Reducing the impact of wind energy development on wildlife requires scientifically based, cost-effective monitoring and mitigation strategies to inform decision makers on sound siting, construction, operations, and decommissioning. In response, the International Energy Agency Wind Technical Collaborative Program initiated Task 34, known as WREN—Working Together to Resolve Environmental Effects of Wind Energy.
The scope of WREN is to facilitate an international collaboration that advances global understanding of the environmental effects of wind energy development and creates a shared global knowledge base for recommended practices for monitoring, research, and mitigation. WREN leverages resources and expertise from 13 member countries (Table 1) and their extended networks to identify priority international needs for research, assess the effectiveness of monitoring and mitigation methods and technologies, and synthesise and disseminate information on the global state of the science. Results include:

- Publishing white papers covering broad concepts and common challenges and short science summaries focusing on a single topic
- Managing Tethys (http://tethys.pnnl.gov) to collect and disseminate reports and publication
- Hosting webinars that provide multiple perspectives on a key issue.

By using a variety of outreach and engagement mechanisms, WREN strives to interact with key stakeholder groups within regulatory agencies, the wind energy industry, conservation organisations, and researchers.

Progress and Achievements

WREN continued to manage and enhance Tethys database, which provide information on key contacts, archives webinars and online meetings, and displays upcoming events. Highlights include:

- 746 new reports and publications
- Updated platform (Drupal 8) with redesigned website
- New mobile-friendly version
- 177,935 page views of which 1,455 were for the WREN webpage.

In August 2019, WREN members from Norway, Portugal, Sweden, the United Kingdom, and the United States attended the 5th Conference on Wind Energy and Wildlife Impacts, Stirling, Scotland. A presentation on “A Risk-based Approach for Addressing Wind and Wildlife Interactions Using Ecosystem Based Management Values” was given.

Task 34 hosted its 16th webinar entitled “Multiple Uses for Offshore Space: Incorporating Wind Energy Development.” The webinar presented perspectives from both Europe, where offshore wind energy

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Table 1. Task 34 Participants in 2019

<table>
<thead>
<tr>
<th>Country/Sponsor</th>
<th>Institution(s)</th>
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<tbody>
<tr>
<td>1 Belgium</td>
<td>Royal Belgian Institute of Natural Sciences</td>
</tr>
<tr>
<td>2 Canada</td>
<td>Environment and Climate Change Canada</td>
</tr>
<tr>
<td>3 France</td>
<td>France Energies Marines</td>
</tr>
<tr>
<td>4 Ireland</td>
<td>Brookfield Renewables</td>
</tr>
<tr>
<td>5 Italy</td>
<td>Italian National Agency for New Technologies, Energy and Sustainable Economic Development</td>
</tr>
<tr>
<td>6 The Netherlands</td>
<td>Rijkswaterstaat</td>
</tr>
<tr>
<td>7 Norway</td>
<td>Norwegian Institute for Nature Research</td>
</tr>
<tr>
<td>8 Portugal</td>
<td>Strix and Bio3</td>
</tr>
<tr>
<td>9 Spain</td>
<td>Spanish Council for Scientific Research</td>
</tr>
<tr>
<td>10 Sweden</td>
<td>Vindval and Swedish Energy Agency</td>
</tr>
<tr>
<td>11 Switzerland</td>
<td>Nateco AG</td>
</tr>
<tr>
<td>12 United Kingdom</td>
<td>Marine Scotland Science</td>
</tr>
</tbody>
</table>
development has existed for decades, and from North America, where development is relatively new. The webinar had 71 live attendees and the recording has been viewed 405 times.

A short science summary entitled “Bat Interactions with Land-based Wind Energy: A European and North American Perspective” was released in April 2019 (Figure 1). It highlights our current understanding of the interactions between bats and wind turbines, the similarities and differences between the two regions, potential mitigation strategies, and recommendations for future research.

WREN members held three in-person meetings in 2019. One of the objectives was to develop a proposal extension for Task 34 through September 2024. Members discussed a strategy for prioritising topics, how to better aggregate, synthesise and disseminate information on the global state of the science, and ways to assess the technical readiness and effectiveness of solutions for monitoring and mitigation wildlife impacts at wind energy facilities.

**Highlight**

WREN develops white papers on overarching challenges faced by the global wind energy and wildlife community. The most recent paper focuses on risk-based management. Lack of a systematic and widely accepted approach for measuring the potential damage to wildlife, habitats, and communities continues to leave wind developers, regulators, and other stakeholders in an uncertain position. This uncertainty may lead to regulatory requirements for studies and monitoring programs that do not necessarily contribute to improved environmental protection. Regulatory requirements and data collection around wind farms during construction, operation, and other project phases need to be consistently linked to the actual risk posed to a range of animals and habitats.
Accounting for risk in consenting/permitting wind projects were reviewed, and a series of risk management tools and approaches surveyed. The paper also explored the adaptation of ecosystem-based management to wind energy development through several case studies, and sets forth a framework and best management practices for applying risk-based principles to wind energy.

This review and analysis may provide helpful insights for improved siting and consenting/permitting processes for regulators, particularly in nations where wind energy is still in the early development stages. Wind project developers may benefit from understanding how regulators may approach consenting/permitting. Policy makers may gain valuable insights into how wind farm development might be managed in the future. Researchers and consultants may benefit from the concepts and suggestions that will improve access to insightful monitoring data from wind farms and will help to direct future data collection efforts.

Outcomes and Significance
Task 34 strives to leverage global perspectives and research to address wind energy and wildlife issues, such as:

- Understanding the patterns of wind turbine and wildlife interactions

- Developing and implementing recommended practices for monitoring at proposed and operating wind energy facilities

- Assessing the effectiveness of mitigation strategies

- Evaluating of technological solutions.

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The outreach and engagement activities are designed to make information more accessible. WREN uses multiple tools to interact with key stakeholder groups to help them make informed decisions. The knowledge transfer among member and non-member nations may assist in decreasing in the levelized cost of energy, minimise barriers to deployment and reducing impacts to wildlife.

Next Steps
In 2020, WREN will complete a short science summary on “European Soaring Birds and Wind Energy”, a webinar on “Lessons Learned from Conducting Wildlife Research at Land-based and Offshore Wind Energy Facilities”, and hold two member meetings, including a virtual meeting in June. Tethys will compile and implement feedback from its annual peer review to improve the website. WREN anticipates beginning a third phase (2020–2024) in October.

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