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Productivity and impact of the Unisinos' Postgraduate Program in Biology and the consequences of its interruption for Brazilian science

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1 **Productivity and impact of the Unisinos' Postgraduate Program in Biology and the**
2 **consequences of its interruption for Brazilian science**

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14

15 **Abstract**

16 On 22 July 2022, the Universidade do Vale do Rio dos Sinos (Unisinos), a private institution
17 in southern Brazil, announced the interruption of 12 of its postgraduate programs, including
18 the Postgraduate Program of Biology (PPG Biologia), whose professors founded the journal
19 Neotropical Biology and Conservation. We conducted a bibliometric analysis of papers
20 published by PPG Biologia in the past 20 years to assess its impact on biological research at
21 a national level. The number of publications and citations increased constantly over the years,
22 with publications growing exponentially. Although most collaborations with other research
23 programs occurred inside Brazil, a significant number of studies were co-authored by
24 researchers from other countries from at least four continents. The main research lines
25 focused on biological sciences, ecology, sociology, education, environmental sciences, and
26 genetics. Despite being affected by the decrease in research funding and the reduction of
27 personnel, PPG Biologia kept its high impact score according to the national evaluation, above
28 that of most programs in private universities. With a team of renowned researchers working
29 on different and sometimes unique research lines, the interruption of PPG Biologia will harm
30 the progress of biological research and conservation across the Neotropical realm.

31

32 **Keywords:** Bibliometric, Biodiversity Loss, Brazil, Environmental Crisis, Political Crisis,
33 Publications

34

35 **Introduction**

36

37 In Brazil, Biodiversity research occurs in both public and private institutions, but, even in
38 private ones, it relies almost entirely on governmental funding (Mittermeier et al. 2005,
39 McManus and Baeta Neves 2021), which has been on constant turmoil (Magnusson et al.
40 2018, Quintans-Júnior et al. 2020). Biodiversity science suffered severe budget cuts by the
41 Brazilian government in the recent years, driven by politicians associated with the agribusiness
42 sector (Fearnside 2016, Magnusson et al. 2018). Agribusiness controls a large proportion of
43 the Brazilian Congress and pushes legislation to reduce environmental protection (Crouzeilles
44 et al. 2017), actively discrediting science through direct attacks on researchers, science denial
45 and misinformation (Hallal 2021). The situation became even worse during Bolsonaro's
46 administration, who have attacked and denied science himself (de Oliveira Andrade 2019,
47 Hallal 2021).

48

49 With the increasing precariousness of science funding in Brazil, the discontinuation of
50 consolidated high-prestige research programs became an additional threat to research (de
51 Oliveira Andrade 2019, Hallal 2021), as many institutions have groups working on unique and
52 important research lines. This is the case of the Postgraduate Program in Biology (*PPG*
53 *Biologia*) of the Universidade do Vale do Rio dos Sinos (Unisinos), located in São Leopoldo,
54 southern Brazil.

55
56 On 22 July 2022, Unisinos announced the interruption of *PPG Biologia* and other 11
57 postgraduate programs. This decision, according to the institution, aims to promote the
58 University's financial balance (Ferreira 2022) but is a serious attack on Brazilian research.
59 *PPG Biologia* was implemented in 2000 with a course for master's degrees and, in 2006,
60 expanded to include doctoral degrees as well. Also in 2006, *PPG Biologia* launched the journal
61 Neotropical Biology and Conservation, which replaced the journal Acta Biologica
62 Leopoldensia, created in 1979 by professors of the Unisinos' Biology course (Maltchik 2006).
63 The program had 13 fully equipped research laboratories led by highly qualified ecologists,
64 zoologists, geneticists, and microbiologists. Its discontinuation interrupted the research of
65 many professors and graduate students and will likely have a noticeable negative impact on
66 Brazilian biological research.

