

Outdoor Recreation on State Lands in Washington

What mobile device data reveal about visitation

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Priest Lake, Idaho

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

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

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

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 trips decreased, day trips by both locals and nonlocals increased, spending decreased (day visitors spend less)

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

Framework

Key definitions

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

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

Framework

Input-Output model metrics

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

number of visitors × average expenditures = visitor spending

visitor spending × economic multipliers = economic contribution

Methods

The central challenge

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

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

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** (± 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 [†]	0	0	0	137,425
	Zoning	0	2,618	5,976	94,409
	Agricultural leases [‡]	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

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

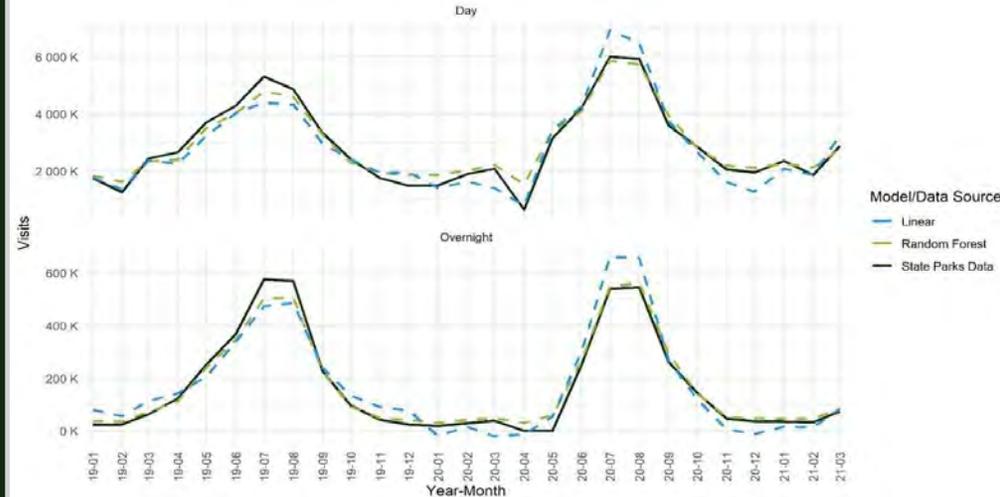
[‡]Some portion of state lands leased for agricultural uses also support recreational opportunities (e.g., hunting, wildlife viewing). Without validation data, we cannot estimate visitation for these lands. This may be addressed in subsequent research.

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
Observed			
Parks	38,456,657	37,549,238	
Modeled			
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

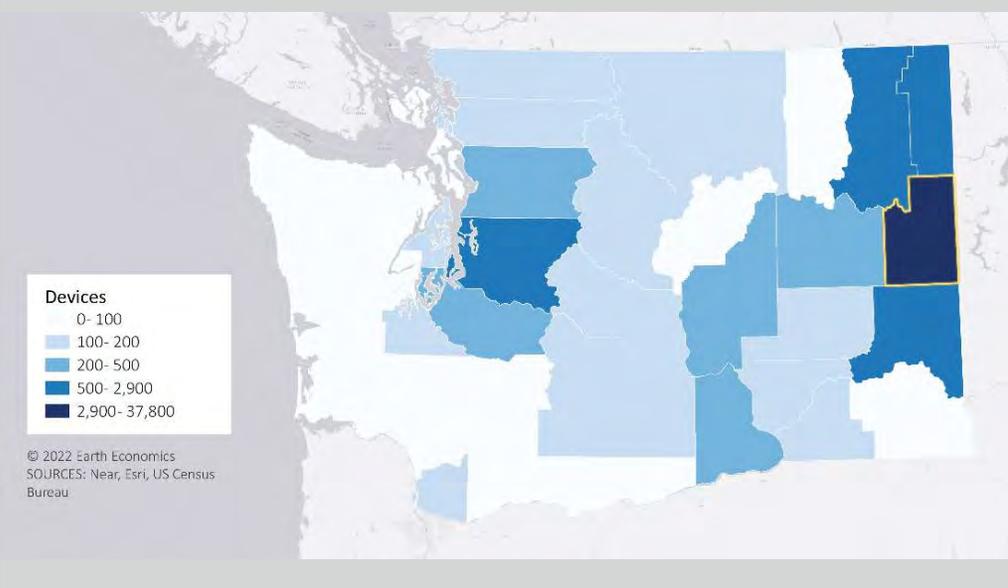
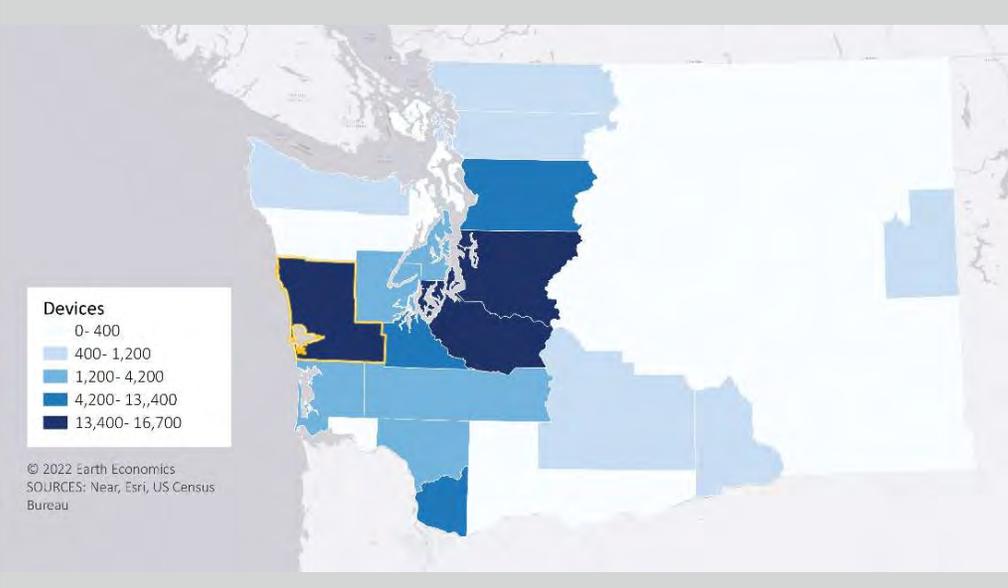
Economic Contributions

