



Environmental Aspects of Renewable Energy

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Key Messages

While renewable energy has many environmental advantages over other approaches to power generation, there are impacts that need to be understood and managed

On-going research is developing a better understanding of the magnitude of those impacts and how to minimize them to reduce the hurdles for future development

Outline

- In The Press
- Defining the Impacts
 - Ecological
 - Sociological
 - Technological
- Implications for Projects
- The Issues in Context
- Ongoing & Future EPRI Research

In The Press

'Some sacrifices' necessary for clean energy

The New York Times

April 28, 2011



News Release
December 9, 2011

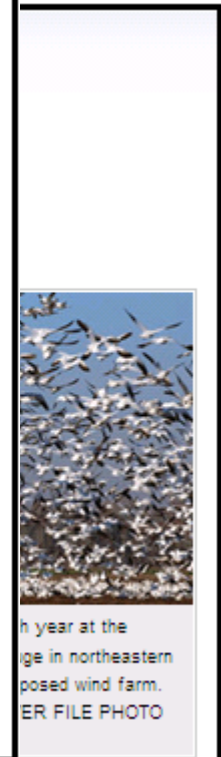
Scientific Literature Review Finds Opportunities for More Research on Solar Energy Development and Impacts to Wildlife

FLAGSTAFF, Ariz. – More peer-reviewed scientific studies of the effects on wildlife of large-scale solar energy developments and operations are needed to adequately assess their impact, especially in the desert Southwest, according to a scientific literature review conducted by the U.S. Geological Survey and published in the journal *BioScience*.

In their literature review, the authors of the paper, USGS scientist Jeffrey Lovich and Maryville College scientist Joshua Ennen, found that out of all the scientific papers they examined, going back well before the 1980s, only one peer-reviewed study addressed the direct impacts of large-scale solar energy development and operations on any kind of wildlife. Peer-reviewed studies are those that have been reviewed by experts in the same field of study and are then published in scientific journals.

One reason why there are few peer-reviewed studies is that the interest in developing alternative energy has grown exponentially in recent years and science has to “catch up.” Opportunities for hypothesis-driven research on solar energy facilities of this scale, particularly research looking at baseline conditions before development, impacts of operation, or conditions after development, have been limited.

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h year at the
ge in northeastern
posed wind farm.
ER FILE PHOTO

The Chatham

Opposition to ENVIRONMENT:

ELLWOOD SHREVE

The Daily News

The lawyer, who represents
disputing a study that conclud

Eric Gillespie has sent a 12-p
Care and Minster of Energy, c
MOE, does not provide full inf

"If somebody just read the pr
reason to have any concerns

He points to expert testimor
concerning the Kent Breeze
health impacts from the noise created by wind turbines.

Ecological Impacts - Wildlife Rule May Halt Wind Turbine Projects



Photo: Donna Dewhurst/USFWS

The agency plan will have a "serious impact on the ability for our industry to develop," Denise Bode, CEO of the Washington, D.C.-based AWEA, told reporters.

“Protecting the golden eagle may prevent 34,000 megawatts of development and \$68 billion in investment, according to the group.

The siting proposal may delay projects for as long as three years, increase costs and force operators to shut turbines at certain times of the year.’ - AWEA

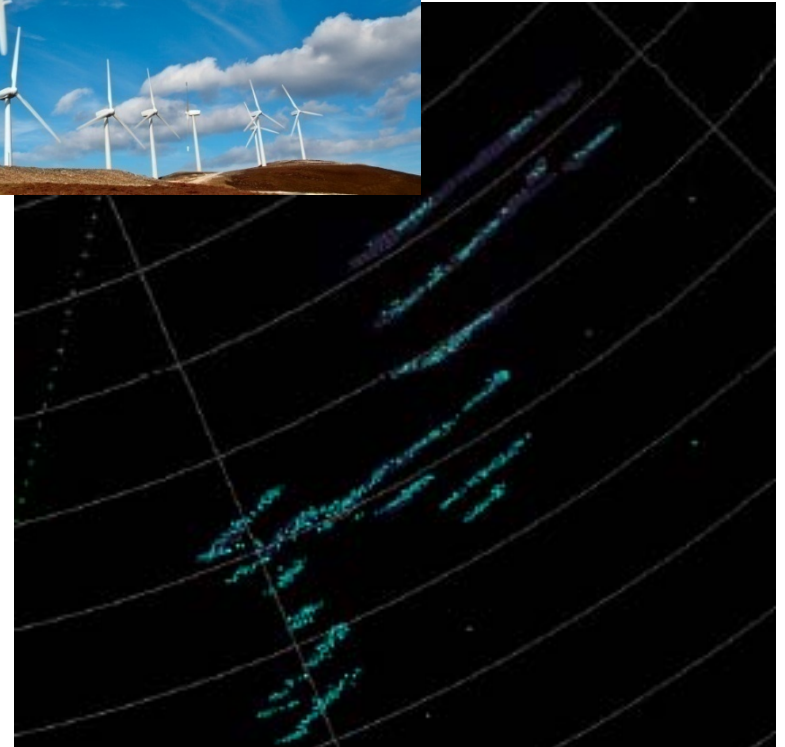
Sociological Impacts - Clean May Not Always Be Green Where Wind Power is Concerned