67
68 Measuring the importance of this postgraduate program can help us understand better the
69 consequences of its discontinuation. Thus, we herein conducted a bibliometric analysis of
70 papers published by *PPG Biologia* in the past 20 years to assess its impact on biology
71 research at a national level, evaluating production, collaborations and comparing overall
72 performance with other Brazilian institutions.

73

74 **Methods**

75

76 We ran a bibliographical review on the Dimensions platform (<https://app.dimensions.ai/>).
77 Dimensions is the "world's largest research information dataset" with over 130 million
78 publications registered, classified, and described on a standardized methodology (Bode et al.
79 2019). The term "Programa Pós-graduação Biologia Unisinos" (Portuguese for "Unisinos
80 Postgraduate Program in Biology") was searched anywhere in the documents, as it could be
81 mentioned in the authors' affiliations and acknowledgment sections.

82

83 We measured the impact of *PPG Biologia* by the number of publications per year and the
84 cumulative citations using the R packages 'dimensionsR' (Aria 2022) and 'bibliometrix' (Aria
85 and Cuccurullo 2023). To test whether there has been a sustained temporal increase in
86 production, number of citations, and accumulated number of citations, we applied simple or
87 exponential linear models in R (R Core Team 2022).

88

89 Text processing and analytics were used to convert text data into quantification data, using
90 the R packages 'tidytext' (Robinson and Silge 2023) and 'tm' (Feinerer and Hornik 2023). That
91 procedure was applied to identify the collaboration of researchers from *PPG Biologia* with
92 researchers from other institutions based on nationality, and the research areas of the
93 publications. We used a circular network and a bipartite network to describe a network of
94 countries with co-authorship and co-authorships in different research areas, respectively,
95 using the R packages 'ggraph' (Pedersen 2022) and 'bipartite' (Dormann et al. 2022). A word

96 cloud (Lang & Chien 2022) was applied using the frequency of keywords from papers
97 published between 2015 and 2021 to identify the main topic of publications.

98

99 Postgraduate programs (PGs) in Brazil are classified by CAPES (Portuguese acronym for
100 Coordination for the Improvement of Higher Education Personnel), which conducts annual
101 evaluations of the PGs' performance based on their impact, such as productivity and
102 personnel formation (Cross et al. 2017). We downloaded data from 2013 to 2020 of all
103 Brazilian PGs in Biological Sciences (389 PGs for the period) from
104 <https://dadosabertos.capes.gov.br/dataset/>. We used two separate Wilcoxon tests to compare
105 the performance of Unisinos with public and private institutions.

