Recreation
1) What Is Recreation?

2) Why Are We Modeling It?

3) Where Are We Modeling It?

4) How Are We Modeling It?
1) **What Is Recreation?**

activities occurring during leisure time involving interaction with or appreciation of the natural environment

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1) What Is Recreation?
   activities occurring during leisure time involving interaction with or appreciation of the natural environment

2) Why Are We Modeling It?
   environment influences decisions about how/when/where to recreate

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activities occurring during leisure time involving interaction with or appreciation of the natural environment

2) **Why Are We Modeling It?**

environment influences decisions about how/when/where to recreate

3) **Where Are We Modeling It?**

(almost) anywhere and anyone data-poor and data-rich recreators in more- and less-developed countries parks and elsewhere

4) **How Are We Modeling It?**
A tiered approach

Tier-1
- Low model complexity
- Coarse (global) data availability
- Simple parameterization
  - Designed for data-limited areas
  - Easy to apply
  - First-cut estimates

Tier-2
- Medium model complexity
- Intermediate data availability

Tier-3
- High model complexity
- Fine (local) data availability
- Complex process-based models
  - Designed for data-rich areas
  - Substantial time to apply
  - More reliable and refined estimates
a tiered approach

- Model complexity
- Data availability

Tier-0
Tier-1
Tier-2
Tier-3
a tiered approach

Tier-0

Outputs: locations of human use

Inputs: locations of human use
Oyster Aquaculture

- Floathomes

- Clam Beaches

- Geoduck Fishing

- Crab Fishing

- Kayaking
Oyster Aquaculture
Floathomes
Clam Beaches
Geoduck Fishing
Crab Fishing
Kayaking
Oyster Aquaculture
Floathomes
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Kayaking

decision to visit

food
water quality
hotels
archaeology
cost
roads
coral reefs
fish
parks
a simple model

decision to visit

visits

food
water quality
hotels
archaeology
cost
roads
coral reefs
fish
parks

visits

visits

visits
a simple model

visitation rate
(visits/time)

economic benefits
($$
$$)

decision to visit

food
water quality
hotels
archaeology
cost
roads
coral reefs
fish
parks
VISITATION RATE = PREDICTOR + PREDICTOR + PREDICTOR + PREDICTOR

- decision to visit
  - food
  - water quality
  - archaeology
  - cost
  - roads
  - coral reefs
  - fish
  - parks

- economic benefits ($$)
- visitation rate (visits / time)
VISITATION RATE = PREDICTOR + PREDICTOR + PREDICTOR + PREDICTOR

shellfish collectors = development + water quality + abundance + area + access + substitute
refuge visitors = ocean + park area + income + population
wildlife viewers = area + income + population
park visitors = water activities + park age + camping + distance to city + distance to town
park visitors = income + park age + year
national park visitors = area + fees + population + substitutes + income + fame
park visitors = recreational activities + distance to city + habitats (#) + trails
park visitors = canyons + historic sites + area + population + boating + wildlife viewing
park visitors = campsites + Lake Superior + distance to city + population + habitats (#) + + trails + bird habitat + bird species + development + built capital + park area
woodland visitors = population + forest attributes + ownership + parking spaces
etc …
**VISITATION RATE** = PREDICTOR + PREDICTOR + PREDICTOR + PREDICTOR

shellfish collectors = development + water quality + abundance + area + access + substitute
refuge visitors = ocean + park area + income + population
wildlife viewers = area + income + population
park visitors = VISITATION RATE = $\beta_1 \cdot$ PREDICTOR + $\beta_2 \cdot$ PREDICTOR + ...
distance to town
park visitors = income + park age + year
national park visitors = recreational activities + distance to city + habitats (#) + trails
canyons + historic sites + area + population + boating + wildlife viewing
park visitors = campsites + Lake Superior + distance to city + population + habitats (#) +
+ trails + bird habitat + bird species + development + built capital + park area
woodland visitors = population + forest attributes + ownership + parking spaces
etc ...

context dependent : each place is different ($\beta_i$ values)

R² = 0.26 – 0.78
response variable

VISITATION RATE

n > 100,000,000
VISITATION RATE

response variable
response variable

VISITATION RATE

n = 73,000
response variable

VISITATION RATE

Map showing visitation rate with various regions highlighted.
VISITATION RATE

response variable
2005 - 2011

819,000 images in MN
83 MN parks
63,000 images in MN parks
11,000 park user-days
by 3,300 people
2005 – 2011

819,000 images in MN
83 MN parks
63,000 images in MN parks
11,000 park user-days
by 3,300 people
response variable

**Pros**
- Data availability
  - a proxy, related to real visitation rates

**And Cons**
- Parameterized using camera-owners
- Photo-density biased differently
  - Un-developed countries
  - At different scales
response variable

**Pros**
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- a proxy, related to real visitation rates

**And Cons**
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recreators in more- and less-developed countries
parks and elsewhere

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- geotagged photos as a proxy for where tourists go
- user-provided inputs
- optional default predictor variable
- proportion of visitor-days
- estimated expenditures
model inputs

