

# Outdoor Recreation on State Lands in Washington

*What mobile device data reveal about visitation*

Earth Economics | June 1, 2023  
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Inland Empire Section Annual Conference  
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EARTH  
ECONOMICS 

# Earth Economics

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A world leader in **applied ecological economics** since 1998

We quantify and value **natural capital** and **ecosystem services**

We have been developing data-driven analyses of **outdoor recreation** since 2015



# Outline

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1. Study context
2. Key takeaways
3. Framework
4. Methods and Analysis
5. Results and applications
6. Future improvements and persistent challenges
7. The value to land managers

# Study context

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Agencies wanted to better understand **visitation** and **consumer spending** associated with **outdoor recreation** on state-managed lands

Washington State Parks and Recreation Commission (**Parks**)

Washington Department of Fish and Wildlife (**WDFW**)

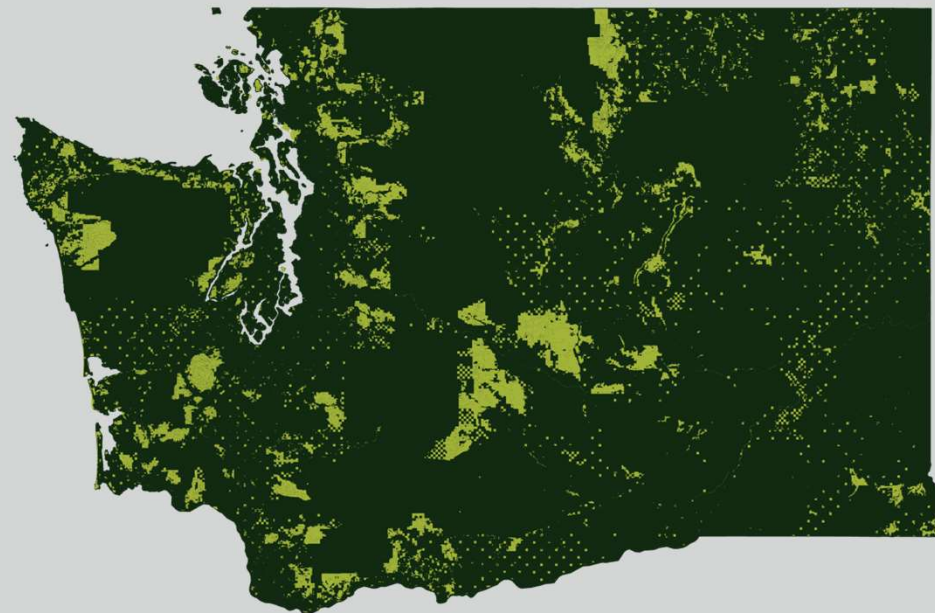
Washington Department of Natural Resources (**WDNR**)



# Study context

## Public recreation lands in WA state

- State parks
- Wildlife areas
- Marine parks
- Heritage sites
- Trails
- Visitor and conference centers
- Water access sites
- Green Dot Roads
- Dispersed DNR lands



# Key takeaways

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**Novel approach:** Leveraging **anonymized mobile device data** to model visitation to state recreation lands

**Big data:** 3.6 million unique devices and **18 billion locational records**

**Complex:** 3 agencies manage **619\*** sites

**Outdoor recreation grew in 2020:** 12% more visitor days than 2019

**COVID impacts:** Overnight visitation decreased, day trips by both locals and nonlocals increased, visitor spending decreased (day visitors spend less)

**Economic impacts:** Every \$1.00 spent by visitors supported **\$1.78 of additional economic activity** in Washington's economy

# Framework

## Key definitions

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An **economic contribution analysis** identifies changes in a regional economy that can be attributed to a given industry, event, or policy

**Input-Output** models track the ways that spending in one industry ripple throughout an economy



# Framework

## Input-Output model economic effects

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1. Direct (changes in spending)
2. Indirect (business-to-business purchases)
3. Induced (effects from labor income)





# Framework

## Input-Output model metrics

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1. Output (the **value of production**)
2. Value added (contribution to **GDP**)
3. Employment (**annual jobs** supported)
4. Labor income (**wages**)
5. Tax revenues (**state and local**)

# Methods

## Key calculations

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number of visitors × average expenditures = visitor spending

visitor spending × economic multipliers = economic contribution



# Methods

## The central challenge

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Visitation can be **difficult to track**

- **Boundaries** can be difficult to identify on the ground
- Sites can have **multiple access points**
- **Limited capacity** to monitor visitorship system-wide



