

The Impact of the Global Open Access Movement on Open Access Publishing by Canadian Government Departments

Yongtao Lin¹, Alana Pollock-Greenwood² & Marisa Ruccolo³

¹ Natural Resources Canada Library, Calgary (ORCID: 0000-0003-4028-8777)
² Natural Resources Canada Library, Hamilton (ORCID: 0000-0003-1095-0205)
³ The Web of Science Group (ORCID: 0000-0002-1627-7579)

Introduction & Objectives

This study explores whether and how the global Open Access (OA) movement has impacted federal government researchers by following the growth in OA publishing and Open Science (OS) initiatives—such as Canada’s Action Plan on Open Government. More specifically:

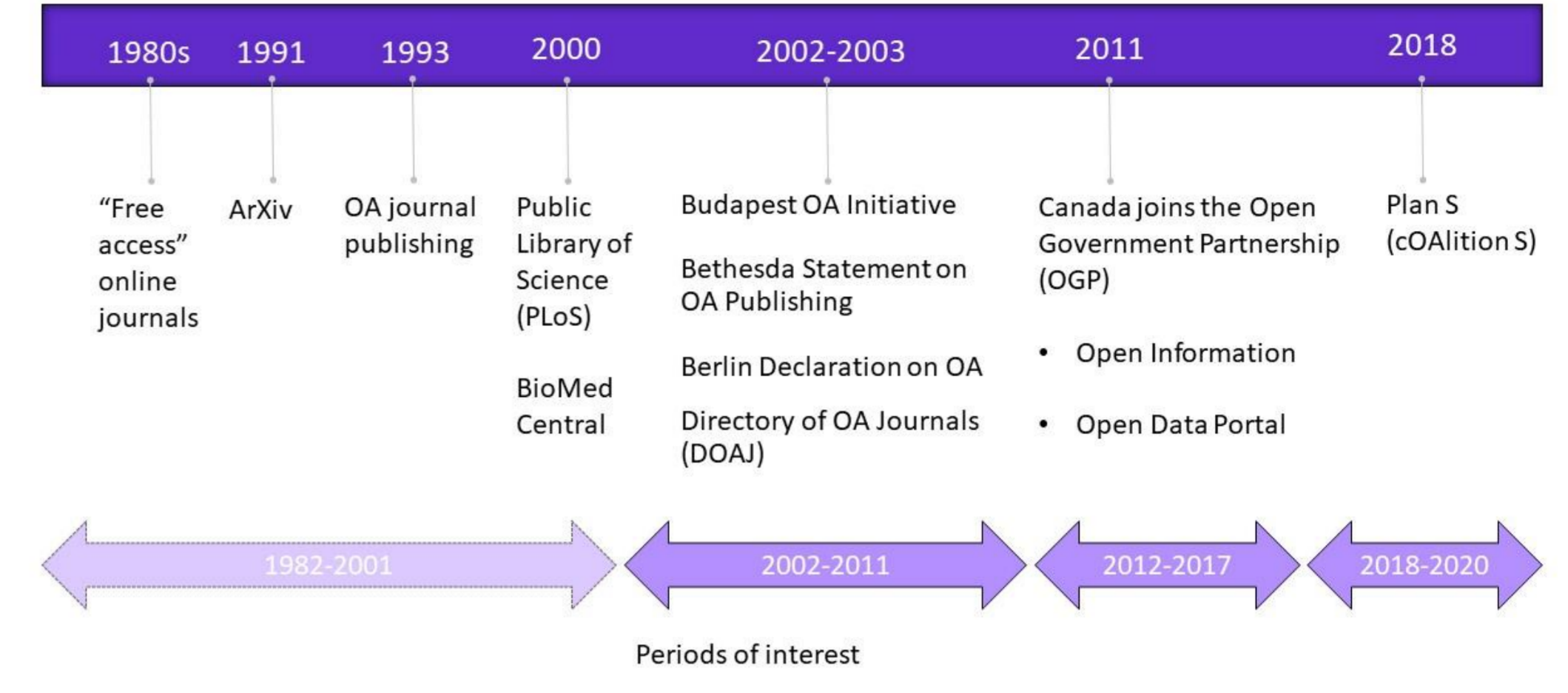
- Have mandates in OA and OS initiatives led to an increase in OA compliance?
- How has the increases of open publications contributed to research impact assessment results?
- What is required for a research system in transition within the federal government to support OA mandates and researchers’ endeavors in this area?

