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FAUNA MONITORING ON TRANSMISSION LINE 500 kV COLINAS - SÃO JOÃO DO PIAUÍ

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ABSTRACT

Since the discovery of electricity, this is considered an essential asset for all areas, such as health, commerce and homes, which the power lines need to be implanted for transmission. However, even through transmission is of great importance, one must know and mitigate the impacts on the environment. In this sense, this work aimed to monitor the impact on local fauna in the previous, implementation and operation phases of the Transmission Line 500 kV Colinas – São João do Piauí the impact of this project on the local fauna. For fauna monitoring the groups Avifauna and Herpetofauna were considered, wihch were monitored between the years 2011 and 2013 by six field campaigns in four previously selected regions. All regions were divided in two sample units to monitor the impacts on both sides of transmission line. For the collection of herpetofauna data, the methods of interception and fall traps ans visual sampling transects were used. For avifauna the methods used were counting of fixed points and capture by ornithologicl fog nets. The results indicated the 85% of the bird wealth in the previous phases remained in the operation of the interprise and an increase in the diversity of reptile and amphibian species from 87 species found in the previous phase to 104 species in the operation phase. In general, the diversity found was significant considering the characteristics of the region, being efforts and investments aimed at preserving the detected species are fundamental.
KEYWORDS: Amphibians, Birds, Reptiles.

MONITORAMENTO DE FAUNA NA LINHA DE TRANSMISSÃO 500 kV COLINAS – SÃO JOÃO DO PIAUÍ

RESUMO

Desde a descoberta da energia elétrica, esta é considerada um bem essencial para todas as áreas, como saúde, comércio e residências, no qual para a transmissão se

faz necessário a implantação de Linhas de Transmissão. Entretanto, mesmo sendo de grande importância a transmissão, deve-se conhecer e mitigar os impactos ao meio ambiente. Nesse sentido, este trabalho teve como objetivo monitorar nas fases prévia, de implantação e operação do empreendimento Linha de Transmissão 500 kV Colinas – São João do Piauí o impacto desse empreendimento sobre a fauna local. Para o monitoramento de fauna foram considerados os grupos Avifauna e Herpetofauna que foram monitoradas entre os anos de 2011 e 2013 por seis campanhas a campo em quatro regiões previamente selecionadas. Todas as regiões foram divididas em duas unidades amostrais para o monitoramento dos impactos em ambos lados da linha de transmissão. Para a coleta de dados da herpetofauna foram utilizados os métodos de armadilhas de interceptação e queda e transectos de amostragem visual. Para a avifauna os métodos utilizados foram contagem de pontos fixos e captura por redes de neblina ornitológicos. Os resultados indicaram que 85% da riqueza de aves nas fases prévias se mantiveram na operação do empreendimento e aumento na diversidade de espécies de répteis e anfíbios de 87 espécies encontratdas na fase prévia para 104 espécies na fase de operação. De modo geral, a diversidade encontrada foi significativa considerando as características da região, sendo fundamental esforços e investimentos voltados a preservação das espécies detectadas
PALAVRAS-CHAVE: Anfíbios, Aves, Répteis.

INTRODUCTION

Since the discovery of electric energy, it has been considered an essential asset for all areas, such as health, commerce and homes, in which for transmission it is necessary to implement Transmission Lines (TL). However, even though transmission is of great importance, the impacts of its implementation on local flora and fauna should be studied and known, as well as the regulatory aspects. (RIBEIRO, 2016).

The use of land by man causes impacts to the fauna and flora in general due to habitat transformation, mainly due to population growth. Habitat reduction and consequent loss of species richness are two consequences of the process of transforming continuous natural areas into fragments (MARTINS FILHO et al., 2019). In addition, decreased disperability, change in areas sizes and increase predation rate, are also influenced byfragmentation, which may occur in isolated events or not, resulting in the local disappearance of some species in the affected regions (OLIVEIRA et al., 2016).

For conservation planning, the making of lists of threatened species has been widely disseminated to outline the rates at risk of extinction, identify threat processes, support protection legislation for animal and plant groups, inform conservation priorities and subsidize environmental impact reports. However, it is important to take into account the knowledge of the regional risks of extinction patterns and the large knowledge gaps (GILLESPIE et al., 2011).