- Industrial-scale wind farms have altered the rural landscape in places where the natural environment and quiet living are high priorities.
- Some of the most vocal resistance to wind farms is about people, not wildlife.
- Issues:
 - Noise and Health
 - Visual Impacts
 - Place Identity
 - Opposition to Change



Technological Impacts - Gulf Coast Turbines Expand Texas Wind But Not Without Worries

- South Texas now accounts for about one-ninth of total wind capacity in Texas, the country's leading wind producer.
- The new turbines have ***raised concerns about their effects on birds and military radar.*** This part of Texas lies along a major migratory bird path, and the Naval Air Station Kingsville, a training ground for jet pilots, has had to "tweak" its radar to block out turbines that look like airplanes to military radar.



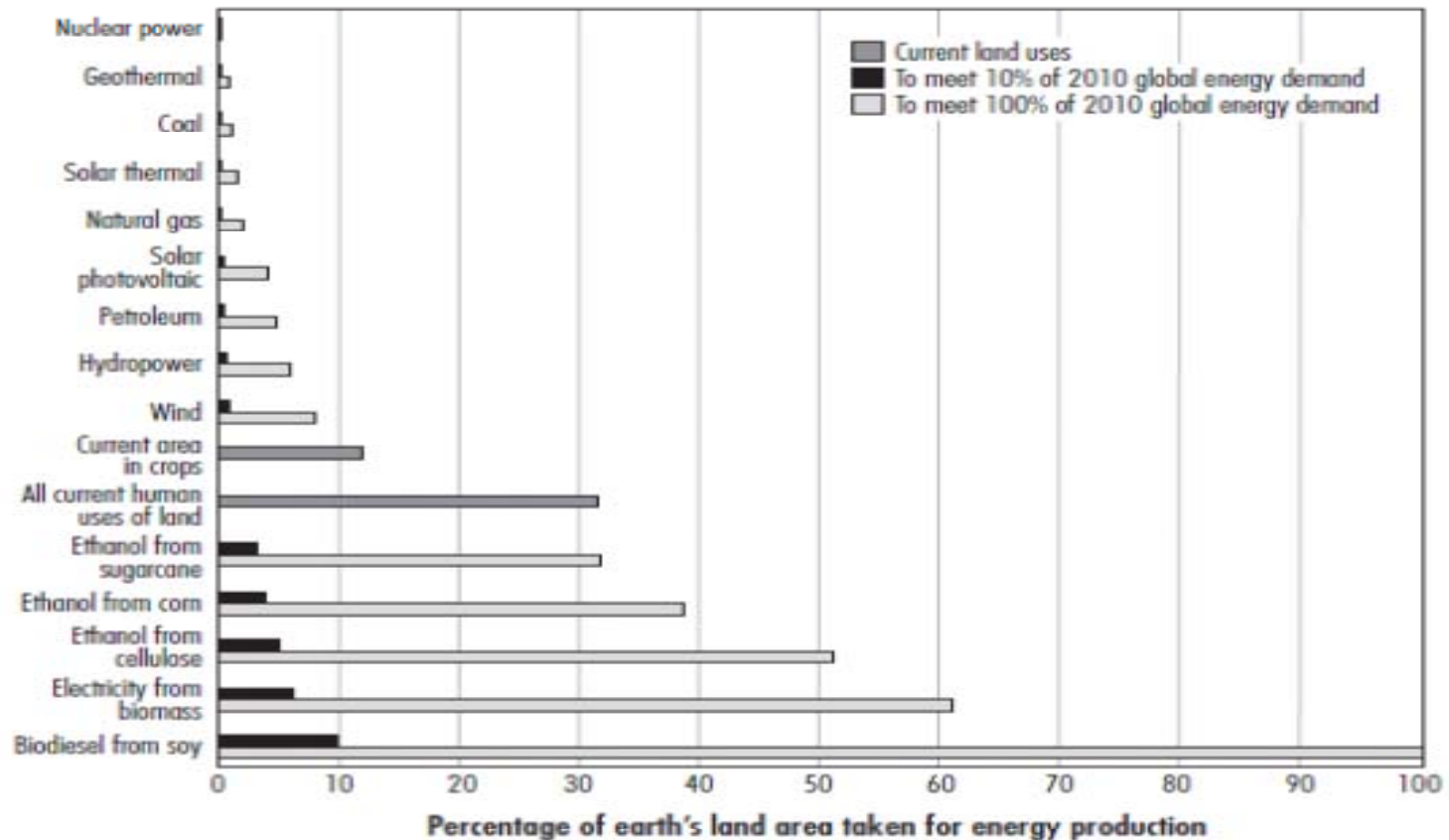
Potential Ramifications

- Extended Project Permit Time
- Pre- and Post- Construction Species Monitoring
- Mandatory Conservation Easements with Perpetual Management Endowments (Up to 5x Increase in Land Requirements and Costs)
- Habitat Conservation Plans; Avian and Bat Protection Plans
- Operational Curtailment (Decreased Production; Lower ROI)
- Project Cancellation