Methodology

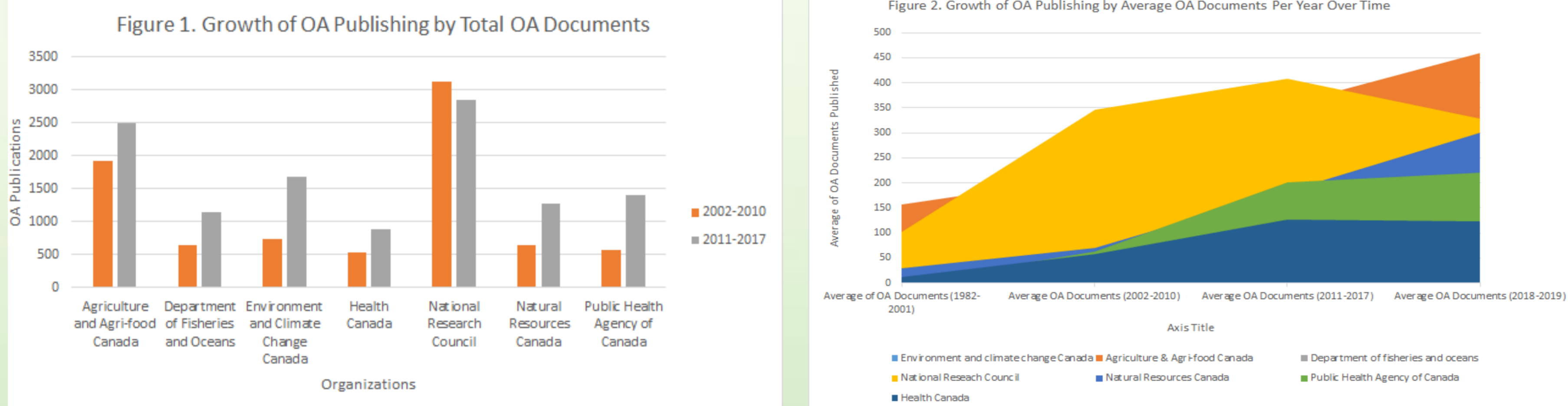
The selection of the Federal Science Library (FSL) departmental and agency publication data for our analysis is a valid representation of Canadian Federal Government researchers as the FSL is a commitment under Canada's Action Plan on Open Government. The FSL Portal provides improved access to federal scientific information including links to publications shared in departmental repositories (i.e. green OA) and articles published in gold or hybrid OA journals.

The Web of Science (WoS) Core Collection database was used to locate OA publications and citation trends in four OA variants: DOAJ Gold, Other Gold, Green Accepted, and Green Published. Analysis was conducted using the WoS Core Collection and InCites Benchmarking & Analytics to form stories in government institutional repositories, citation premiums benefiting from OA publishing, Canadian funders and collaborators for OA documents, etc. A major limitation of this study is that not all OA publications by government researchers are captured for analysis since they are not indexed in WoS.