In ecological studies, it is widely discussed and accepted that the biogeographic subdivision of continents and regions simplifies and integrates the complexity of natural ecosystems and species variation, with a unique method of biogeographic approach for the analysis of species extinction risk being recently supported in the literature according to the category of the International Union for Conservation of Nature (IUCN, 2020) and criteria at the regional level.

In this sense, surveys to compose lists of species in enterprises with environmental impact on Brazil can become a very useful tool in the refinement of biodiversity conservation actions, mainly in the form of monitoring involving different regions, biomes and ecosystems types.. Thus, it is possible to evaluate the loss of species among different ecosystems types with different pressures environmental degradation. As tools for these actions, there are the various biota inventory and monitoring techniques, especially of terrestrial fauna, impacted by electric energy generation and transmission projects proposed by several researchers (CAVALCANTI, 1999).

Considering the above, in order to meet the premises exposed in the impact assessment phase of the 500 kV Hills Transmission Line - São João do Piauí and understand the impacts of the linear enterprises implementation on the fauna, two large groups were monitored, being: Birdlife and Herpetofauna, for presenting themselves as organisms that respond quickly to possible impacts arising from undertakings of this nature.

MATERIAL AND METHODS

This work was carried out in six campaigns to monitor herpetofauna and birdlife between the years 2011 and 2013, the first campaign carried out between September and October of 2011, the second on February of 2012, the third between July and August of 2012, the fourth in October of 2012, the fifth between November and December of 2012 and the sixth (last) between February and March of 2013 , all in the operation phase of the project. Furthermore, it should be noted that during the second and fourth campaign, only species belonging to the birdlife group were evaluated.

Study area

The Colinas - São João do Piauí 500 kV TL is 710 km long and runs through the municipalities of Colinas do Tocantins, Barra do Ouro, Goiatins and Palmeirantes in the state of Tocantins, Carolina, Riachão, Balsas, Loreto and Sambaíba in the state of Maranhão and Ribeiro Gonçalves, Uruçuí, Sebastião Leal, Manoel Emídio, Colônia do Gurguéia, Canto do Buriti, Eliseu Martins, Brejo do Piauí , Ribeira do Puaií, Bertolínia and São João do Piauí in the state of Piauí.

For this, two areas in the state of Tocantins and two in Piauí were selected as the study area for the monitoring of fauna, located in the municipalities of Palmeirante and Goiatins in Tocantins, and Ribeiro Gonçalves and Elizeu Martins in Piauí. For monitoring were considered the herpetofauna and birdlife groups, since these are considered organisms that respond quickly to possible impacts from linear enterprises, such as transmission lines.

For each sampling region, a forest fragment intercepted by the central axis of the TL was delimited, and this site was called the sampling unit. These sample units were in turn divided into two sampling sites (one sampling site on each side of the line). The location of the sample regions follows below:

- Sample Region A: municipality of Palmeirante, TO (Location: 7°52’49.13”S / 47°54’24.72”O);
- Sample Region B: municipality of Goiatins, TO (Location: 7°47’58.02”S / 47°22’26.18”O);

- Sample Region C: municipality of Ribeiro Gonçalves, PI (Location: 7°36'26.14"S / 45°14'13.41"O);
- Sample Region D: municipality of Eliseu Martins, PI (Location: 8°08'18.89"S / 43°39'37.07"O).

Data collection

For the collection of herpetofauna data, the methods of Pitfall traps and visual sampling transectos were used, of which the following description is described below:

- Traps of Interception and Fall (pirfall): This method consists of the installation of buried containers, so that the opening remains at ground level, functioning as pitfall traps, interconnected by guide fences. At each sampling site, five sampling modules were installed, each consisting of four buckets of 60 liters arranged in Y. Each module was separated from each other by at least 100 meters away. In total, 40 buckets were used for each sampling unit (composed of two sampling sites). The traps remained open for five nights in each area, being checked daily.

- Visual Sampling Transectos (active search): the use of this method took place in random locations and different from those chosen for the use of traps, which consisted of walking trails and bites. This method was applied both early in the morning and at dusk for the diurnal species, and, during the night, with the help of lantern, seeking to find the noívagas species.

After data collection, all captured individuals were marked with the Visible Implant Fluorescent Elastomer (VIE) technique and later released.

For the birdlife, the sampling methodologies were used: fixed points (IPA) and capture with fog nets. The specifications are below:

- Fixed point count: fixed point sampling was performed for three consecutive days, determining five points per sampling region, and um one point was located in the LT servitude range, two dois points in areas adjacent to the range and two points in areas farther from the line, preferably in forested environments.