# Methods

## A solution

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We can **model visitation** based on:

- anonymized **mobile device data** (location and time of day)
- **site attributes** (size, shoreline access, region)
- **control variables** (weather, air quality, season)



# Interlude

## Cleaning and correcting data

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Raw data are *rarely* ready to use

- removing **non-visitors** (common locations, speed filters)
- removing **duplicate** device records
- correcting **geospatial data**
- adjusting for **device location accuracy** ( $\pm 15$  ft)



# Interlude

## Lands by agency

|                       |                                  | Acres |         |         |           |
|-----------------------|----------------------------------|-------|---------|---------|-----------|
|                       |                                  | GDOT  | Parks   | WDFW    | WDNR      |
| Initial footprints    |                                  |       | 144,378 | 925,086 | 3,929,471 |
| Road buffers          |                                  | 4,371 |         |         |           |
| Removed               | Overlaps <sup>†</sup>            | 0     | 0       | 0       | 137,425   |
|                       | Zoning                           | 0     | 2,618   | 5,976   | 94,409    |
|                       | Agricultural leases <sup>‡</sup> | 26    | 1,170   | 25,384  | 432,723   |
|                       | Roadways                         | 0     | 8,849   | 12,906  | 179,501   |
|                       | GPS accuracy buffer (-15 ft)     | 0     | 2,559   | 11,178  | 201,795   |
| Final site footprints |                                  | 4,345 | 129,182 | 869,642 | 2,978,027 |
| Proportion removed    |                                  | 0.6%  | 10.5%   | 6.0%    | 24.2%     |
| Locations (sites)     |                                  | 8     | 219     | 208     | 184       |

<sup>†</sup>Lands owned by WDNR but managed by WDFW. After consultation with agency staff, we attributed visitation and spending on these lands to WDFW.

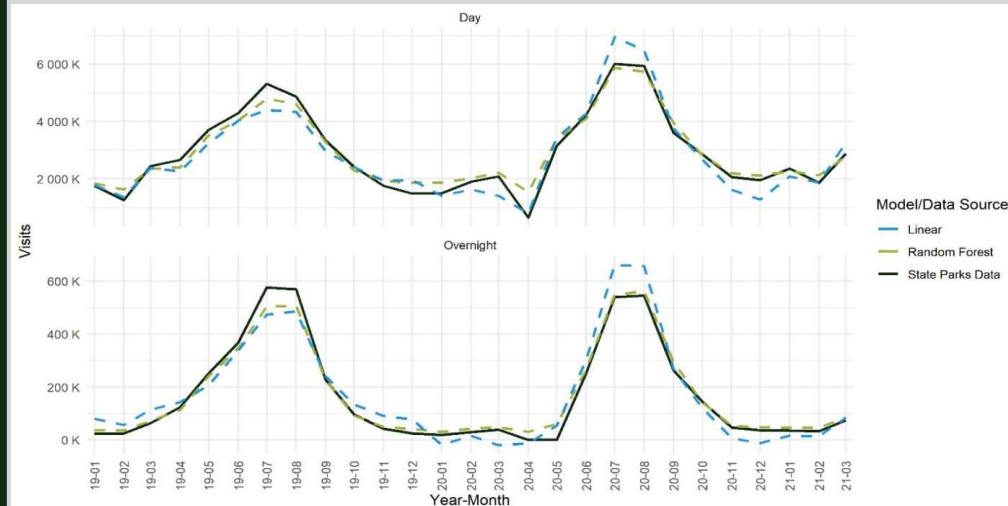
<sup>‡</sup>Some portion of state lands leased for agricultural uses also support recreational opportunities (e.g., hunting, wildlife viewing). Without validation data, we cannot estimate visitation for these lands. This may be addressed in subsequent research.