106

107 Data and script provided in Krüger (2023).

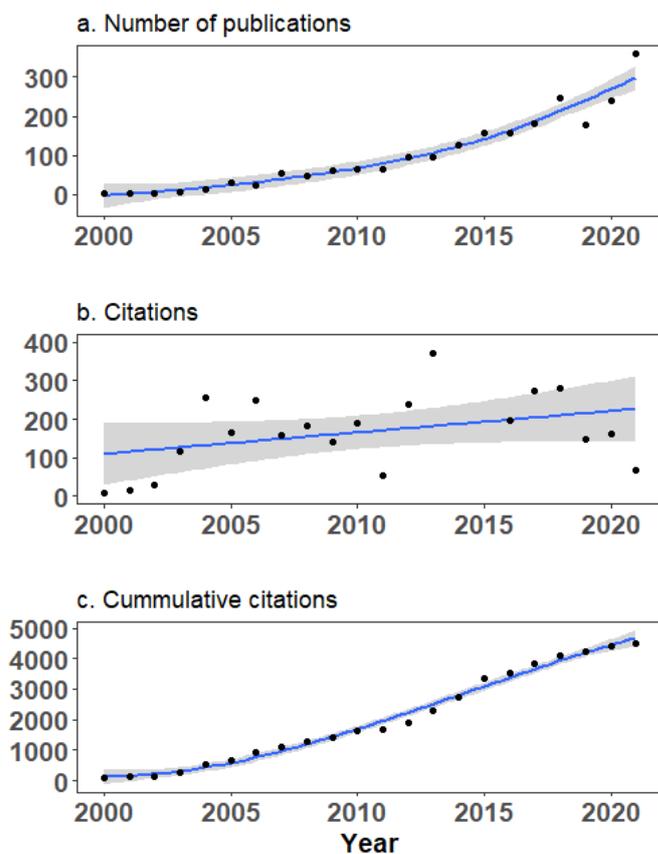
108

109 Results

110

111 The productivity of PPG Biologia (Fig. 1a) increased exponentially (adj. $R^2 = 0.898$, $F_{1,26} =$
112 23.91 , $P < 0.001$) from less than 10 peer-reviewed publications per year in 1999 to over 300
113 publications per year in 2022. Citations per year (Fig. 1b) increased on a weak but significant
114 linear trend (adj. $R^2 = 0.233$, $F_{1,26} = 7.90$, $P = 0.009$), reaching a maximum of 400 citations in
115 one year. The accumulated number of citations (Fig. 1c) increased exponentially from less
116 than 50 to over 4,000 in 20 years (adj. $R^2 = 0.901$, $F_{1,26} = 24.69$, $P < 0.001$).

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118

119

120 Figure 1. Number of publications mentioning “Programa Pós-graduação Biologia Unisinos”
 121 (a), number of citations per year of those same papers (b); and accumulated citations (c) of
 122 those papers between 2000 and 2021.

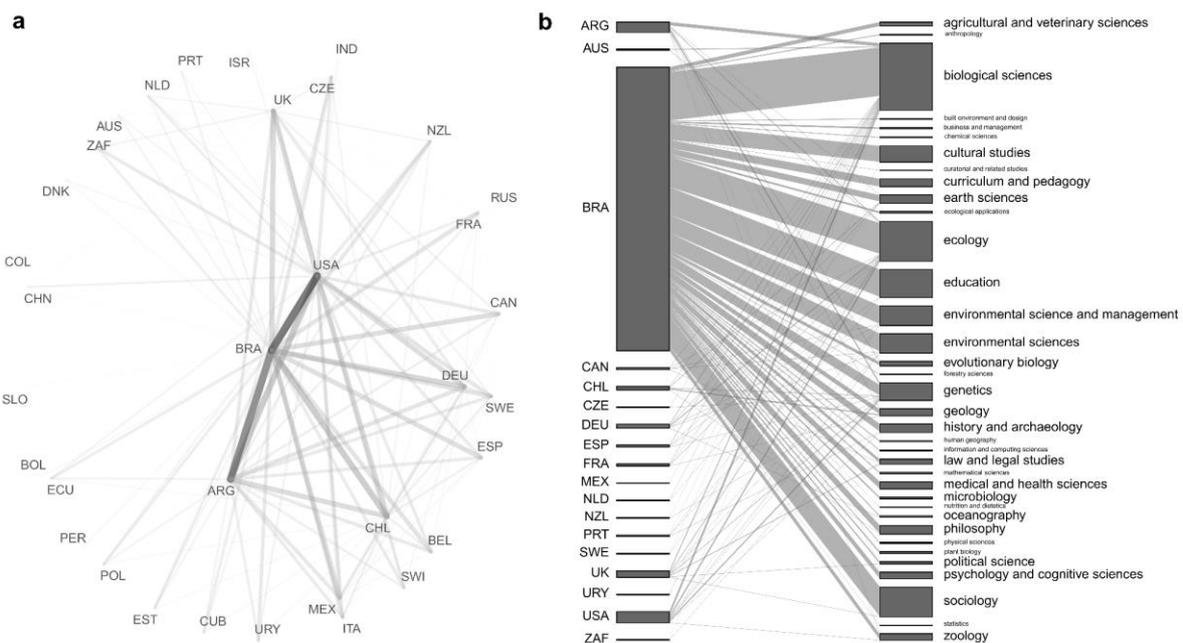
123

124 PPG Biologia published papers mostly with authors from other Brazilian institutions but also
 125 with authors from other 34 countries. USA and Argentina were the countries with the largest
 126 numbers of papers co-authored with Unisinos researchers after Brazil, followed by the United
 127 Kingdom, Chile, Spain, and Germany (Fig 2). Most frequent publications predominated in
 128 research lines of biological sciences, ecology, sociology, education, environmental sciences,
 129 and genetics but were spread through a diverse range of lines (Fig. 2b).

