Impacts on biodiversity and expected inputs to management from monitoring

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ABSTRACT

Monitoring the impacts of projects and evaluating the efficacy of mitigation are key components of follow-up. Monitoring impacts on biodiversity is particularly challenging due to ecosystem complexity, while compliance with conditions of permits often require the collection of large amounts of data that not always are properly analyzed to extract relevant information for environmental management. The commitment of some companies with performance targets such as no net loss is an opportunity to push the boundaries of regulatory monitoring from data collection and storage to evidence-based demonstration of outcomes. We reviewed a set of documents related to biodiversity management and to the permit process, started in 2004, of a bauxite mine in the Brazilian Amazon. Firstly, we revised the list of impacts and respective mitigation, then we related monitored parameters to the impacts. The monitoring plans were reviewed for frequency, grid, indicators and the interpretation provided by the reports. We observed that those reports do not show evidence of occurrence of all impacts. They are prepared to demonstrate compliance with regulatory requirements, but do not provide analysis about the actual magnitude of impacts by comparing with the baseline or reference values. However, a contrasting approach was used to deal with an impact not predicted in the EIA, fauna run-over in internal roads, and in external railway and highway. Informed by specific monitoring, additional mitigation is being implemented, reinforcing the importance of follow-up and adaptive management in mining projects.

Key-words: EIA follow-up, mining, reports, magnitude, fauna run-over

Introduction

Monitoring, as part of EIA follow-up, alongside impacts' evaluation, management and communication (MORRISON-SAUNDERS *et al.*, 2021), is an important source of information and knowledge to the environmental management of operating undertakings (SÁNCHEZ, 2012). Monitoring is meant to be responsible for producing data and information, to be consolidated into the necessary knowledge to promote effective impacts management, including the path to avoid and minimize impacts (DURNING, 2012; MORETTO *et al.*, 2021).

Biodiversity targets such as 'No Net Loss' (NNL) or 'Net Gain' (NG) at project level, meaning that all lost biodiversity will be restored and offset (BBOP, 2012), are adopted by sectorial groups, environmental certifications and as conditions to finance projects. As examples of institutions that promote those targets are the International Finance Corporation (IFC) with its Performance Standards (PS), the Aluminium Stewardship Initiative (ASI), a certification tailored to the aluminium supply chain from mining to end use, and the International Council on Mining and Metals (ICMM), a business organization.

Hence, it became important to demonstrate more than compliance with regulatory requirements, also being necessary to create strategies to achieve those targets and show their accomplishment. For that reason, biodiversity monitoring running to answer compliance requirements on EIA follow-up phase is of interest, as it could generate data capable of demonstrating actual achievements. However, it may not always contain the

necessary information to demonstrate achievement of voluntary corporate commitments, and having those targets adopted by companies are an opportunity to improve data collection, storage and analysis.

In this context, the research's objective is to understand if monitoring is properly demonstrating the actual impacts of a mining operation, necessary to promote effective management of impacts on biodiversity, and to demonstrate results related to biodiversity targets as well.

Materials and methods

The research described on this paper has the Juruti bauxite mine as study object. Situated in the Brazilian Amazon and belonging to Alcoa, it started operation in 2009. We reviewed a set of documents related to the EIA process, including the Environmental Impact Statement (EIS) presented in 2004, the operation's environmental management plan and the annual compliance reports (that contain monitoring data), available for the period 2016-23.

We firstly revised the list of impacts on biodiversity, by building causal chains of the kind 'activities-aspects-impacts', adjusting the original description of impacts (from the EIS) when imprecise, and adding impacts missed in the EIS, as needed. Then, mitigation measures implemented in the mine were associated to the revised impacts. By detailing its monitoring indicators, a first analysis of monitoring adequacy to the revised impacts was developed. Finally, the monitoring plans were reviewed for frequency, grid, parameters and indicators, and the interpretation about the impact provided by the annual reports.

Results and Discussion

The initial analysis resulted, from the *ex-post* revision, in 21 impacts related to biodiversity. We reviewed 11 plans that in 2022 were fully or partially monitoring 19 impacts, as detailed in Margarido *et al.* (2023). Those steps highlighted the importance of having clear and precise impacts as a starting point to adequate monitoring, since not all monitoring plans had indicators capable of detecting the related impacts.

The review of monitoring plans started by organizing the characteristics of interest, such as methodology and how they describe collected data. As a partial result, it was possible to trace a timeline about the monitoring plans, tracking, for example, changes in the monitoring grid or sampling effort, as seen in the fauna monitoring, impossibility of accessing certain monitoring areas due to extreme events, such as floods or fires, as seen in the flora monitoring, and changes in indicators, seen in the extinction risk flora monitoring in the railway. The understanding of each monitoring plan's history is important to determine whether or not monitoring has been improving over time, and possibly to explain some decisions on monitoring managing. Those are studies still on course.

