Advances in Predicting Wildlife Exposure to Wind Energy Development

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NREL modeling: An example of a step towards more realistic projections of wildlife risk from wind energy development

Ideas to cover:

- How do we currently assess the risk that wind energy development and operation will have adverse impacts on a species?
- What are the limitations to current approach?
- Introducing an alternative approach – NREL model of wind deployment potential
  - **Links a geospatial renewable energy potential model (reV) with a sector-wide build out and operations model (ReEDS).**
  - **Addresses multiple limits on development of new wind energy and can accommodate data on distribution and abundance of wildlife**
  - **Offers a multi-factor analysis of deployment potential**

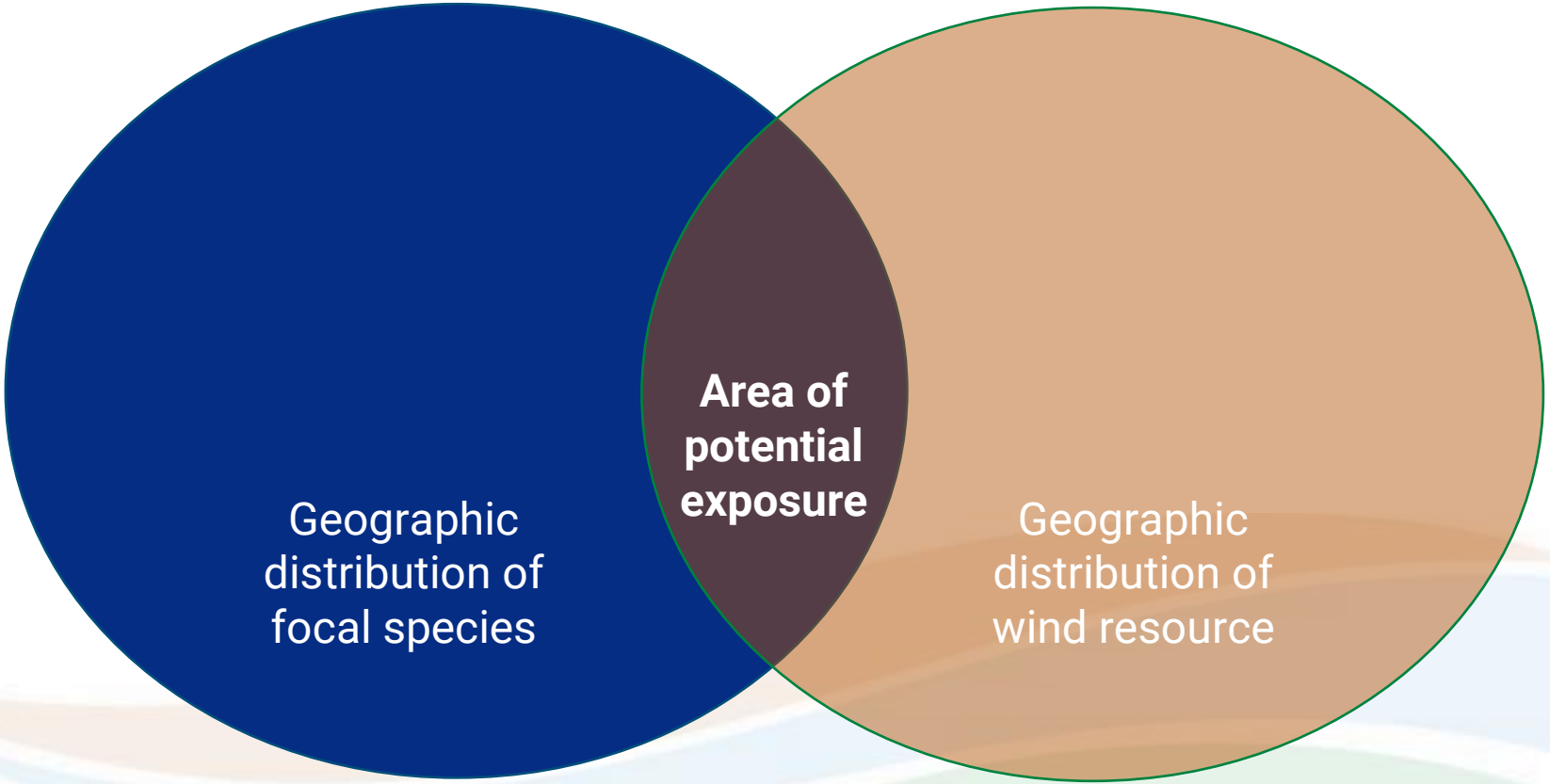
Background: Predicting wildlife exposure to wind energy