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

Applications

Visitor Origins

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



Applications

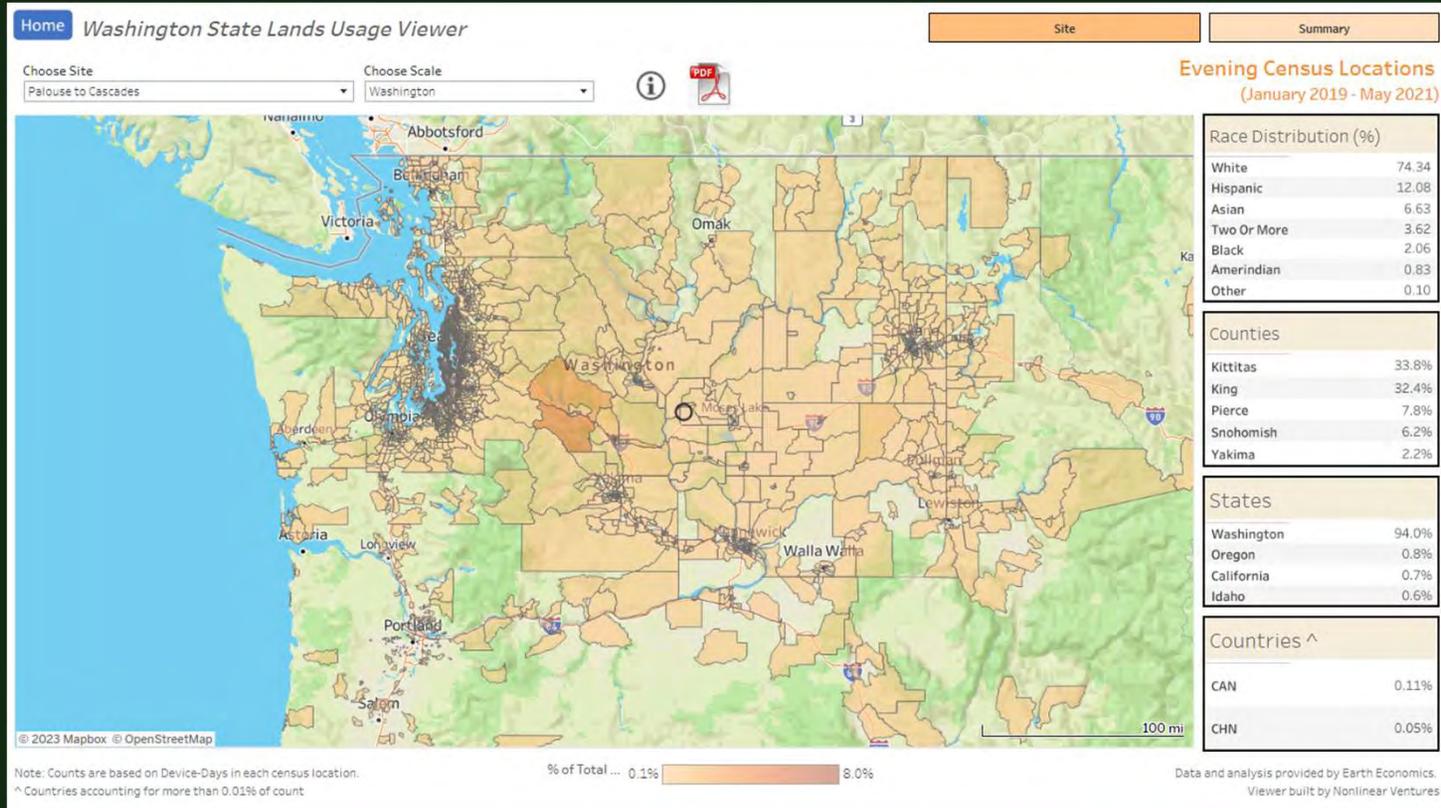
Visitor demographics

- 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%

