



BIOLOGICAL SCIENCES

Publishing in English is associated with an increase of the impact factor of Brazilian biodiversity journals

JUAN C.S. ABAD, RAONY M. ALENCAR, BEN H. MARIMON JR, BEATRIZ MARIMON, ADELMO C.C. SILVA, HALINA JANCOSKI, RENAN S. REZENDE & ESTEVÃO ALVES-SILVA

Abstract: English is the lingua franca for scientific communication, but some journals, especially in developing countries, still publish non-English studies. A shift towards publishing in English may promote internationalization and more visibility of scientific journals. Here we compared quality indexes between Brazilian journals that have always published in English and journals that have published in languages other than English. We also investigated whether a temporal shift towards publishing in English led to elevated quality measures. Our analyses covered 16 Brazilian biodiversity journals and accounted for 12640 papers published since 2007. The mean impact factor was on average 55% higher in journals that have published consistently in English, compared to the so-called multilanguage journals. The proportion of publications in English increased to nearly three times the original value in multilanguage journals between 2007 and 2016, and the impact factor tripled during this period. At the same time, the Qualis-Capes classifications (B1-B2-B3) tended to fall. Publishing in English can be a first step to increased visibility, and this is particularly important for biodiversity journals, since Brazilian ecosystems are considered of interest to the international scientific community and nature conservation.

Key words: Internationalization, impact factor, *lingua franca*, Scielo, Qualis-Capes.

INTRODUCTION

For researchers to reach a higher scientific status and academic promotion, they are encouraged to communicate their research findings as peer-reviewed publications in respectable refereed journals (Luukkonen 1992, Bornmann & Williams 2017). Beyond publishing, having their work cited is also important, as this helps all levels of academic work to reach wider audiences (Clapham 2005). To achieve this, publishing scientific papers in English has become paramount (López-Navarro et al. 2015, Di Bitetti & Ferreras 2017).

The ‘national literature tradition’, meaning that authors tend to publish in the language of the country they live in (Swales 1985, Meneghini & Packer 2007, Ma et al. 2012), has prevailed throughout the history of Latin American scientific journals. Until recently, publications in Portuguese and Spanish were commonplace and accounted for a significant part of what was published in journals from the southern neotropical region. Nonetheless, in the past 10 years or so, this pattern has changed substantially, and journals have gradually modified their publishing policies, thus submissions of manuscripts in English have

been strongly recommended, or mandatory (Paiva & Pagano 2001). In some instances, non-English papers can be invisible to databases (Guerrero-Bote & Moya-Anegón 2014), or avoided by readers (Stankus et al. 1982, Thorp et al. 1988), therefore hindering even further the visibility of journals.

This shift to publish in English might have implications for journals. Firstly, it might promote the internationalization and inclusion in ISI (Institute of Scientific Information, ISI Thomson) (González-Alcaide et al. 2012), with consequent increases in the impact factor. The impact factor shows the average number of citations received by a journal in a given period or time, and is used worldwide as a measure of relative quality (Meneghini et al. 2008). Secondly, journals might acquire more relevancy, visibility, higher download rates, attraction of foreign researchers and higher citation rates, what can ultimately boost the relative importance and quality of the journal worldwide (Lira et al. 2013). These topics have been evaluated, for instance, in traditional Chinese journals. The shift from the mother language to the English language doubled the citation index of Chinese journals, becoming more visible to researchers worldwide (Li & Zhang 2003).

Whether these trends are in course in Latin American journals are unknown, but a shift to publishing in English over the 'national literature tradition' is assumed to have changed the measures of journal quality. This condition becomes particularly relevant in the case of biodiversity and ecology-scoped journals in Brazil, whose importance has grown substantially due to environmental problems and its central role in terms of the nature conservation (e.g. Amazonia and climate change, Cerrado and Atlantic Rainforest as hotspots for biodiversity conservation – e.g. Fearnside 2009).

