A Landscape Perspective on Conservation

for

NRC Committee Addressing Sustainability Linkages

CBES

Center for BioEnergy Sustainability

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Roadmap for talk

- Landscape perspective
- Gaps in knowledge and tools
- Solutions offered by landscape perspective

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A Landscape Perspective is Needed

- It is now recognized that:
  - *the spatial scale of environmental problems is large*
  - *all ecological processes (and management actions) occur in a spatial context*
- Ecological systems can be viewed as spatially and temporally hierarchical
  - *processes observed at one level*
    - *arise from lower-level behaviors*
    - *are constrained by higher level processes*
  - *solutions need to be provided within a spatial context*

Mechanisms by which Natural and Anthropogenic Disturbances Affect Ecological Processes

- Species changes
- Land cover changes
- Changes to natural disturbance regimes
- Changes to biogeochemical cycles

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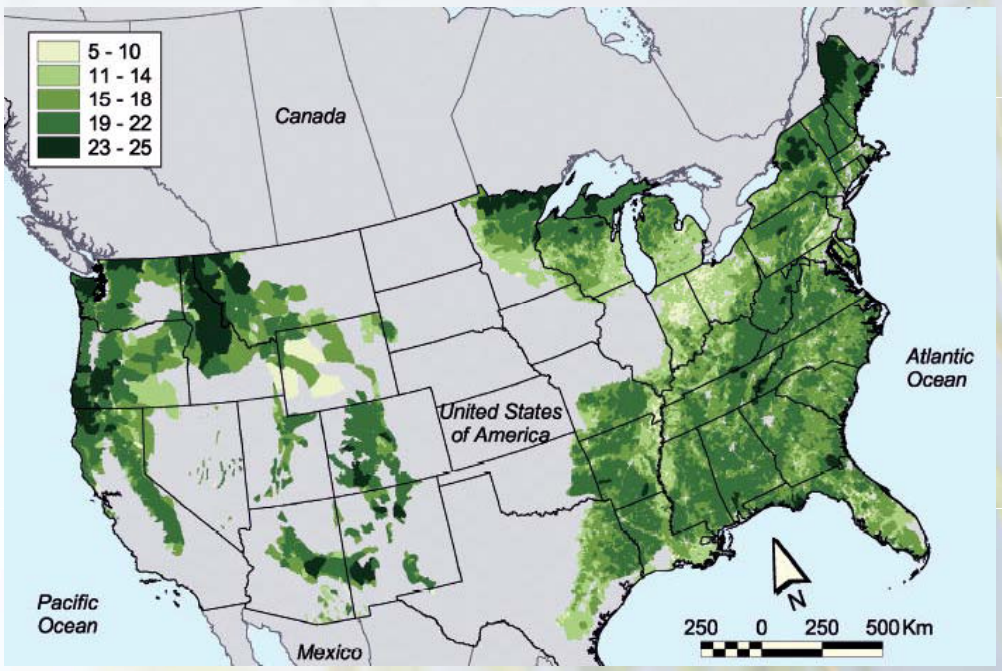
Species changes

- Local extirpation (e.g. lady slippers)
- Changes to population (e.g. roads bisecting pop.)
- Introduction of new species
- Changes in role of trophic relations (e.g., Port Orford cedar fungus)

Land cover changes

- Changes in extent
  - **Habitat alterations**
  - **Changes in corridors**
    - Pathways for invasive species (gypsy moth)
    - Disruption of migration routes
- Changes in juxtaposition of land cover types
  - **Effects on edge species**
  - **Erosion from disturbed areas**



Map of connected forests (from Heilman et al. 2002 BioScience 52: 411-422)

Changing Disturbance Regimes

- Disruption of frequency
  - Low level, frequent fires
  - Seasonal floods
- Increase in intensity
  - Fires in western US
  - Floods
  - Pine bark beetle outbreaks
- Spread of disturbances
  - long horn beetle
- Instigating other disturbances
  - Landslides