**INPUTS**

area of interest (for parameterization)

cell size or local areas (for outputs)
VISTATION RATE = PREDICTOR + PREDICTOR + PREDICTOR + PREDICTOR
VISITATION RATE = PREDICTOR + PREDICTOR + PREDICTOR + PREDICTOR
VISITATION RATE = NATURE + CULTURE + SUPERSTRUCTURE + INDUSTRY + COST

distance to city
VISITATION RATE = NATURE + CULTURE + SUPERSTRUCTURE + INDUSTRY + COST

predictor variables

warehouse
production plant
manufacturer
storage
etc ...

distance to city
predictor variables

\[
\text{VISITATION RATE} = \text{NATURE} + \text{CULTURE} + \text{SUPERSTRUCTURE} + \text{INDUSTRY} + \text{COST}
\]

road
parking
airport
motel
car rental
visitor information
signage
etc …

distance to city
VISITATION RATE = NATURE + CULTURE + SUPERSTRUCTURE + INDUSTRY + COST

predictor variables

archaeological site
cemetery
historic building
sculpture
food
church
etc ...

warehouse
production plant
manufacturer
environmental
information
age
etc ...

distance to city
VISITATION RATE = \textbf{NATURE} + \textbf{CULTURE} + \textbf{SUPERSTRUCTURE} + \textbf{INDUSTRY} + \textbf{COST}

- waterfall
- cave
- canyon
- beach
- marine reserve
- significant tree
- peak
- etc ...

- archaeological site
- cemetery
- historic building
- sculpture
- visitor information
- etc ...

- warehouse
- production plant
- manufacturer
- etc ...

- distance to city

- predictor variables

- water
- road
- parking
- airport
- motel
- car rental
- etc ...

- visitation rate = nature + culture + superstructure + industry + cost
VISITATION RATE = NATURE + CULTURE + SUPERSTRUCTURE + INDUSTRY + COST

distance to city

predictor variables
predictor variables

visitation rate = nature + culture + superstructure + industry + cost

distance to city
predictor variables

\[
\text{visitation rate} = \text{nature} + \text{culture} + \text{superstructure} + \text{industry} + \text{cost}
\]
predictor variables

\[ \text{visitation rate} = \text{nature} + \text{culture} + \text{superstructure} + \text{industry} + \text{cost} \]
VISITATION RATE = \text{NATURE} + \text{CULTURE} + \text{SUPERSTRUCTURE} + \text{INDUSTRY} + \text{COST}

\text{predictor variables}

density \quad (\#/\text{km}^2)

distance to city

waterfall
cave
canyon
garden
beach
marine reserve
significant tree
peak
etc …
VISITATION RATE = \( \text{NATURE} + \text{CULTURE} + \text{SUPERSTRUCTURE} + \text{INDUSTRY} + \text{COST} \)
+ \( \text{LAND/OCEAN USE/OVER} + \text{AREA} + \text{USER-DEFINED} \)

**Predictor variables**

- Distance to city
- Density \( (#/\text{km}^2) \)
- Nature
- Culture
- Superstructure
- Industry
- Cost
- Land/ocean use/cover
- Area
- User-defined

**Features**

- Waterfall
- Archaeological site
- Cave
- Canyon
- Garden
- Beach
- Marine preserve
- Park
- Airport
- Visitor information
- Signage
- Coral
- Mangrove
- Seagrass
- Ocean
- Forest
- Agriculture
- Urban
- Grassland
- Protected
VISITATION RATE = NATURE + CULTURE + SUPERSTRUCTURE + INDUSTRY + COST
+ LAND/OCEAN USE/COVER + AREA + USER-DEFINED

predictor variables

density
( #/km² )

distance to city

coral
mangrove
seagrass
ocean
forest
agriculture
urban
grassland
protected
VISITATION RATE = \text{NATURE} + \text{CULTURE} + \text{SUPERSTRUCTURE} + \text{INDUSTRY} + \text{COST} \\
+ \text{LAND/OCEAN USE/COVER} + \text{AREA} + \text{USER-DEFINED}
\[
\text{VISITATION RATE} = \text{NATURE} + \text{CULTURE} + \text{SUPERSTRUCTURE} + \text{INDUSTRY} + \text{COST} + \text{LAND/OCEAN USE/COVER} + \text{AREA} + \text{USER-DEFINED}
\]
model outputs

Outputs

proportional visitation rate
( % of total visitor-days )
model outputs

**Outputs**

proportional visitation rate

( % of total visitor-days )

**Approved Use**

relative differences among local areas

relative change over time/scenarios (% change)

parameterization: states – countries

estimation: 1 – 10 km²
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   - geotagged photos as a proxy for where tourists go
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   - estimated expenditures
**Revenue From Expenditures**

activities

\[= \text{visitation (visitor-days)} \cdot \text{participation}_i (\%) \cdot \text{expense to participate}_i (\$)\]

accommodation

\[= \text{visitation (visitor-days)} \cdot \text{occupancy (people/room/night)} \cdot \text{room ($/night)}\]

taxes

additional expenses

multiplier
Future

version 0.1
released this summer!

version 0.2
activities
originating location
tavel-cost model