For that reason, we conducted a survey in the literature to investigate if temporal changes in publishing language of selected Brazilian journals (in the field of biodiversity) enhanced publishing metrics such as citation rates (i.e. the impact factor) and the "Qualis-Capes". This latter comprises a list of periodicals with a categorical index and is implemented by Brazilian Government to indicate the relative quality of a given journal (see Begossi 2016 for the clarification of the Qualis-Capes system). We were moved to conduct this study by the fact that Portuguese is an exotic language to the scientific community, increasing Brazil's need to adopt English (in publications) to increase Brazilian research visibility worldwide (Lira et al. 2013).

In this study, we sampled two types of journals, hereafter referred to as "English-only" (journals that have always published papers in English) and "multilanguage" (journals that published in either English, Spanish and Portuguese) in order to investigate if differences in quality measures were related to the specified publishing languages. We (i) examined whether the impact factor (IF) was related to the two journal types and time; (ii) recorded the temporal changes in the proportion of papers published in Portuguese, Spanish and English in multilanguage journals, and sought for a gradual trend to adopt English as the *lingua franca*; (iii) analyzed whether increased proportion of publishing in English is related to measures of journal quality in the multilanguage journals; and (iv) investigated the temporal relationship between changes in the Qualis-Capes according to journal's IF, type and time.

We expected that (i) English-only journals would show significantly higher quality measures than multilanguage journals; (ii) a shift towards adopting English as the current language in multilanguage journals; (iii) increased fraction

of publications in English should grant elevated quality measures in multilanguage journals; (iv) a positive relationship between Qualis-Capes, IF and time, thus showing that researches could use either index as a measure of journal quality.

MATERIALS AND METHODS

Conditions of study

Our research was based on Brazilian journals only, for the following reasons: there are several issues per year, increased visibility (Collazo-Reyes 2014), and papers in full are easy and freely available in Scielo (the Scientific Electronic Library Online - www.scielo.org/) (see aims and achievements of Scielo in Meneghini et al. 2006). In addition, these journals publish studies from all over the Latin America where they traditionally receive texts in Spanish, Portuguese and English. To conclude, Brazilian literature includes both journals that have published in English and journals that accept papers in Portuguese, Spanish and English, thus rendering the possibility of comparisons regarding their quality measures. Furthermore, the selected journals have IF, which permits the evaluation of our objectives.

This study accounted for journals which focused on ecology/biodiversity. The ecology group included journals of botany, zoology, ecology and earth sciences, collectively regarded as “Biodiversity” by the Qualis-Capes system Capes (Coordination for the Improvement of Higher Education Personnel). The Capes is a Brazilian Foundation within the Ministry of Education whose central purpose is to coordinate efforts to improve the quality of Brazil’s faculty and staff in higher education through grant programs (fellowships and also financial support for infrastructure) (Santos 2009). This foundation has established a system named Qualis-Capes and a committee ranks

journals according to science field (Biodiversity, Education, Engineering) and quality. In this classification, journals are placed in eight distinct categories based on the IF and relevance for a given field, in the following decreasing order: A1, A2, B1, B2, B3, B4, B5, C (Ferreira et al. 2013, Barata 2016). As reviewed by Barata (2016), CAPES determines that the distribution of periodicals in the Qualis-Capes for each area must have $A1 < A2$, $A1 + A2 + B1 \leq 50\%$, and $A1 + A2 \leq 25\%$ of the total number of journals that published articles by the graduate programs of that area. A few journals that are considered especially relevant for a given field may be included in a Qualis-Capes classification by a decision of the committee, and not based on IF. A journal will not be found in the Qualis-Capes list if none of the graduate programs of that area published in it that year (Barata 2016). In the biodiversity category, the “A” refers to world-class journals with the highest IF; journals in “B” group have medium IF, and the “C” group comprises local to regional journals without IF (Rocha-e-Silva 2009, Begossi 2016).

