Proceedings of the Technical Expertise in Stock Assessment (TESA) national workshop on 'Tools for transparent, traceable, and transferable assessments,' 27–30 November 2018 in Nanaimo, British Columbia

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Rapport technique canadien des sciences halieutiques et aquatiques

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Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

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PROCEEDINGS OF THE TECHNICAL EXPERTISE IN STOCK ASSESSMENT (TESA) NATIONAL WORKSHOP ON 'TOOLS FOR TRANSPARENT, TRACEABLE, AND TRANSFERABLE ASSESSMENTS,' 27–30 NOVEMBER 2018 IN NANAIMO, BRITISH COLUMBIA

by

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ABSTRACT

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A four-day workshop was held in Nanaimo, British Columbia, from 27–30 November 2018. The aim was to foster a common understanding of modern computational methods and tools among stock assessment scientists in Fisheries and Oceans Canada (DFO). These tools enable efficient sharing of code and writing of complex stock assessment documents within an assessment team, and easy sharing of methods with other scientists. This should lead to more transparent, traceable, and transferable (TTT) assessments in DFO.

Transparent means a clear and open way to show data, code, and results, such that others should be able to reproduce the assessment. *Traceable* means that there is a clear link from database queries and code to final results (numbers, tables, and graphs in an assessment document). *Transferable* means that it should be feasible for another person to reproduce an assessment and build upon it with a minimal learning curve. A fourth T could be *Translatable* in the sense that with two official languages, it is important to ensure consistent and efficient translations between official languages.

Software demonstrations were given of Git, GitHub, R Markdown, knitr, LaTeX, and the creation of R packages. For example, the csasdown R package was introduced to show how properly formatted documents produced for Canadian Science Advisory Secretariat (CSAS) processes can be built and elegantly updated with new assessment model results. Presentations were given on open data standards, on CSAS formatting and accessibility constraints, and on GitLab (a Git service available to Government of Canada employees). Anticipated changes to the Fisheries Act in 2019, particularly in relation to the need for limit reference points, were discussed with respect to how TTT tools could support the operationalisation of providing science advice in DFO. Participants formed several breakout groups to practice using these tools, creating, for example, an automated report from a multispecies survey, and an R package to facilitate fast, cheap, and efficient translation of figures appearing in CSAS documents. This proceedings document was written collectively during the workshop using the TTT tools as a testament to the efficiency of this way of collaborative working.

RÉSUMÉ

Edwards, A.M., Duplisea, D.E., Grinnell, M.H., Anderson, S.C., Grandin, C.J., Ricard, D., Keppel, E.A., Anderson, E.D., Baker, K.D., Benoît, H.P., Cleary, J.S., Connors, B.M., Desgagnés, M., English, P.A., Fishman, D.J., Freshwater, C., Hedges, K.J., Holt, C.A., Holt, K.R., Kronlund, A.R., Mariscak, A., Obradovich, S.G., Patten, B.A., Rogers, B., Rooper, C.N., Simpson, M.R., Surette, T.J., Tallman, R.F., Wheeland, L.J., Wor, C., and Zhu, X. 2018. Proceedings of the Technical Expertise in Stock Assessment (TESA) national workshop on 'Tools for transparent, traceable, and transferable assessments,' 27–30 November 2018 in Nanaimo, British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 3290: v + 10 p.

Un groupe de travail de 4 jours a eu lieu à Nanaimo, Colombie-Britanique, du 27 au 30 novembre 2018. L'objectif était de favoriser une compréhension commune des outils et méthodes modernes parmi les scientifiques en évaluation des stocks de Pêches et Océans Canada (MPO). Ces outils permettent un échange efficace de code informatique et l'écriture de documents d'évaluations complexes à l'intérieur d'une équipe d'évaluation, et le partage facile de méthodes avec d'autres scientifiques. Ceci devrait mener à des évaluations plus transparentes, traçables et transférables (TTT) au MPO.