Open Access (OA) Timeline

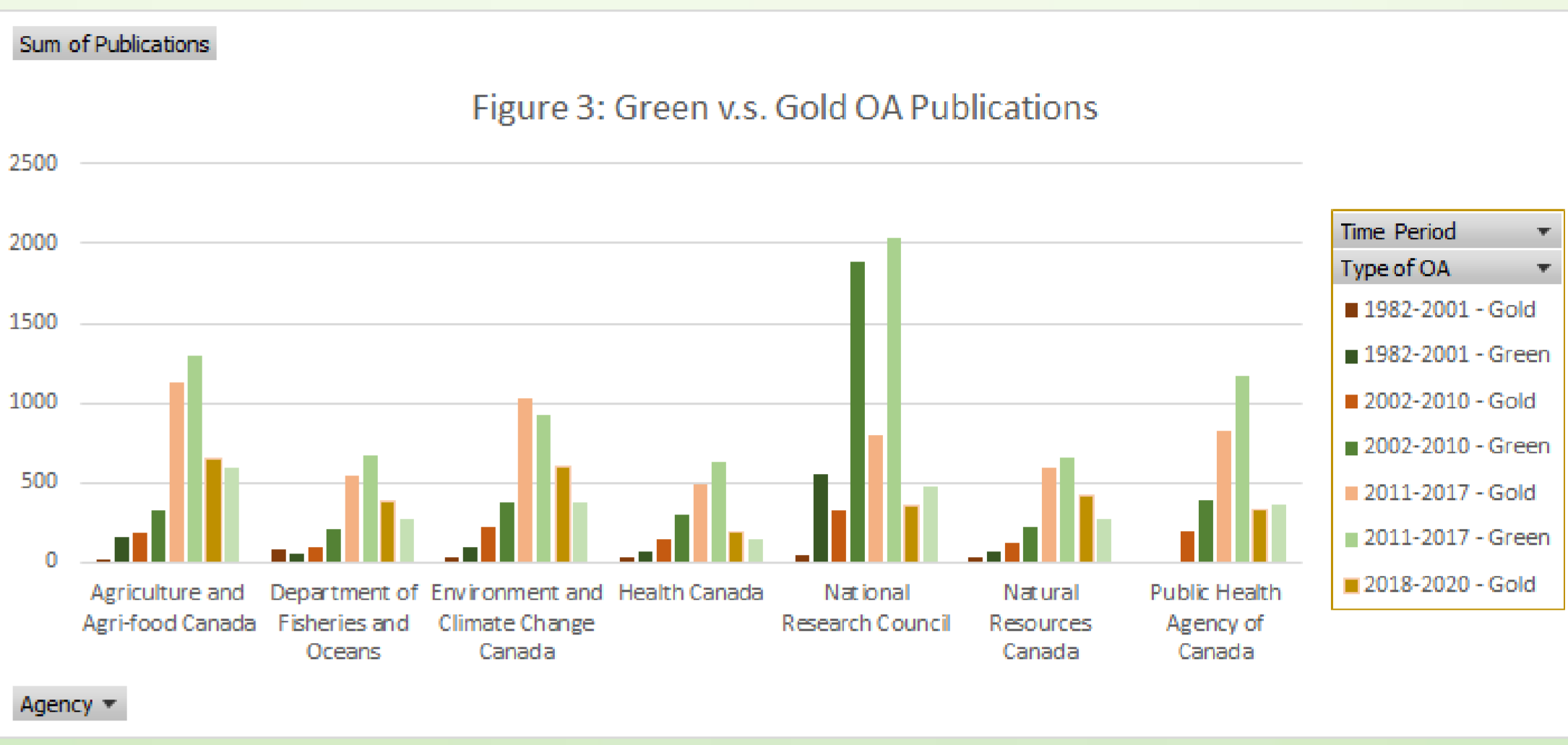


OA Trends



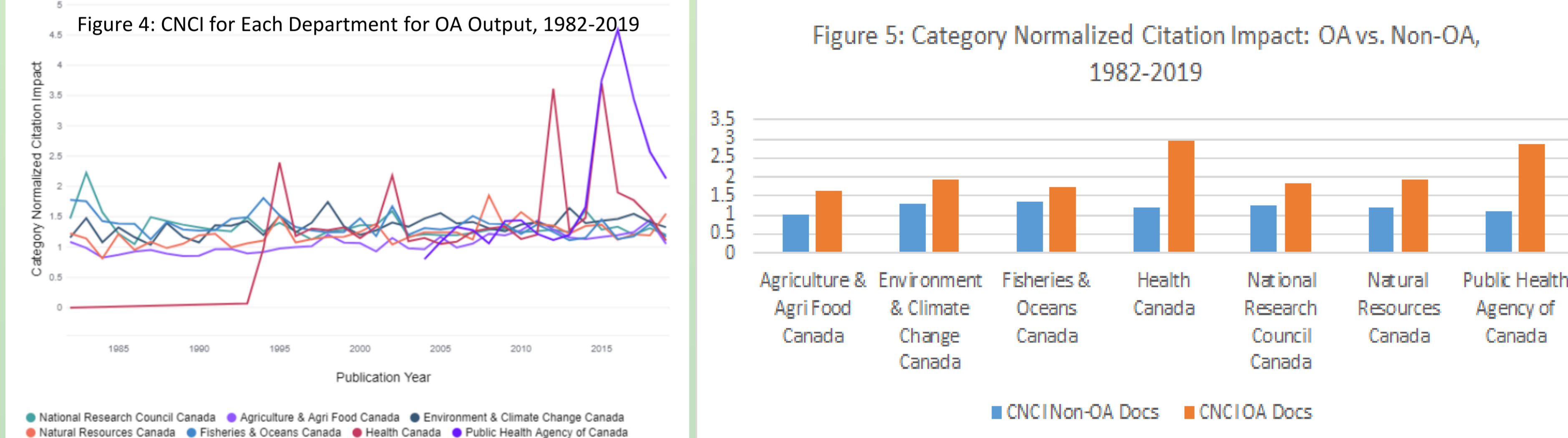
All OA documents indexed in WoS as gold and green OA variants were retrieved within the publication year clusters of **Prior to 2001, 2002-2010, 2011-2018, and 2018-2019**. The periods of interest on the OA Timeline (i.e. 2002, 2011 and 2018) and the Open Government Directive (2011) were compared against the growth of OA publishing from 1982-2019 inclusively. Figure 1 shows the counts of all OA documents for the seven FSL departments and agencies in two different time frames. The number of OA publications for all FSL departments increased significantly with a consistent growth trend, with the exception of National Research Council Canada, which showed a slight decrease while still ranking first overall. When we normalized the data for the 2018-2020 period by number of year it shows the most growth in gold OA publications across all seven departments. As seen in Figure 2, the increases were between 3 and 16 folds for all FSL organizations.

Trends in Green & Gold OA



Growth of green and gold OA for all FSL departments can be seen from 2002 onward in Figure 3. This correlates with an increase in OA and Open Government initiatives indicated in the OA Timeline above.