Data sampling

After a survey in the Scielo webpage, we retrieved 16 journals that fulfilled our criteria. These journals were then separated in two classes, accounting for those that are English-only ($n = 6$; Acta Limnologica Brasiliensia, Brazilian Archives of Biology and Technology, Brazilian Journal of Biology, Brazilian Journal of Oceanography, Neotropical Ichthyology and Scientia Agricola) and those that are multilanguage ($n = 10$; Acta Amazonica, Acta Scientiarum Animal Sciences, Acta Botanica Brasílica, Ciência Florestal, Horticultura Brasileira, Iheringia Série Zoologia, Revista Brasileira de Entomologia, Revista Árvore, Rodriguésia and Zoologia). All journal issues published between 2007 and 2016 were sampled, whenever available. Only original

articles, reviews and scientific notes were included in our sampling; thus, book reviews, obituaries and erratum were excluded from the database.

The official webpage of In Cites Journal Citation Reports (Thomson Reuters - JCR), which provides the official and most used IF values is not available in our State (Mato Grosso, Brazil), not even via institutional access (University of the Mato Grosso State). In addition, the IF is not shown in the Scielo journal's official sites. Thus, IF values were obtained from the Scimago Journal & Country Rank webpage (<http://www.scijournal.org>), and focused on the cites per document in the last two years (shown as Cites / Doc. (2 years) in the webpage). This metric evaluates the number of citations divided by the number of papers published in the journal in the past two years. According to the information on the webpage, the Cites/Doc. (2 years) is similar to the Thomson Reuters' measure of IF.

Qualis-Capes indexes associated with each journal/year were consulted at <https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/veiculoPublicacaoQualis/listaConsultaGeralPeriodicos.jsf> (accessed on 5 of September 2017). This webpage currently provides the data for two evaluation periods (2010-2012 and 2013-2016), rather than the classification by year. In all searches, the field "Área de Avaliação" (evaluation field) was tagged as 'Biodiversity'.

Statistical analyses

Quantitative data is shown as mean and standard deviation in the text, but median and range values are shown in figures whenever appropriate. The relationship among IF (dependent variable), journal types and time (both employed as factors) was examined with a two-way Analysis of Variance (Anova) (objective i). Two models, one with and one without

interaction effects (journal types* time) were performed, but no statistical difference was found ($F_{121,122} = 1.7040$; $P = 0.0596$). Thus, the most parsimonious model is presented.

The relationship between the proportion of English papers and IF (per year) (objectives ii and iii) was tested using different regression models (linear, logarithmic, exponential) and the best fit of the model was determined using the R^2 . The proportion of publication in English in multilanguage journals was achieved by dividing the number of papers in English by the total number of papers, in a range from 0 (no paper in English) to 1 (English-only journal).

Changes in Qualis-Capes per evaluation period in multilanguage and English-only journals were analyzed through comparison of figures (objective iv), by plotting the initial (2010-2012) and the final (2013-2016) Qualis-Capes values side by side. The IF per evaluation period was also compared. Statistical analyses were performed in R statistical software version 3.3.2, and the level of significance (α) for statistical tests was set to 0.05.

RESULTS

IF was on average 55% higher in English-only journals, compared to multilanguage journals (0.76 ± 0.27 and 0.49 ± 0.23 , respectively) (Figure 1a). Time and journal type were significantly related to the journal's changes in IF (Figure 1b, Table I). Annual IF median values of English-only journals were higher than those observed in multilanguage journals from 2007 to 2016 (Figure 1b).

