Landscape Forecasting of Plant Diseases and their Effects

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Future Landscapes May Be Radically Different

Sources of change and uncertainty:

- Insects and pathogens
- Climate change
- Disturbance change
- Land-use change
- Market forces
- Human adaptation to all of the above



Landscapes Have Trajectories





Landscapes Have Trajectories







Must We Be Proactive?

Yes. The consequences are higher:

- Habitat for critical or endangered species
- Ecosystem services
- Irreversible change



Must We Be Proactive?

Global Food Security

- Human population expected to grow by \sim 3B
- Multiple Threats: Emerging plant diseases, climate change, land use change, etc.
- We depend on our landscapes for a broad range of ecosystem services in addition to food production.
- How do we enhance food security while maintaining broader landscape health and functioning?



Our Approach







Our Primary Thesis

Landscape management must address threats to long-term landscape health and embrace innovation and uncertainty.





Question We Address

- What are the threats? What are the solutions?
- Which management approaches will be most effective?
- Which landscapes are most amenable?



Our Approach

Multi-disciplinary:

• Landscape ecology, ecosystem ecology, social sciences, and landscape management

Data-driven:

- Geospatial: soils, biota, climate
- Social/management data at many scales
- Local knowledge

Future-oriented:

- Forecast landscape change
- Assist innovation
- Inform policy



Forecasting Landscape Change

Goals:

- Learn about the future
- Promote innovation





Forecasting Landscape Change

Data Science



Forecasting Landscape Change



Sierra Nevada

Sierra Nevada

Forecasting Forest Change

Data Science = Input Data LANDIS-II Landscape Change Model

Projections

Results: Insects vs. Other Disturbances

Conclusions (ongoing...)

- As compared to wildfires, insects and disease are more challenging to manage.
- Local interventions will not be sufficient: landscape interventions necessary to reduce host density.
- Insects and disease are challenging to forecast: insufficient data, population dynamics, novel agents
- Net benefits of pro-active management scale linearly with effort

Forecasting Proactive Management

What have we learned?

- Every landscape is unique
- Adaptation can be effective!
- Adaptation will need to be extensive and committed
- Ecosystem service tradeoffs may be large
- Translation to policy and action requires co-development of knowledge

Thank You!

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