Transparent: Il existe un moyen clair et ouvert d'afficher des données, du code, et des résultats, et d'autres utilisateurs devraient pouvoir reproduire l'évaluation; *traçable*: On devrait pouvoir relier les résultats aux composantes de l'évaluation; et, *transférable*: Il devrait être possible à une autre personne de se charger de l'évaluation et de l'innover avec une courbe d'apprentissage minimale. Un quatrième T pourrait être *Traduisible* puisque avec deux langues officielles il est important de s'assurer que les documents suivent un standard qui permet des traductions consistentes entre les langues officielles.

Des exemples de logiciels ont été présentés pour Git, GitHub, R Markdown, knitr, LaTeX et la création de composantes du logiciel R (R packages). Par exemple, le package csasdown a été présenté pour montrer comment des documents correctement formatés produits durant les processus scientifiques du Secrétariat Canadien de Consultation Scientifique (SCCS) peuvent être créés et élégamment mis à jour avec de nouveaus résultats de modèles d'évaluation.

Des présentations sur les standards de données ouvertes, sur les contraintes de mise en page et d'accessibilité du SCCS, et sur GitLab (un service Git accessible aux employé(e)s du gouvernement du Canada) ont aussi eu lieu. Les changements anticipés à la loi sur les pêches en 2019, particulièrement en ce qui à trait au besoin de points de référence, ont été discutés par rapport au rôle de support que pourrait jouer les outils TTT dans l'opérationnalisation de ces changements législatifs pour fournir des avis scientifiques au MPO. Les participants ont formé plusieurs sous-groupes afin de pratiquer l'utilisation de ces outils, créant, par exemple, un rapport automatisé d'un relevé multi-espèce, et un package R facilitant des traductions rapides, abordables et efficaces des figures apparaissant dans les documents SCCS. Le présent rapport a été écrit collectivement durant le groupe de travail en utilisant les outils TTT, un témoignage de l'efficacité de cette manière de travailler collaborativement.

1 INTRODUCTION

The purpose of the Technical Expertise in Stock Assessment (TESA) program is to promote stock assessment excellence through organizing national activities that contribute to the development of expertise in stock assessment across Fisheries and Oceans Canada (DFO).

TESA was created in 2009, in response to a loss of stock assessment expertise in DFO owing to retirements. Each year, TESA organises three or four training courses and one or two topical workshops on stock assessment issues. TESA is a national program with one or two representatives in each region – for more details see the GCpedia website (only accessible from the DFO network).

A four-day TESA workshop was held to foster a common understanding of modern computational methods and tools among stock assessment scientists in DFO. These tools enable efficient sharing of code and writing of complex stock assessment documents within an assessment team, and easy sharing of methods with others. This should lead to more transparent, traceable, and transferable (TTT) assessments in DFO.

The following definitions were used:

- *Transparent* means a clear and open way to show data, code, and results, such that others should be able to reproduce the assessment.

- *Traceable* means that there is a clear link from database queries and code to final results (numbers, tables, and graphs in an assessment document).

- *Transferable* means that it should be feasible for another person to reproduce an assessment and build upon it with a minimal learning curve.

A fourth T could be *Translatable* in the sense that with two official languages, it is important to ensure consistent and efficient translations between official languages.

This document briefly summarises each day's presentations and activities. Various software demonstrations were given, and participants later split into breakout groups to work on various projects and practice the techniques. One group created an R package to produce an automated report from a multispecies survey (that they intend to use in real-time so that the report can be produced during the survey). A second group created rosettafish, an R package to facilitate efficient translation of text (e.g., axes labels) within figures of Canadian Science Advice Secretariat (CSAS) documents. The package contains an expanding list of translated technical terms (that users can help update), and also allows for translation into Inuktitut. A third group commenced writing this Proceedings document (using a template by Matthew Grinnell), which was completed in the week after the workshop. This demonstrates the efficiency of using these tools to work collaboratively. Other groups worked on a variety of other projects, such as organising their existing code into a more TTT-type framework.

The workshop took place at the Coast Bastion Hotel in Nanaimo, British Columbia in an interactive classroom setting (Figure 1). Workshop participants are listed in Table 1. Workshop materials specific to this repository](https://github.com/pbs-assess/TTTworkshop), with further training materials and examples on the git-course repository and the csasdown repository.