Of the 12640 papers examined, 7447 were published in multilanguage journals. In the latter, papers in Spanish, English and Portuguese accounted for 1.73% ($n = 129$), 40.57% ($n = 3021$) and 57.70% ($n = 4297$) of the publications,

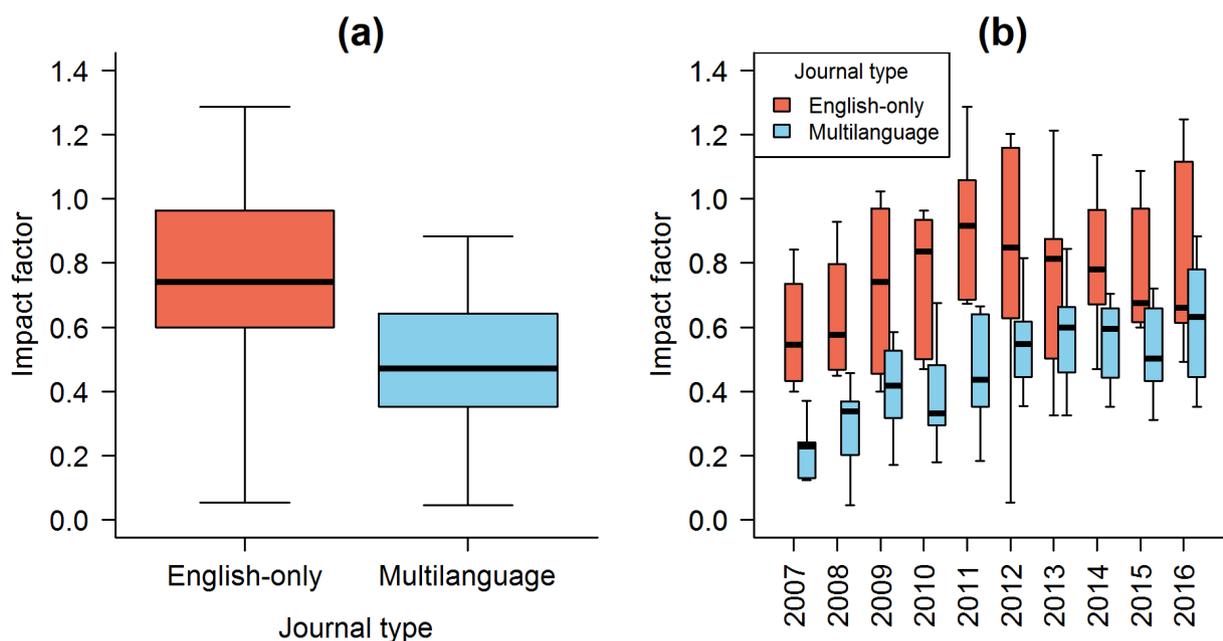


Figure 1. Relationship between impact factor (cites per document in the past two years), journal types and time. (a) Journals that have consistently published in English had the highest impact factors. (b) In both journal types, the impact factor ascended in time, but in general English-only journals had consistently higher IF values than their multilanguage counterparts. First (lower line) and third (higher line) quartiles, the median (bold line), upper and lower limits (projected line).

respectively. A gradual temporal change towards publishing papers in English was noted, in which the fraction of papers in English had nearly a 3-fold increase from 2007 to 2016 (Figure 2).

The temporal relationship between IF and the proportion of papers in English in multilanguage journals was positive ($R^2 = 0.8645$, asymptote = 0.8195, slope = 0.8129), but the relationship was logarithmic rather than linear (i.e. $y = a + b(\log(x))$) (Figure 3).

In general, the Qualis-Capes remained stationary (37.5% of journals) or decreased (62.5% of journals), irrespective of journal type (Figure 4a-b). In addition, no journal was currently labelled above the B2 category. In the first Qualis-Capes evaluation, and in the two following years, three Brazilian journals were B1-ranked, but in the last years these journals were downgraded to B2 or B3. The IF, however, increased in most (85%) journals during both

evaluation periods and the IF of remaining journals (15%) decreased (Figure 4c, d).

DISCUSSION

In general, all but the last of our hypotheses were corroborated. English-only journals had greater IF factors than multilanguage journals; and multilanguage journals experienced increases in IF as they had more fraction of papers been published in English. Nonetheless, even with an increase in IF in both journal types and a shift towards publishing in English in multilanguage journals, the journal’s Qualis-Capes lowered.

