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Essays and Perspectives

Another blown in the wind: bats and the licensing of wind farms in Brazil

*Rebeca Beltrão Valença, Enrico Bernard**

Laboratório de Ciência Aplicada à Conservação da Biodiversidade, Department of Zoology, Universidade Federal de Pernambuco (UFPE), Recife, PE, Brazil

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ABSTRACT

Brazil is the third largest market for new investments in wind power in the world and thousands of turbines will become operational in the coming years. Wind power is necessary but, as any other source of energy, it has environmental impacts, especially on bats. Due to such rapid expansion and the volume of investiments on course, an analysis of the current environmental licensing of wind farms in Brazil is necessary. Here we compared normatives from Brazil with similar ones from Portugal, the United States and Canada. By using 21 driving questions, we detected that there is no an international standard in the licensing of wind farms, ranging from simplified to rigorous approaches, from mandatory to voluntary normatives. Despite having specific and mandatory legislation dated from 2014, Brazil's federal and state normatives have a vague and relaxed approach regarding the possible impacts of wind farms on bats. Larger wind parks can be fractioned in smaller units, licensed based on simplified and less rigorous studies, but with no explanation on how or when such fractionating may occur, neither details on when adopt it. Only Brazilian legislations do not clearly specify the procedures and the minimum necessary effort for pre and post-installation, and which should be the mitigation measures adopted for the impacts of wind farms. The Brazilian federal and state normatives must be revised and until that, the current EIA procedures should be seen as insufficient to accurately determine the real impact of wind farms on the Brazilian bat fauna.

Introduction

Wind power generation is among the fastest growing electric sources across the planet and the global wind capacity exceeded 336 GW in 2014 (WWEA, 2014). Brazil follows such tendency and the country has become the third largest market for new investments in wind power in the world (WWEA, 2014). Brazil is expected to be in the top 10 wind power

* *Corresponding author at*: Laboratório de Ciência Aplicada à Conservação da Biodiversidade, Departamento de Zoologia, Universidade Federal de Pernambuco (UFPE), 50670-420, Recife, PE, Brazil.
E-mail address: enrico.bernard@ufpe.br (E. Bernard).
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generators in the near future, with potential to generate 300 GW (ABEEólica, 2012; WWEA, 2014).

Like any other form of electricity generation, wind power has pros and cons. Wind farms can affect the flying fauna, especially bats, with impacts ranging from behavioral disturbances to the death of animals by collision with turbine blades or barotrauma (Kunz et al., 2007a; Baerwald et al., 2008). If cumulative, such impacts can have severe medium and long-term effects on bat populations (Kunz et al., 2007b), involving both local and migratory species (Voigt et al., 2012). There is a need for further studies and better regulation of the impact assessment studies of wind farms on bats (ASM, 2008; Arnett et al., 2013; Bernard et al., 2014).

Established in Brazil in 1981, the environmental licensing is an administrative act granting the license requested by an entrepreneur to projects that can produce any degradation in the environment. In Brazil, this process is divided into three phases: the preliminary license (*Licença Preliminar* – LP), requested in the preliminary phase of the project planning; the installation license (*Licença de Instalação* – LI), authorizing the start of construction or installation project with the fulfillment of previous requirements; and the operation license (*Licença de Operação* – LO), which authorizes the operation of the project with the fulfillment of all the conditions required by the previous licenses (Brasil, 1997). The authorities responsible for the environmental licensing were established by Law 140/2011, and include the federal licensing agency (IBAMA), state or even municipal agencies (Brasil, 2011; CONAMA, 2014).

Until 2014 there was a conflict between the regulations for the licensing of wind farms in Brazil due to the Resolutions 01/1986 and 279/2001 by *Conselho Nacional do Meio Ambiente* (CONAMA), which differed on the need to apply an EIA or just a Simplified Environmental Report (*Relatório Ambiental Simplificado* – RAS) for wind parks (Barbosa Filho and Azevedo, 2013). Article 2 of CONAMA's Resolutions 01/1986 requires the submission of EIA for electricity generation plants above 10 MW, whatever the primary energy source, i.e. virtually all Brazilian power plants. However, Article 1 of CONAMA's Resolutions 279/2001 allowed the adoption of RAS for projects with low environmental impact, including wind farms and other alternative energy sources.

