# Lecture 10: Wildlife and water economics

FOR 4684 Natural Resource Economics and Management

UAM
Making College Possible

School of Forest Resources


## Linkages between economics and ecology

- Is growth always good?
- Quantity vs. quality in economic growth
- Can technology always bail us out?

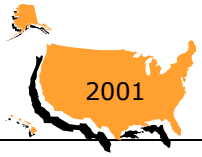
## Some non-timber forest activities

- Wildlife
  - Fishing/Hunting
  - Wildlife viewing
- Tourism/travel
  - Sightseeing
  - Camping/hiking
  - Wildlife-related

## National Survey of Fishing, Hunting, and Wildlife Associated Recreation

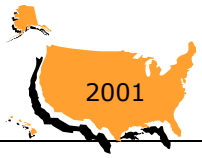
- Survey data collected by US Census Bureau
  - Every five years (2001 is latest)
  - http://www.census.gov/prod/www/abs/fishing.html
- Economics are considerable for entire United States in 2001:
  - 82 million participants
  - Expenditures of $108 billion

## Consumptive vs. non-consumptive




- Sportspersons
  - 37.8 million participants
  - 786 million days
  - $70 billion in expenditures
- Wildlife watchers
  - 66.1 million participants
  - $38.4 billion in expenditures

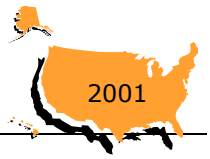
## Sportspersons




- Hunting
  - 13.0 million hunters
  - 228 million days hunting
  - $20.6 billion in expenditures
- Fishing
  - 34.1 million anglers
  - 557 million days fishing
  - $35.6 billion in expenditures

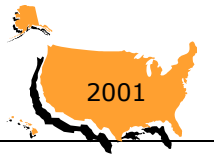
- $13.8 billion in unspecified expenditures

## Hunting expenditures



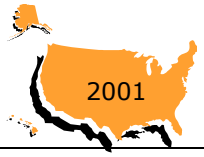

| | |
|---|---|
| Trip-related | $5.3 billion |
| Food and lodging | $2.4 billion |
| Transportation | $1.8 billion |
| Other trip costs | $1.0 billion |
| Equipment | $10.4 billion |
| Hunting | $4.6 billion |
| Auxiliary equipment | $1.2 billion |
| Other | $4.6 billion |
| Other | $5.0 billion |
| Magazines, books | $0.1 billion |
| Memberships | $0.2 billion |
| Land leasing and ownership | $4.0 billion |
| Licenses, stamps, tags and permits | $0.7 billion |

## Fishing expenditures



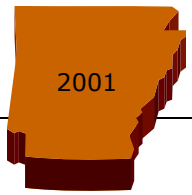

| | |
|---|---|
| Trip-related | $14.7 billion |
| Food and lodging | $6.0 billion |
| Transportation | $3.5 billion |
| Other trip costs | $5.3 billion |
| Equipment | $17.0 billion |
| Fishing | $4.6 billion |
| Auxiliary equipment | $0.7 billion |
| Special equipment | $11.6 billion |
| Other | $4.0 billion |
| Magazines, books | $0.1 billion |
| Memberships | $0.1 billion |
| Land leasing and ownership | $3.2 billion |
| Licenses, stamps, tags and permits | $0.6 billion |

## Wildlife watching expenditures




| | |
|---|---|
| ○ Trip-related | $8.2 billion |
| • Food and lodging | $4.8 billion |
| • Transportation | $2.7 billion |
| • Other trip costs | $0.7 billion |
| ○ Equipment | $23.5 billion |
| • Wildlife watching | $7.4 billion |
| • Auxiliary equipment | $0.7 billion |
| • Special equipment | $15.5 billion |
| ○ Other | $6.7 billion |
| • Magazines, books | $0.3 billion |
| • Memberships | $0.9 billion |
| • Land leasing and ownership | $4.8 billion |
| • Plantings | $0.7 billion |

## Let's look at Arkansas




- ○ Hunting
  - Expenditures $517 million
  - 7.1 million activity-days
- ○ Fishing
  - Expenditures $446 million
  - 11.8 million activity days
- ○ Wildlife watching
  - Expenditures of $244 million
  - 1.6 millions activity days