Land Use Requirements

Updated Study in
2012

Land Requirements of Alternative Energy Sources

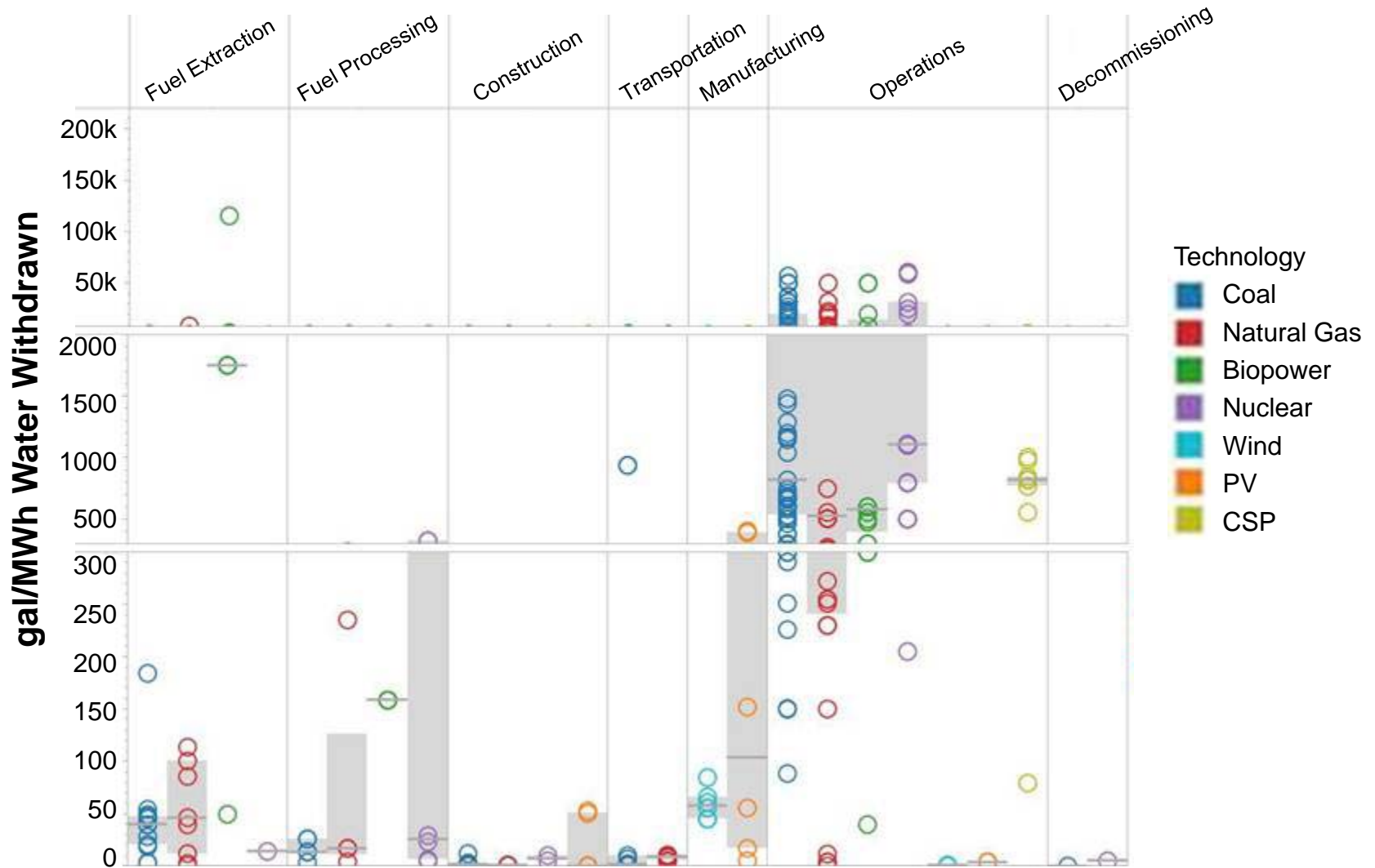


Sources: Land intensiveness data from McDonald et al. (2009); land area data from Melillo et al. (2009); global energy demand data from EIA (2009a).

Graph from Andrews et al. (2011), Alternative Energy Sources and Land Use. In Climate Change and Land Policies, Edited by Gregory K. Ingram and Yu-Hung Hong, Cambridge, MA: Lincoln Institute of Land Policy. ISBN:978-1-55844-217-7