Figure 1. Sean Anderson introducing R package development at the four-day TESA workshop on tools for transparent, traceable, and transferable assessments.

2   DAY 1

2.1   MOTIVATION FOR THE WORKSHOP (EDWARDS AND DUPLISEA)

This workshop was motivated by several recent developments:

(1) The TESA Template Model Builder (TMB) course in Halifax in January 2018 introduced many DFO assessment scientists to tools such as GitHub and the advantages of a strong versioning system, centralised methods repositories, and the ability to share code. Git and GitHub were already well used at the Pacific Biological Station but not as widely in other DFO labs, and the national advantages of such an approach became clearer after the TMB course.

(2) The International Council for the Exploration of the Sea (ICES) developed an initiative called the Transparent Assessment Framework that works towards TTT goals. ICES representatives gave a webinar to TESA in the Spring of 2017 on this initiative, which was a source of inspiration in developing this TTT workshop.

(3) There has been a desire in DFO to create a common look-and-feel for science advice arising from stock assessments. Previous experience has shown that such desires do not readily get met when pushed from the top down, but using these modern sharing tools should help create some common looking outputs as emergent products of this way of working.

(4) Bill C-68 (changes to the Fisheries Act) is currently in the Senate. Bill C-68 contains specific wording around the need to develop, for example, limit reference points and recovery plans. The legislated need for such products that come from assessment scientists' workbenches is a

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motivating factor to work clearly in a TTT framework.

(5) The need to develop bilingual documentation for DFO CSAS documents motivates the development of translation tools for tables and graphics that can be applied consistently, quickly, and across all regions. The fourth and appropriately silent T in TTT can be considered translation, but in reality Translation is no less important than the others.

Table 1. Participants in the four-day TESA workshop on tools for transparent, traceable, and transferable assessments.

Region	Name	Day 1	2	3	4
Central and Arctic	Kevin Hedges	✓	✓	✓	✓
Central and Arctic	Ross Tallman	✓	✓	✓	✓
Central and Arctic	Xinhua Zhu	✓	✓	✓	✓
Gulf	Daniel Ricard	✓	✓	✓	✓
Gulf	David Fishman	✓	✓	✓	
Gulf	Tobie Surette	✓	✓	✓	✓
National Capital	Rob Kronlund	✓	✓	✓	✓
Newfoundland and Labrador	Bob Rogers	✓	✓	✓	✓
Newfoundland and Labrador	Krista Baker	✓	✓	✓	✓
Newfoundland and Labrador	Laura Wheeland	✓	✓	✓	✓
Newfoundland and Labrador	Mark Simpson	✓	✓	✓	✓
Pacific	Andrew Edwards (chair, instructor)	✓	✓	✓	✓
Pacific	Brendan Connors	✓	✓	✓	✓
Pacific	Cameron Freshwater	✓	✓	✓	✓
Pacific	Carrie Holt	✓	✓	✓	✓
Pacific	Catarina Wor			✓	✓
Pacific	Chris Grandin (instructor)	✓	✓	✓	✓
Pacific	Chris Rooper	✓	✓	✓	
Pacific	Elise Keppel (instructor)	✓	✓	✓	✓
Pacific	Erika Anderson	✓	✓	✓	✓
Pacific	Jaclyn Cleary	✓	✓	✓	
Pacific	Kendra Holt	✓	✓	✓	✓
Pacific	Matthew Grinnell (instructor)	✓	✓	✓	✓
Pacific	Philina English	✓	✓	✓	✓
Pacific	Sean Anderson (instructor)	✓	✓	✓	✓
Pacific	Shannon Obradovich	✓	✓	✓	✓
Québec	Daniel Duplisea (chair)	✓	✓	✓	✓
Québec	Hugues Benoît	✓	✓	✓	✓
Québec	Mathieu Desgagnés	✓	✓	✓	✓

2.2 ADVANTAGES OF USING A TTT APPROACH

Assessment staff work collaboratively and previous methods for collaboration (e.g., email) are inefficient and prone to errors, while a structured sharing system with versioning and update notifications is much more efficient. Assessment models generally need to be updated every time a new assessment is scheduled, rather than built from the ground up, but the technical team running the model may change from year to year. Transferable approaches allow a more efficient transfer of code to new staff to get them up and running. Otherwise, substantial amounts of work are likely to be unnecessarily repeated — repetition is avoided when code (including the writing up of lengthy assessment documents) is easily transferable among individuals and constructed in a transparent manner.