# Analysis

## Mobile device data

- State Parks visitor data used to **predict visitation** on Parks, WDFW, and WDNR lands
- Controlling for **site attributes** (spatial extent, visitor amenities, air quality, elevation...)
- Identifying **visitor types** (day/overnight, local/nonlocal)
- Linear and **random forest models**

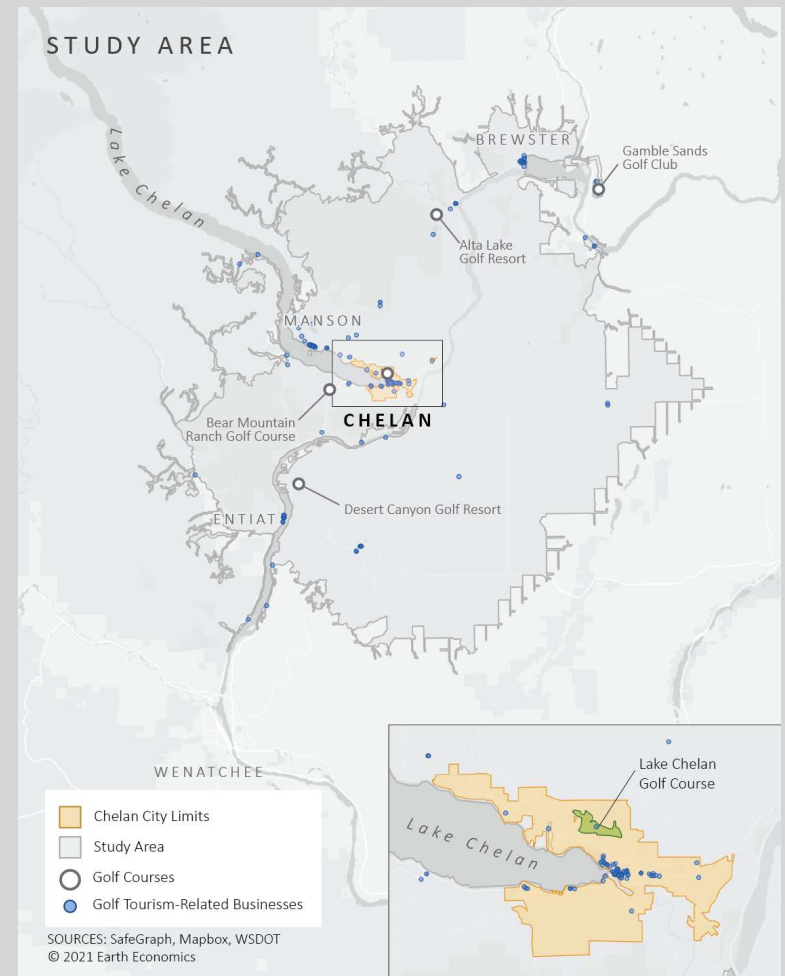
## Model



# Analysis

## Defining who and what is local

- All areas within a 50-mi drive
- Defined for all 619 locations statewide (~20K actual sites)
- Spending opportunities by industry
- Spending was apportioned based on industry footprints, economic productivity





# Results

## Visitor days

- Despite closures in early 2020, visitation to all agency lands increased over the prior year

| Agency          | 2019       | 2020       | Change |
|-----------------|------------|------------|--------|
| <b>Observed</b> |            |            |        |
| Parks           | 38,456,657 | 37,549,238 |        |
| <b>Modeled</b>  |            |            |        |
| WDFW            | 27,230,000 | 29,069,000 | +7%    |
| WDNR            | 16,572,000 | 20,080,000 | +21%   |
| Parks           | 34,239,000 | 37,991,000 | +11%   |
| Total           | 78,041,000 | 87,139,000 | +12%   |

# Results

## Visitor days

- Some shifts in visitation were likely **personal responses to the pandemic**

| VISITOR TYPE |           | 2019    | 2020 |     |
|--------------|-----------|---------|------|-----|
| Local        | day use   | 42%     | 53%  |     |
|              | overnight | in area | 25%  | 15% |
|              |           | on-site | 1%   | 1%  |
| Nonlocal     | day use   | 10%     | 13%  |     |
|              | overnight | in area | 20%  | 15% |
|              |           | on-site | 2%   | 2%  |

# Results

## Spending

- We estimated average annual consumer spending of \$3.3B over the two-year period
- While visitation increased 12% in 2020, spending decreased 2%
- Every \$1 spent by visitors generated \$1.78 in the state economy

| Agency          | (millions) |         | Change |
|-----------------|------------|---------|--------|
|                 | 2019       | 2020    |        |
| WDFW            | \$1,428    | \$1,393 | -2%    |
| WDNR            | \$726      | \$735   | +1%    |
| Parks           | \$1,195    | \$1,141 | -5%    |
| All State Lands | \$3,349    | \$3,269 | -2%    |