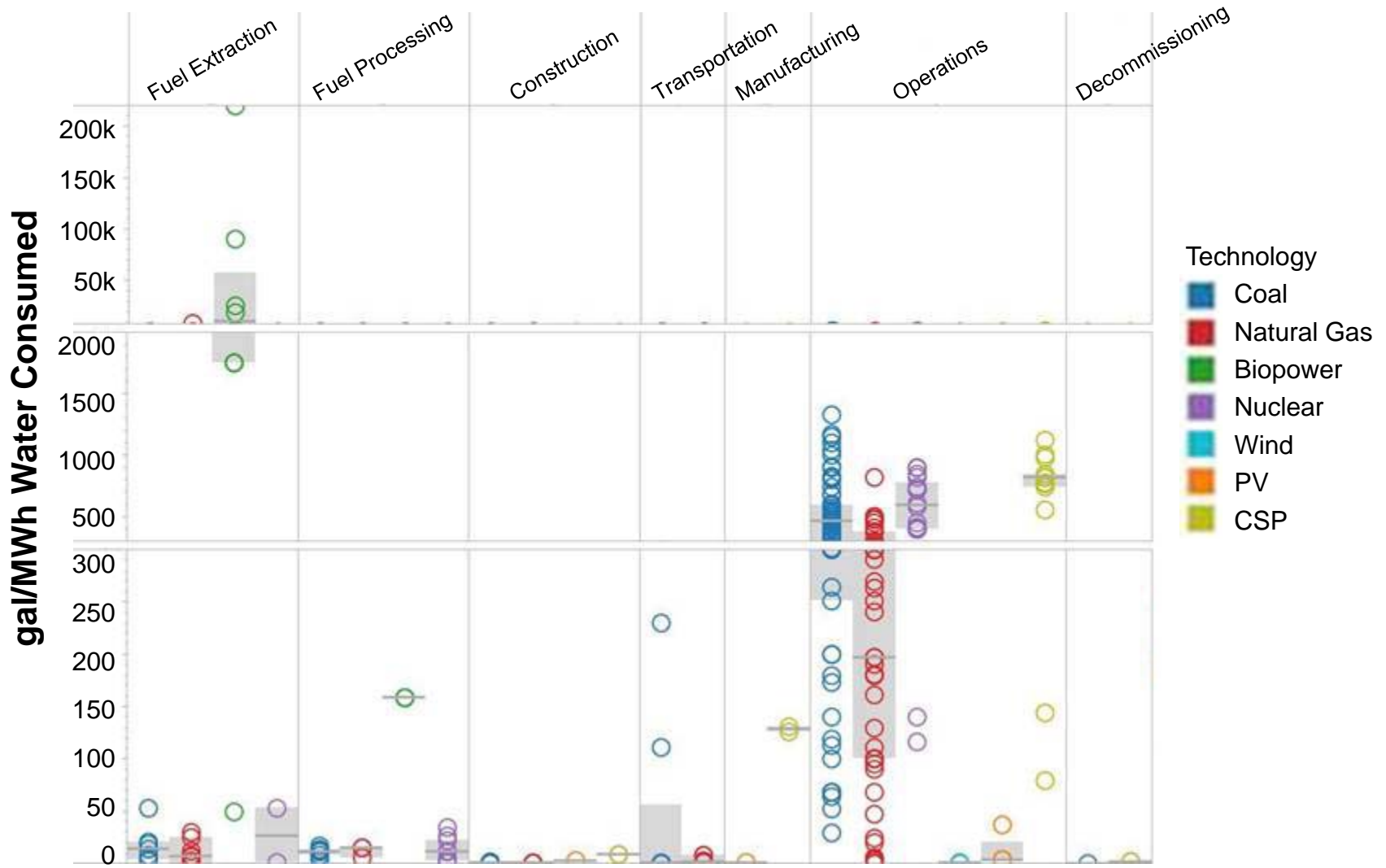
Context: Water Use Efficiency

Water Withdrawn by Generation Type



Context: Water Use Efficiency

Water Consumed by Generation Type



Bird Mortality By Cause

| Cause of Death | Number killed per 10,000 deaths due to human activity |
|-----------------------------|---|
| Buildings/windows | 5,500 |
| House cats | 1,000 |
| Other | 1,000 |
| High tension lines | 800 |
