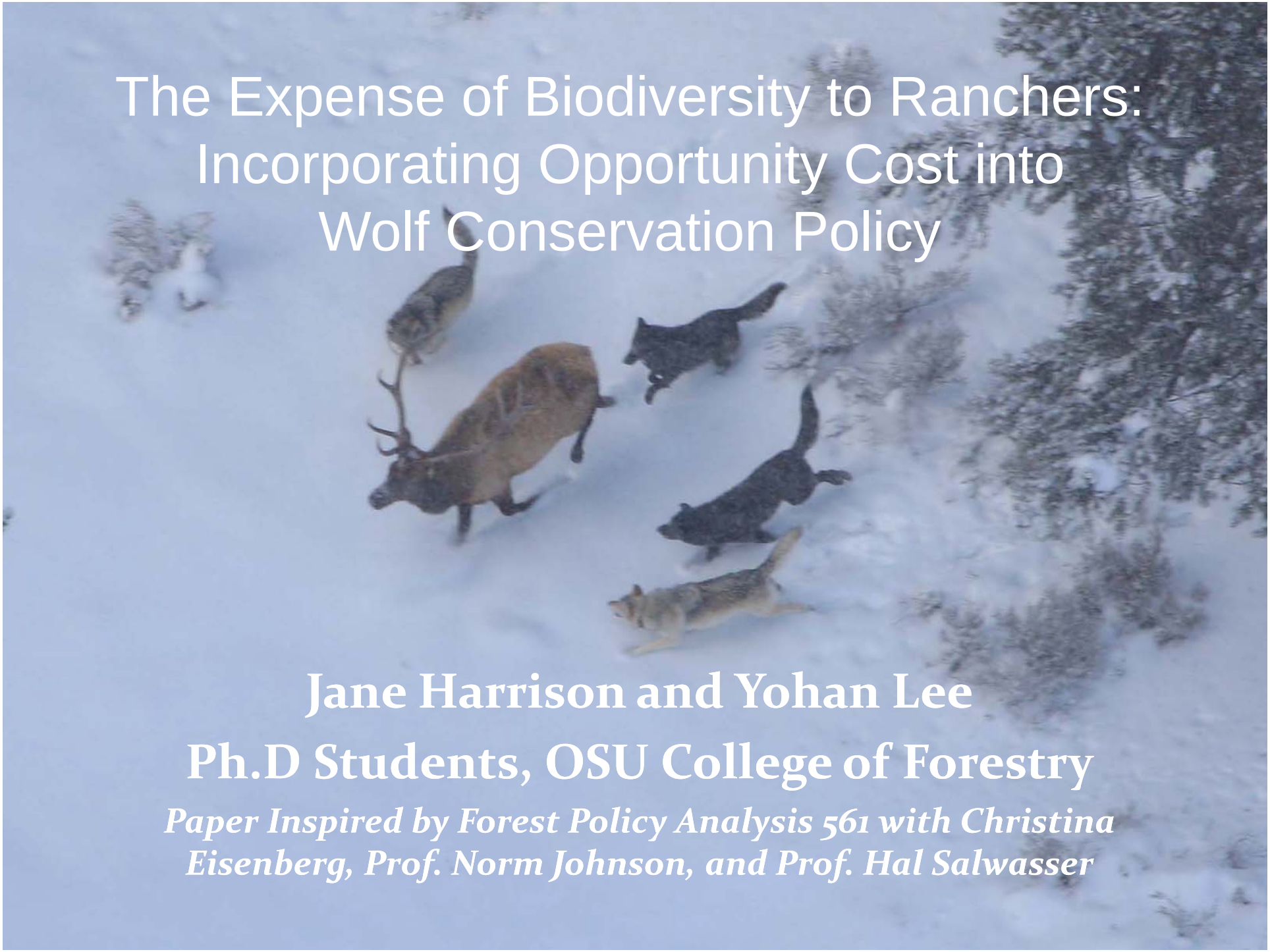
The Expense of Biodiversity to Ranchers: Incorporating Opportunity Cost into Wolf Conservation Policy



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Overview

- Introduction
- Literature Review on Wolf Management and Biodiversity Economics
- Theoretical Model
- Model Illustration
- Conclusion

Introduction

- The gray wolf was re-introduced to Yellowstone National Park in 1995.
- USFWS de-listed wolf as endangered species in 2008.
- 1,645 wolves in Northern Rocky Mountains by 2009.
- Conflict between local landowners and extra-locals implies an uncertain future for the wolf.