As multilanguage journals published more frequently in English, an increase in IF was noted. This should encourage journals to adopt English as the *lingua franca*, as the English-only journals have done all along (Lira et al. 2013). The relationship between the IF and

Table I. Relationship among the impact factor (intercept, dependent variable), official language of journals (English-only and multilanguage) and time (both employed as factors). Journal’s impact factors were statistically related to language and time ($P < 0.05$).

Variables	Df	Sum Sq.	MeanSq.	F-value	P-value
Language	1	2.3858	2.5060	46.8466	<0.0000
Time	1	1.2060	0.7873	23.6800	<0.0010
Residuals	138	7.0283	0.5093		

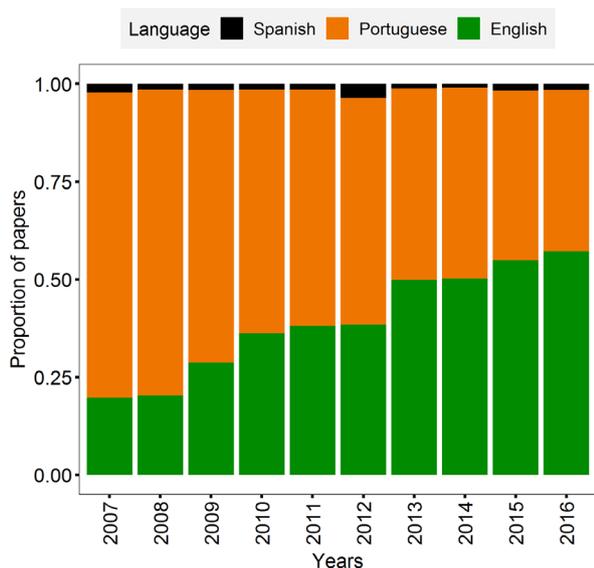


Figure 2. Annual changes in the proportion of papers published in different languages in multilanguage journals. Along the years, multilanguage journals tended to publish more papers in English.

the proportion of publications in English (in multilanguage journals) was logarithmic. The main concern with this model is that the IF value tend to stabilize in 0.8195, as this indicates that all papers within journals are published in English (the proportion of 1, see Figure 3). This estimated maximum value is 78% higher than the actual average IF of these journals (0.46), and 8% higher than the average IF of English-only journals. Thus, adopting English as the official publishing language can indeed increase journal’s IF.

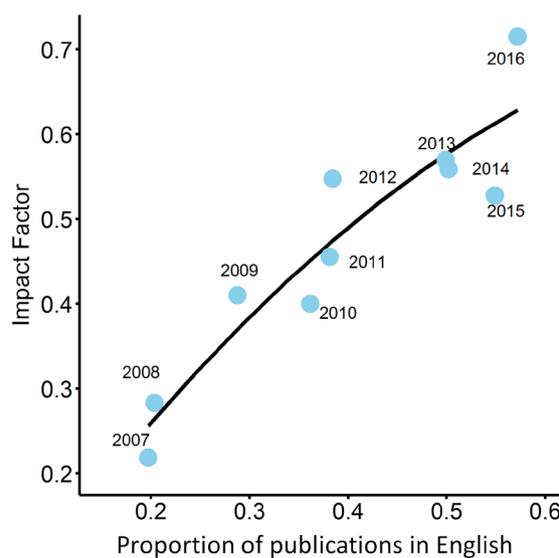


Figure 3. Positive relationship between the mean impact factor of selected multilanguage journals and the proportion of papers published in English per year.