More recently, CONAMA's Resolution 462 of July 25th 2014 established new procedures for the environmental licensing of wind parks. This resolution aimed to resolve the discrepancy between the previous resolutions and provided legal support for those analyzing the licensing process. Thus, it was decided that the RAS would be acceptable for projects with low environmental impact and state agencies should be responsible for most of the licencing (see Table S1).

Although there are reports of mortality in the few areas monitored (e.g. Barros et al., 2015), in Brazil 70% of areas with high wind potential do not have sufficient information for the analysis of the likely risks and impacts on bats (Bernard et al., 2014). Northeastern Brazil, the largest wind potential in the country, has no published data on the mortality of bats, confirming the existence of gaps on the information on real impacts and ongoing mitigation measures (Bernard et al., 2014). Such reality shows that the licensing of wind farms in the country needs improvement. Maps identifying environmentally sensitive areas, a clearer legislation and the dissemination of technical information on wind farms and their impacts are urgent for the improvement of the wind farms licensing process in the country (Brasil, 2009; Bernard et al., 2014). To contribute to such a discussion, here we compare the strengths and weaknesses of Brazilian current normative for the licensing of wind farms with similar legislation from other countries, focusing on potential impacts on the chiropterofauna.

Methodology

We compared the Brazilian standards and procedures on the licensing of wind farms with similar legislations from Portugal, the United States (federal, hereafter USA, and those from the states of Pennsylvania and California), and the Canadian provinces of Ontario and Alberta. In Brazil, we present both the federal normative (hereafter Brazil), as well as the state normatives for Rio Grande do Sul, which has the oldest commercial wind farms in the country, and Bahia, the state with some of the largest operating wind parks. Portugal was selected as a member of the European Community, due to the easy access of its normative, and due to the fact it was published in 2014, the same year of publication of Brazil's latest normative, allowing a comparison of two very recent norms. United Statesńormative was selected as an example from North America, as well as due to the country's economical position, existence of a long history of environmental impact assessments with regulatory frameworks usually developed in association with specific sectors. In Canada, the licensing is not done at the federal level, so Alberta and Ontario were included due to their very detailed provincial normatives and licensing system, oriented for the protection of bats. Our selection of Canadian provinces and American states followed suggestions of professionals consulted in those countries (Table S1). All consultations were held between May 2014 and August 2015.

Twenty-one driving questions were established to facilitate comparison between the normatives consulted, ranging from the existence of specific legislation, to the necessity and validity of the licenses, and details of the monitoring procedures (Table S2). We considered two specific criteria in the analysis of the specificity: (1) the existence of standards aimed exclusively for wind power, and (2) the existence of standards directly oriented for bats in the environmental impact assessment. To access the completeness of the legislation we set two classes based on the number of responses to eight of the 21 questions (numbers 13–21; Table S2): incomplete, for one to four questions included in the licensing process; and complete, for more than four questions.

Results

Specificity and completeness

The nine cases we analyzed predict specific licensing systems for wind power, but in Portugal, USA, Pennsylvania and California standards are voluntary, i.e., should not be taken as an obligation by the entrepreneur, while in Brazil, Bahia, Rio

Table 1 – Obligatoriness, specificity and completeness of standards applied in the environmental licensing process involving bats and wind farms in seven study cases. Standards aimed exclusively for wind power and directly oriented for bats in the environmental impact assessment were considered as specific. Standards taken as an obligation by the entrepreneur were considered as mandatory. Standards were considered complete if they included a minimum set of variables focused on the monitoring of bat fatalities (See Table S2 for details).