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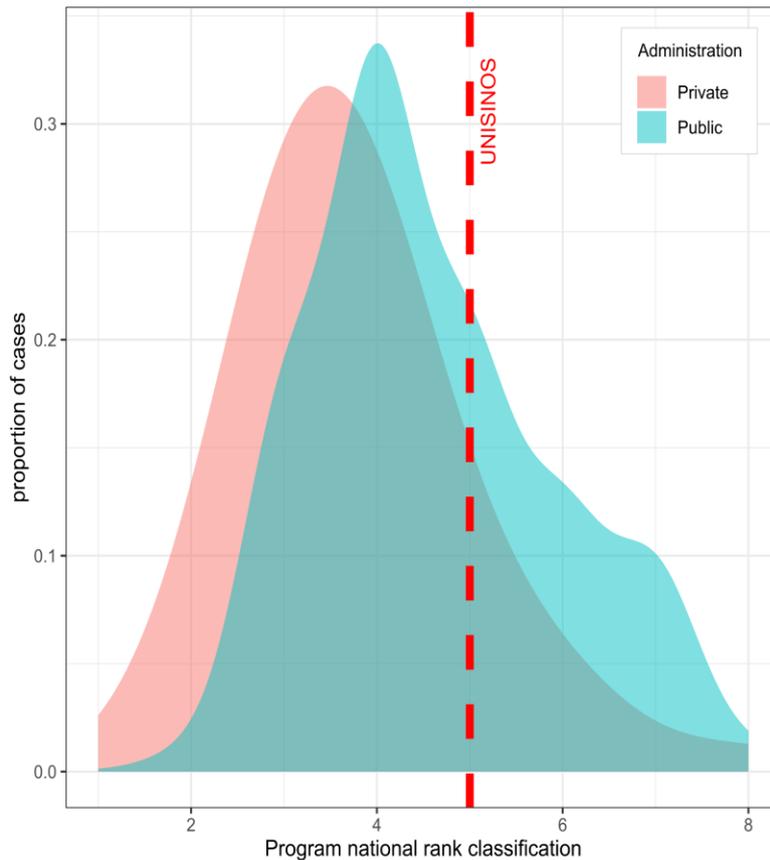


133
 134 Figure 2. Network of the nationality of coauthors' institutions for papers published by
 135 researchers from the Unisinos Postgraduate Program in Biology between 2015 and 2021,
 136 including only countries with more than two publications (a) and a bipartite network connecting
 137 the nationality of the authors' institutions with the publications' research lines, including only
 138 research lines with at least two publications (b). Line width in both 'a' and 'b' represents
 139 frequency; bar height in 'b' indicates the frequency of countries (left) and research lines (right).

140

141 Keyword analysis (Fig. 3) revealed a predominance of studies dealing with animals, behavior,
 142 ecosystems, biodiversity, genetics, and populations; other less frequent words showed a wide
 143 range of studied topics. The keyword “Brazil” was also highlighted; “south” and “America” also
 144 appeared but with a lower frequency.

145



156
 157 Figure 4. Frequency distribution of national rank classification for Brazil's Postgraduate
 158 Programs in Biological Sciences classified as public (blue) and private (red) administration
 159 between 2015 and 2020 in relation to the current classification of Unisinos' Postgraduate
 160 Program in Biology.