# Results

## Economic Contributions

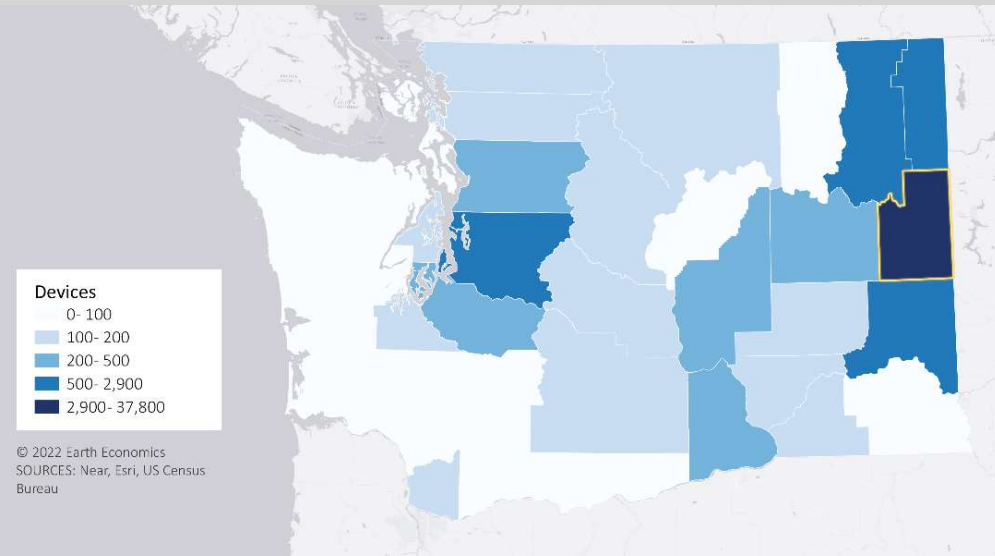
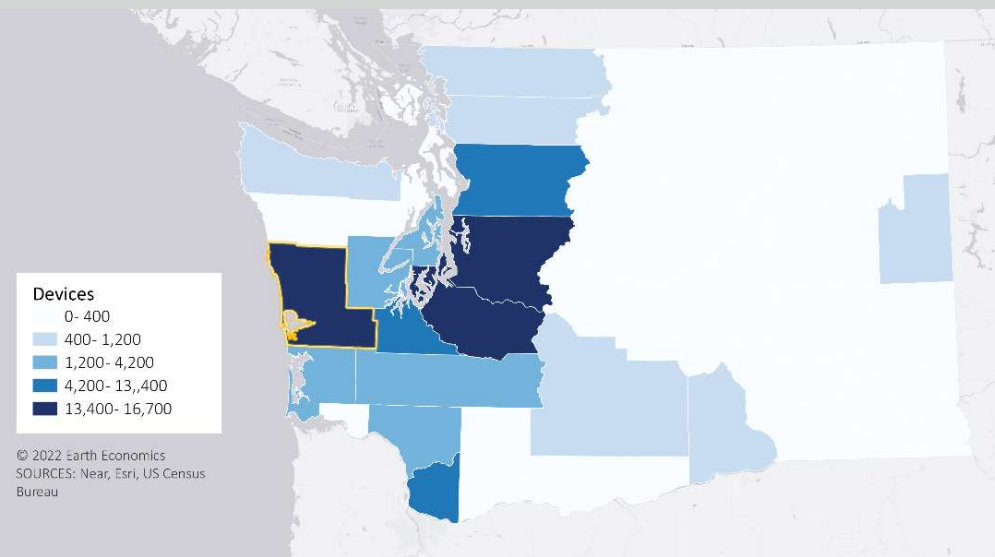
| Agency                 | Employment<br>(full- and part-time) |               | Labor Income<br>(\$ million) |                  | Economic Output<br>(\$ million) |                  | Local and State Taxes<br>(\$ million) |                |
|------------------------|-------------------------------------|---------------|------------------------------|------------------|---------------------------------|------------------|---------------------------------------|----------------|
|                        | 2019                                | 2020          | 2019                         | 2020             | 2019                            | 2020             | 2019                                  | 2020           |
| <b>WDFW</b>            | 15,500                              | 14,800        | \$692.7                      | \$656.6          | \$2,557.8                       | \$2,472.6        | \$184.4                               | \$178.7        |
| <b>WDNR</b>            | 8,000                               | 7,500         | \$348.8                      | \$332.8          | \$1,282.7                       | \$1,272.4        | \$91.9                                | \$90.1         |
| <b>Parks</b>           | 15,300                              | 14,100        | \$663.8                      | \$612.1          | \$2,231.3                       | \$2,110.3        | \$168.8                               | \$158.9        |
| <b>All State Lands</b> | <b>38,800</b>                       | <b>36,400</b> | <b>\$1,705.2</b>             | <b>\$1,601.5</b> | <b>\$6,071.8</b>                | <b>\$5,855.3</b> | <b>\$445.1</b>                        | <b>\$427.7</b> |