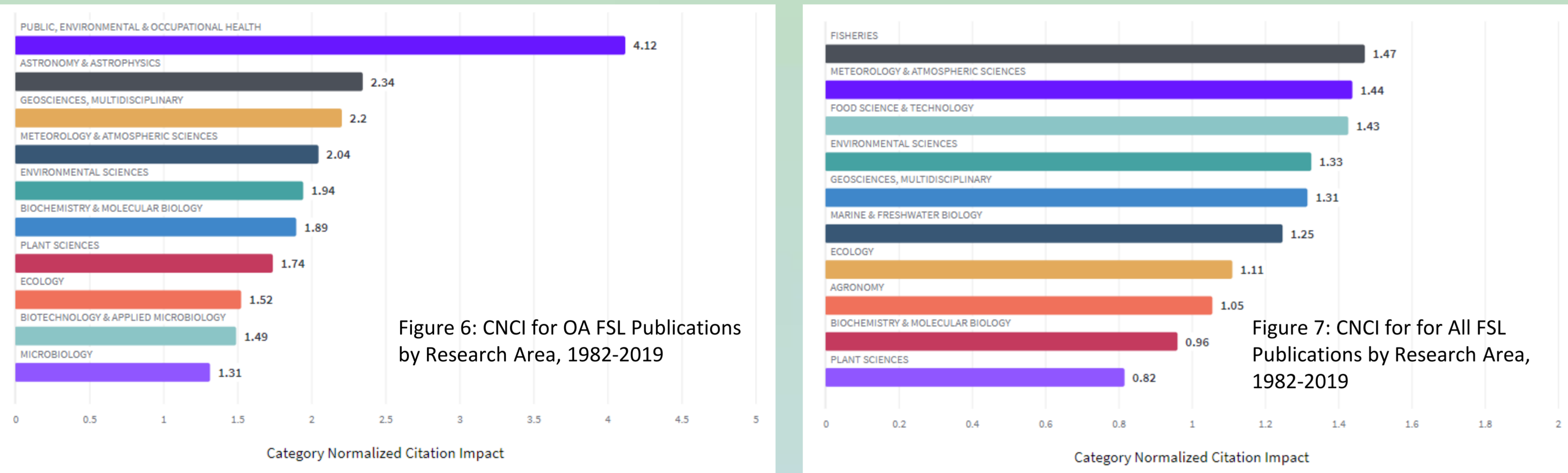
Citations & OA



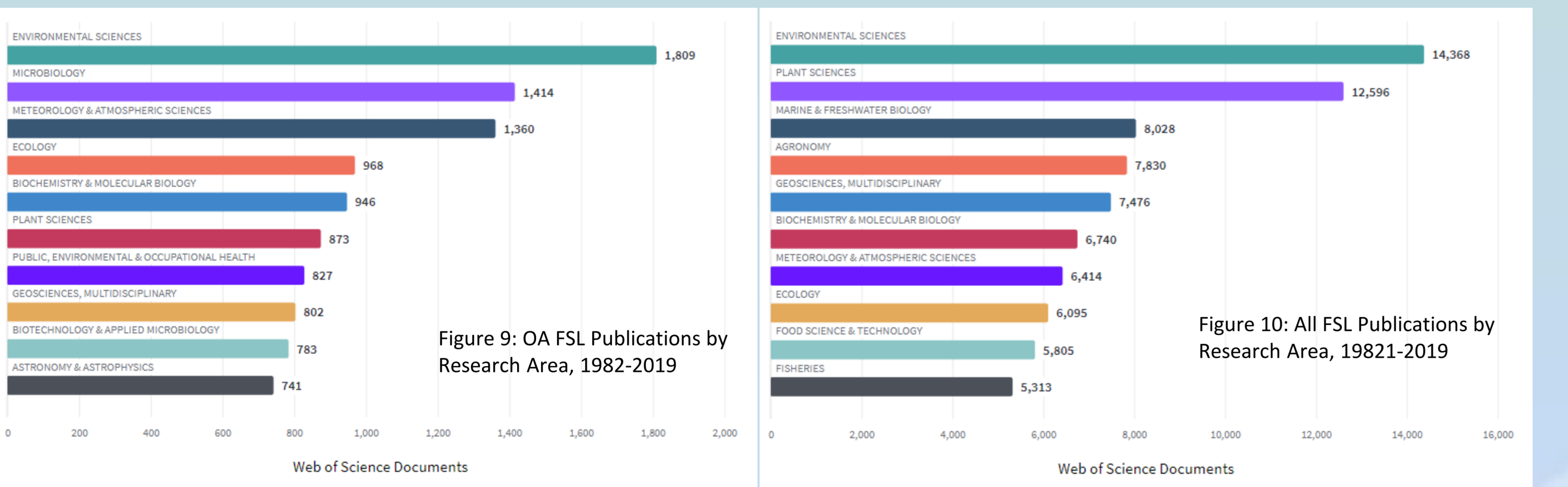
In Figure 4, the trend graph demonstrates the Category Normalized Citation Impact (CNCI) for each department for OA publications from 1982-2019. Most FSL departments show an above-average citation impact for their OA publications. Health Canada and Public Health Agency of Canada were established in 1993 and 2004 respectively, explaining the gaps in data for these organizations.

Figure 5 shows that the CNCI for each department is higher for OA publications than non-OA publications from 1982-2019. Health Canada and Public Health Agency of Canada have the largest CNCIs at 2.93 and 2.87 for OA publications versus 1.21 and 1.11 for non-OA publications, approximately 2.5 times higher for OA publications.