| Vehicles | 700 |
| Pesticides | 700 |
| Communication towers | 250 |
| Wind turbines | >1 |

Source: AWEA Wind Power Myths vs. Facts (Erickson et al., Summary of Anthropogenic Sources of Bird Mortality; www.awea.org)

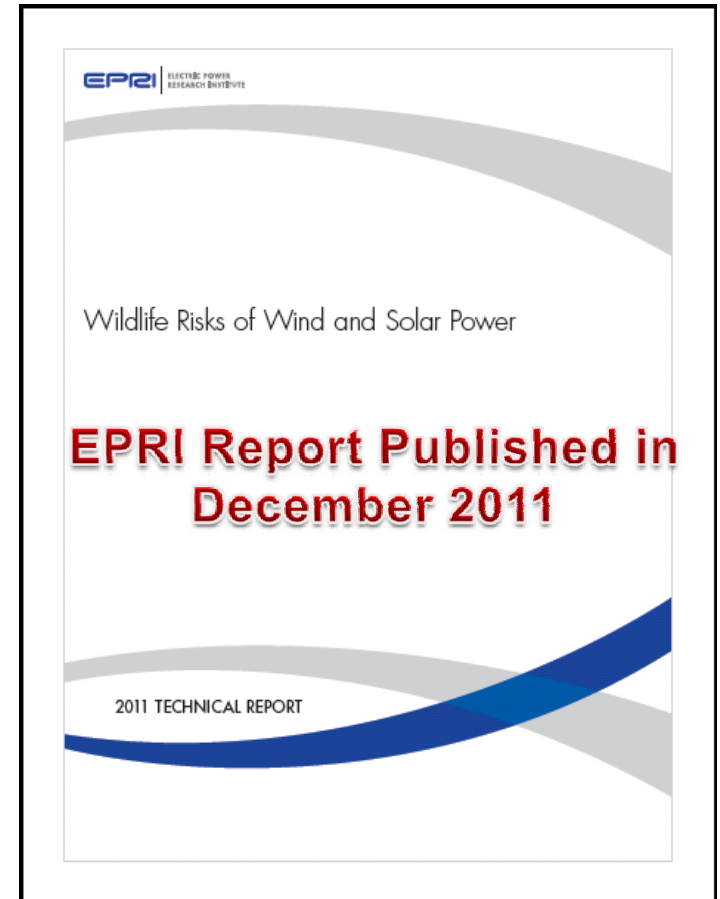
Wildlife Risks Analysis

Context: Robust assessment of ecological risk is necessary to evaluate environmental impacts of future renewable development

Key findings:

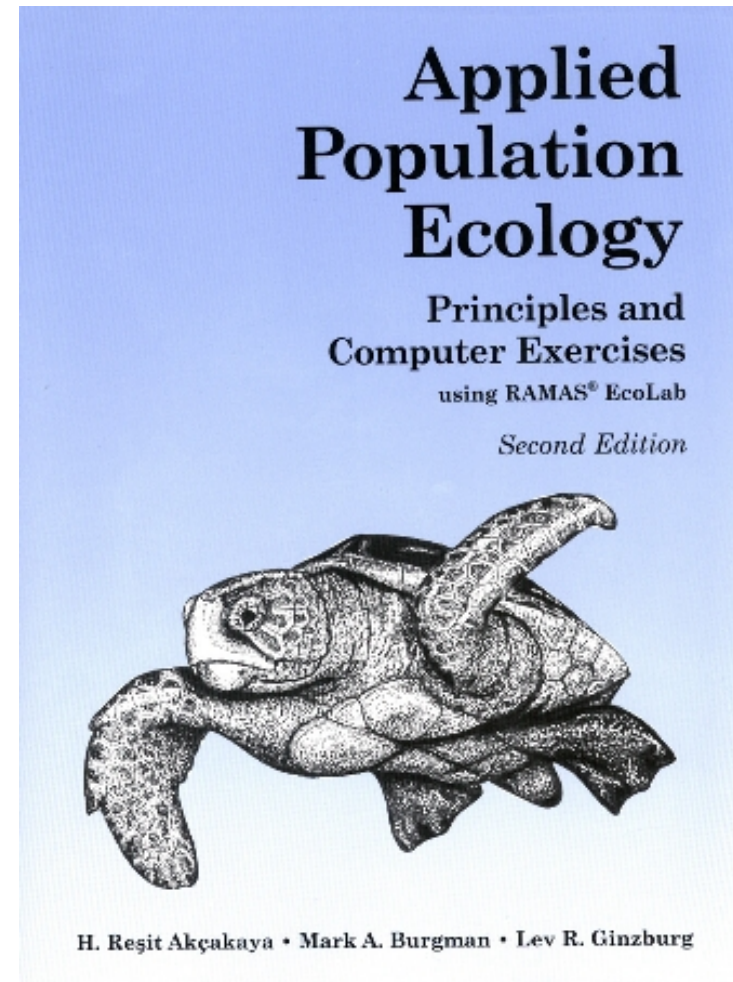
- Wildlife risks are site specific
 - Species have unique habitat territories, all sites do not have equal habitat value
- Different species require different strategies for risk management and mitigation
- Risks are technology specific
- A proactive approach for developers is the best way forward

Relevance: Knowledge of key issues related to wildlife impacts from renewable project development will result in improved mitigation strategies and a reduction in the overall impact on biological diversity



Metapopulation Risk Analysis Model

- RAMAS® GIS
 - Developed by Applied Biomathematics in partnership with EPRI
 - Widely used and accepted
 - Academia, industry, agencies
 - Recognized as a key tool by EPA (2009)
 - Over 40 peer-reviewed publications per year world-wide



Managing Species Issues for Renewables – A Practical Application of RAMAS Methodology

Objectives and Scope

- Eagle risk assessment and population modeling for wind development and siting
- Analysis of habitat viability
- Tailored modeling for future population assessments

Value

- Understanding of wind energy impacts on eagles provides greater insight into required mitigation efforts
- Add certainty to long-term operations and provide "adaptive mitigation" strategies



This represents a shift from site specific project monitoring to a more biologically significant population level impact study.

Noise Impacts of Wind Energy



Context: Data are lacking with respect to measured sound from operating projects and effects on community health

Objectives/Plans:

- Address knowledge gaps and provide policymakers with objective information
- A wind farm in New York State is currently being monitored
- Residents in close proximity to the wind farms are being surveyed

Relevance: Results will provide critical information on potential health effects related to wind turbine noise and help communities develop siting criteria to minimize risk

Wind Turbine Shutdown System to Reduce Bat Mortality

Context: A bat detection system to trigger wind turbine shutdown when bats are present near the rotor sweep area of the turbine would minimize bat mortality and reduce/eliminate seasonal curtailments



Progress to Date:

- Road-side testing at an active wind farm determined equipment worked.
 - Ultrasonic microphones were able to detect artificial bat calls
 - Not adversely affected by ambient and wind turbine noise
- Currently developing an automatic shutdown system to protect bats and utility wind farms
- The shutdown system will be based on a risk model in development
- Turbine SCADA system will inform the risk model to determine shutdown with respect to the level of risk
 - (6-10 factors will be evaluated by the risk software)
- Host utility participating to implement the system and perform trial studies

Relevance: Bat detection system will minimize wind turbine's effects on bats, while providing a solution other than seasonal curtailment.

Conclusion

There is still uncertainty around the most effective way to integrate renewable energy projects in the environment while maintaining a balance between productivity and conservation

The electric power industry is currently working to resolve these issues through focused research aimed at improving the relationship between renewable energy facilities and the environment where they are situated

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