | \$613,422.30- \$633,869.70 | \$2,144,104.00- \$2,215,574.00 |
| Restriction on Water Usage | | \$11.95- \$13.35 | \$23.90- \$35.85 | \$24,434,655.00 \$27,297,292.00 | \$85,406,805.00 \$95,412,624.00 |
| | | | | Over 10 Years | Over 10 years |
| Water Conservation Areas | | | | \$25,968,210.00- \$ 52,549,840.00 | \$ 90,767,070.00- \$183,678,230.00 |
| Wetland Species | | | | \$3,271,586.00- \$6,543,171.00 | \$11,435,220.00- \$22,870,440.00 |
| Dry land Species | | | | \$6,134,223.00- \$6,543,171.00 | \$21,441,040.00- \$22,870,440.00 |
| Florida Bay Species | | | | \$6,134,223.00- \$6,338,697.00 | \$21,441,040.00- \$22,155,740.00 |
| Restriction on Water Usage | | | | \$244,346,550.00 \$272,972,920.00 | \$854,068,050.00 \$954,126,240.00 |
| Saltwater Anglers- Willingness to Pay | | | | | |
| Current and Active Fishing Licenses Population WTP n= 1,235,381 | | | | | |
| Wetland Species | 0.0058 0.0068 | \$0.29- \$0.31 | \$15.05- \$16.10 | \$358,260.50- \$382,968.11 | |
| | | | | Over 10 years | |
| Wetland Species | | | | \$3,582,605.00- \$3,829,681.10 | |

Comparison of surveyed WTP and estimated additional costs

For South Florida households for 1 year

| WTP Survey | Costs for 30% assumption | Costs for 50% assumption |
|-----------------|-----------------------------|-----------------------------|
| \$24-27 million | \$400 million | \$686 million |

→ great discrepancy between estimated costs of OWR
and stated willingness to pay

Outlook

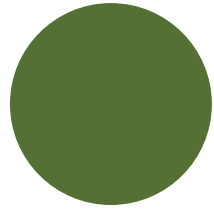
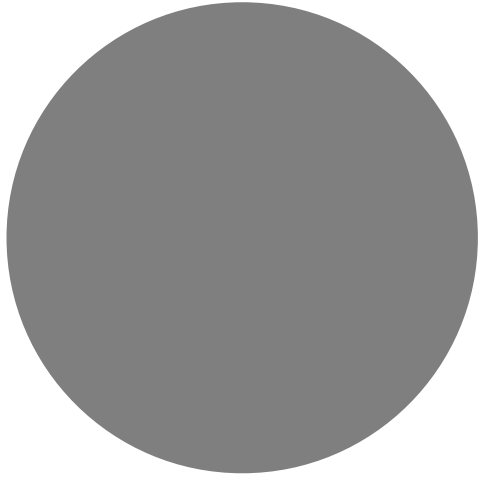
- Development of penalty function
 - Following approaches by Takatsuka et al., 2018; Brown et al., 2018
 - Capturing economic loss due to having OWR/not meeting target flow
 - With monetary value or amount of water as dependent variable
 - Precipitation, evapotranspiration, lake levels, population growth etc. as independent variables

Acknowledgements

We acknowledge support from the National Science Foundation (Award #1204762; # 1832693).

We are thankful to Nadia Seeteram, Vic Engel, Mike Sukop, and the members of South Florida Water Sustainability and Climate (SFWSC) team for their input and support in pursuing this study. However, the opinions expressed here are solely of the authors.





Thank you
for your attention



Bibliography

- Brown, C. E., Bhat, M. G., Rehage, J. S., Mirchi, A., Boucek, R., Engel, V., ... & Sukop, M. (2018). Ecological-economic assessment of the effects of freshwater flow in the Florida Everglades on recreational fisheries. *Science of the Total Environment*, 627, 480-493.
- Lee, M., Tansel, B., Balbin, M. (2011). Influence of residential water use efficiency measures on household water demand: A four year longitudinal study. *Resources, Conservation and Recycling*. 56, 1.
- Mayer, P. W., DeOreo, W. B., Opitz, E. M., Kiefer, J. C., Davis, W. Y., Dziegielewski, B., & Nelson, J. O. (1999). Residential end uses of water.
- Milman, A., & Polsky, C. (2016). POLICY FRAMEWORKS INFLUENCING OUTDOOR WATER-USE RESTRICTIONS 1. *Journal of the American Water Resources Association*, 52(3), 605–619. <https://doi.org/10.1111/1752-1688.12409>
- Seeteram, N. A., Engel, V., & Mozumder, P. (2018). Implications of a valuation study for ecological and social indicators associated with Everglades restoration. *Science of The Total Environment*, 627, 792-801.
- SFWMD, 2017. Annual Utility Rate Survey.
- SFWMD, 2019. Lawn Watering Restrictions. Retrieved from <https://www.sfwmd.gov/community-residents/landscape-irrigation>
- South Florida Water Management District (SFWMD), (2018). Who we are. Retrieved from <https://www.sfwmd.gov/who-we-are>
- Survis, F. D., & Root, T. L. (2012). Evaluating the effectiveness of water restrictions : A case study from Southeast Florida. *Journal of Environmental Management*, 112, 377–383. <https://doi.org/10.1016/j.jenvman.2012.08.010>
- Takatsuka, Y., Niekus, M. R., Harrington, J., Feng, S., Watkins, D., Mirchi, A., ... & Sukop, M. C. (2018). Value of irrigation water usage in South Florida agriculture. *Science of The Total Environment*, 626, 486-496.
- U.S. EPA (2013). Reduce your outdoor water use.
- U.S. EPA (2017). Water use today. Retrieved from [https://www.epa.gov/watersense/how-we-use-water#Daily Life%20](https://www.epa.gov/watersense/how-we-use-water#Daily%20Life%20)