- Capture with the aid of ornithological mist nets: in each sampling region, four points were determined for the installation of the nets, two in open areas and two in forested areas, five networks per point. The networks were opened for seven consecutive days in each campaign.

The captured birds were individually packed in cotton bags until the specimens were screened. Subsequently, measures and measures were identified. To perform a control regarding the recaptures during the fieldwork, the captured individuals were marked by cutting, with sharp scissors, the tip of one of the feathers, remiges or retrizes, taking the relevant records in the field worksheet.

RESULTS AND DISCUSSION

Herpetofauna monitoring

A total of 104 species were recorded in the four sampled areas, 60 of which were anuran amphibians distributed in seven families (Bufonidae, Cycloramphidae, Hylidae, Leptodactylidae, Leiuperidae, Strabomaintainede and Microhylidae) and 20 genera (Adenomera, Barycholos, Chiasmocleis, Corythomantis, Dendropsophus, Dermatonotus, Elachistocleis, Eupemphix, Hypsiboas, Leptodactylus, Osteocephalus, Phylomedusa, Physalaemus, Pleurodema, Proceratophrys, Pseudis, Pseudopalodicola, Rhinella, Scinax and Trachycephalus) and 44 reptile species, 30 lizard species and 14 species of snakes Lizards were distributed in 12 families (Alligatoridae, Amphisbaenidae, Dactyloidae, Gekkonidae, Gymnophthalmidae, Iguanidae, Phyllodactylidae, Polychrotidae, Scincidae, Sphaerodactylidae, Teiidae and Tropiduridae) and 18 genera (Ameiva, Ameivula, Amphisbaena, Anolis, Cnemidophorus, Coleodactylus, Colobosaura, Gymnodactylus, Hemidactylus, Iguana, Kentropix, Mabuya, Micrpharableus, Norops, Paleosuchos, Phylopezus, Tropidudus and Tupinambis). The snakes were distributed into four families (Boidae, Colubridae, Dipsadidae and Viperidae) and 12 genera (Apostolepis, Boa, Boiruna, Bothrops, Caudisona, Epicrates, Helicops, Leptodeira, Liophis, Philodryas, Psomophis and Tantilla). Of the total species collected, the anurans correspond to 57.69%, the lizards at 28.85% and the snakes at 13.46%.

Of all the studied areas of the municipalities of Tocantins, Palmeirante presented 69 species in total and Goiatins, 45 species. From the areas of the municipalities of Piauí, Ribeiro Gonçalves presented 32 species and Eliseu Martins presented 31. The distribution of species richness has continued since the first campaign with Palmeirante representing the richest area and Elisha Martins the least diverse.

It should be noted that thissurvey provides a preliminary estimate of species that can still be found in the area covered by lt 500 kV Colinas – São João do Piauí. However, it is considered representative when compared to the other inventories already carried out in the Brazilian Cerrado. It should be considered the fact that some species of wide distribution and common were not observed in this inventory, such as: *Phyllomedusa hypochondrialis* and *Hypsiboas raniceps*, which reinforces the need for further surveys during the operation phase so that a more accurate evaluation of the occurrence ofherpetofauna species in the region (VECHIO et al., 2016).

It was observed that the number of species of anuran amphibians was higher than that observed by Barreto (2007) for the Cerrado. Comparing the results of this study with those of other cerrado regions, in the aforementioned study, it is observed that *Rhinella granulosa, Leptodactylus fuscus* and *Physalaemus cuvieri* are species of wide distribution, occurring in several areas of the biome already sampled, such as Balsas (MA), Jalapão (TO), Silvânia (GO), Estação Ecológica de Águas Emendadas (EEAE), Parque Nacional de Sete Cidades (PI) (PNSC) and Uruçuí (PI) (ANDRADE et al., 2017).

In relation to snakes, the number of species found is probably underestimated. This is a common problem for studies with this group, since most of it is composed of abundant, fossorial or cryptic animals, making them difficult to collect.

Compared to the herpetofauna surveys carried out before the operation phase of the enterprise (in the EIA and I.L. phases), the Phase of Installation License (I.L.)

of TL was the one that obtained the greatest richness, reaching 107 species of reptiles and amphibians, followed by the present study, with 104 species and by the preliminary study (EIA) of the same TL, with 87 species of herpetofauna.