OA & Research Areas



The data for Figures 6 & 7 were extracted from InCites Benchmarking & Analytics’ “Research Areas” Explorer, choosing the WoS category schema, including the publications indexed in *Emerging Sources Citation Index*, for the 1982-2019 timeframe. Both graphs were generated on January 22 for a fair comparison. Figure 6 has the OA Gold, Other Gold, Green Published and Green Accepted filter added, whereas Figure 7 includes all publications (i.e. OA and non-OA) for the exact same timeframe and other filters. In Figure 6, we note a distinct lead from the **Public, Environmental & Occupational Health** research area which was cited almost twice the amount as the second to tenth place research areas. This confirms the findings from the literature that reported more significant impact of OA on the subject areas of medicine and other health related disciplines. Figure 7 demonstrates a very small gap between the ten research areas, however, the top eight ranked above the global average on 1 and the last two areas, just slightly below.



Figures 9 & 10 demonstrate a quantitative number of publications, also known as output, by Research Areas. Both graphs were generated on January 22 for a fair comparison. Figure 9 has the OA Gold, Other Gold, Green Published and Green Accepted filters added, whereas Figure 10 includes all publications (i.e. OA and non-OA) for the exact same timeframe and other filters. In Figure 9, we note a distinct lead in the **Environmental Sciences** research area where the output represents a net advantage over the second and third research areas and over 40% more than the areas ranked fourth to tenth. In Figure 10, we note that the **Environmental and Plant Sciences** research area has over 50% more output than the other eight, which are closer in numbers. This precisely validates that Environment and Plant Science is the science of protecting our environment and developing new agricultural practices, covering ever-evolving and encompassing topics such as plant biology, soil science, ecology, applied genetics and biotechnology.