Localitie	Specific?	Mandatory?	Complete?
Brasil	√	√	
Bahia	√	√	
Rio Grande do Sul	√	√	
Portugal	√		√
USA	√		√
Pennsylvania	√		√
California	√		√
Ontario	√	√	√
Alberta	√	√	√

Grande do Sul, Ontario and Alberta they are mandatory. Standards from Portugal, USA, Pennsylvania, California, Ontario and Alberta can be considered complete, but incomplete in Brazil, Bahia and Rio Grande do Sul (Table 1).

Responsibility

Licensing responsibility falls on different administrative levels: states or provinces (USA, Pennsylvania, California, Canada, Ontario and Alberta), federal (Portugal), or may depend on the location of the wind farm, as in the case of Brazil in general (Table S2). Here, licensing can be performed by the Union (as in transboundary projects, continental waters, federal protected areas or Indigenous Lands), by state governments (if located in more than one municipality, in state protected areas, or when there is a legal instrument or convention delegated by the Union), or by municipalities (if the environmental impact is local, or when delegated by legal instrument or agreement by the State).

Payment and incentives

Licensing payment is predominantly an entrepreneur's responsibility (Brazil, Bahia, Rio Grande do Sul, Portugal, Pennsylvania, Ontario and Alberta). In the US and California there is no clear definition of who should bear these costs. With the exception of Alberta, in all other sites there are tax incentives for the deployment of wind farms (Table S2).

Licence validity and transparency

Licenses validity varied: not specified for Rio Grande do Sul, USA, California, Pennsylvania, Canada and Ontario; 4–10 years in Brazil and Bahia; and at >10 years in Portugal and Alberta (Table S2). Brazil, Bahia, Rio Grande do Sul, USA, Ontario and Alberta consider the disclosure of information contained in the EIA as mandatory. Portugal requires disclosure, with the exception of cases involving trade secrets or national security. In Pennsylvania such disclosure only happens with the entrepreneur's consent. In California there is no specification on this subject.

Environmental impact assessments (EIA)

The need for EIA varies according to different characteristics: existing information pre-construction (California); number of towers and proximity to other wind farms (Portugal); wind farm size or the proximity to wildlife habitats (Ontario) (Table S2). In the US, Pennsylvania and Alberta there is no specification on when an EIA is needed. In Brazil, the need for an EIA at federal level is based primarily on the sensitivity of the area where the project will be built. In Bahia, wind parks in general are considered as having "low environmental impact" and an EIA/RIMA is not mandatory, but may be requested for those considered "likely to cause significant environmental degradation". Rio Grande do Sul base the need on the amount of energy generated by the park, and an EIA is mandatory for parks producing ≥100 MW, or those located in areas of high and medium environmental sensitivity, independent of size. Only Brazilian standards adopt the concept of Area Directly Affected (*Área de Influência Direta*) and Area Indirectly Affected (*Área de Influência Indireta*).

Wind farm subdivisions

In no one of the sites there are any ban on licensing fractionation, i.e., treating large wind farms as smaller units for environmental purpouses. Ontario cites the possibility of licensing wind farms with <10 or >10 turbines, suggesting the possibility of fractionation. The other studies neither specify about this possibility, nor prohibit it. Brazil make distinction between wind farms (a set of turbine units) and wind complex (set of wind farms), allowing fractionation of both (Table S2).

Simplified environmental studies

Brazil, Bahia, Rio Grande do Norte, Portugal, California and Ontario all allow Simplified Environmental Studies (*Relatório Ambiental Simplificado*) for some types of wind projects (Table S2). USA, Pennsylvania and Alberta have no such specification. In all localities there is the need to adopt impact mitigation measures for wind projects. However, Brazil and Bahia only mentions such necessity, with no specification on what kind of mitigations must be adopted.

Monitoring

Except for Bahia and Rio Grande do Sul, all other localities have indications for pre- and pos-installation monitoring. Brazil, however, only mentions monitoring but neither specifies procedures nor extension. In Bahia and Rio Grande do Sul such detailment is supposed to be present in specific reference terms, but we were not able to find any of them. For sites with such determination, extension varied between different stages and studies: Pre-monitoring from 8 months (Portugal) to 2 years. (Alberta); Post-monitoring from ≥1 years. (USA, Pennsylvania, California and Alberta) to ≥3 years. (Portugal and Ontario) (Table S2). Pre-monitoring period varies according to the suggested methodology (Pennsylvania, California, Alberta

and Ontario). In Portugal and the USA there is no such specification. USA, California and Alberta also do not determine when post-monitoring should occur.