2.3 MOTIVATION FOR USING Git (EDWARDS)

Emailing individual files between an assessment team does not preserve folder structure, which is important for code functionality, particularly when building complicated models with nested functions. Using Git and GitHub is more efficient and less prone to errors by preserving folder structure, and allows analysts to work on code simultaneously.

Git tracks changes to files and keeps all previous changes, so that previous versions are never lost. GitHub is a web-based service for sharing and collaborating on code. By using branches, individual developers can simultaneously work on the same project without worrying about overwriting each others' work. Git merges versions of the document edited by different users, and highlights lines with conflicts that need to be resolved. Git also tracks the authors of changes, which can be viewed using the 'blame' button. During development (or post-development), Git also allows analysts to easily reference pieces of code and/or changes in code when posing questions or issues, using remote repositories. Issues can be easily tracked on the GitHub site and used as a continuously updated to-do list, with a permanently recorded history. Individual issues that need to be addressed can also be assigned to specific analysts within a working group.

Git and GitHub, together with some of the other TTT tools discussed below, have been successfully used in recent stock assessments of Pacific Herring (DFO 2019), Pacific Cod (Forrest et al., under revision), and Pacific Hake (Edwards et al. 2018), as well as a data synopsis of over 100 species of groundfish (Anderson et al., under revision).

2.4 INTERACTIVE INTRODUCTION TO Git (EDWARDS AND GRANDIN)

Chris Grandin and Andrew Edwards led the group though the steps for basic Git functions:

- creating a remote repository on a host site (e.g., GitHub)
- adding a `.gitignore` file that specifies files that Git should not track (e.g., data files)
- cloning the repository to your local hard drive
- adding a file to the repository
- staging and committing the file with an informative message
- editing files

- staging and committing changes to update the document
- pushing to the remote repository and
- referencing previous commits using their 'hash' code.

A `.gitconfig` file was shared that includes useful keyboard shortcuts.

Next, Edwards addressed a family of Git functions that are more likely to be used during a collaboration:

- making a new branch separate from the master
- merging branches, and addressing any conflicts that arise
- pushing branches upstream so they can be accessed by others
- deleting old branches to keep your workspace tidy
- stashing changes that have not been committed when you switch branches
- examining network graphs (on GitHub site) to interpret branch structure
- adding remote forks and fetching a collaborator's changes from them and
- using `git diff` to compare changes between a collaborator's branch or fork and yours.

3 DAY 2

3.1 INTRODUCTION TO R Markdown (EDWARDS)

Andrew Edwards presented an introduction to the basics of R Markdown. R Markdown allows analysts to intersperse text and R code in a single file. The text and results of the R code are then elegantly converted into HTML, PDF, or Word formats using the knitr and rmarkdown R packages, and pandoc (a universal document converter). R Markdown is a markup language that is compatible with LaTeX, but easier to learn. Basic formatting options were presented. Some recommendations included naming code chunks using unique and useful identifiers (to aid in using caches and finding errors), and that caches are useful when working with large calculations.

3.2 INTRODUCTION TO csasdown (ANDERSON)

Pacific Region has written an R package called csasdown (based on the R packages bookdown and thesisdown) to help authors write Research Documents formatted for CSAS. Sean Anderson showed how a template document can be produced using the following R code:

```
# devtools::install_github("pbs-assess/csasdown")
rmarkdown::draft("index.Rmd", template = "resdoc", package = "csasdown")
```

Using this draft document, participants explored how to produce and link figures, tables, and references within a Research Document.

