

## Policy Forums

## Gold at what cost? Another megaproject threatens biodiversity in the Amazon



Raffael M. Tófoli<sup>a,\*</sup>, Rosa M. Dias<sup>b</sup>, Gustavo H. Zaia Alves<sup>b,c</sup>, David J. Hoeinghaus<sup>d</sup>, Luiz C. Gomes<sup>b</sup>, Matheus T. Baumgartner<sup>b</sup>, Angelo A. Agostinho<sup>b</sup>

<sup>a</sup> Centro Universitário Ingá (Uningá), Maringá, PR, Brazil

<sup>b</sup> Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais (PEA), Universidade Estadual de Maringá, Maringá, PR, Brazil

<sup>c</sup> PostDoctoral Fellowship, Universidade Estadual de Maringá, Maringá, PR, Brazil

<sup>d</sup> Department of Biological Sciences and the Advanced Environmental Research Institute, University of North Texas, Denton, TX, United States

## ARTICLE INFO

## Article history:

Received 24 March 2017

Accepted 13 June 2017

Available online 26 June 2017

## Keywords:

Xingu River

Volta Grande Project

Mining

Belo Sun

Endemic species

## ABSTRACT

The Xingu River, located in northern Brazil, is already under the impacts of one of the most harmful projects in the history of the Amazon – the Belo Monte hydroelectric dam. A new megaproject called the ‘Volta Grande Project’, led by Canadian gold mining company *Belo Sun* will be situated adjacent to the same stretch of the Xingu that is dewatered by the Belo Monte complex. Various aspects of the project are controversial. There are reports that the mining company acquired public lands illegally, the affected area has high biodiversity and endemism of several taxonomic groups, and mining operations would be approximately 9.5 km from indigenous lands. Synergistic impacts of impoundment and mining operations are expected to dramatically alter the Xingu’s biodiversity and ecosystem services that support indigenous people and riverine populations. Moreover, the mining activities will generate tons of toxic waste that will be stored in a high-risk tailings dam, which exposes the Xingu River to catastrophic consequences similar to those of the Doce River disaster.

© 2017 Associação Brasileira de Ciência Ecológica e Conservação. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

The Brazilian Amazon is facing intense development pressure (Almeida et al., 2016; El Bizri et al., 2016; Fearnside, 2016; Ferreira et al., 2014; Tófoli et al., 2016; Winemiller et al., 2016). For example, the Volta Grande region, a 130 km stretch of rapids and braided channels on the Xingu River that is known for its rich endemic fauna and importance to numerous indigenous groups (e.g. Lujan and Conway, 2015; Sabaj Pérez, 2015), is impacted by one of the most harmful infrastructure projects in the history of the Amazon – the Belo Monte hydroelectric complex. The upstream dam (Pimental) of the Belo Monte complex floods part of the Volta Grande under a reservoir, while flows in the stretch below Pimental are greatly reduced as 60–70% of the water is diverted to a new 20 km channel to drive the turbines in the Belo Monte hydropower dam downstream.

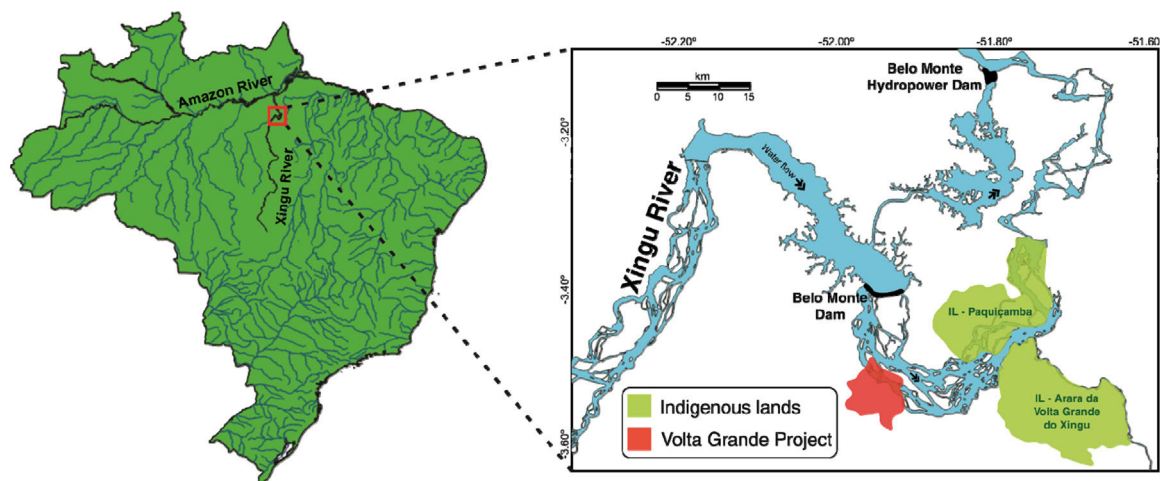
The full impacts of Belo Monte will take time to manifest, but fisheries, navigation, and livelihoods were already affected during the construction process (e.g. Magalhães et al., 2016). Now, a new megaproject called the ‘Volta Grande Project’ will be situated adjacent to the same stretch of the Xingu that is dewatered by the Belo Monte complex (Fig. 1). This project, led by Canadian mining company *Belo Sun*, will be the largest gold mining operation in Brazil.