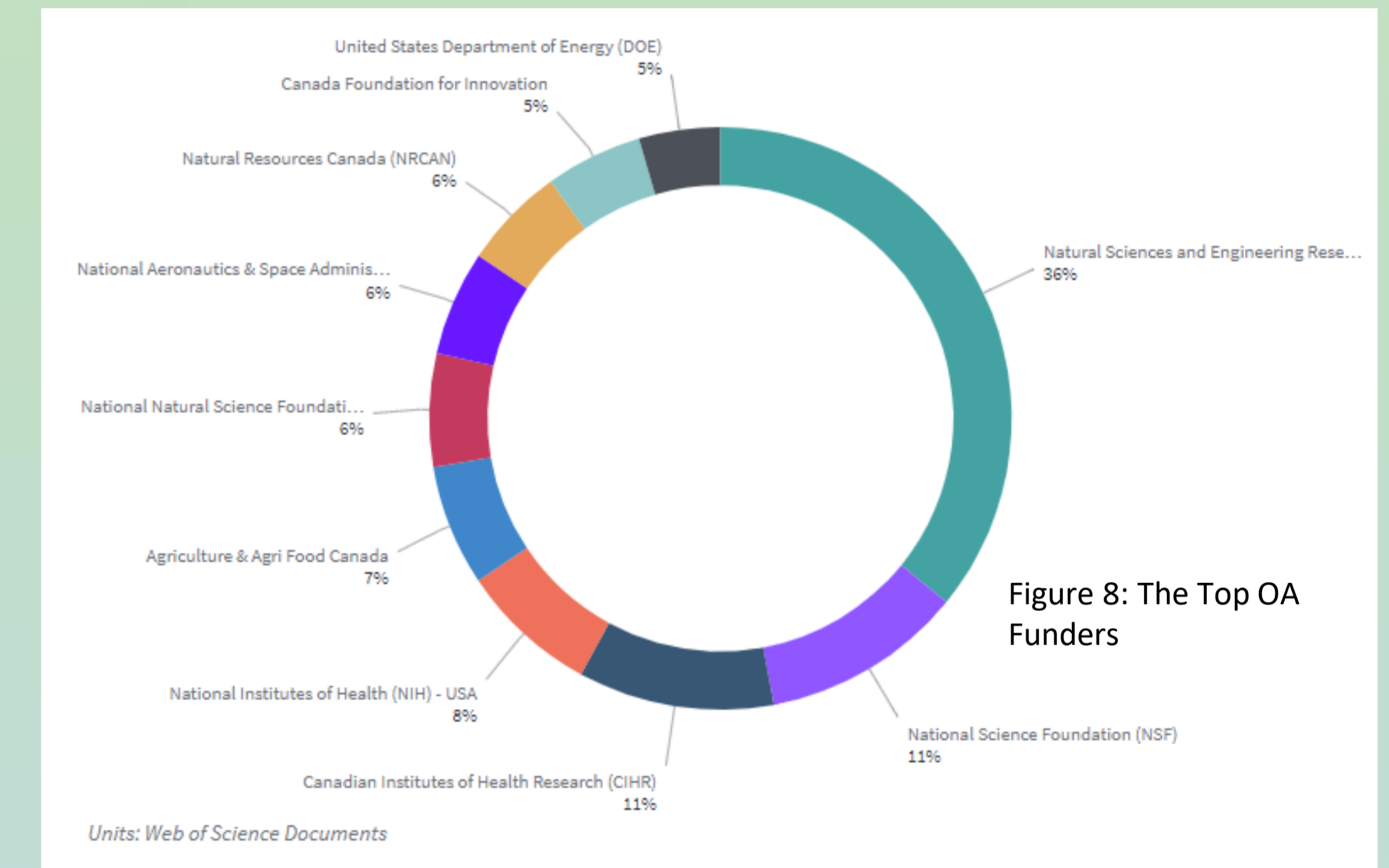
Glossary of Select Terms

- **Category Normalized Citation Impact (CNCI)** is the most used indicator to compare across disciplines as the figure reflects the citations per paper, normalized by subject, year of publication and document type. The global average being 1, a higher number represents an above-average citation impact.
- **DOAJ Gold** in WoS, defined as “Articles published in journals listed on the Directory of Open Access Journals (DOAJ). To be listed on the DOAJ, all articles in these journals must have a license in accordance with the Budapest Open Access Initiative.”
- **Green Accepted** are “accepted manuscripts hosted on a repository. Content is peer reviewed and final, but may not have been through the publisher’s copyediting or typesetting.” **Other Gold** are open access articles are those identified as having a Creative Commons (CC) license but are not in journals listed on the DOAJ. Most of these articles are from hybrid journals.
- **Green Published** are “final published versions of articles hosted on an institutional or subject-based repository (e.g. an article out of its embargo period posted to PubMed Central).” **Hybrid** open access journals are subscription journals that include some open access articles.
- **[Five-year] Journal Impact Factor:** The 5-year Journal Impact Factor is the average number of times articles from the journal published in the past 5 years have been cited in the JCR year. It is calculated by dividing the number of citations in the JCR year by the total number of articles in the five previous years.
- **Research areas** or “Web of Science categories” in InCites B&A, are determined at the journal level. A journal may belong to up to four categories and the best performing category is selected in this case.
- **Web of Science Documents** is a quantitative measure that indicates the number of publications.

References

Canada’s Action Plan on Open Government 2012-2014. (2013). Retrieved from <https://open.canada.ca/en/canadas-action-plan-open-government>
 Directive on Open Government. (2014). Retrieved from <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=28108>
 Federal Science Library. (2019). Retrieved from <https://science-libraries.canada.ca/eng/home/>
 Increase Openness of Federal Science Activities (Open Science) - Commitment 14. (2019). Retrieved from <https://open.canada.ca/en/commitment/misar/2016-2018/commitment-14-increase-openness-federal-science-activities-open-science>
 Martin-Martin, A., Costas, R., Van Leeuwen, T., & Delgado López-Cózar, E. (2018). Evidence of open access of scientific publications in Google Scholar: A large-scale analysis. *Journal of Informetrics*, 12(3), 819–841. <https://doi.org/10.1016/j.joi.2018.06.012>
 Perianes-Rodríguez, A., & Olmeda-Gómez, C. (2019). Effects of journal choice on the visibility of scientific publications: a comparison between subscription-based and full Open Access models. *Scientometrics*, 121(3), 1737–1752. <https://doi.org/10.1007/s11192-019-03265-y>
 Suber, P. (2004). Very Brief Introduction to Open Access. Retrieved from <http://legacy.earlham.edu/~peters/fos/brief.htm>
 Tri-Agency Open Access Policy on Publications - Science.gc.ca. (2016). Retrieved from http://www.science.gc.ca/etd/site/063.nsf/eng/h_F6765465.html?OpenDocument

