How does basic scientific research done at Kansas’ universities benefit Kansas citizens?

Contributions of Ecological Forecasting- University of Kansas, Kansas State University
What is Ecoforecasting?

- Understanding what will happen to ecological goods and services in the future
- Global change creates a shifting baseline
- We take advantage of more data and increased computing power
- Can apply to disease, invasive species, carbon sequestration, and any other ecological characteristic of interest
Why Ecoforecasting Matters

- A grand challenge for the 21st century: sense, evaluate, model and forecast the biological and ecological consequences of global changes (National Research Council)
- Global change phenomena are critical for grasslands
  - ecosystem of global importance, providing resources and services to human societies worldwide
  - ecosystem critical to the Kansas and regional economy.
Ecoforecasting EPSCoR Track I and Track II

- Infrastructure development
- Track I 2007-2009
  - Kansas State University
  - University of Kansas
- Track II 2009-2011
  - University of Oklahoma
  - Oklahoma State University
Today’s talk

- Types of infrastructure
  - Stuff
  - People

- Benefits to the citizens of Kansas
  - Research as an economic force
  - Ecosystem goods and services
  - Managing and preserving our natural world
Infrastructure tools: biogeochemistry, climate

New tools to sense environment such as scintillometers and flux towers
Infrastructure: Network Architecture - linking tools in the field to cyberinfrastructure

Internet

Router

Satellite link

Storage and Computing Resources

Field Deployment

Field Wireless Network (e.g. Motes, Sun Spot, hybrid RFID, Wi-Fi, others...
Developing Cyber Infrastructure
Data Collections and Databases
How are we to deal with all the data?
Implementing these methodologies at the broader scale

- Our involvement in national networks
  - NEON
  - STREON
- What kinds of forecasting can we link these network-derived data too?
National Ecological Observatory Network - an example of tools needed - ecoforecasting allows us to integrate with this framework (courtesy MacMahon)
Tentative NEON core sites

We are one...
We are a candidate stream research experiment and observational network (STREON) site.
An example of research- and linking to ecoforecasting

- Dr. Samantha Wisely, and students Sara Bowe and Heather Barton, Dr. Caterina Scoglio and students Alie Sydney and Phillip Schumm
- Skunks and rabies spread- and ecologically based approach
Landscape genetic approaches can help us understand epidemiological links: most researchers 2 nodes

How landscape features be identified that promote or hinder pathogen emergence

How host background affects pathogen transmission properties

How host population connectivity and dispersal influences disease emergence
How does disease spread across the landscape?

Skunks placed by natural density

Network of probability of skunk interaction

Transmission clusters
Nutrients in Midwest streams
Thresholds common with diversity and total phosphorus in water column

\[
\begin{align*}
\text{Richness} & = 0.040 \\
50\% & = 0.051 \\
95\% & = 0.091
\end{align*}
\]
Primary consumers more strongly influenced

![Graph showing TP (mg/L) for different categories]

- Total
- PRIM
- GATH
- SCR
- SHR
- PRED

TP (mg/L)
Ecoforecast implications

- Diversity will decrease with increased P
- Predators will be less effected than consumers
- Phosphorus may be more important than nitrogen in this case
Agriculture controls phosphorus in Kansas
Transport driven by floods, so management objective determines best practices
We are just becoming able to forecast large-scale ecological change

- Ability to collect and deal with large data sets including historic and wide spatial coverage
- Multidisciplinary research becoming the norm, and is necessary to solve ecological problems
- Need broader synthesis and connections
The Remaining Challenge

Integrate science framework with cyber framework for ecological forecasting
NSF just awarded
EPSCoR Track II: Cyberinfrastructure to enable research
• Oklahoma and Kansas
A CyberCommons for Ecological Forecasting
• Four universities: KU, KSU, OU, OSU
• $6M ($3M for KS: $1.5 M each for KU, KSU
• Integration of the Science Framework with the Cyber Framework
Relevant questions

- What are the consequences of global change for our region?
- How will we fit into cap and trade solutions for control of greenhouse gases?
- How will the environment transmit emerging diseases and pest species?
- How will human actions influence the ability of the ecosystem to sustainably support activities such as agriculture?
- Can we maintain our natural biological resources into the future?
Research as an economic engine

- NSF LTER has created long term infrastructure
- This grant has led to numerous other grants
- EPSCoR money enhances the ability to attract extramural support
- New faculty lines that will bring in extramural funding and catalyze new research areas
Non-LTER Konza-Related Research

Non-LTER Konza-Related Research

thousands of dollars

$13.9M

$6.74M

$5.40M

$800K

$600K

I  II  III  IV  V

LTER Funding Cycle
Ecosystem goods and services values generated by the natural environment

- Sequestration of greenhouse gases
- Water supply
- Erosion control
- Pollution control
- Commodities (e.g. hay)
- Recreation (e.g. hunting)
Property value decreases with increased eutrophication of lakes

<table>
<thead>
<tr>
<th>Ecoregion</th>
<th>% Increase in Hypereutrophic Classification</th>
<th>Million Dollars</th>
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</thead>
<tbody>
<tr>
<td>I</td>
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<td>0</td>
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<td>II</td>
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<td>XIV</td>
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<td>400</td>
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</table>

Property value decreases with increased eutrophication of lakes.
Another example- woody encroachment of prairie

- Woody vegetation has increased in the Flint Hills
- Value of ecosystem goods and services greater for grassland than forest in this region (related to hay or livestock production, but also greater biodiversity)
Relative ecosystem goods and services- value for area the size of the Flint Hills (50,000 km²)

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Value per hectare ($)</th>
<th>Total value (billion $ per year)</th>
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<tbody>
<tr>
<td>Eastern Forest</td>
<td>4258</td>
<td>21.3</td>
</tr>
<tr>
<td>Great Plains (native)</td>
<td>5207</td>
<td>26.0</td>
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<tr>
<td>Great Plains (restored)</td>
<td>3765</td>
<td>18.8</td>
</tr>
</tbody>
</table>
Summary

- Ecological systems vital to Kansas citizens
- Unprecedented ability to predict how a changing world will influence Kansas ecosystems
- Research generates dollars
- Research can aid decisions to maximize value to Kansas