Changes to Biogeochemical Cycles

- Air quality
- Biomass change
- Climate change
- Changes in cycling of water, nutrients and energy

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Gaps in knowledge and tools

Gap: Addressing appropriate scale of issue

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Gap: Data availability and use

- Need to be at appropriate temporal and spatial scale
- Need to relate to phenomenon of interest
  - e.g., land cover ≠ land use
- Need to be affected by process of concern

Gap: Experiments that include key drivers and appropriate scales

ORNL Sweet gum FACE Site

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Gap: Models that include key processes at appropriate scales and that are well documented

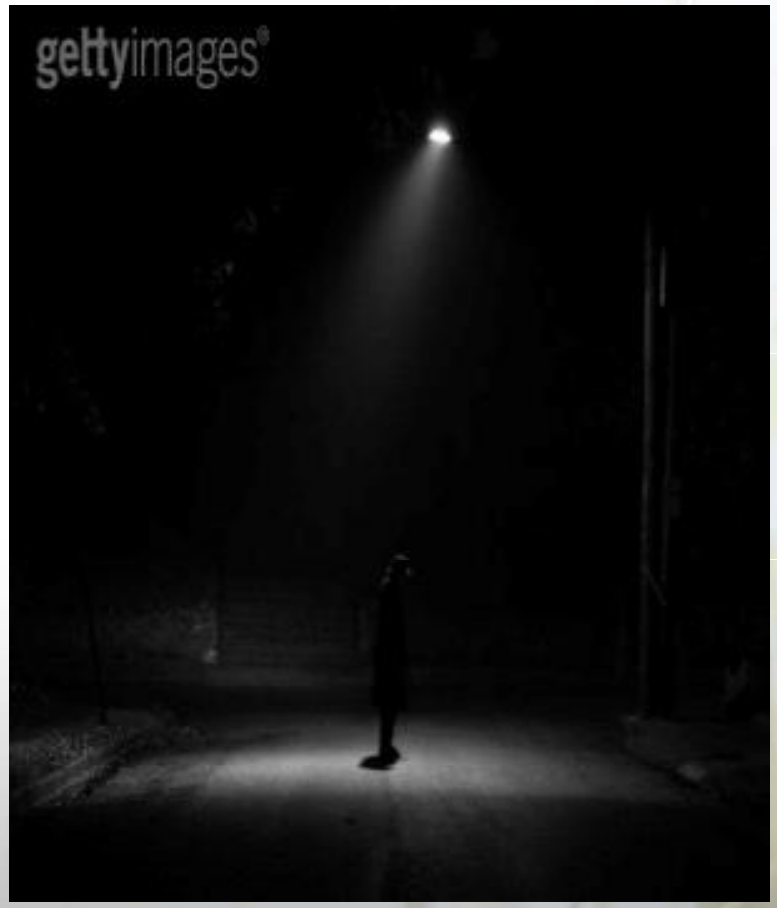

Image by Kevin Osborn

We don't want to be like the drunk looking under the lamppost for lost keys

Gap: Linking ecosystem function to services

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Gap: Quantifying monetary and non-monetary values of ecosystem services