The comparison of the richness of reptiles and amphibians during the three phases of environmental licensing of TL (preliminary phase of preparation of the environmental study, during the implementation of the enterprise and after the implementation of the enterprise) indicates a variation inversely proportional towhat is understoodof the impacts generated by the enterprise, since, in the preliminary phase of the environmental study, it is expected the most significant registration of species, due to the total absence of disturbances generated by TL, and during the implementation of the project, a phase in which the impacts are more significant, with suppression of vegetation and increased noise, caused by the machines and circulation of vehicles in the directly affected areas, it is expected the disappearance of species more sensitive to environmental disturbance. During the operation phase, it is expected that the species register increases, with the return of species that disappear during the critical phase of lt installation.

In the areas of Tocantins, the main impact factor on the diversity of herpetofauna was the presence of cattle that alters the landscape for extensive livestock. In Palmeirante, the banks of the tributary of the Tocantins River, which crosses the lt servitude range, may not be enough to maintain a viable population in the sampled region, as it is totally surrounded by pasture, although it was the area that presented the largest number of species in all campaigns, which demonstrates the ability of herpetofauna species to adapt to degraded environments.

In Goiatins, the impacts frequently observed were fires, in addition to cattle raising. In Ribeiro Gonçalves, the agricultural frontier of soybeans is increasingly approaching and is another cause for concern for the conservation of local herpetofauna. In Eliseu Martins, during the first monitoring campaign in the O.L. (operating license) phase, it was possible to find several times hunters in the sampling area. Therefore, in addition to the changes caused by agriculture and livestock, the local fauna still suffers from the actions of small groups of hunters who go there to feed a market for illegal commercialization of wild species.

Conservation actions are more efficiently adopted when it is possible to identify which species are most vulnerable to habitat loss, thus aiming at maintaining populations in the long term. As this is a monitoring work, it is believed to be able to visualize some of these patterns more conclusively in the long run. The identification of species sensitive to fragmentation and which still occupy degraded areas is a major advance for the purpose of biodiversity conservation.

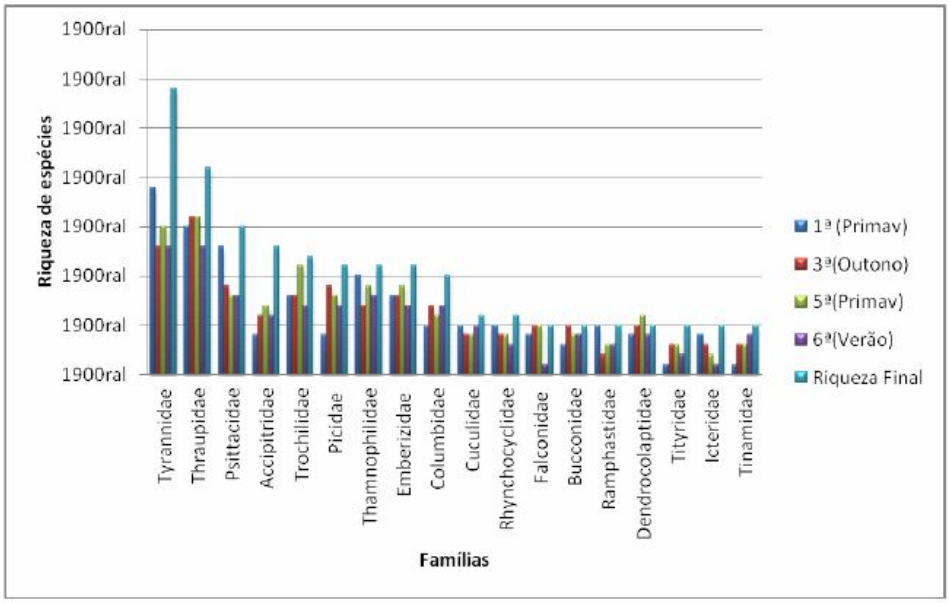
Within the list of species observed in the monitoring section of LT 500 kV Colinas – São João do Piauí, a greater conservation effort is suggested for species of wide geographical distribution and for the paguá alligator (*Paleosuchus palpebrosus*), threatened with extinction, according to the IUCN list. It is noteworthy that this species was recorded only in the first monitoring campaign, and was no longer seen, so it would be strongly recommended actions to evaluate the status of this species in particular and, based on these results, more efficient mitigation measures could be proposed.