## Controversial aspects of the Volta Grande Project

Similar to Belo Monte (e.g. Lees et al., 2016; Tollefson, 2016), various aspects of the Volta Grande Project are controversial. We briefly summarize three controversial aspects of this project that deserve attention, especially given the potential for the current political climate to affect environmental policy (Fearnside, 2016). First, there have been irregularities in the procedures for land acquisition necessary for the project. Specifically, there are reports that the mining company acquired public lands without consulting the responsible federal agency (Chamber of Deputies, 2016). Subsequently, the National Human Rights Council affirmed that the

\* Corresponding author.

E-mail address: [biotofoli@gmail.com](mailto:biotofoli@gmail.com) (R.M. Tófoli).



**Fig. 1.** Map of the Volta Grande region of the Xingu River and locations of the Belo Monte hydropower complex and the Volta Grande Project relative to indigenous lands.

company is illegally removing the local population (Federal Public Ministry, 2016).

Second, the affected area has a rich and unique biodiversity that will be severely impacted by mining activities. This unique biodiversity includes endemism (i.e. found nowhere else on Earth) of several taxonomic groups, especially in the fish fauna that is exceptionally diverse (Lees et al., 2016). The complex habitat heterogeneity provided by rapids, braided channels, various substrates, and seasonal flood dynamics provides a variety of niches that support more than 450 fish species (mainly rheophilic species), including at least 26 endemic species (Camargo et al., 2004; Isaac et al., 2008; Sawakuchi et al., 2015).

Finally, the region is the cradle of the Xingu's indigenous ethnic groups and mining operations would be approximately 9.5 km from current indigenous lands. Although the Environmental Impact Assessment did not meet the requirements of the National Foundation for Indigenous People (FUNAI), the project received the license for construction from the responsible environmental agency of Pará state (Semas, 2017). Currently, the license for construction was temporarily suspended by the Federal Regional Court of the 1° Region. The decision meets the request of the Federal Public Ministry, which considers that the Volta Grande Project failed in assessing impacts on indigenous groups (Federal Public Ministry, 2017).

### The future of Xingu is far from 'Belo'

Once operational, the Volta Grande Project estimates an initial extraction of 3.5 million tons of mill feed per year, expanding to full production of 7 million tons per year in the third year. The extraction activities are expected to last 17 years, generating tons of waste that will be retained by a tailings dam even after completion of mining operations. Belo Sun's Environmental Impact Assessment classified the tailings dam in the high-risk category, which means that, although dam failure is unlikely, it would have catastrophic consequences (EIA, 2012; RIMA, 2012). Brazil recently witnessed exactly such an event – the Doce River disaster (Fernandes et al., 2016). In that case, considered by many to be the single greatest environmental disaster in Brazil's history, a tailings dam collapse caused the death of several people, essentially destroyed the river from the point of the collapse to the mouth, and sent a toxic plume into the southern Atlantic Ocean (Neves et al., 2016).

In addition to the aforementioned concerns, we believe a critical issue was not well addressed in the Volta Grande Project's Environmental Impact Assessment. Specifically, the study poorly

describes the synergetic effects of the Volta Grande Project and the Belo Monte complex, and according to the Federal Public Ministry, the Mining Company did not call the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) to discuss the cumulative effects derived from these two infrastructure projects. Synergistic impacts of impoundment and mining operations are expected to dramatically alter the Xingu's watershed, hydrology, water quality, habitats and biological diversity, and ultimately erode ecosystem services such as fisheries production that support indigenous people and riverine populations. The Volta Grande Project will exacerbate the irreparable losses of biodiversity and ecosystem functioning expected from Belo Monte.

