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From the Editor

Improvement of reproducibility and research transparency in Silva Fennica

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Young scientists learn at the beginning of the graduate school – if not earlier – that reproducibility is a basic feature of science. All research must be reported so that other scientists will be able to repeat the study. After the declaration of this noble aim, starts its dilution: You do not need to explain standard protocols; you do not need to describe standard tests; if you follow a method described elsewhere, it is enough to cite the original source (Blackwell and Martin 2011).

This is ok if you really use standard protocols. For example, the earlier standard and still widely used method for determining total nitrogen concentration in soil and tissue samples, the Kjeldahl digestion, has been slightly modified in tens or hundreds of laboratories around the world. They give almost the same results but the modification done in Lab A may be the reason why they got a statistically significant difference between treatments and Lab B did not. The belief that something is standard when it is not is another problem. A doctoral student responded to my criticism that it is unnecessary to mention the measure of deviation given with the mean because "the standard error is the standard for showing deviation". In this case, you should use the standard deviation if you want to explain the variation in the data, and the standard error of mean if you need to know how reliable your estimate of mean is. There are other measures of variation and, thus, the used measure must be written out. You might refer to an original source by writing that the deviation of the isotopic composition of nitrogen in a sample from the isotopic composition of N in the air, $\delta^{15}N$, is calculated according to the classic work of Shearer and Kohl (1986). Just remember to tell, which of their two formulae you use!

Biomedical research community was shattered by the news that the biotech company Amgen was able to reproduce only 6 out 53 high-profile cancer studies and a bit earlier another company, Bayer, reported reproduction of 14 biomedical studies out of 67 (Kaiser 2015). We do not have any reason to assume that the non-reproducibility would be a result of a serious research misconduct i.e., fabrication, falsification or plagiarism. The non-reproducibility may be caused by sloppy science or the questionable research practices that form the grey area between good conduct of research and misconduct (Fraser et al. 2018). The non-reproducibility may be caused also by sloppy writing, as the small-looking omissions described above.

Reproducibility has different meanings in different disciplines, and even within a discipline, it may have different dimensions. In a laboratory science, reproduction means exact repetition of an

experiment done by other scientists. In humanities, reproduction of a study may reveal the effects of the backgrounds of the scholars on the interpretation of the observations. Forest sciences are not a discipline but, rather, a collection of forest-oriented research lines based on various disciplines. Thus, reproducibility has several dimensions in forest sciences. The direct repetition may be feasible in laboratory and greenhouse studies and, with some limitations, in nurseries. Much of the field research on forests is inherently non-reproducible. For example, direct repetition of a 25-year study on the development of the tree line in Northern Fennoscandia (Franke et al. 2015) would require another 25 years of measurements. However, the environment would not be the same because of the global climate change and successional dynamics of the forests, and several biotic factors may alter the development of the tree line. Conceptual reproduction i.e., repeating a study under different conditions and perhaps varying some independent variables that is possible with field research over a few years is not a practical solution in this case. Only the third dimension of reproducibility, reanalysis of data, may be applied for reviewing the reliability of this kind of study. This calls for open data, research materials and codes.

Silva Fennica is a pioneer of open access publishing cherishing the Everyone's Right to Forest Science since 1998. It is time to take the next step towards open science with enhanced transparency and reproducibility of the articles published in the journal. Beginning of 2021, Silva Fennica will apply the Transparency and openness promotion guidelines of the Center for Open Science (Table 1). We will start on Level 1 of all the eight points. After a transition period, the length of which will be announced before the end of this year, we will go to level 2 in citation standards, data transparency, analytic methods transparency, research materials transparency, and design and analysis transparency. Silva Fennica will remain on Level 1 in preregistration of studies and analysis plans, and in replication studies, mainly because we do not have the necessary editorial resources as a small publisher. Author guidelines of Silva Fennica will be updated at latest in September for Level 1 with preliminary instructions for Level 2 for those authors who pioneer transparency and openness in forest sciences.

Citation standards refer to the use community-based standards, such as nomenclature and reporting standards, where applicable. Silva Fennica will require e.g., that plant nomenclature follows an internationally recognised database and soils are classified according to the World Reference Base for Soil Resources (2014). If publicly available data has been used in an article, the data must be cited according to the instructions of DataCite (https://datacite.org/cite-your-data.html) in the list of references. When universal standards are used for citing research objects and research data, readers around the world will have exact information on your materials and methods. Silva Fennica will articulate closely these standards in the forthcoming revision of Author guidelines.

As the first step to data transparency, Silva Fennica will require that from January 2021 onwards authors state in a dedicated section of the article if data are available and how to access them. In principle, data should be open and authors are requested to write an explanation if they are not open. Data must be posted in trusted open repository for wide reusability. Sometimes there are good reasons not to open data or data may need to be curated for removing sensitive information e.g., personally identifying information or exact location information on threatened species. After a transition period, Silva Fennica will start to request opening of data as a condition for publishing, unless the authors have acceptable reasons for not opening their data. Open data will enable full review of a study, reanalysis of old data with new methods, which may reveal new information, and meaningful meta analyses. According to the experience of scientists who already open their data, open data increase collaboration. A good example of the value of open data is a study on the geographic gradient in the within-species genetic variability (Miraldo et al. 2016); it would not have been possible without the work of the hundreds of scientists who have deposited the 138 000 gene sequences used in the analysis to GenBank (https://www.ncbi.nlm.nih.gov/genbank/) from their own studies.