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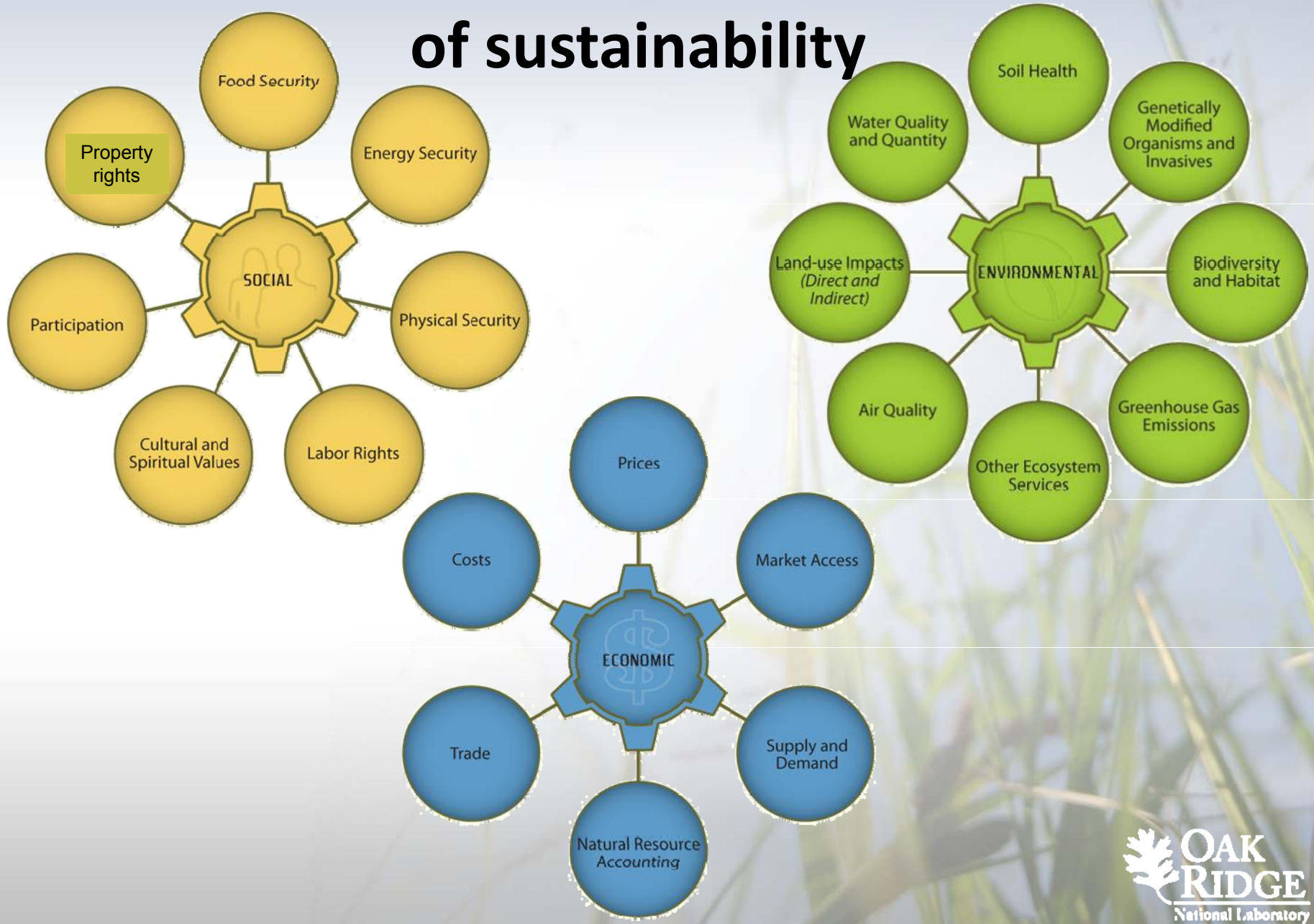
Gap: Considering all components of sustainability



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Solutions offered by landscape perspective

Solution: Adapting research for resource management

- Acknowledge full scope of problem within a systems perspective
- Explore diversity of approaches
- Use long-term vision to direct research
- Explore alternative futures
- Engage the people affected by the resource uses

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Solution: Tools that address problems in appropriate manner

- Including human drivers and responses
- Dealing with spatial and temporal dynamics
- Considering interactions and tradeoffs
- Quantifying uncertainties and sensitivities

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Solution: Collaboration between scientists and decision makers