If we assume that journals seek for internationalization, why do multilanguage journals still publish non-English papers? This might be due to ‘national literature tradition’, where authors publish in their mother language (Swales 1985, Li et al. 2014). Despite being seemingly detrimental to journals (as measured through IF increases over time), the national literature might actually benefit young students, especially in Brazil, where English skills are low (Friedrich 2000). Reading in Portuguese can have a great impact on students interested in science, and this is especially true for undergraduate

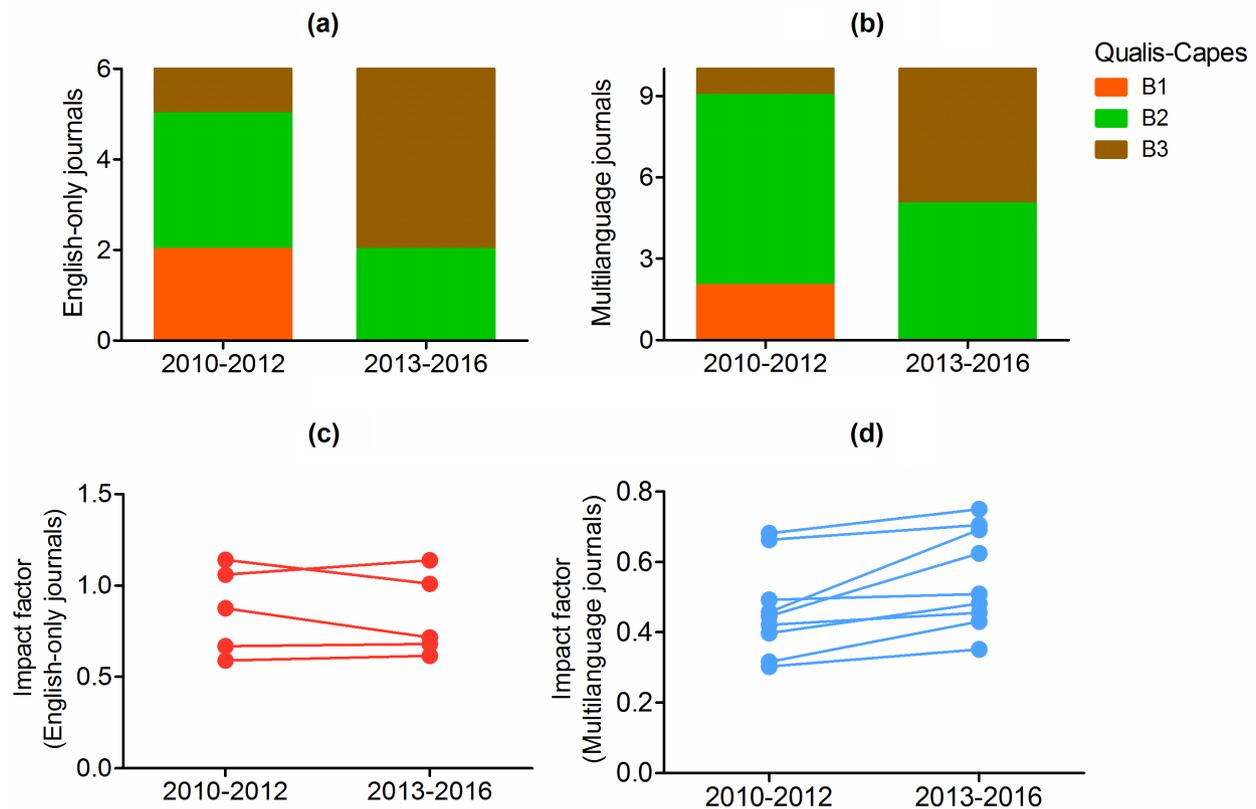


Figure 4. (a-b) Variation in the Qualis-Capes classes over two evaluation periods (2010-2012 and 2013-2016). Most journals were downgraded to B2 or B3 ranks. (c-d) The temporal trend in impact factors (IF) of journals in two evaluation periods. The trend line shows the extent to which IF increased or decreased in both journal types. Each point represents a journal.

students (as in Nurweni & Read 1999). In addition, publishing in their own country language can be helpful for researchers in their early careers (Ma et al. 2012).

The national literature might present interesting pieces of evidence on several important issues (Ma et al. 2012), but (unfortunately) they become of limited use due to the publication in a non-English language (Lira et al. 2013). The lack of contact of foreign researchers with the (biodiversity) studies performed in Latin American (because of language restriction – see Stankus et al. 1982, Thorp et al. 1988) can discourage further discussion and attention to topics of great interest to ecologists.