# Applications

## Visitor Origins

- Common evening locations of visitors can be used to identify local vs nonlocal visitors



# Applications

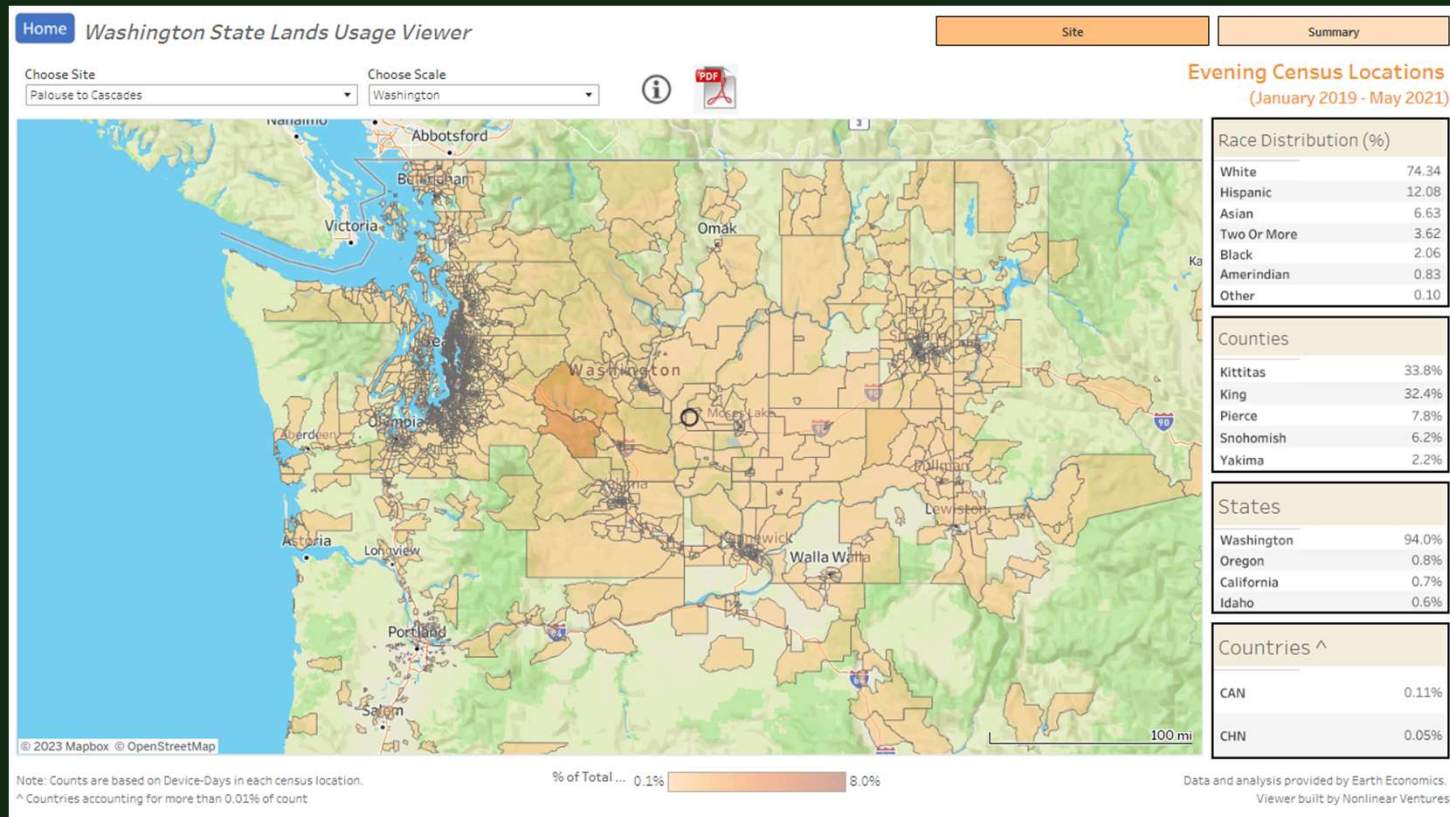
## Visitor demographics

- Matching common evening locations to **Census data** provides general demographic insights
- Could inform placement of **translations** for interpretive signs
- **Outreach** and **engagement**

| Race and Ethnicity     | Parks | WDFW | WDNR | All Lands |
|------------------------|-------|------|------|-----------|
| White                  | 76%   | 76%  | 79%  | 77%       |
| Black/African American | 3%    | 2%   | 2%   | 2%        |
| Asian                  | 7%    | 3%   | 4%   | 5%        |
| Hispanic/Latino        | 10%   | 14%  | 9%   | 11%       |
| American Indian        | 1%    | 2%   | 2%   | 2%        |
| Multiracial            | 4%    | 4%   | 4%   | 4%        |