### Concluding remarks

The Brazilian environmental system is fragile. The current political context in Brazil is directly contributing to massive budget cuts in the environmental sector and is encouraging proposals to loosen environmental regulations and abbreviate the licensing process for major infrastructure projects (Almeida et al., 2016; El País, 2017; Fearnside, 2016; Ferreira et al., 2014; Pelicice et al., 2017; Tollefson, 2016). The consequences of rapid development coupled with inadequate environmental regulations or enforcement can be catastrophic. For example, the Doce River disaster likely could have been avoided if the environmental inspection system was rigorously enforced (Fernandes et al., 2016).

Unsustainable environmental policies stimulate harmful infrastructure development because scientific advice is systematically ignored (Azevedo-Santos et al., 2017). Furthermore, massive projects such as the Volta Grande Project, which are expected to have significant and far-reaching environmental impacts, should not be licensed by state environmental departments, but by the Federal environmental agency. Federal agencies have more highly-qualified technical staff and broader jurisdiction and are thus better equipped to cope with the significant spatial and temporal scales and interactions with other projects that should be considered during assessment. At this point, research is urgently needed to understand the synergistic environmental impacts of Belo Monte and the Volta Grande Project, not only for monitoring and remediating the impacts to the Xingu River basin, but also to inform future development. New developments in the Amazon facilitate further expansion (Fearnside, 2015), and environmental assessments must consider and detail the synergistic effects of multiple projects on biodiversity and ecosystem functioning during the planning and approval process rather than only in hindsight.

## Conflicts of interest

The authors declare no conflicts of interest.

## Acknowledgements

The authors thank the Graduate Program in Ecology of Continental Aquatic Environments (PEA), National Council for Scientific and Technological Development (CNPq) and Coordination for the Improvement of Higher Education Personnel (CAPES) for financial support and for the scholarship granted to Gustavo H.Z. Alves and Matheus T. Baumgartner. Angelo A. Agostinho and Luiz C. Gomes received CNPq research grants. Comments provided by the Editor and two anonymous reviewers clarified and improved the manuscript.