- Predicting locations where future wind energy development may overlap with the distribution of species of concern is a common way of assessing risk
- Risk depends on the probability of a negative effect and the magnitude of the effect should it occur
- Exposure of wildlife to wind energy development is often used as a metric for the probability of a negative effect
- Exposure is estimated by the overlap between one predictor of development (wind resource) and species presence, e.g., static range limits

Using wind resource and species' ranges to predict exposure of wildlife to new development

The next three slides show the theory and practice of using the overlap of the geographic range of species and wind resource (assessed by wind speed) to predict exposure and risk to wildlife

Overlap in geographic range of species and wind resource is typically used to define potential exposure and risk



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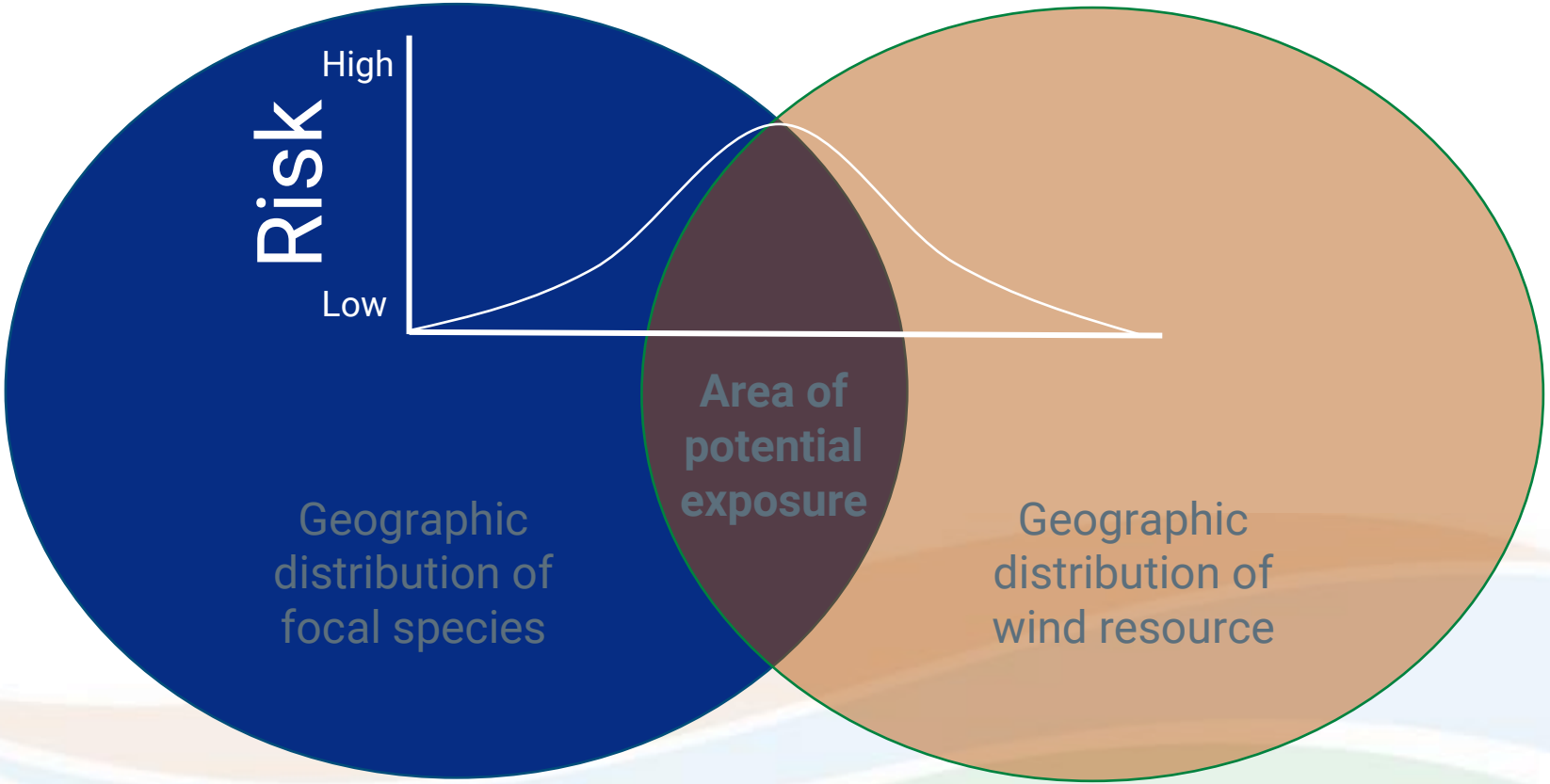
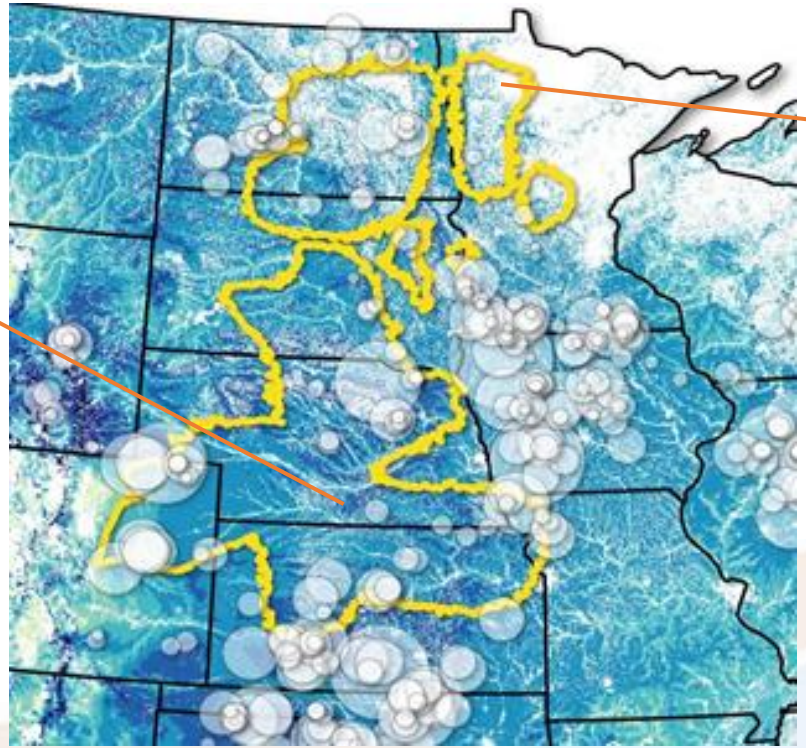