3.3   OPEN DATA PROTOCOLS (PATTEN)

Bruce Patten (Pacific Biological Station) came to present an overview of the Darwin Core (DWC) observational data model, and the benefits of its potential application to fisheries science. This data model provides a standard for representing survey data in a consistent format that allows for integration of data sets from multiple sources. The DWC model has been extended by the Ocean Biogeographic Information System (OBIS) initiative to be more useful for marine biological and oceanographic survey data; this is called the OBIS-ENV-DATA schema. He listed several online repositories for biological data that use DWC data standards including OBIS and related R tools (RODBC, robis, and obistools R packages). Several international data sharing initiatives such as OBIS are exchanging data using this format. Canada has committed to contributing to these efforts, and DFO has already participated to some degree. Patten proposed that DFO Science put some effort towards mapping existing databases to the OBIS-ENV-DATA schema with the idea of developing data sets in this format for use by analysts.

3.4   DEFENSIBLE SCIENCE ADVICE (KRONLUND)

Rob Kronlund provided a brief overview of the broad implications of Bill C-68 in the context of the DFO Precautionary Approach (PA) Framework (DFO 2013). Proposed language in Bill C-68 implies there will be legislative imperatives for evidence to support management measures to maintain stocks at or above sustainable levels (Provision 6.1(1)), maintain stocks above Limit Reference Points (Provision 6.1(2)), and rebuild stocks above Limit Reference Points within specified time periods (Provision 6.2). The provisions require taking into account the biology of the fish and environmental conditions affecting the stock. Fish stocks currently tracked by the Sustainability Survey for Fisheries, and others as needed, will need PA Framework elements to meet requirements under Bill C-68 (such as reference points, harvest control rules, consideration of uncertainty). In general, defensible science advice means that the advice meets current standards of acceptable scientific and fisheries management practice, including reproducibility, a key element of this workshop. The suite of software tools discussed in the workshop also enable national standardization of how uncertainty, stock status, and risks associated with management trade-offs are communicated, a step that would also improve the defence of science advice.

4   DAY 3

4.1   WRITING R PACKAGES (ANDERSON)

The third day of the TTT workshop started with a presentation by Sean Anderson on R package development. Anderson used materials from presentations by Hadley Wickham (senior scientist at RStudio) to get participants started with developing R packages. The development of R packages is greatly simplified by using an RStudio project, and taking advantage of its many available tools related to package development. For example, one can create a project in RStudio and define it as an R package, and the software will create the necessary backbone of an R package. Anderson covered

the development of an R package, the generation of its documentation using roxygen2, unit testing of the package, and checking of the package against common standards using `R CMD check`.

Participants performed exercises to learn how to alter an example package. Anderson demonstrated a number of useful functions for package development in the R packages devtools and usethis. Anderson presented resources from Hadley Wickham such as *Advanced R* (Wickham 2014), *R Packages* (Wickham 2015), and *R for Data Science* (Wickham and Grolemund 2017). These resources are available on-line as well as in print form.

4.2 TRANSLATING CSAS DOCUMENTS (MARISCAK)

Ann Mariscak (Pacific Region CSAS office) spoke regarding new policies for generating CSAS documents. As a legal requirement, DFO must ensure that all CSAS documents are available in both official languages. Also, all CSAS documents must be accessible for persons with disabilities and be compatible with tools such as screen readers. It was noted that translation of text will slow the final output of documents and increase their cost. Tools such as LaTeX and csasdown may be able to assist, and thereby shorten the time and reduce the cost to produce fully translated and accessible documents.

A big problem is translation of figures into the other official language. It was suggested that it might be possible for an automated translation of frequently used words such as "Age" or "Fork length." Mariscak mentioned a recent example of having to manually replace all the words by their translated versions in all the figures in a lengthy Research Document; this took someone 35 hours, excluding the time and expense of actually getting the words translated. This motivated participants' development of the rosettafish package (see below), such that authors should somewhat easily be able to create figures in both languages. Mariscak also noted that manual editing (through Photoshop and other tools) often degrades figure quality.