OA Funders



In Figure 8, the funders are captured by WoS as it indexes the complete acknowledgment paragraph on the manuscript and is dependant on the authors’ mentions. Natural Sciences and Engineering Research Council of Canada (NSERC) is the top funder with 36%, followed by another Canadian Tri-Agency, Canadian Institutes of Health Research (CIHR), with 11%, a tie with the third funder, National Science Foundation. Non-Canadian funding agencies result in international collaborators’ or co-authorship funding.

The Tri-Agency – consisting of NSERC, CIHR, and Social Sciences and Humanities Research Council (SSHRC) – has an OA Policy which states that publications arising from Tri-Agency-supported research must be freely accessible within 12 months of publication via an OA journal or an online repository. The Tri-Agency recommends that manuscripts also be deposited in an online repository upon publication. As NSERC and CIHR are two of the top funders of FSL research, their OA Policy should show an impact on the number of gold and green OA publications produced by FSL authors.

Where do FSL Researchers Publish in OA? Top 25 Journals	5-year JIF
PLOS ONE	3.34
Atmospheric Chemistry & Physics	6.2
Scientific Reports	4.53
Applied & Environmental Microbiology	4.7
Proceedings of the National Academy of Sciences of the United States of America	10.6
Astrophysical Journal	5.53
Zookeys	1.1
Plant Physiology	7.02
Journal of Geophysical Research – Atmospheres	4.42
Journal of Clinical Microbiology	4.18
Optics Express	3.53
Environmental Health Perspectives	9.81
BMC Genomics	4.14
Journal of Virology	4.26
Geophysical Research Letters	4.91
Monthly Notices of the Royal Astronomical Society	4.99
Remote Sensing	4.74
Journal of Bacteriology	4.84
Ecology and Evolution	2.86
Canadian Medical Association	7.72
Astronomy & Astrophysics	5.38

The table above shows the top journals by number of WoS indexed OA documents (all variants) where FSL researchers were published from 1982-2019, with the five-year Journal Impact Factor (2014-2018) of the respective journal. These journals provide a variety of OA options to FSL authors:

- The top three journals, PLOS ONE, Atmospheric Chemistry & Physics and Scientific Reports are fully Gold OA.
- Nine of the twenty-five journals are DOAJ Gold journals.
- The Canadian Medical Association Journal, the only one Canadian journal that made it to the top 25 list, is fully gold OA as of January 14, 2020 – authors pay an article processing charge (APC) to publish.

Results & Discussion

- The spread of OA content speeds up the progress of science, and provides immediate access to all forms of scientific outputs.
- The trends and impact of OA growth have been apparent for all the organizations examined, with different degrees of increase in the total of OA documents published and their citations. This increase may be related to the influence of the mission and research activities of the organizations, new and evolving research focuses, funding and publishing requirements, and the adoption and implementation of OA and OS.
- Librarians and information professionals in government libraries are becoming increasingly well versed in how OA accelerates discovery and innovation across disciplines. However, our experiences with federal science and technology activities reporting and publishing through the means of OA are still limited. This study, along with our literature review, demonstrates the areas of knowledge and gaps we are hoping to fill, especially related to how research libraries can support the organizations and researchers in making publicly-funded research freely accessible to the Canadians in a timely manner.
- A cross-department-wide repository for all research outputs by all departments will increase the magnitude of OA contents, and have a significant impact on how federal government conducts research assessment.