Example: Risk to greater prairie-chicken presumed highest where its range overlaps with areas of highest wind speed

High risk (high wind speed)

Low risk (low wind speed)



Wind Speed
(meters/second)
- ≥ 10
- 9.0 to 9.9
- 8.0 to 8.9
- 7.0 to 7.9
- 6.0 to 6.9
- 5.0 to 5.9
- 4.0 to 4.9
- 3.0 to 3.9
- < 3.0

Greater Prairie-Chicken Range

For illustrative purposes only; not an actual risk map

Challenges with this approach

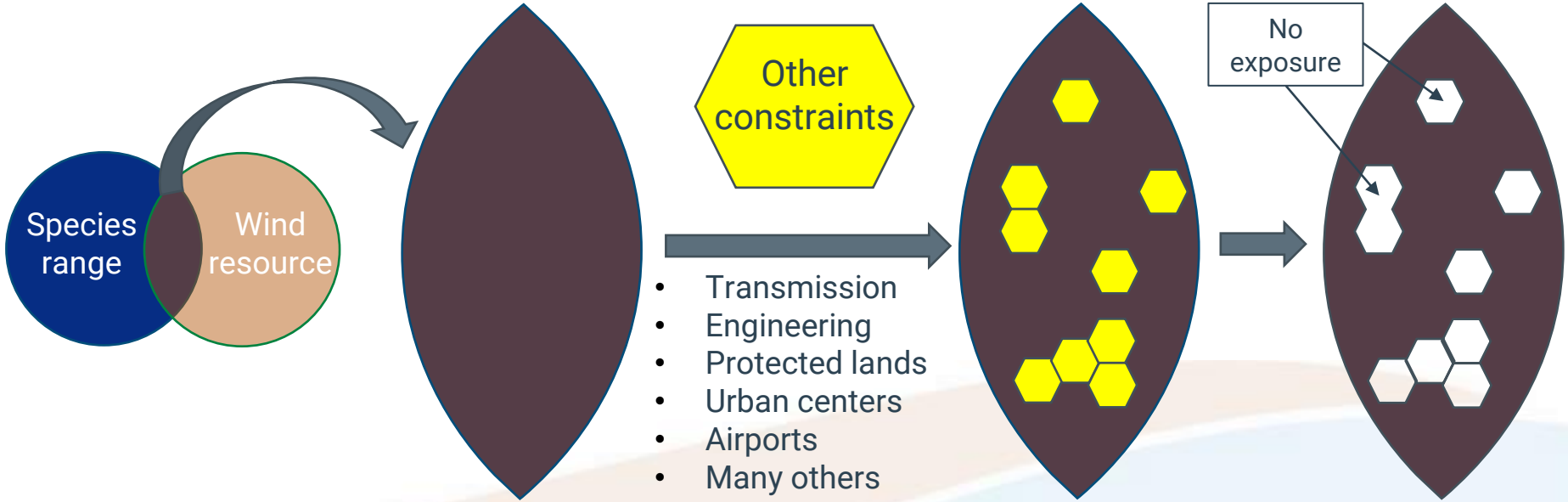
- Single-factor measurements likely overestimate exposure of wildlife to new wind-energy facilities because they ignore 1) other constraints on development, and 2) variation in abundance of a species within its geographic range.