The increase in papers published in English did not increase the Qualis-Capes classification of journals. This indicates that the language of publication is not related to this metrics of journal quality. Since its origins, the Qualis-Capes has been strongly criticized (Andriolo et al. 2010) because of its metrics and low relation with the IF. Rocha-e-Silva (2009) argues that this system devalues Brazilian research, as no national journal is ranked as “A”; many of them are in “B” category and Scielo journals are “B3”, far below international journals. In the present study, none of the journals examined were ranked as “A”. Furthermore, the journals that were initially “B1” were downgraded to “B2” or “B3”.

This disequilibrium between Qualis-Capes and IF may discourage submissions to these

journals (Santos 2009), because during the evaluation of universities and researchers, publications ranked as B2 or B3 receive less credit. According to Andriolo et al. (2010), national journals should receive more visibility, funding and support for internationalization; in addition, researchers should be encouraged to publish in national journals as well. We hope this work can stimulate a better contextualization and adjustment of the Capes quality system to provide a clear relationship between Qualis-Capes and IF grading, therefore promoting the Brazilian national journals and recognizing their continuous and effective efforts to seek greater internationalization.

Other factors can affect the article success such as international collaborations and the prevalence of super ties (for more see also Petersen 2015). Lower IF is observed in group of the subsets of non-collaborative articles by low collaborations (Meneghini et al. 2008). The prevalence of super ties by international collaborations was not evaluated in this study, but further study is suggested for Brazilian national journals.

CONCLUSION

Science must have a common language that permits rapid communication and comprehension of the research. English is nowadays unarguably the *lingua franca* of science (Bornmann et al. 2012, Vardakas et al. 2015), and a clear enhance in journal's IF was noted as journals published a higher fraction of papers in English. Although recognizing English as the official language for scientific communication, we still encourage researchers (non-native English speakers) to publish at least abstracts in their mother language, as is promoted in *Biotropica*, for instance. This can facilitate access to students who have no fluency

in the English language and make science more democratic for those interested in a particular research field. Such strategy can be implemented in the online version of most journals as there are fewer expenses than printing, and distribution is much more effective.

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JUAN C.S. ABAD¹

<https://orcid.org/0000-0001-6988-5220>

RAONY M. ALENCAR¹

<https://orcid.org/0000-0002-7675-0436>

BEN H. MARIMON JR¹

<https://orcid.org/0000-0002-6359-6281>

BEATRIZ MARIMON¹

<https://orcid.org/0000-0003-3105-2914>

ADELMO C.C. SILVA¹

<https://orcid.org/0000-0002-7272-1531>

HALINA JANCOSKI¹

<https://orcid.org/0000-0002-9413-3159>

RENAN S. REZENDE^{1,2}

<https://orcid.org/0000-0002-4129-0863>

ESTEVÃO ALVES-SILVA¹

<https://orcid.org/0000-0002-1650-8605>

¹Universidade do Estado de Mato Grosso, Rua
Prof. Dr. Renato Figueiro Varella, s/n, Caixa Postal
08, 78690-000 Nova Xavantina, MT, Brazil

²Programa de Pós-Graduação em Ciências Ambientais,
Universidade Comunitária da Região de Chapecó, Servidão
Anjo da Guarda, 295-D, Efapi, 89809-000 Chapecó, SC, Brazil

Correspondence to: **Juan Carlo Silva Abad**

E-mail: csa.juan@gmail.com

Author contributions

R.S. Rezende and E. Alves-Silva contributed to conception, design, data acquisition and interpretation, drafted and critically revised the manuscript. J.C.S. Abad, R.M. Alencar, B.H. Marimon Jr., B. Marimon, A.C.C. Silva and H. Jancoski contributed to data acquisition and interpretation and critically revised the manuscript. All authors gave their final approval and agree to be accountable for all aspects of the work.

