Local Determinants and the Wealth of Wildlife

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Introduction

Examines how **local factors influence the valuation of natural capital** using elk and mule deer populations in Wyoming as a case study.

- Current natural capital valuation techniques by [1] and [2].
- Geographic, ecological, and anthropogenic factors affect variations in the shadow values of wildlife resources.

Natural capital and other forms of capital are not always perfect substitutes, especially in contexts of resource depletion and ecosystem stress.

Data

Herd-level population data that spans from 1980-2020 and herd-level characteristics data from 2014-2020 are extracted and processed with the following sources:

- **Wyoming Game and Fish Department (WGFD) Job Completion Reports (JCRs)**: Estimate big game populations
- **WGFD Annual Reports**: Resident and non-resident distribution
- **WGFD Drawing Odds**: Demand for big game
- **Wyoming Department of Transportation**: Wildlife-vehicle collisions

Methods

- **Natural Capital Unit Value:**

$$P = \frac{W_s(s, x(s)) + \dot{P}}{\delta - [G_s(s) - f_s(x(s))]} \tag{1}$$

- **Population Growth and Harvest Models:**

$$G_{i,t}(s_{i,t+1} - s_{i,t} + H_{i,t}) = \alpha_0 + \alpha_1 s_{i,t} + \alpha_2 s_{i,t}^2 + \epsilon_{i,t}, \tag{2}$$

$$H_{i,t}(s_{i,t}) = \alpha_0 + \alpha_1 s_{i,t} + \alpha_2 s_{i,t}^2 + \epsilon_{i,t}. \tag{3}$$

- **License Allocation Model:**

$$L_{i,t}(s_{i,t}) = \beta_0 + \beta_1(s_{i,t-1} - \bar{O}_i) + \beta_2 r_{R,i,t-1} + \beta_3 r_{N,i,t-1} + \beta_4 s_{i,t-1} + \epsilon_{i,t}. \tag{4}$$

Resident and non-resident licenses are distributed as:

$$L_{R,i}(s_i) = S_i[L_i(s_i)], \tag{5}$$

$$L_{N,i}(s_i) = (1 - S_i)[L_i(s_i)]. \tag{6}$$

- **Net Benefits of Wildlife Resources:**

$$W_i(s_i) = GS_i + HS_i + OS_i, \tag{7}$$

where:

$$GS_i = n_{R,i}(s_i)T_{R,i} + n_{N,i}(s_i)T_{N,i} + L_{R,i}(s_i)p_{R,i} + L_{N,i}(s_i)p_{N,i} - C(s_i), \tag{8}$$

$$HS_i = v(d_{R,i}, d_{N,i}) + m(r_{R,i} + r_{N,i}), \tag{9}$$

$$OS_i = \mu[L_{R,i}(s_i)y_{R,i} + L_{N,i}(s_i)y_{N,i}]. \tag{10}$$

Management costs are estimated as:

$$C(s_i) = c_1 s_i + \gamma_0 + \gamma_1 s_i + \gamma_2 s_i^2 + \gamma_3 D_i + \gamma_4 D_i^2 + \epsilon_i. \tag{11}$$

Results

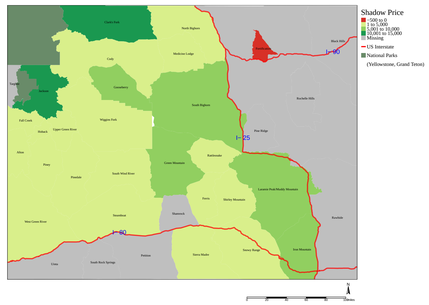

Figure 1: Elk Shadow Value

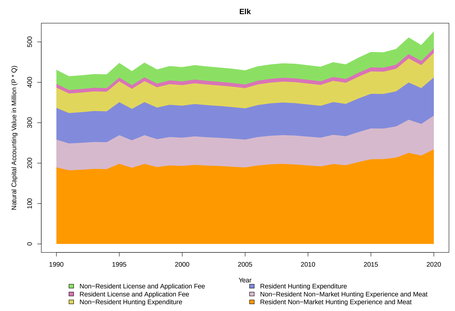

Figure 2: Elk Natural Capital Accounting

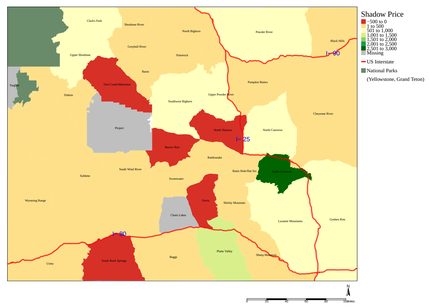

Figure 3: Mule Deer Shadow Value

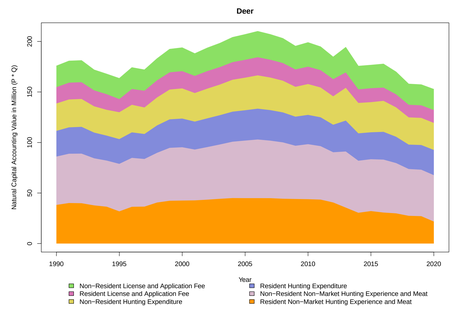

Figure 4: Mule Deer Natural Capital Accounting

Conclusion

- **Natural Capital Valuation:** Improved methods by enhancing precision and accounting for governance that was historically focus on natioanl-level.
- **Localized Valuation:** Subnational accounting highlights local contexts, which Wyoming's elk ($482.7M) and mule deer ($170.3M) illustrate this.
- **Key Insights:** Herd-level valuations vary; some herds (e.g., Ferris elk) have negative values due to high management costs, exceeding hunting revenues.
- **Policy Implications:** Restitution prices ($6,000 elk, $4,000 deer) fail to reflect ecological and economic differences. Herd-level valuation can guide judicial decisions and conservation investments.
- **Broader Impact:** Demonstrates valuation's utility for resources without market prices and highlights the importance of conservation measures like wildlife crossings.
- **Limitations:** Requires detailed data; economic programs must adapt to local management practices and wildlife dynamics.

References

[1] Eli P. Fenichel and Joshua K. Abbott. Natural capital: From metaphor to measurement. *Journal of the Association of Environmental and Resource Economists*, 1(1/2):1–27, 2014. doi: 10.1086/676034. URL https://doi.org/10.1086/676034.

[2] Bailey Kirkland, Jacob Hochard, Wai Yan Siu, and David Finnoff. Welfare and distribution in state-led wildlife management. *Environmental and Resource Economics*, 2024. doi: 10.1007/s10640-024-00895-6.