Monitoring effort and methodologies

With the exception of Brazil, Bahia and Rio Grande do Sul, and the pre-monitoring in the US, all other localities adopt a minimum monitoring effort: from a radius ≤ 120 m around turbines (pre-monitoring in Ontario), up to 10 km from the project (pre-monitoring in Portugal). The methodologies used varies from simple (Portugal) to specific (Alberta). Post-installation monitoring is more complex, involving, for example, the search for carcasses in an area with radius ≥ turbine height (Portugal, California, Alberta). Such effort can also vary depending on the number of turbines (Table S2).

Complementary methodologies

In the pre-monitoring, different methodologies were cited, from mist netting and acoustic sampling, to search for colonies and roost counting. The complexity of the sample varied from a very detailed protocol, as in Alberta, up to simple approaches, like those adopted in low priority sites in Pennsylvania (Table S2). In Portugal, USA, Pennsylvania, California, Ontario and Alberta, the post-monitoring includes the search for dead bats, with tests for carcass removal and the establishment of search efficiency rates. Brazil, Bahia and Rio Grande do Sul does not specify the appropriate methodology for post-monitoring, with no guidance for the search of carcasses. In Portugal, Pennsylvania, California and Ontario, searches must be performed by humans with the help of dogs, while USA does not mention the need for dogs. Brazil, Bahia, Rio Grande do Sul and Alberta do not specify if such procedure should occur (Table S2).

Discussion

Due to the adoption of a mandatory legislation, one could expect greater rigor and specificity in the licensing of wind farms in Brazil. In practice this was not observed. Despite having a specific and recent federal and state legislations (dated from 2014), we identified that the Brazilian licensing system for wind farms has relaxed standards and regulations regarding possible impacts on the bat fauna. For environmental purpouses, Brazilian standards allow larger wind parks to be fractioned in smaller licencing units, which can be licensed based on simplified and less rigorous studies (the *Relatório Ambiental Simplificado* – RAS). However, the same legislation neither explains how or when such fractionating may occur. Details on when a RAS must be adopted are sometimes vague and the lack of a standard, allow the excessive use of such approach or, more worryingly, for this to become the rule. In Bahia, for example, all wind parks are considered a priori as having low environmental impact.

The lack of information in the environmental licensing process is especially striking in Brazil (Brasil, 2009; Barbosa Filho and Azevedo, 2013). Eleven Brazilian states already have operating wind parks, and in seven of them is it possible to licence a wind park based on a Simplified Environmental Report (RAS). Such simplification tends to substantially reduce the amount of information sent to analysts and, in a vicious cycle, by allowing simplified studies, the environmental licensing agencies will receive less qualified information, increasing the possibility of mistakes when assessing the real impact of the projects (Bernard et al., 2014). Environmental agencies cannot ignore that cumulative effects of smaller numbers of turbines in a series of adjacent or nearby parks can cause in practice a greater effect than described in a simplified report (Voigt et al., 2012; Roscioni et al., 2013).

Among the cases we analyzed, Brazilian federal standards did not specify the procedures and the necessary effort for pre and post-installation monitoring, ignoring, for example, the need to search for carcasses, or the use of other specific and more efficient methodologies already used in other countries, like trained dogs (e.g. Homan et al., 2001; Paula et al., 2011). Post-installation data is useful and important and should also be considered to reduce bat mortality in wind farms (Arnett et al., 2011; Rydell et al., 2010; Amorim et al., 2012). The relationships between wind speed and mortality is an example. Studies have shown that increasing turbine cut-in speeds, i.e. the lowest wind speed at which turbines generate power to the utility system, could mitigate mortality. In Pennsylvania, relatively small changes to wind-turbine operation resulted in nightly reductions in bat mortality, ranging from 44% to 93%, with <1% annual power loss (Arnett et al., 2011). In Alberta, Canada, changing the wind-speed trigger at which the turbine rotors are allowed to begin turning or altering blade angles to reduce rotor speed resulted in a significant reduction in bat fatalities (by 60.0% or 57.5%, respectively – Baerwald et al., 2009).