161
 162
 163 **Discussion**

164
 165 During its almost 22 years of existence, PPG Biologia showed an exponential increase in
 166 productivity. Even in the face of the severe budget cuts in Brazilian research following the
 167 impeachment of president Dilma Rousseff in 2016 and the election of Jair Bolsonaro in 2018
 168 (Quintans-Júnior et al. 2020), the productivity kept growing, which suggests that PPG Biologia
 169 was a resilient research program. The number of citations showed a smaller increase across
 170 the years, but the overall trend may result from a considerable reduction in citations in the last
 171 few years. If one considers true that the number of citations determines the quality of research,
 172 which is a controversial topic (Caon et al. 2020), this may be the metric that reflects the
 173 consequences of both budget cuts from funding agencies and the gradual reduction in the
 174 number of researchers in PPG Biologia, which started with the gradual dismissal of professors
 175 since 2016 (personal observation). As a result, although the number of publications continued
 176 to increase, the research areas covered likely decreased, thus reducing the research fields
 177 that would find relevant studies among the most recent productions of PPG Biologia.

178
 179 Although PPG Biologia conducted most studies with other Brazilian researchers,
 180 collaborations with researchers in other countries from at least four continents and covering a

181 diversity of research lines also stood out. The reasons for international collaborations in
182 research are numerous but often motivated by the researcher's reputation, access to research
183 funds, and an increase in quality and multidisciplinary due to the expertise of collaborators
184 (Dusdal and Powell 2021). Many researchers of PPG Biologia are renowned experts in their
185 fields, and the research groups of PPG Biologia included several research lines addressing
186 globally relevant topics related to genetics and evolution (Silva et al. 2021, Allgayer et al.
187 2022), taxonomy of highly diverse Neotropical groups (Rodrigues et al. 2020, 2021, Hellmann
188 et al. 2022, Marques et al. 2022, Reis and Lehmann A. 2022), as well as the dynamics of
189 ecosystems, communities, and populations (Boll and Leal-Zanchet 2018, Fontoura et al. 2019,
190 MOSER et al. 2022), including the study of human impact through pollution (Dalzochio et al.
191 2018, Finger et al. 2021, Bauer et al. 2022), agriculture (Meneghel et al. 2022), habitat
192 fragmentation (Baldissera et al. 2020, Dalmolin et al. 2023), and climate change (Fontana et
193 al. 2018, Krüger et al. 2018, Epele et al. 2022). One can notice this diversity in research lines
194 through the most frequent keywords in recent publications.

195
196 CAPES score to evaluate Brazilian Postgraduate Programs ranges between 1 and 7, with 6
197 and 7 indicating excellence (and achieved by very few programs) and 1 and 2 meaning that
198 the program is discredited. Thus, the most realistic score for any active postgraduate program
199 varies from 3 to 5. Although this evaluation system is often questioned and has its flaws
200 (Barata 2019), it is impressive that PPG Biologia was able to keep the highest realistic score
201 in the face of the ever-growing attacks that it received through the reduction of research funds
202 and the gradual decrease in the number of researchers. This is even more impressive
203 considering that PPG Biologia was part of a private university, Unisinos, and the overall scores
204 of programs in private universities are lower than those of public universities. This difference
205 in score between public and private institutions is likely explained by the fact that private
206 universities invest very little in research and rely almost exclusively on public funding
207 (McManus and Baeta Neves 2021).

208
209 Unisinos is a Jesuit university and is said to be a non-profit entity interested in academic
210 excellence and the promotion and development of education
211 (<https://www.unisinos.br/institucional>). However, not only did it discontinue 12 postgraduate
212 programs and dismissed about 40 professors at once, but started a partnership with a large
213 firearm company in 2021 (Rede Brasil Atual 2022). Such attitudes do not seem to agree with
214 the principles that Unisinos supposedly holds.

215

216 **Conclusion**

217

218 Despite the constant attacks through budget cuts and reduction of personnel, PPG Biologia
219 was able to keep its high-quality score over the years. With a research team including
220 renowned researchers and encompassing a diversity of relevant research lines, it showed a
221 promising future as a promoter of knowledge and conservation of Neotropical ecosystems.
222 Unfortunately, this future was denied by the sudden decision of an allegedly non-profit
223 institution to favor profit over research, education, and nature conservation.

224

225

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