## Economics of travel and tourism in Arkansas


- 2001 data
- Tourism data not segregated by reason
  - 1/3 sightseeing
  - 1/5 camping
  - 1/20 hiking
  - Between 1/10 and 1/7 wildlife related travel
- Expenditures of $3,812,245,000
- 19,848,000 person-trips
- Travel-generated payroll $842,278,000
- Travel-generated employment 57,497

## Water resource economics

## Valuing water – general principles

- Value of water depends on:
  - Time
  - Location
  - Quantity
  - Quality
  - Use
- Water use can be consumptive or non-consumptive
- Water uses:
  - Municipal
  - Industrial
  - Agricultural
  - Recreational

## Value of water right vs. value of water use

- Water right
  - Water right is legal access to specific water source or quantity of water
    - May reflect multiple uses
    - May be capitalized over life of water right
  - Value of water right usually greater than value of use
- Water use
  - Value of use of a specific quantity at a specific year or time of use

## Valuing water rights

- Sales comparison
  - Direct market sales of water rights
- Income capitalization
  - Present value of net benefits from water rights
- Land use differentials
  - Value of similar land parcels with and without water rights
  - Econometrics – comparison of land values with and without water
- Least-cost alternatives
  - The least cost alternative that develops new water supplies – the cost of increasing supply.

## Valuing water rights – income capitalization method

- A forest landowner owns 1,000 acres of forest land in Gunnison County, Colorado.
- Annual water production from this forest is 2,000 acre-feet.
- Landowner is willing to sell the water rights to this land for 10-years for a price of $250 per acre-foot.
- What is the value of the 10-year water rights for this property if capitalized at 6% per year?

$$V_0 = \$500{,}000\,\frac{1-1.06^{-10}}{0.06} = \$3{,}680{,}044$$

## Water vs. timber

- The same forest landowner would like to harvest timber from his forest.
- Annual timber harvests over the next 10 years would provide a net benefit to the land owner of $150,000 per year.
- Annual water flows would be reduced by 5%.
- What should the landowner do?

$$V_{timber} = \$150{,}000 \frac{1-1.06^{-10}}{0.06} = \$1{,}104{,}013$$

Value of reduced water production: $V_{water} = \$450{,}000 \frac{1-1.06^{-10}}{0.06} = \$3{,}312{,}039$

"Cost" of reduced water production: = 3,680,044 - 3,312,039 = $368,005

**Decision:**
**Cut timber and sell less water!**

## Case study: Value of land a function of land components

Northern Minnesota hedonic land price approaches

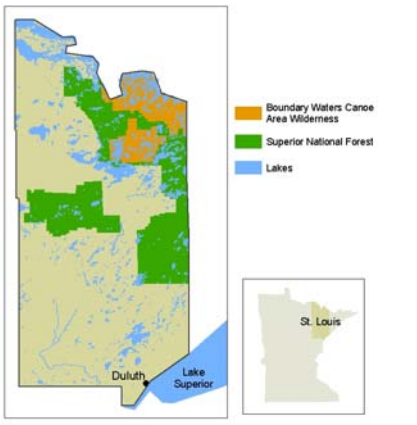
## Land values affected by proximity to water: recreation land in Minnesota

- Research done by USDA Forest Service North Central Experiment Station
  - Stephanie Snyder, Michael Kilgore, Rachel Hudson, and Jacob Donnay
- Land prices in north Minnesota have been exploding
  - 80-acre parcel near Two Harbors, MN
    - 2000: $19,300
    - 2002: $120,000
    - 2003: $299,000
    - 2007: $695,000
- What is driving up the land prices?
- What factors influence land prices?

## Hedonic pricing approach

- Price of land $/unit area is used as proxy for land value
- Factors that increase land prices are:
  - Parcel size
  - Road frontage
  - Proximity to recreation areas
  - Timber volume
  - Site productivity
  - Hunting potential
  - Development potential
  - Population growth
  - Distance to cities
  - Proximity to water

Study area: St. Louis County, MN



## Hedonic model

$$P = a + \beta X + \varepsilon$$

P = natural log of sales price per hectare of parcel
X = vector (set) of explanatory variables
a = intercept of regression line
ε = error term