The next three slides illustrate how better predictions are possible with models that consider multiple constraints on development, realistic patterns of distribution and abundance, and feedbacks between the two.

Using multiple-factor analyses to estimate exposure of wildlife to wind-energy development

Potential exposure:
Single factor (e.g., wind resource)

Potential exposure:
Multiple factors

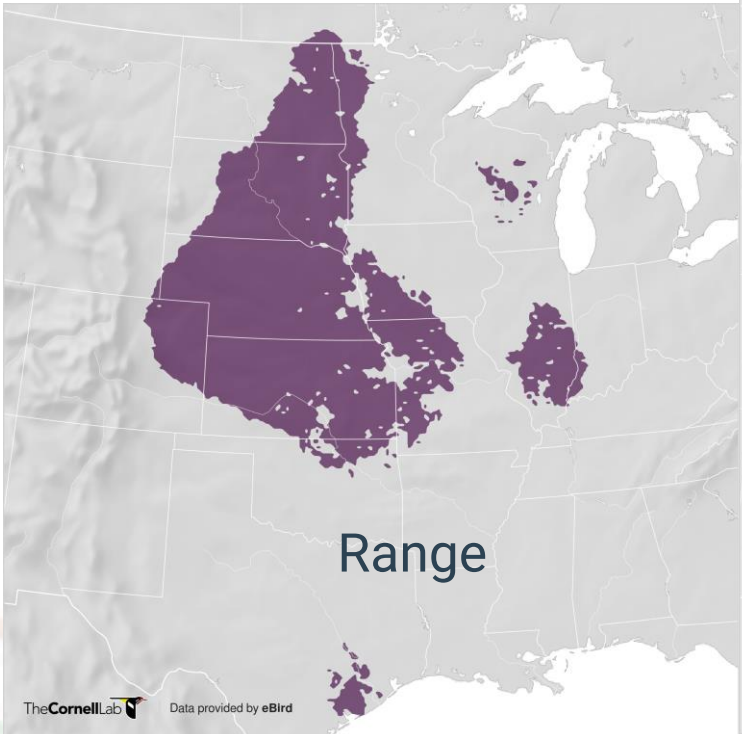


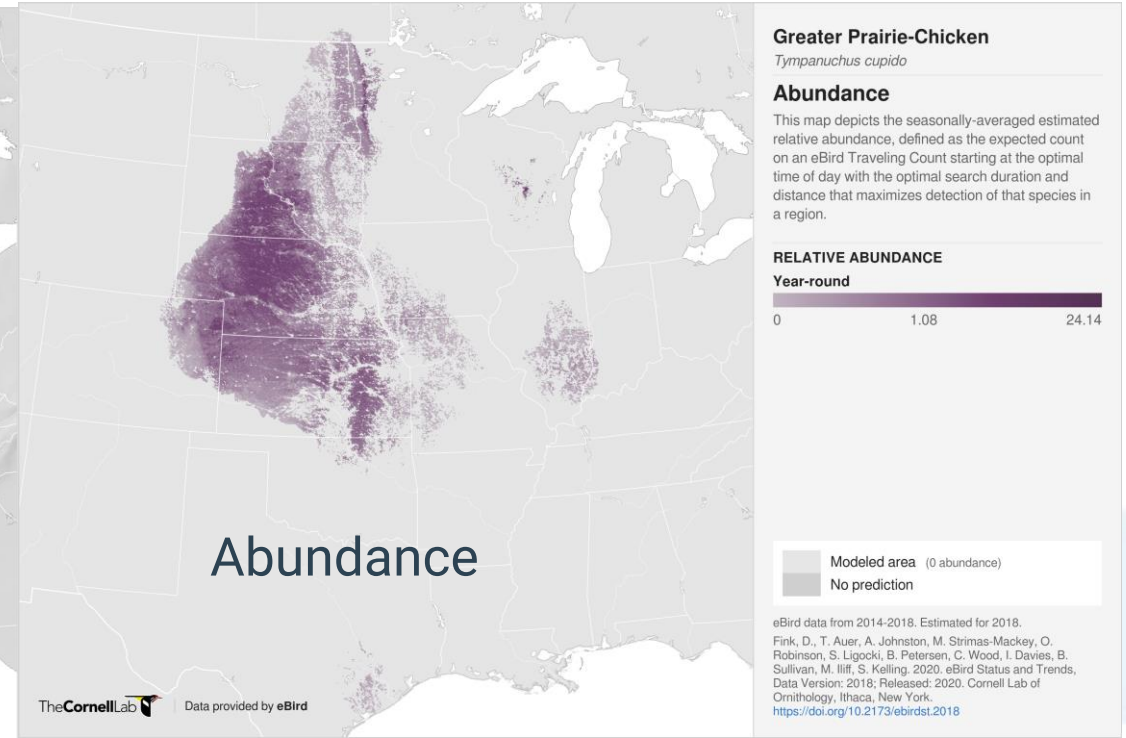
Exposure predicted everywhere in species range with high wind speeds

Exposure predicted only in parts of range where development is feasible

Potential exposure to wind energy also influenced by spatial variation in abundance of species

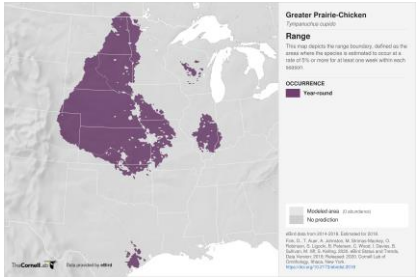
A range maps shows limits of distribution……but abundance varies substantially within those limits.



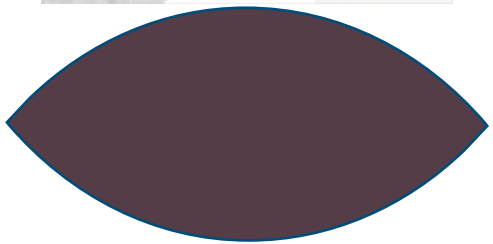


Incorporating variation in abundance leads to robust estimates of exposure for risk assessment and conservation planning

If we ***ignore*** spatial variation in abundance…



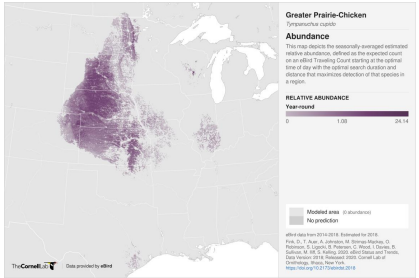