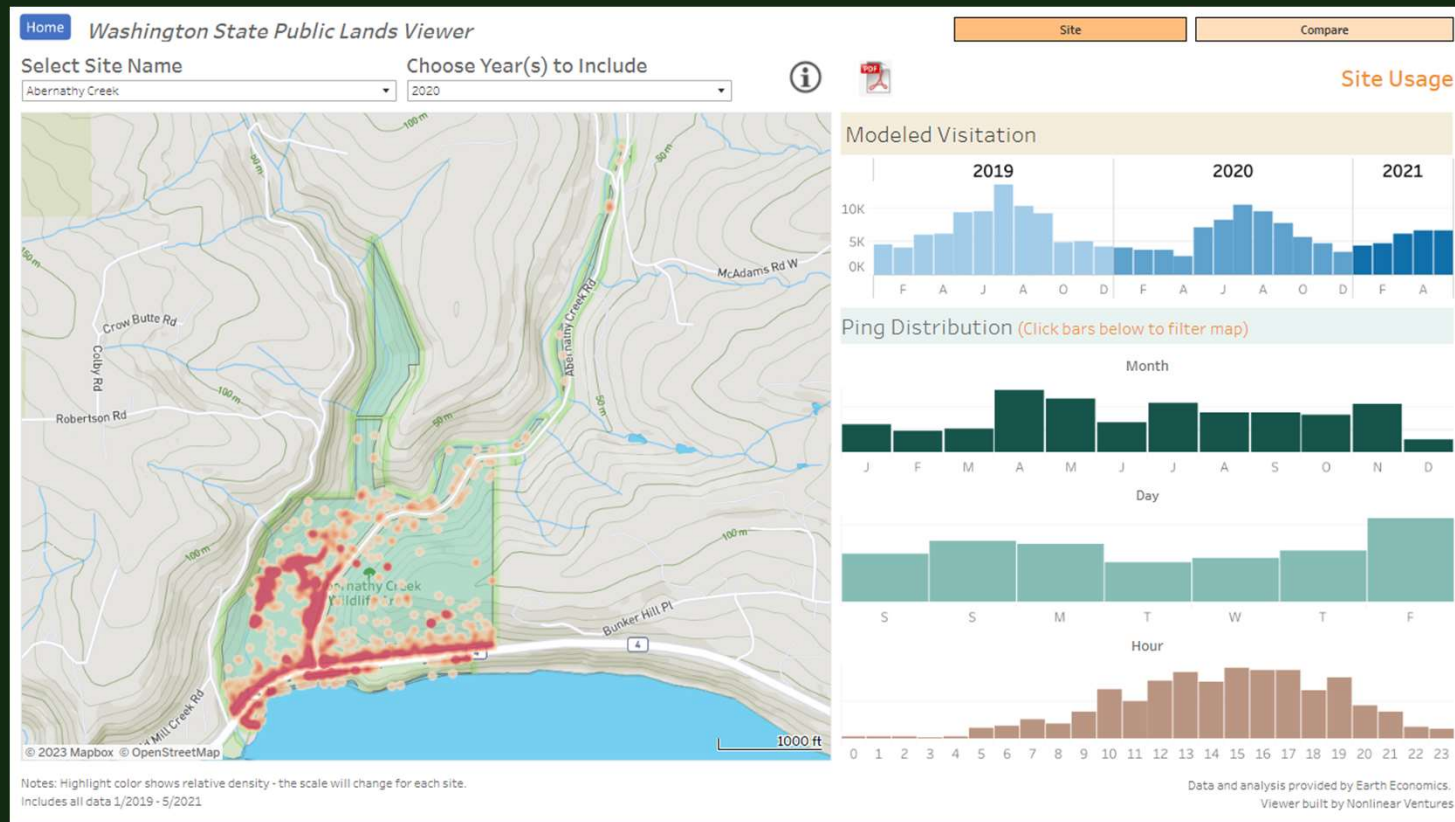
# Applications

## Visitor origins, Census demographics



# Applications

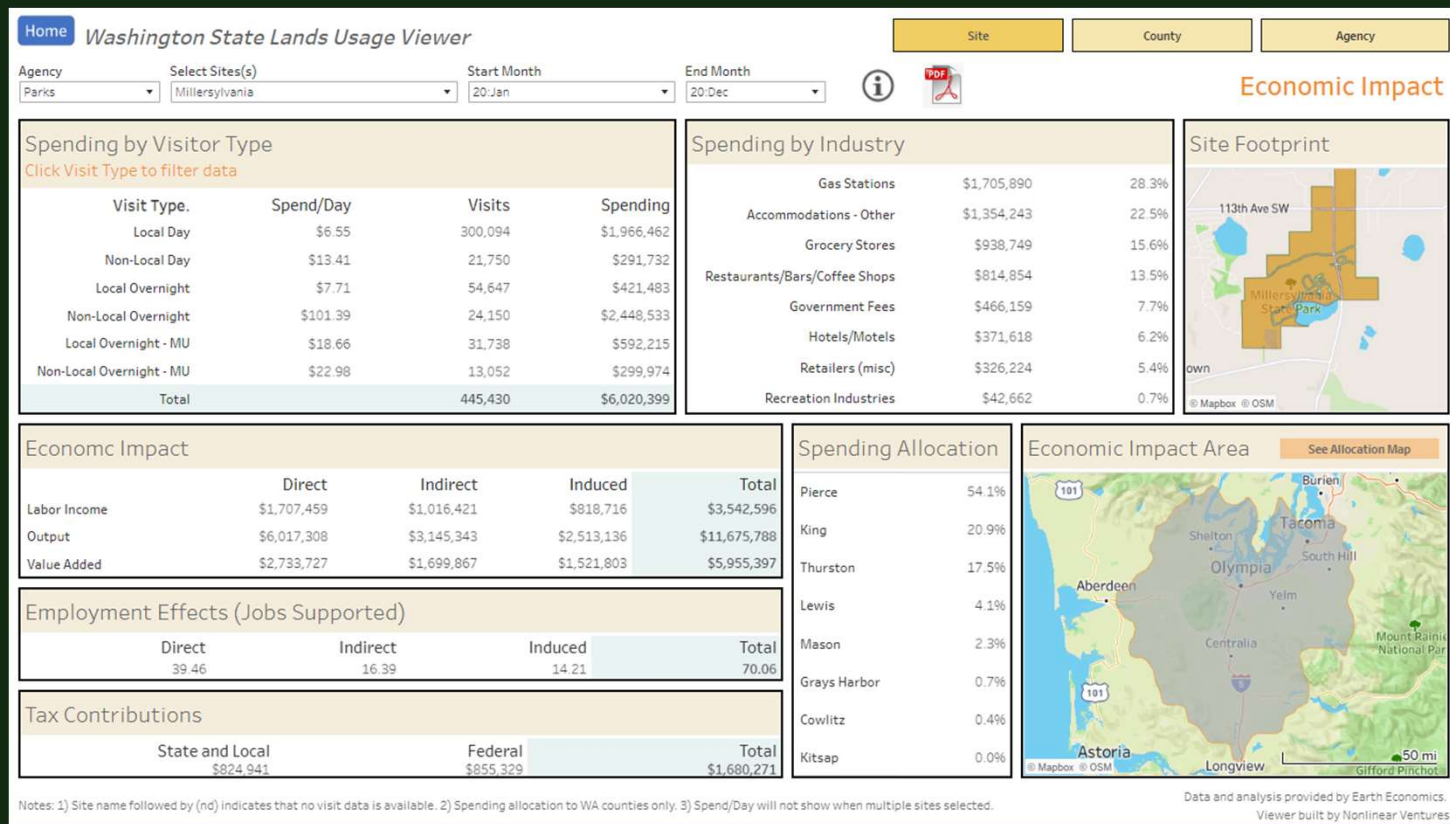
## Site use patterns





# Applications

## Spending and economic impact data



# Applications

## Year-over-year differences

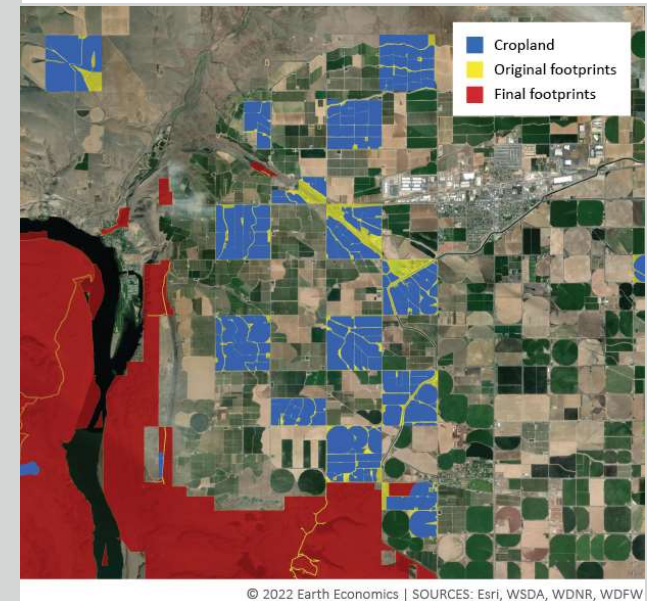
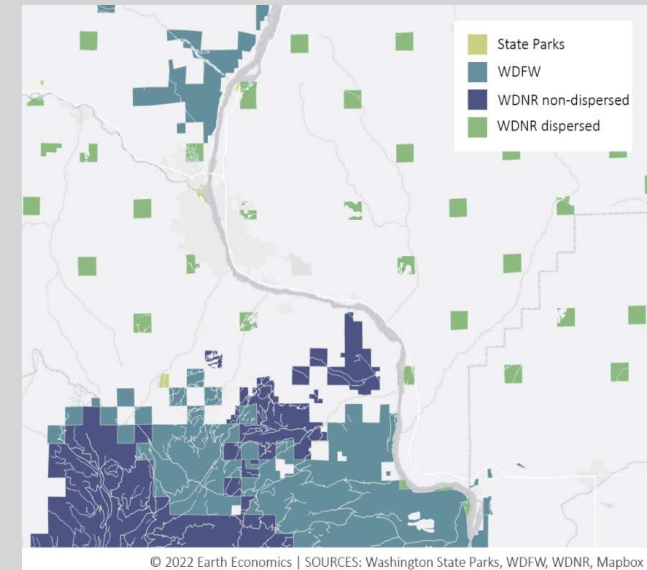
- These data can also improve our understanding of **how visitors interact with local business sectors**

| Industry                 | 2019  | 2020  | Dif    |
|--------------------------|-------|-------|--------|
| Grocery stores           | 30.2% | 34.3% | 4.1%   |
| Gas stations             | 32.5% | 40.6% | 8.1%   |
| Sporting goods stores    | 8.5%  | 7.2%  | -1.3%  |
| Misc. retail             | 7.1%  | 5.5%  | -1.6%  |
| Rentals                  | 0.5%  | 0.4%  | -0.1%  |
| Other recreation         | 13.8% | 8.5%  | -5.3%  |