Table 1. Summary of eight standards and three levels of the Transparency and openness promotion guidelines for scientific journals (https://www.cos.io/our-services/top-guidelines).

	Level 1	Level 2	Level 3
Citation Standards	Journal describes citation of data in guidelines to authors with clear rules and examples.	Article provides appropriate citation for data and materials used consistent with journal's author guidelines.	Article is not published until providing appropriate citation for data and materials following journal's author guidelines.
Data Transparency	Article states whether data are available, and, if so, where to access them.	Data must be posted to a trusted repository. Exceptions must be identified at article submission.	Data must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.
Analytic Methods (Code) Transparency	Article states whether code is available, and, if so, where to access them.	Code must be posted to a trusted repository. Exceptions must be identified at article submission.	Code must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.
Research Materials Transparency	Article states whether materials are available, and, if so, where to access them.	Materials must be posted to a trusted repository. Exceptions must be identified at article submission.	Materials must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.
Design and Analysis Transparency	Journal articulates design transparency standards.	Journal requires adherence to design transparency standards for review and publication.	Journal requires and enforces adherence to design transparency standards for review and publication.
Preregistration of studies	Journal encourages preregistration of studies and provides link in article to preregistration if it exists.	Journal encourages preregistration of studies and provides link in article and certification of meeting preregistration badge requirements.	Journal requires preregistration of studies and provides link and badge in article to meeting requirements.
Preregistration of analysis plans	Journal encourages preanalysis plans and provides link in article to registered analysis plan if it exists.	Journal encourages preanalysis plans and provides link in article and certification of meeting registered analysis plan badge requirements.	Journal requires preregistration of studies with analysis plans and provides link and badge in article to meeting requirements.
Replication	Journal encourages submission of replication studies.	Journal encourages submission of replication studies and conducts results blind review.	Journal uses Registered Reports as a submission option for replication studies with peer review prior to observing the study outcomes.

Analytic methods or code transparency is needed for understanding how results were derived from the research data. From January 2021 onwards, authors will be required to state if their code is available and how to access it. Silva Fennica will consider the openness as the principle and deviations must be justified. Like in the case of research data, Silva Fennica will start to require code openness as a condition for publishing an article after a transition period. Short codes may be submitted to Silva Fennica with the manuscript as supplementary files while extensive codes are better to deposit to a trusted repository.

Research materials are the materials used for conducting the research or collected during the research but are not in a directly analysable form. Research data is always in an alphanumeric format that can be analysed with a code. Research materials may be digital e.g., questionnaires, survey instruments, and scripts used by research personnel in social sciences, video used in forest work research, photographs used for identifying plants, or laser scanning data collected for a particular study. Satellite images are seldom property of the researcher and they must be cited according to the instructions of DataCite, and plant specimens studied in a museum collection must be identified so that other scientist may find them. Physical materials include e.g., voucher specimens of plants

collected for a particular research project or cryopreserved microbia. Silva Fennica will request authors to state if materials are available and if not, why. Closer instructions will be available after updating the Author guidelines.

Silva Fennica's Associate Editor for Biometry and Methods, Lauri Mehtätalo, wrote last year an editorial on design and analysis transparency (Mehtätalo 2019). Transparent writing is essential for understanding how a study was conducted and analysed. Silva Fennica has always been quite strict on these requirements and they will be articulated more clearly in the updated Author guidelines. All authors will be required to state: "We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study." (Simmons et al. 2012).

Preregistration of studies and preregistration of analysis plans refer to depositing research and analysis plans in a repository where they get a persistent identifier. The objective is to reduce such sloppy research practices as unreporting variables (that do not support expectations), unreporting covariates, unreporting models tested with the data or hypothesising after results are known, or HARKing (Fraser et al. 2018). Preregistrations are not always practical in forestry field research but when they are, they should be used. Thus, Silva Fennica will encourage preregistration of studies and analysis plans and authors will be requested to state if preregistrations exist and give the link to them. Preregistration documents may also be added as supplementary files for convenience of the reviewers and readers.

Replication is in the heart of reproducibility. All new research findings should be verified by replicating the study, yet forms of replication may differ in different contexts. As a change of journal policies, Silva Fennica will begin to encourage submission of replication studies yet with some restrictions. Normally, a few direct repetitions are needed before the scientific consensus on the results is achieved. Silva Fennica will consider direct repetitions that contribute towards accepting or rejecting of new results but not direct repetitions of established observations. Like direct repetition, reproduction of analyses of data of research opening new insights to the functioning of organisms or communities or those promising enhancement to forestry practice is needed for verifying the results. Silva Fennica will consider the data reanalyses that contribute towards accepting or rejecting new results. Conceptual reproductions help to verify original results and enhance our understanding on the generality of the research outcomes. Silva Fennica will encourage submissions of conceptual reproductions. The publication decision will be based on the importance of the new insights and value added to earlier research.

Forest research may not affect the life and death of individuals like medicine. However, it does affect the way we manage our ecosystems and natural resources. We need the best science for ensuring the future of our single planet. Openness, reproducibility and transparency are needed for achieving this goal. Everyone has right to good forest science.

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