Nevertheless, organizing information contained on the annual reports also showed that those compliance reports present poor evidence of impacts. The reports' main content were the results of monitoring campaigns carried out on the year. We observed that the related impacts were not explicitly stated on the reports, a desirable characteristic. We also noted that when monitoring results were compared with previous ones, it was common to be with data collected during operation, therefore not connecting to the pre-mining baseline, and pointing some trends, but hardly describing impact magnitude or providing any interpretation.

Fauna monitoring is an interesting example to be explored. Terrestrial fauna monitoring should be capable to answer to the following impacts: fauna individuals' loss, fauna injury, population decline, diversity decrease and disturbance of terrestrial ecosystem stability. Taking the 2022 annual report, we observe that the fauna monitoring is twofold: general monitoring for different groups, and a fauna run-over monitoring.

For the general monitoring, the selected indicators were: abundance, species richness, diversity and equitability. Besides reporting those indicators, some analysis were made, being presented here two that try to express some understanding about impacts.

(1) Comparison of indicators for the same year by grouping the monitoring grid according to the area of influence, that appears in the 2022 annual report. For the group that supposedly is less impacted by the mining activity, there are two monitored areas: a control area, in a conserved sector of forest with similar characteristics of the suppressed vegetation on mining, and an area under influence of human activity other than mining, but possibly being indirectly impacted. Another group of monitored areas is the one where mining activities occur, and are already in recovering process. And a third group is composed by the directly impacted areas, that includes one where they release the fauna rescued during vegetation suppression activities for mining. Even if this comparison initially looks valid to settle differences that could characterize the impact, there are some bias on the grouping that make such comparison impossible.

(2) Interannual comparison. In the 2022 reports they were presented in a complete way, with a graph of abundance and richness for every monitored year. They also group those years under the EIS data (baseline), monitoring implantation data and monitoring operation data. Again, there are limitations to this comparison that are not explicit on the report. The fact that, when presenting this data, there are no further considerations about the monitoring grid or effort does not allow to say that the fauna richness prior or post mining have changed.

In both analysis, the report itself, even though putting up the comparison, does not state that the different results imply on the impact's magnitude, what would be expected. But it does not either explicit the comparisons' limitations, that we can only understand through the timeline of monitoring plans, and would be important to avoid misinterpretation. Also, having those limitations on sight would possibly point to monitoring features that could be improved to be more conclusive about the impacts, such as the grid location or the adopted indicators. In both cases, we deem there are more accurate analysis that can be done to understand the impacts' magnitude, for example, using the control area as comparison basis for the indicators, or adopting relative abundance indices to allow the trend analysis over the years (MCCOMB *et al.*, 2021).

As to the fauna run-over monitoring, it represents a contrasting scenario. To that monitoring, the selected indicators already provide evidence on impacts that we have reviewed (fauna individuals' loss and fauna injury specifically): taxonomic identification, abundance, richness, number of run-over individuals, animal condition (dead or alive) and run-over rate. Also, the monitored areas are clearly defined as the areas where the impact occurs, to be: the internal mine roads, the dedicated railway that is used to transport the ore to the harbor, and the public highway that connects the mine and the nearest town, used daily to transport employees and supplies.

As monitoring is conducted on a daily basis, it enables the ongoing rescue of injured fauna, taken to the wildlife rehabilitation facility, installed in the mining plant in 2020, thereby mitigating the impact. It is also possible to extract information about locations that have increased fauna run-over, about the most impacted fauna groups, and propose additional mitigating measures based on that evidence. One example are the wildlife passages installed in 2023 on the railway surroundings, focused on arboreal mammals.

It is worth mentioning that the origins of this monitoring plan is different from the general fauna monitoring. It is more recent, having started in 2019, and was motivated by observed incidents that were reported to the regulating body. In contrast, the general monitoring stemmed from the EIS. Fauna run-over was not identified as an impact in the EIS and consequently, no mitigation or monitoring was originally proposed. The run-over monitoring plan was designed on more robust grounds, aiming at looking for spatial patterns and the most impacted species, while the objectives of the general monitoring

plan are wider, but also vague, looking to estimate ecological parameters of population, determine the spatial distribution of species, analyze patterns and seasonal influence and identify threatened species. As a consequence, since its inception, fauna run-over monitoring informed the proposition of mitigating measures, to be refined with monitoring knowledge; On the other hand, the purpose of the general monitoring does not seem, at least it is not stated on the reports, to evaluate the efficacy of mitigation (what is done on other monitoring plan that accompanies fauna rescued on vegetation suppression, but not connected when interpreting results), and alert for any possible adaptation or improvement.

Conclusion

An accurate description of impacts is essential for designing monitoring plans and for interpreting their results. In the reviewed case, it was found that compliance reports do not necessarily seek to determine the magnitude of impacts or evaluate mitigation effectiveness, but when monitoring was targeted at supporting impact mitigation, in the case of fauna run-over, an integrated approach has proved to be capable of promoting an effective and adaptive management of biodiversity impacts.

The adoption of biodiversity targets by companies may be an opportunity to deepen the analysis of already available data from compliance related monitoring and transform them in information of interest to a range of stakeholders, thus not limited to regulatory compliance.

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