Wind energy is one of several renewable energy options that can replace traditional fossil fuel energy sources and greenhouse gas emissions. Wind turbines can also cause direct and indirect impacts to wildlife through collisions, construction activity, and habitat loss and fragmentation. Managers can reduce the impact on wildlife through planning, mitigation efforts, monitoring, and research before and after construction.

**The Wind Energy Boom**

Wind energy is an increasingly important sector of the renewable energy industry. U.S. wind power capacity increased from 25,000 Megawatts (MW) in 2008 to 61,000 MW at the end of 2013. Capacity has ballooned globally from 121,000 MW to 318,000 MW in the same time period. Wind power now constitutes 4.1% of all electrical generation in the U.S., up from 1.8% in 2009. A burgeoning wind industry has positive implications for global greenhouse gas emissions, but the turbines and infrastructure surrounding them can have serious effects on wildlife and their habitat.

**Threats to Wildlife**

**Collisions**

Fast moving turbine blades have proved lethal for several species of birds and mammals. Early studies in California found that raptors experienced high mortality rates, especially when compared to their low-reproductive rates and population sizes. Several studies have shown high mortality rates at specific wind farms that use old technology, are sited along migration corridors, and/or are in areas with high bird populations.

More recent studies have focused on bat fatalities at wind energy facilities. Migratory, tree-roosting species have been found to be especially vulnerable to wind turbines, particularly in the U.S. where facilities are sited on eastern, wooded ridges. Estimates of mortality rates in the eastern U.S. range from 20.8 to 69.6 fatalities per turbine. Researchers suspect that bat populations are severely impacted by these losses.

Songbirds are also susceptible to collisions, but fatalities are usually not high enough to impact healthy populations. Migratory and resident species that are declining or of special concern can be further threatened by wind turbine related mortality if turbines are sited in high concentration areas or critical habitat.

**Methods that Reduce Impact of Wind Energy and Wildlife**

Wind energy developers can employ numerous strategies to mitigate or prevent damage to wildlife or habitat. Strategies include turning off the turbines during migration, low wind, and warm weather, clustering construction around already fragmented, and siting turbines in low bird abundance areas.

The eastern red bat (*Lasiurus borealis*) is one of several migratory bat species most affected by wind turbines. Thousands of insectivorous bats are killed every year as they migrate south over turbine-lined ridges to their winter ranges. (Credit: Merlin D. Tuttle/BCI)
Habitat Degradation
The total amount of habitat permanently altered by wind energy can be small compared to other forms of land use. However, surrounding habitat is still degraded in the near and long term by construction, roads, noise, human presence, and fragmentation. Studies have found that grassland birds and some mammals, including mule deer and elk, tend to avoid turbine pads, especially during construction. Species that rely on unfragmented, congruent habitat or specifically avoid anthropogenic activity are especially vulnerable. Entire wind farms, including a significant buffer around them, become unsuitable for species that avoid roads, buildings, and power lines such as prairie grouse.

Opportunities to Reduce Threats
Avoiding Collision
Research has found that bat species most threatened by wind turbines tend to be most active in low wind weather, before and after storms, and during fall migration while others found that most bats are killed on low wind nights. Bat mortality can be substantially reduced if wind turbines are turned off at these high risk times. Turbines can be placed in areas of lower abundance outside migratory pathways to avoid high bird mortality rates. Raptor mortality was much lower at certain wind farms with lower abundance of birds than at farms with large populations.

Avoiding Habitat Degradation
Landscape level planning is essential to reduce the impact of wind energy development on wildlife. Wind farms can be placed to avoid critical habitat such as sage grouse leks or migratory pathways. Developers can also find ways to build turbines using the least amount of roads, transmission lines, and other infrastructure as possible to reduce fragmentation effects. The best option is often to site turbines on land that is already developed to make use of existing infrastructure and avoid disturbing intact habitat areas.