4.2.1 Editing vs. translation

There was a suggestion that documents can be translated using Google Docs, and then sent for 'editing' as opposed to 'translation.' If editing is a less expensive service than translation, this could be an option worth considering in some situations. Authors choosing to follow this approach would have to ensure the integrity of the text was correctly maintained through the translation process.

4.2.2 Translation databases

Mariscak mentioned the existence of a Government of Canada database called Termium Plus. Termium Plus is an invaluable tool used for the translation of technical terminology. The quality of the translation is perpetually being improved through expert-user feedback and contribution. Daniel Ricard mentioned another translation document native to DFO called the DFO Bilingual Lexicon, part of the Writing and Publishing Tools of the DFO Communications Toolbox.

4.3 BREAK-OUT GROUPS

Workshop participants separated into five break-out groups. Workshop participants were able to self-select which group they went to, which worked well.

The first group worked on an applied example, in which they developed a trip report for the Newfoundland and Labrador Region using R Markdown (see below).

The second group focused on a brainstorming session about the development of tools to automate language translation of figures in CSAS documents (Figure 2). This resulted in the creation of a new R package rosettafish, which translates common figure annotations between English, French, and Inuktitut.

The remaining three groups worked on collaboratively writing text for this workshop's Proceedings document using GitHub, with each group tasked with summarising one day of the workshop. A Proceedings template document that met the format requirements for a 'Canadian Technical Report of Fisheries and Aquatic Sciences' was compiled ahead of time by Matthew Grinnell. The three report-writing groups were able to clone the relevant repository and collaboratively draft this Proceedings document.
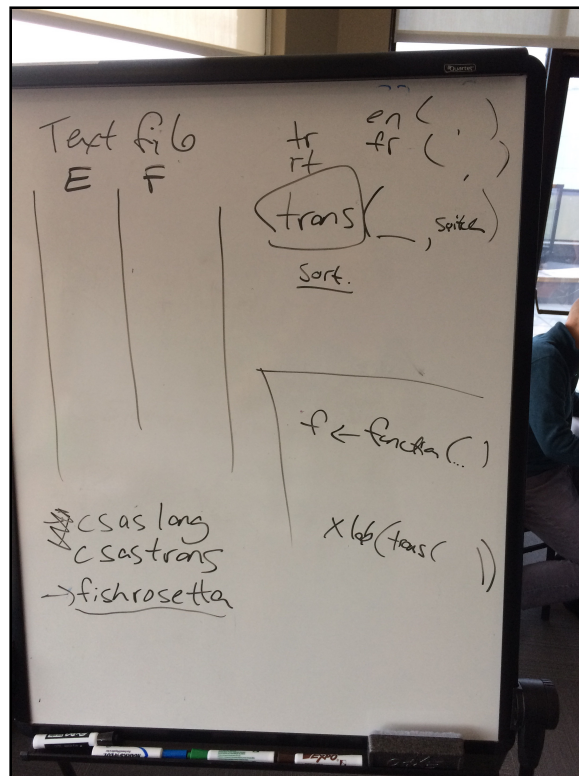

Figure 2. Genesis of the rosettafish R package at the four-day TESA workshop on tools for transparent, traceable, and transferable assessments.

4.3.1 Multi-species survey automated report

A breakout group (Krista Baker, Brendan Connors, Kevin Hedges, Bob Roger, Mark Simpson, and Laura Wheeland) was formed to work on an applied example of all of the workshop topics. The group created a GitHub repository, an R project, and an R Markdown document to standardize and automate the creation of survey trip reports. The group used the Newfoundland and Labrador Region multispecies surveys as a test case, and tailored the project to handling the particular data structure from those surveys, but the project could easily be adapted for other trip types (e.g., shellfish surveys). Work was divided among group members, and coordinated through GitHub. Individual tasks included creating the GitHub repository, creating the R project, drafting separate R Markdown files to provide a trip summary, survey map, and catch summary, and then creating a bookdown file to combine the separate R Markdown files into a single PDF report. The R Markdown files combined standard text and dynamic calculations in R to automatically generate survey details and summary results. By the end of the workshop the report project was completed, and automated survey reports had been successfully generated.