In Bahia and Rio Grande do Sul procedures and the necessary effort for pre and post-installation monitoring are supposed to be present in specific reference terms, but we were not able to find any of them. EIA based on the single use of mist netting at ground level are not acceptable anymore, facing the evidence that insectivorous species flying high above the reach of mist nets seem to be more affected (Barros et al., 2015). Similarly, the adoption of carcass removal tests and the establishment of search efficiency rates proved to be necessary to better access the real number of dead individuals (e.g. Huso, 2011; Villegas-Patraca et al., 2012; Korner-Nievergelt et al., 2013).

Brazilian federal standard is unique, since the minimum monitoring effort is not specified either and, at federal level, the country was the only that does not specify which should be the mitigation measures adopted for the impacts of wind farms. Such gaps allow wind farm operators to choose which techniques and minimum effort they will adopt depending on the state their park is located on. However, Brazilian state environmental agencies vary concerning their infrastructure, financial resources, qualified personal and procedures adopted for environmental control and enforcement. Therefore, the lack of a unifying legislation leave room for local licensing agencies or different analysts to request very distinct sets of information (Barbosa Filho and Azevedo, 2013), and the same operator with same-size parks in two different states may have to deal with two very distinct licencing

procedures. As a result, broad comparisons between parks in different areas or operated by distinct companies are impractical.

Moreover, some of the state legislations are quite confusing with standards and procedures diluted in several different documents and decrees. This is the case of Bahia, where procedures for the licencing of wind farms are presented in at least four different documents and changed in a very fast and unclear way. For example, the State Decree 14024 of June 6th 2012 considered wind farms in general as having moderate potential for environmental impact, and classified parks with 31–120 turbines as medium size. However, Decree 14032, published just nine days later, reclassified the potential environmental impact of wind farms as low, and stated that parks with up to 120 turbines should be considered small. The rationale for such change is unknown.

Wind energy is here to stay and, in fact, such modality is better when compared with other energy sources, like burning fossil fuels. In Brazil, wind farms are often considered as having low environmental impact (ABEEólica, 2012). But to be considered true, this perception must be confronted with real and verifiable data, as the evaluation of the significance of the impacts of any given enterprise depends on several variables. Poor assessment standards will produce poor data, and without a reliable approach neither the environmental agencies nor the Brazilian society will be able to judge how greener wind power generation really is.

The current procedures should be seen as insufficient to accurately determine the real impact of wind farms on the Brazilian bat fauna and a review of the legislation dealing with this subject proven to be necessary. For migratory birds, for example, CONAMA's Resolution 462/2014 determines the need to conduct EIA at regular route areas, and known sites for resting, feeding and reproduction. However, similar sensitive areas, like large roosts in caves, are not even considered for bats, leaving unprotected parts of the nearly 180 known species of bats in Brazil (Nogueira et al., 2014).

For real improvements, Brazilian state and federal environmental agencies should consult other similar existing legislation–some of them are also mandatory, but considerably more comprehensive than the current standards. Two examples are the Canadian provinces of Ontario (Ontário, 2011) and Alberta (Alberta, 2011), which provide details about all the methodology to be applied both in the pre and post-monitoring for bats. Moreover, according to Article 17 of Brazil's CONAMA Resolution 462/2014, wind farms must be equipped with appropriate technology to prevent negative impacts on fauna (Brasil, 2014). Such resolution could be used as a basis for improvements in the EIA involving wind farms and bats in Brazil. Finally, similar calls for the revision of existing legislations are underway in other countries as well (e.g. Camina, 2012; Voigt et al., 2015), showing that the mortality of bats associated with wind parks is an issue that should not be ignored.

Conflict of interest

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ncon.2015.09.001.

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