

Hötker, H., K.-M. Thomsen, and H. Jeromin. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

Summary: The purpose of this report is to compile and to evaluate the available information on the impacts of exploitation of renewable energy sources on birds and bats. The focus is on wind energy as there is only little information on the impact on birds and bats of other sources of renewable energy. The report aims at better understanding the size of the impact, the potential effects of re-powering (exchanging small old wind turbines by new big turbines), and possible measures to reduce the negative impact on birds by wind turbines. In addition the need for further research is highlighted. The evaluation is based on 127 separate studies (wind farms) in ten countries, most of them in Germany. Most studies were brief (not more than two years) and did not include the preconstruction period. Before-After Control Impact studies that combine data collection before and after, in this case construction of a wind farm, on both the proposed development site and at least one reference site were rare. In only a few cases, would the design of the study and the length of the study period theoretically allow statistically significant effects of wind farms on birds and bats to be found at all. Assessments of impacts, therefore, are usually based on few studies only. This report includes all studies readily available to the authors, irrespective of the length of the study period and the quality of the study design. In order to base the assessments on as many independent samples as possible even rather unsystematic observations were included. The information of the data was reduced to a level that justified the application of sign tests. The compilation of many different individual studies gave the following results: The main potential hazards to birds and bats from wind farms are disturbance leading to displacement or exclusion and collision mortality. Although there is a high degree of agreement among experts that wind farms may have negative impacts on bird populations no statistically significant evidence of negative impacts on populations of breeding birds could be found. There was a tendency waders nesting on open grounds to be displaced by wind farms. Some passerines obviously profited from wind farms. They were probably affected by secondary impacts, e.g. changes in land management or abandonment from agricultural use next to the wind plants. The impact of wind farms on non-breeding birds was stronger. Wind farms had significantly negative effects on local populations of geese, Wigeons, Golden Plovers and Lapwings. With the exceptions of Lapwings, Black-tailed Godwits and Redshanks most bird species used the space close to wind turbines during the breeding season. The minimal distances observed between birds and pylons rarely exceeded 100 m during the breeding season. Some passerines showed a tendency to settle closer to bigger than to smaller wind turbines. During the non-breeding season many bird species of open landscapes avoided approaching wind parks closer than a few hundred metres. This particularly held true for geese and waders. In accordance with published information disturbance of geese may occur at least up to 500 m from wind turbines. For most species during the non-breeding season, the distances at which disturbance could be noted increased with the size of the wind turbines. For Lapwings this relationship was statistically significant. There was no evidence that birds generally became „habituated“ to wind farms in the years after their construction. The results of the few studies lasting longer than one season revealed about as many cases of birds occurring closer to wind farms (indications for the existence of habituation) over the years as those of birds occurring further away from wind farms (indications for the lack of habituation). The question whether wind farms act as barriers to movement of birds has so far received relatively little systematic scientific attention. Wind farms are thought to be barriers if birds approaching them change their flight direction, both on migration or during other regular flights. There is evidence for the occurrence of a barrier effect in 81 bird species. Geese, Common Cranes, waders and small passerines were affected in particular. However, the extent to which the disturbances due to wind farms of migrating or flying birds influences energy budgets or the timing of migration of birds remains unknown. Collision rates (annual number of killed individuals per turbine) have only rarely been studied with appropriate methods (e. g. with controls of scavenger activities). In particular, such studies are missing for Germany. Collision rates varied between 0 and more than 50 collisions per turbine per year for both birds and bats. Obviously the habitat influenced the number of collisions. Birds were at high risks at wind farms close to wetlands where gulls were the most common victims and at wind farms on mountain ridges (USA, Spain), where many raptors were killed. Wind farms in or close to forests posed high collision risks for bats. For both birds and bats, the collision risk increased with increasing size of the wind turbine. The relationship, however, was not statistically significant. Gulls and raptors accounted for most of the victims. In Germany the relatively high numbers of White-tailed Eagles (13) and Red Kites (41) killed give cause for concern. Germany hosts about half of the world population of breeding Red Kites and has a particular responsibility for this species. Bird species that were easily disturbed by wind farms (geese, waders) were only rarely found among the victims. Bats were struck by wind turbines mostly in late summer or autumn during the period of migration and dispersal. Population models created by the software VORTEX

revealed that significant decreases in size of bird and bat populations may be caused by relatively small (0,1 %) additive increases in annual mortality rates, provided they are not counter acted by density dependent increases in reproduction rates. Short-lived species with high reproductive rates are more affected than long-lived species with low reproductive rates. The latter, however, are less able to substitute additional mortality by increasing reproductive rates. The effects of „repowering“ (substitution of old, small turbines by new turbines with higher capacity) on birds and bats is assessed by the available data and by simple models. There is no information, however, on the effects of the newest generation of very large wind turbines. According to current knowledge, repowering will reduce negative impacts on birds and bats (disturbance and mortality) if the total capacity of a wind farm is not changed (many small turbines are replaced by few big turbines). In a scenario in which the capacity of a wind farm is increased 1.5 fold, negative impacts start to dominate. In case of a doubling of wind farm capacity, repowering increases the negative impacts of the wind farm. Repowering offers the chance to remove wind farms from sites that are associated with high impacts or risks for birds and bats. New turbines could be constructed on sites that are likely to be less problematic with respect to birds and bats. Effective methods of reducing the negative impacts of wind energy use on birds and bats include:

- choice of the right site for wind farms (avoidance of wetlands, woodlands, important sites for sensitive non-breeding birds and mountain ridges with high numbers of raptors and vultures),
- measures to reduce the attractiveness of wind farm sites for potential collision victims,
- configuration of turbines within wind farms (placement of turbines parallel to and not across the main migration or flight directions of birds),
- construction of wind turbines: replacement of lattice towers, wire-cables and overhead power lines.

Measures to increase the visibility of wind turbines and to reduce the effects of illumination remain to be studied. In spite of many publications on windfarms and birds there still is a great demand for further research. First of all there is an urgent need for reliable data on collision rates at wind turbines of birds and bats in Germany. This holds true particularly for the new and big turbines which will replace the present generation of wind turbines. It is still unclear whether these big and necessarily illuminated turbines pose a high collision risk to nocturnal migrants which have not yet been greatly affected by smaller turbines. The high collision rates of Red Kites in Germany also merit urgently study. The aim of the research has to be a quick reduction of the collision rates. The sensitivity to wind farms of many other bird species that are of particular nature conservation interest (storks, raptors, Cranes) has not yet been sufficiently studied. There is hardly any information on the impacts of arrays of solar panels on birds and bats. Studies should be initiated as soon as possible.