Monitoring of birdlife

At the end of the six monitoring campaigns, four (1st, 3rd, 5th and 6th) for species survey and two (2nd and 4th) only for the flag monitoring program, 252 bird

species were recorded, distributed in 22 orders and 53 families, in the areas of influence of lt 500 kV Colinas – São João do Piauí. Of these, 120 (47.6%) belong to the "non-passerine" group, while 132 (52.4%) belong to the order passerines. Among the non-passerine, the families Psittacidae (macaws and parrots), with 15 species, followed by Acciptridae (hawks) and Trochilidae (hummingbirds), with 13 and 12 species, were the most representative; among the passerines, the families Tyrannidae (bem-te-vis and suiriris), with 29 species, and Thraupidae (sanhaçus and saíras), with 21, were the richest. Figure 1 shows the most representative families (with more than five species at the end of monitoring).

FIGURE 1 - More representative families in the areas of influence of LT, during the 4 monitoring campaigns in the operation phase



Source: Prepared by the authors (2013).

The greatest representativeness of the Tyrannidae family was already expected in the case of the largest family of birds in Brazil (SIGRIST, 2009), largely composed of species of wide geographical distribution, occupying the most varied habitats (SICK, 1997). Like Tyrannidae, the Thraupidae family has species of wide distribution, occupying mainly forest edges and semi-open areas (SIGRIST, 2009). The ease with which the species of this family occupy different habitats is associated with their various eating habits (fruits, nectar and insects) (SICK, 1997; SIGRIST, 2009), these resources, present practically throughout the year.

The highest species richness (167) was recorded in the 5th campaign, held between the months of Nov/Dec 2012, followed by the 3rd, 1st and 6th campaigns. Although some studies indicate that seasonality influences bird richness (ALMEIDA, 2019), in general, the number of species was similar throughout the monitoring campaigns. The 6th campaign, between February and March 2013, presented the lowest richness, perhaps due to the fact that it was carried out in a period of "low activity" of birds (mainly passerines), which comprises the end of summer and early autumn, characterized by the end of the reproductive season, thus reducing the detectability of certain species.

The region of Palmeirante (TO) presented the highest species richness, with

160 species; of these, six were endemic to the Cerrado, three classified in the "almost threatened" criterion according to the IUCN, in addition to seven species sensitive to environmental changes (level A). The region of Palmeirante, located in an ecotono zone between the Amazon and Cerrado biomes, is home to an important biodiversity in the northern region of Tocantins, which lacks environmental studies and information. As Amazonian species recorded in the areas of influence of LT and which can also be found in transition areas with Cerrado, it can be mentioned: *Querula purpurata* (anambé-uma) which can be seen in Figure 7, *Pyrrhura amazonum* (hellmayr tiriba) and *Tyranneutes stolzmanni* (uirapuruzinho) (SOUSA et al., 2018).

The 252 species of birds were recorded during the campaigns in the operation phase of lt 500 kV Colinas – São João do Piauí. Small differences in diversity throughout the campaigns can be explained by seasonal responses of certain species in the study area (SOUSA et al, 2018). The richness of birds recorded in the operation phase corresponds to 85.13% of the richness recorded in previous surveys and 80.77% of the installation phase.

Negative effects arising from linear enterprises occur in the implementation phases, with the direct impact on vegetation, through the suppression, loss and fragmentation of habitats (ALMEIDA et al., 2017) in the operation, with the maintenance of the safety range that, in the long term, can lead to loss in biological diversity as a result of the effects of edge.

CONCLUSION

The presence of threatened species requires investments for their preservations. The creation of environmental education programs and continuous monitoring of the populations of these species should be encouraged. The meeting of some difficult-to-identify species highlights the importance of investments in basic research (such as taxonomy and ecology) in the region.

Generally speaking, although the region is quite degraded, the encounter of more than 100 species of amphibians and reptiles is significant. Therefore, it is essential that efforts and investments are dedicated to the preservation of the species found. In this sense, we suggest that investments and further studies be made to increase the number of areas of diversity protection, with recovery and expansion of those already installed and research to create new units.

The results indicated that the composition of bird species remained temporally, since about 85% of the richness found inthe previous phases remained in the operation phase, including most bioindicator species (endemic and threatened), and 32 species were added to the previous listings during the operation. However, such negative effects may be subtle, requiring specific studies of long-term population monitoring.

Negative highlight was the non-registration of the threatened species Xiphocolaptes falcirostris, which had records only in the preparation phase of the environmental study in the same sampleregions.

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