## Partial list of results (all variables significant at α = 0.05)

Adjusted $R^2$ = 69%, Mean $/ha = $2376

| Variable | Marginal effect on price (coefficient value) |
|---|---|
| Lake frontage | +7176 |
| Previous owner a relative | -1097 |
| River frontage | +1870 |
| Road density | +1347 |
| Road access | +1143 |
| Intent to build a home | +918 |
| Time on market | -575 |
| Population density | +115 |
| % Agricultural land in area | -84 |
| % water in area | +48 |
| Date of sale | +34 |
| Contract for deed financing | +566 |
| Trees > 10 years old | +431 |
| Distance to town | -23 |

## Case study: Water valuation

Watershed restoration in Macon County, Tennessee

## Valuing ecosystem services – a case study of watershed restoration

- Contingent valuation method (CVM)
- Construct a hypothetical market or scenario in survey instrument
- Estimate willingness to pay (WTP) or willingness to accept payment (WTA) and bequest values for resources

## Problems with CVM

- Valid responses?
- Would individuals really pay what they say in the survey?

## CVM survey design

- CV survey must clearly describe the goods being valued
- Case study: stream bank restoration in Little Tennessee River watershed
- Restoration measures being used:
  - Fencing to restrict livestock from stream banks
  - Rebuilding stream banks with revetment (live tree branches interwoven on stream bank)
  - Buffer zones or SMZs

## Identify ecosystem services to be valued and measures or indicators of success

- Erosion control
- Purification of water
- Fish and wildlife habitat
- Preservation of natural areas

## CVM survey

- Macon County TN
- Civic groups formed basis of survey population
- Invitation with $40 compensation for participation
- 191 people participated

## CVM methods

- Introduced to three stream bank methods
  - Rank importance
- Importance of four ecosystem services
- Provide a matrix of management methods and quality/quantity of ecosystem services

## Matrix of management/ecosystem service level

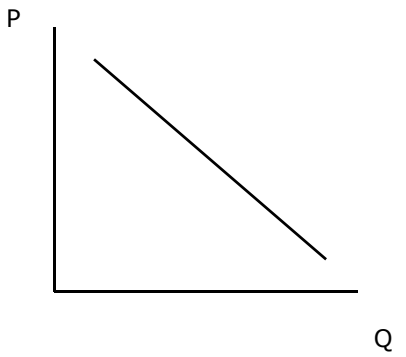
| Service | Current situation | Program 1 | Program 2 | Program 3 | Program 4 |
|---|---|---|---|---|---|
| Fish | Low | Low | Low | Moderate | Low |
| Water clarity | Low | Moderate | Moderate | Moderate | Low |
| Wildlife habitat | Low | Moderate | Moderate | High | Moderate |
| Water uses | Low | Low | Moderate | High | Moderate |
| Natural areas | Low | Low | Moderate | Moderate | Low |
| Program Cost | None | $10 / yr | $25 / yr | $50 /yr | $100 / yr |

## Analysis of data

- Statistical analysis of data to model likelihood of acceptance of cost
  - A willingness to pay for ecosystem services
  - A "no" vote as price of program increases caps a persons WTP for ecosystems services
- Based on some form of "victim liability" – that is, victims of some environmental damage should pay some amount to improve environmental quality.
  - Acceptance of a certain level of environmental "damage" is assumed.

## Results

- WTP estimates can provide a user "demand curve" for ecosystem services




Water clarity

# In-class WTP survey

WTP for hunting success

# Let's do our own WTP survey in class…

- Assume this class representative of all forestry students in SFR
  - Roughly 15% of population
- Question is: WTP for harvest of:
  - A trophy buck (4x4 or better, 150+ BC points)
    - $10 $25 $50 $100 $200 $400
  - A quality buck (6-8 pt)
    - $10 $25 $50 $100 $200 $400
  - A doe
    - $10 $25 $50 $100 $200 $400
- Put your WTP for each on a sheet of paper and give to instructor

## Analysis of data

| | Sample | | Population |
|---|---|---|---|
| | 8 | | 60 |
| Price | Survey Yes | % Survey Yes | Quantity |
| 0 | | 0% | 0 |
| 10 | | 0% | 0 |
| 25 | | 0% | 0 |
| 50 | | 0% | 0 |
| 100 | | 0% | 0 |
| 200 | | 0% | 0 |
| 400 | | 0% | 0 |

## Next lecture…

Taxation!