Historic Gray Wolf Range

Gray Wolf Range at Time of ESA Listing (1974)

Current Range and Mexican Wolf Recovery Area

Idaho Legislature House Resolution No. 43

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are needed to see this picture.

Model Overview

- We present an economic model to determine optimal wolf population and distribution in NRM.
- The model includes ecological and economic information in an implicitly spatial social welfare maximization problem.

Ecologically Effective Population

- The concept of minimum viable population is commonly used to set goals for species at risk of extinction.
- The USFWS employed a MVP model to assess wolf population numbers and distribution and delist this keystone species in the NRM, shifting management to the states.
- A larger wolf population may be needed to gain benefits from trophic cascades (Soulé 1987; Eisenberg et al. 2010).
- The spatial distribution of wolf population is paramount to understanding effects on different land ownerships.

Setting a Price for Biodiversity

- The total economic value of a species consists of use (e.g. recreational hunting) and non use (e.g. existence and bequest) values.
- Contingent Valuation method is a survey technique for the valuation of non-markets goods and services.
  - Duffield and Neher (1996) find the net benefits to wolf introduction at Yellowstone to be between $6 and $8.9 million annually.
- Prices should summarize information about a chain of production relationships that connect land use to biodiversity (Montgomery et al. 1999).

Theoretical Model

- Constrained Optimization Problem:

$$\text{Max } L = U(X_W, X_O) + \lambda[B - P_W X_W - P_O X_O]$$

- Wolf population size X_W and other uses X_O
- The first order conditions yield the optimality condition:

$$(\partial U/\partial X_W)/(\partial U/\partial X_O) = P_S/P_O$$

- The price of wolf conservation should equate to the marginal opportunity cost of providing it.

Livestock Depredation and Trophic Cascades

- Externalities change the optimization problem:

$$\text{Max } L = U(X_W, X_O) + R(X_W) + \lambda[B - P_W X_W - P_O X_O - L(X_W)]$$

- Benefits from trophic cascades $R(X_W)$
- Loss from Depredation $L(X_W)$
- The new optimality condition is:

$$((\partial U + \partial R)/\partial X_W)/(\partial U/\partial X_O) = (P_W + \partial L/\partial X_W)/P_O$$

Management Price for Wolves

- We define P_W as the mgmt. price for increases in habitat for population size X_W equal to the MRS between habitat and other uses X_O:

$$P_W + \partial L/\partial X_W =$$

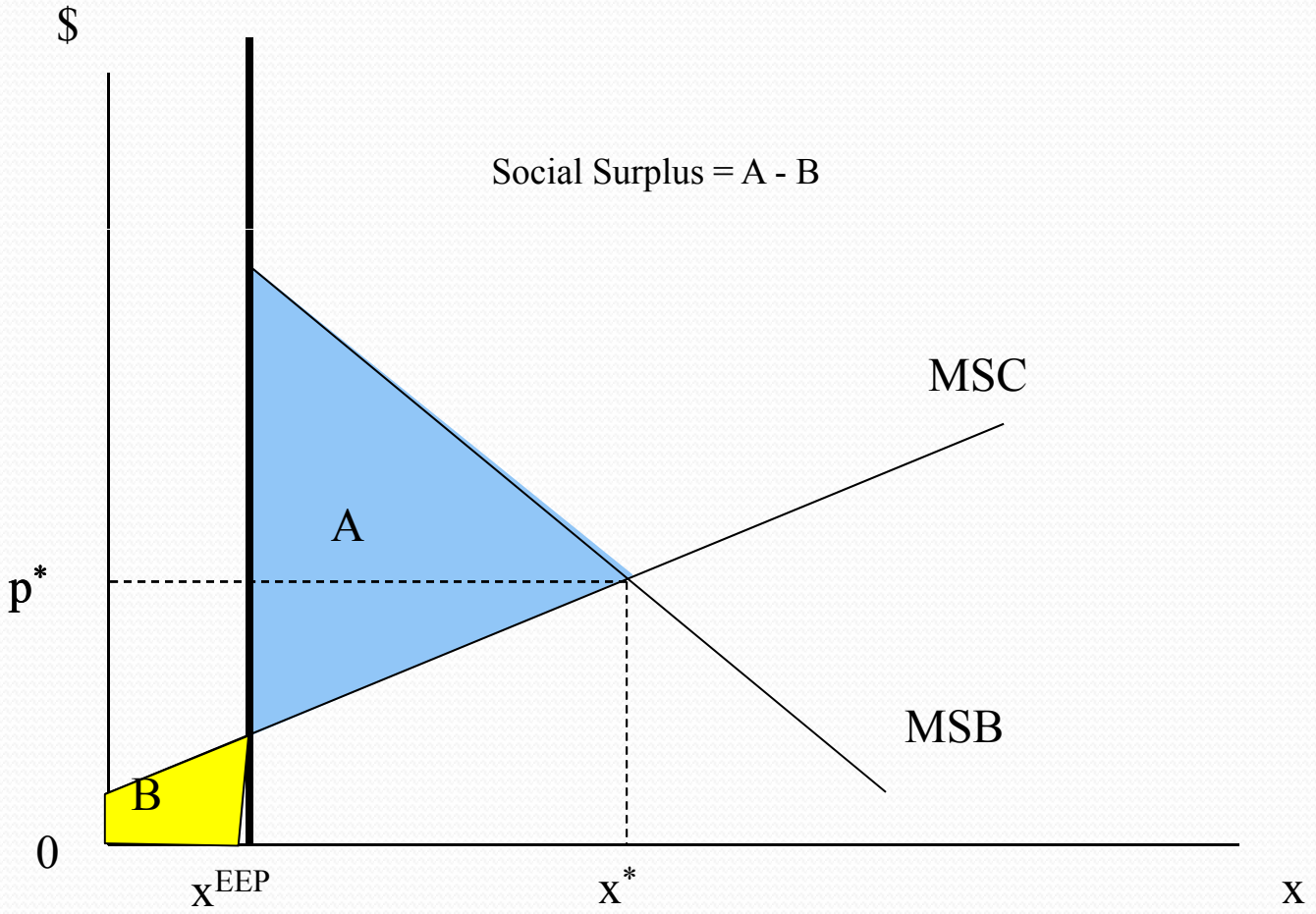
$$[((\partial U+\partial R)/\partial E(D))/(\partial U/\partial X_O)][\partial E(D)/\partial X_W]$$

- Price of Wolves

$$P_W = P_D E(\Delta D_W)(\partial V_W(X_W)/\partial X_W) - \partial L/\partial X_W$$

- Expected value to consumers of biodiversity E(D)
- Viability Function V_W measures ecological benefits

Model Illustration



Policy Implications of Model

- Understanding the components of the price of wolves allows land managers and policy makers to come up with creative ways to manage wolf population and distribution.
- The benefits accruing to increases in wolf population X_S must equal the costs.
- Hunting permits and a tax of $1/visitor at YNP could be used to offset the losses from depredation.
- The costs of monitoring the wolf population are high and should be added to this model.
- Losses to ungulate hunters may need to be added to the model.

Conclusions

- A price for wolf conservation allows land managers to determine the optimal number and distribution of wolves across varied ownerships.
- The theoretical model incorporates both ecological and economic benefits and costs in determining optimal wolf management policy.
- The model could be applied to different geographical scales (e.g. Wyoming, NRM, United States, North America).
  - Wolves move across political boundaries!

My “wolf” Russell

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References


Thank you