- Collaboration
  - Iterative process to build consensus
  - Set goals that reward collaboration
- Technology transfer
  - Presenting information in an understandable manner
  - Designing research in terms of management design (see the end at the beginning)
- Dealing directly with risk
  - Define uncertainties
  - Communicate risk

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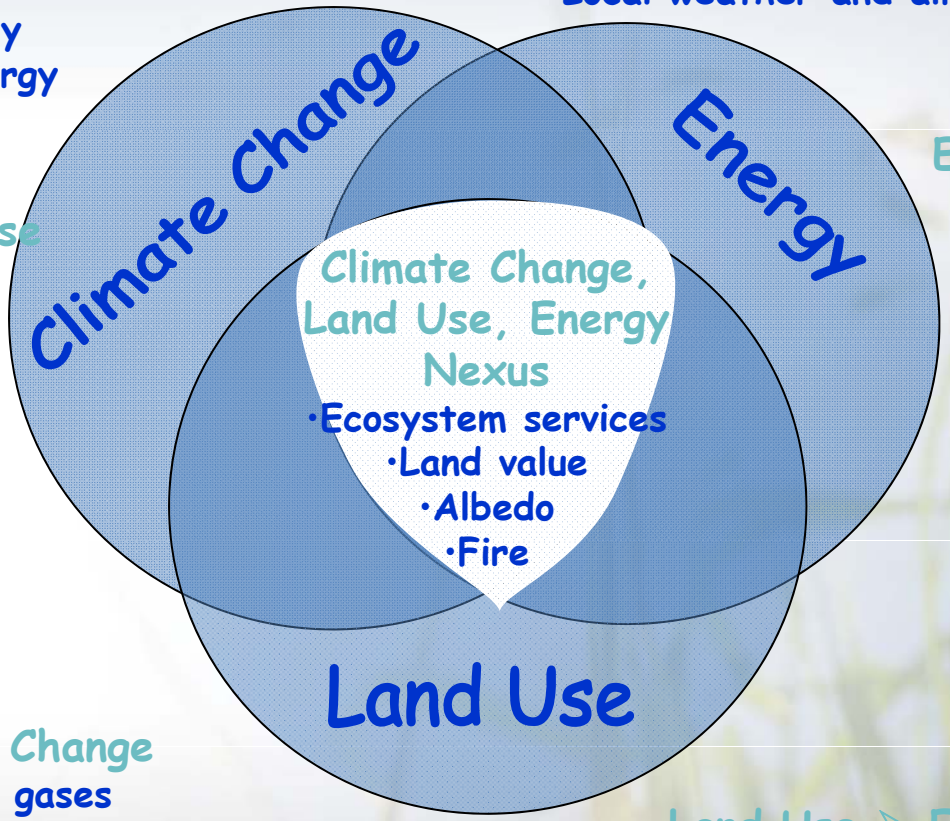
Solution: Addressing Linkages

Climate Change ➢ Energy
- Energy Options
- Intensity of use
- Distribution of supply and demand for energy

Energy ➢ Climate Change
- Greenhouse gas emissions and carbon sequestration
- Local weather and air quality



Climate Change ➢ Land Use
- Productivity
- Suitability for life forms and management practices
- Distribution of land uses
- Human settlement patterns

Energy ➢ Land Use
- Energy extraction, production and distribution footprint
- Infrastructure and settlement plans

Land Use ➢ Climate Change
- Release of greenhouse gases
- Amount of carbon sequestration
- Weather changes
- Vulnerability to climate change

Land Use ➢ Energy
- Options for energy extraction, infrastructure, and production
- Efficiency of energy production
- Demand for energy

[From Dale, Efroymson and Kline, In review. The land use – climate energy nexus. *Landscape Ecology*.]

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Challenge: Everyone wants the answer now!

- Seeking a technology “fix”
- Society resists change
  - Happens incrementally
  - Results following disaster
- Policy incentives, mandates and restrictions are viewed with caution
- The process of scientific investigation is not understood

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