… and realistic constraints on development potential…



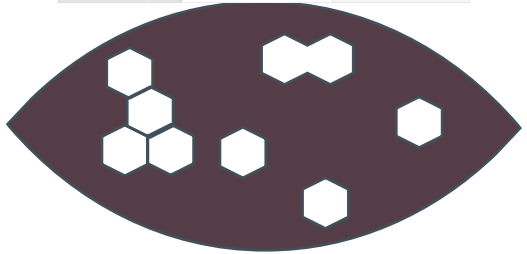
Then we will:

- Miss spatial variation in risk
- Overestimate wildlife constraints on wind development
- Focus limited conservation resources on low-priority areas and species

If we ***incorporate*** spatial variation in abundance…



… and ***set*** realistic constraints on development potential…



Then we will:

- Identify risk hotspots
- More accurately estimate costs and benefits of build-out scenarios
- Focus investment in areas with highest potential return

Risk assessment is improved by systems-level thinking

Accurate, precise estimates of exposure and risk require considering:

- Multiple constraints: wind energy development potential is shaped by many factors, not simply potential value of the resource
- Spatial variation in species abundance
- Constraints are dynamic: land-use change, changes in technology, and climate change will affect exposure and risk

NREL model is an example of a step towards more realistic projections of wildlife exposure to wind energy, offering a potentially unified approach to risk assessment.