| Hotels, motels           | 11.7% | 9.8%  | -1.9%  |
| Full-service restaurants | 38.1% | 29.1% | -9.0%  |
| Fast food restaurants    | 24.1% | 20.2% | -3.9%  |
| Cafes, coffee shops      | 22.6% | 2.0%  | -20.6% |

# Improvements

## Expanding the models

- Some dispersed recreation lands (top) and agricultural leases (bottom) were not included
- More visitation data are needed to estimate visitation to these lands



# Persistent challenges

## Sensitivities and limiting factors

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- **Privacy** concerns
- Datasets vary in **quality** and **cost**
  - differences can **affect model estimates**
  - higher **cost** does not guarantee higher **quality** (and vice versa)
  - the user base **fluctuates** (devices, apps, location sharing)
  - businesses and **industries change**
- Availability of **observed visitation data** (model training)
- **Bias** in mobile device data

# The value to land managers

## The importance of better recreation data

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- Drives long-term recreation strategy and implementation
- Elevates awareness of the value of public lands
- Raises interest in impact assessments and adaptive management
- Speaks to the value of collaboration between natural resource and land management agencies



# Thank you for your time

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Download the full report at:

[www.eartheconomics.org/all-publications/2022/wdfw](http://www.eartheconomics.org/all-publications/2022/wdfw)



# FAQs

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- Why can't we just count device location records?
- Incomplete cellular coverage
- Scenic views, Sunday drives
- Recreation on agricultural leases
- Dispersed, open-access sites