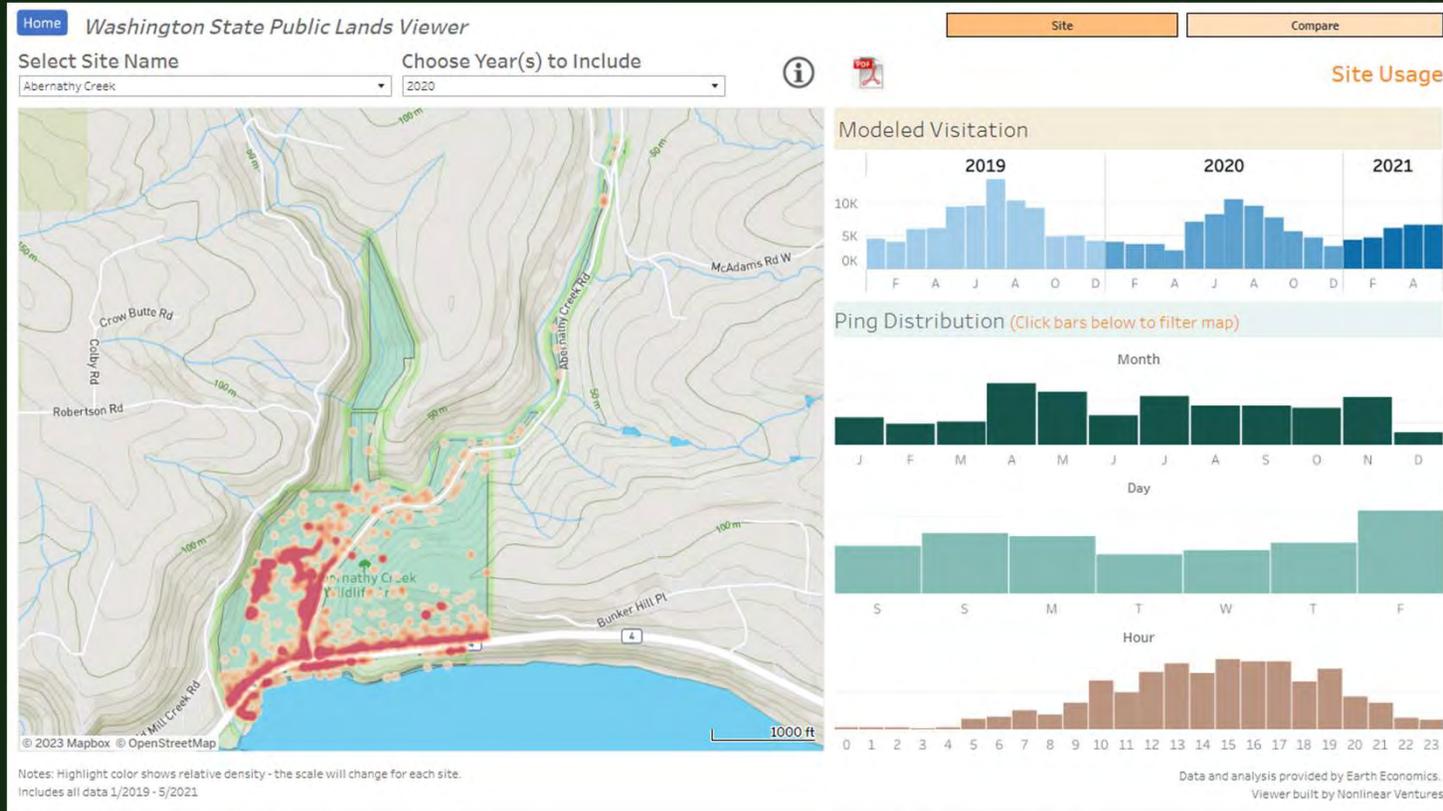
Applications

Visitor origins, Census demographics



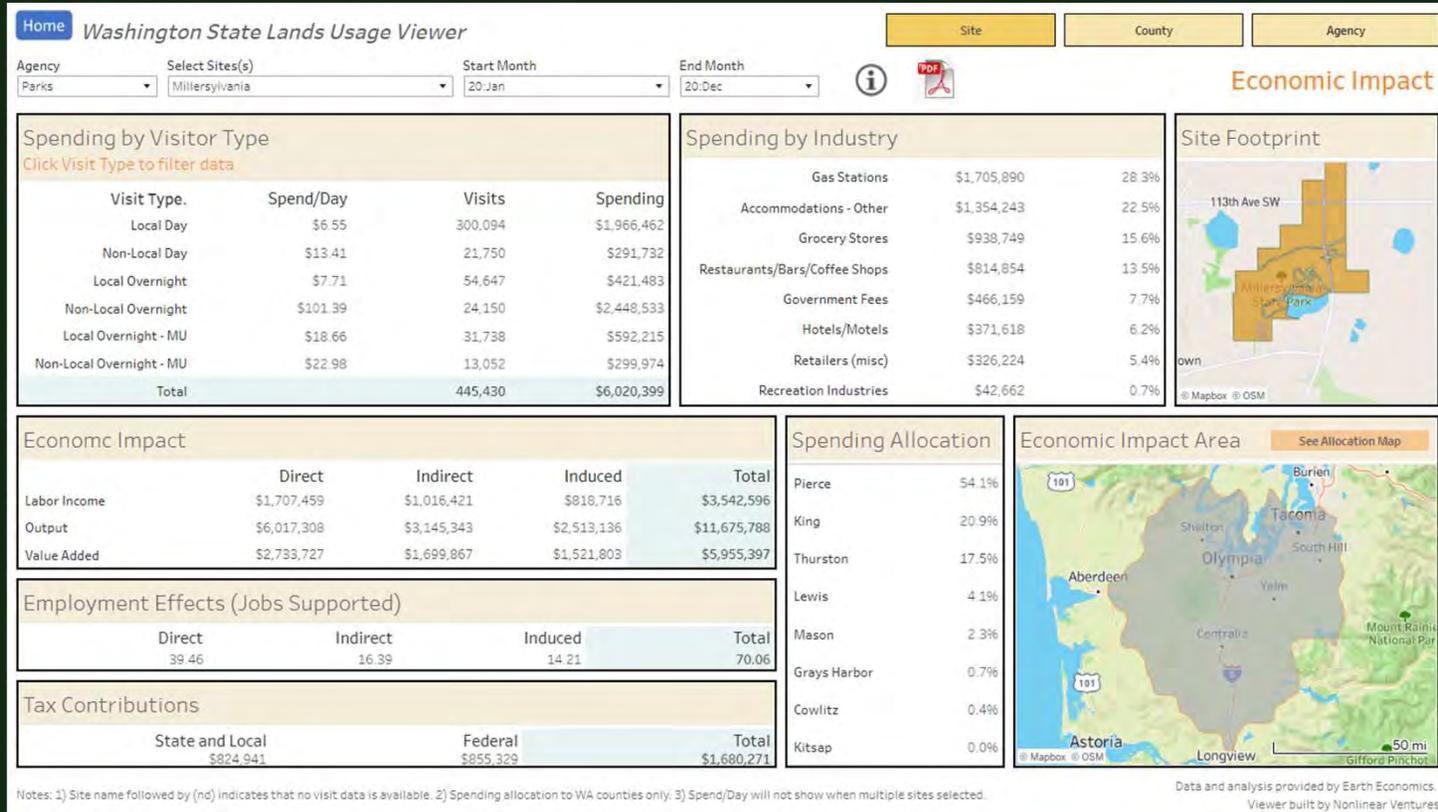
Applications

Site use patterns



Applications

Spending and economic impact data



Applications

Year-over-year differences

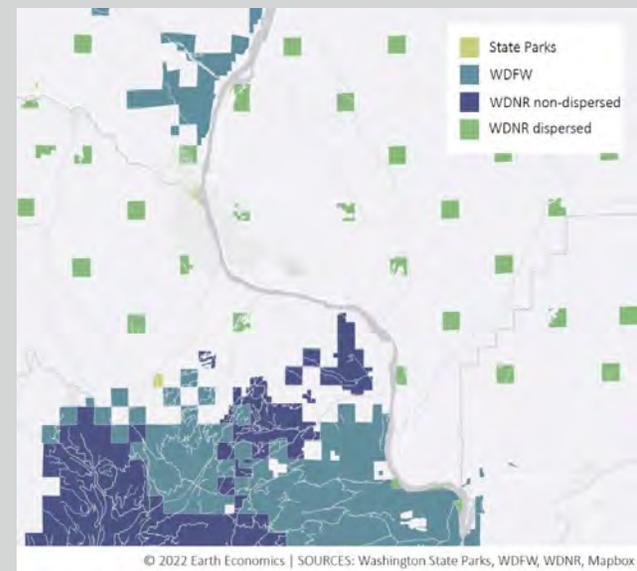
- These data can also improve our understanding of **how visitors interact with local business sectors**

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

- **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

- 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