## References

- Almeida, R.M., Lovejoy, T.E., Roland, F., 2016. Brazil's Amazon conservation in peril. *Science* 353, 228.
- Azevedo-Santos, V.M., Fearnside, P.M., Oliveira, C.S., et al., 2017. Removing the abyss between conservation science and policy decisions in Brazil. *Biodivers. Conserv.*, <http://dx.doi.org/10.1007/s10531-017-1316-x>.
- Camargo, M., Giarrizzo, T., Isaac, V., 2004. Review of the geographic distribution of fish fauna of the Xingu River Basin, Brazil. *Ecotropica* 10, 123–147.
- Chamber of Deputies, 2016. Ata da 20<sup>a</sup> Sessão da Câmara dos Deputados, Deliberativa Ordinária, Vespertina, da 2<sup>a</sup> Sessão Legislativa Ordinária, da 55<sup>a</sup> Legislatura, em 1<sup>o</sup> de março de 2016, <http://www.camara.leg.br/internet/plenario/notas/ordinari/2016/3/V0103161400.pdf> (accessed 02.03.17).
- EIA – Estudo de Impacto Ambiental, 2012. Projeto Volta Grande, <https://www.semas.pa.gov.br/documentos/estudos-de-impacto-ambiental/> (accessed 31.05.17).
- El Bizri, H.R., Macedo, C.B., Paglia, A.P., et al., 2016. Mining undermining Brazil's environment. *Science* 353, 228.
- El País, 2017. O vexame de cortar pela metade a ínfima verba para o Meio Ambiente, [http://brasil.elpais.com/brasil/2017/04/17/opinion/1492429127\\_224699.html](http://brasil.elpais.com/brasil/2017/04/17/opinion/1492429127_224699.html) (accessed 29.05.17).
- Fearnside, P.M., 2016. Brazilian politics threaten environmental policies. *Science* 353, 746–748.
- Fearnside, P.M., 2015. Amazon dams and waterways: Brazil's Tapajós Basin plans. *Ambio* 44, 426–439.
- Federal Public Ministry, 2016. MPF/PA: atingidos por Belo Sun e Belo Monte preocupam Conselho Nacional de Direitos Humanos, <http://pfdc.pgr.mpf.br/informativos/edicoes-2016/outubro/mpf-pa-atingidos-por-belo-sun-e-belo-monte-preocupam-conselho-nacional-de-direitos-humanos/> (accessed 16.01.17).
- Federal Public Ministry, 2017. MPF/PA: TRF1 suspende licença de instalação da mineradora canadense Belo Sun, no Xingu, <http://www.mpf.mp.br/pa/sala-de-imprensa/noticias-pa/trf1-suspende-licenca-de-instalacao-da-mineradora-canadense-belo-sun-no-xingu> (accessed 29.05.17).
- Fernandes, G.W., Goulart, F.F., Ranieri, B.D., et al., 2016. Deep into the mud: ecological and socio-economic impacts of the dam breach in Mariana, Brazil. *Nat. Conserv.* 14, 35–45.
- Ferreira, J., Aragão, L.E.O.C., Barlow, J., et al., 2014. Brazil's environmental leadership at risk. *Science* 346, 706–707.
- Isaac, V.J., Zorro, M.C., Sarpedonti, V., et al., 2008. Diagnóstico ambiental da AHE – Belo Monte – Médio e Baixo Rio Xingu – Ictiofauna e Pesca. Museu Paraense Emílio Goeldi, Universidade Federal do Pará, <http://licenciamento.ibama.gov.br/Hidretricas/Belo%20Monte/EIA/Volume%2019%20-%20RELATORIOS%20MPEG%20ICTIOFAUNA/TEXTO/RELAT%20RIO%20FINAL%20ICTIOFAUNA%20E%20PESCA%20V7.pdf> (accessed 20.11.16).
- Lees, A.C., Peres, C.A., Fearnside, P.M., et al., 2016. Hydropower and the future of Amazonian biodiversity. *Biodivers. Conserv.* 25, 451–466.
- Lujan, N.K., Conway, K.W., 2015. Life in the fast lane: a review of rheophily in freshwater fishes. In: Riesch, R., Tobler, M., Plath, M. (Eds.), *Extremophile Fishes*. Springer International Publishing, New York, pp. 107–136.
- Magalhães, S.B., Silva, Y.Y.P., Vidal, C.L., 2016. Não há peixe para pescar neste verão: efeitos socioambientais durante a construção de grandes barragens – o caso Belo Monte. *Desenvolv. Ambiente* 37, 111–134.
- Neves, A.C.O., Nunes, F.P., Carvalho, F.A., et al., 2016. Neglect of ecosystems services by mining, and the worst environmental disaster in Brazil. *Nat. Conserv.* 14, 24–27.
- Pelicice, F.M., Azevedo-Santos, V.M., Vitule, J.R.S., et al., 2017. Neotropical freshwater fishes imperilled by unsustainable policies. *Fish Fish.*, <http://dx.doi.org/10.1111/faf.12228>.
- RIMA – Relatório de Impacto Ambiental, 2012. Projeto Volta Grande, <http://www.sema.pa.gov.br/download/2BSML001-1-EA-RIM-0002.RIMA.REVISADO.pdf> (accessed 08.12.16).
- Sabaj Pérez, M., 2015. Where the Xingu bends and will soon break. *Sci. Am.* 103, 95–403.
- Sawakuchi, A.O., Hartman, G.A., Sawakuchi, H.O., et al., 2015. The Volta Grande do Xingu: reconstruction of past environments and forecasting of future scenarios of a unique Amazonian fluvial landscape. *Sci. Dril.* 20, 21–32.
- Semas, 2017. Projeto Volta Grande recebe licença de instalação, <https://www.semas.pa.gov.br/2017/02/02/projeto-volta-grande-recebe-licenca-de-instalacao/> (accessed 30.05.17).
- Tófoli, R.M., Alves, G.H.Z., Dias, R.M., et al., 2016. Brazil's Amazonian fish at risk by decree. *Science* 353, 229.
- Tollefson, J., 2016. Brazil debates loosening environmental protections. *Nature* 539, 147–148.
- Winemiller, K.O., McIntyre, P.B., Castello, L., et al., 2016. Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong. *Science* 351, 128–129.