5   DAY 4

5.1   Git FOR GOVERNMENT OF CANADA EMPLOYEES (RICARD)

Daniel Ricard spoke about gccode, a GitLab enterprise account offered by the Government of Canada, through Shared Services Canada (SSC). One must be on a Government of Canada network to access the website and the remote Git server. DFO employees can create an account on gccode, and use it as they would use GitHub. One advantage of using gccode is that it is provided by SSC and therefore has no privacy concerns that may arise from using a publicly available system such as GitHub (although GitHub does provide private repositories, and GitHub is not used to share data). The downside is that the Git server can only be accessed from one's office or a Virtual Private Network, and so cannot be used for collaboration with non-government colleagues.

5.2   BREAK-OUT GROUPS

Workshop participants continued to work in small groups on tasks from the previous day, including writing this report. They also continued to develop the rosettafish R package, which will be used to translate more than 200 full pages of figures in Anderson et al. (under revision) for the final CSAS Research Document.

6   CONCLUSIONS

Common templates for CSAS reports (e.g., Research Documents, Science Responses) are useful to ensure web accessibility standards and to speed up publishing times for DFO reports. Assisting DFO employees with standard translation tools between languages ensures rapid and equal quality

documents and presentations (especially quality of figures), regardless of the original language. Common graphical standards for different plot types draw more attention to the advice rather than the particular mode of presentation. Seeking stronger standards in this regard should aid the communication of science work, advice, and uncertainties. Using tools that facilitate traceability and transferability (such as GitHub, R packages, and R Markdown) for documenting and disseminating assessment code, is a means of promoting a transparent line of work. This transparency includes the decisions, assumptions, and known issues which are key components of defensible science advice. Assessment and advice conforming to TTT can provide strong support for decision-making that is based on such advice. These tools allow greater transferability and reproducibility in the assessment process that permits new staff to come on-line quickly, and for the process to better deal with staff changes and absences (e.g., owing to parental leave). Furthermore, such transferability can reduce the stress on any one individual assessor, since they know that the assessment can be completed by the rest of the team if, for example, they get sick. This transferability is not the case if much of the code only exists on their computer (in which case the assessment may not get completed).

It is important to be aware that some of these tools require considerable expertise, and can sometimes be difficult to set up due to minor technical issues. If they are going to be used, dedicated staff and/or training needs to be integrated into the stock assessment-advice workflow and not simply as a side activity. In addition, using these tools in DFO assessment work can promote greater within- and between-region collaboration that can improve the speed and quality of science advice.

REFERENCES

Anderson, S.C., Keppel, E.A., and Edwards, A.M. Under revision. A reproducible data synopsis for over 100 species of British Columbia groundfish. DFO Can. Sci. Advis. Sec. Res. Doc.

DFO. 2013. Guidance for the development of rebuilding plans under the precautionary approach framework: Growing stocks out of the critical zone. Sustainable fisheries framework (SFF): A fishery decision-making framework incorporating the precautionary approach.

DFO. 2019. In press. Status of Pacific Herring (*Clupea pallasii*) in 2018 and forecast for 2019. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/001: 38 p.

Edwards, A.M., Taylor, I.G., Grandin, C.J., and Berger, A.M. 2018. Status of the Pacific Hake (whiting) stock in U.S. and Canadian waters in 2018. Prepared by the Joint Technical Committee of the U.S. and Canada Pacific Hake/Whiting Agreement, National Marine Fishery Service and Fisheries and Oceans Canada. 222 p.

Forrest, R.E., Anderson, S.C., Grandin, C.J., and Starr, P.J. Under revision. Assessment of Pacific Cod (*Gadus macrocephalus*) for Hecate Strait and Queen Charlotte Sound (Area 5ABCD), and West Coast Vancouver Island (Area 3CD) in 2018. DFO Can. Sci. Advis. Sec. Res. Doc.

Wickham, H. 2014. Advanced R. Taylor & Francis.

Wickham, H. 2015. R Packages. O'Reilly Media.

Wickham, H., and Grolemund, G. 2017. R for Data Science. O'Reilly Media.