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24th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Victoria, Canada
June 19-24, 2024

UNITED STATES PROPOSAL FOR ADOPTING OPEN SCIENCE FOR ISC STOCK ASSESSMENTS

June 2024

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Proposal

Adopting Open Science for ISC Stock Assessments

Background

Open science represents a transformative approach where research processes and outputs are shared openly, aiming to foster inclusivity, collaboration, and accessibility across the scientific community. For the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), adopting an open science framework is pivotal in enhancing the transparency and efficacy of fisheries stock assessments. By aligning with global standards of open data and reproducible research, the ISC can set a precedent for rigorous, accessible, and collaborative fisheries science, ensuring that scientists and stakeholders at all levels are equipped with the best available information for decision-making. The integration of open science principles into the ISC's operations addresses several pressing challenges within fisheries science. Traditional stock assessments can often be opaque and restricted to a limited audience, limiting the scope for external validation and collaboration. By adopting open science practices, the ISC aims to democratize access to research data and methodologies, enhancing the reliability and reproducibility of assessments. The shift towards a more open framework will not only increase scientific transparency but also bolster stakeholder trust and foster a more inclusive environment for global contributors, thereby enhancing the overall quality and acceptance of the scientific outputs.

The primary goal of this proposal is to develop a comprehensive open science plan within the ISC to revolutionize how fisheries stock assessments are conducted and shared. Objectives include establishing a standardized framework for data sharing that respects privacy and security, adopting tools for effective data management and collaboration, and promoting the use of reproducible research practices across all ISC activities. Ultimately, this initiative aims to streamline processes, facilitate wider participation in assessment reviews, and improve the accuracy and timeliness of stock status updates, thus directly contributing to the sustainable management of fisheries resources.

Tools for Open Science

To successfully implement open science practices, the ISC will leverage a variety of tools designed to enhance transparency, collaboration, and efficiency. Version control systems like GitHub will be pivotal for managing project files, enabling changes to be tracked and reviewed easily, fostering a collaborative environment. For data sharing and storage, platforms for secure file sharing that adhere to confidentiality regulations will be utilized to ensure data is accessible yet secure. These platforms support the central hosting of model input data, allowing stakeholders to access and use the data for analysis seamlessly. Cloud-based or remote high-

throughput/high-performance computing solutions that are accessible to all ISC working group members can provide efficiencies in scientific analyses. Access to a shared computing solution can enhance collaboration and reproducibility. By adopting these tools, the ISC can standardize its workflows for data management, ensure consistent access to up-to-date information, and enhance the collaborative capacity of its global research network, ultimately leading to more robust and transparent stock assessments.

Code Sharing and Reproducibility

Central to the ISC's open science initiative is the commitment to code sharing and the reproducibility of research. By making all analytical scripts publicly available, preferably hosted in GitHub repositories, the ISC can ensure that its methodologies are transparent and accessible to the wider scientific community. This approach not only facilitates peer review and continuous improvement of analytical methods but also serves as a valuable educational resource, passively sharing knowledge and enabling others to learn and adapt techniques without direct instruction. Additionally, establishing environments where code can be easily rerun ensures that analyses remain viable and accurate, even as underlying technologies evolve. This practice not only builds trust within the scientific community but also significantly enhances the collaborative potential across different projects and disciplines, contributing to more robust and reliable fisheries management practices. If an ISC GitHub Enterprise is established, this would promote the creation of R packages and tools (such as Shiny apps for model visualization) that can be shared among all working groups and used for any stock assessment. It would also allow assessment output to be standardized across working groups, unifying the content and format of reports, and improving communication for scientists, fishery managers and stakeholders. The tools can be built and maintained by anyone within the group, reducing the overall burden on any one individual and ensuring that everyone has equal access to the tools while also promoting consistency in outputs and supporting workflow automation.

Pilot project

The 2024 ISC NPO shortfin mako shark assessment used many of these open science tools and principles (e.g., GitHub, Shiny dashboards, and high-throughput computing) and is an example of what implementation could look like for the ISC. However, challenges remain regarding identifying the most appropriate workflow, file-sharing, and computational solutions, which should be improved upon through the multi-year *Implementation Strategy*. Additionally, a key component of the *Implementation Strategy* will be providing education and training to ISC working group members.

Implementation Strategy

The implementation of the open science plan within the ISC will follow a structured and phased approach. Building on the approaches used in the 2024 ISC NPO shortfin mako shark assessment, the implementation strategy would serve as a testbed for the integration of open science tools and practices, allowing the ISC to evaluate their effectiveness and make necessary adjustments before a wider deployment. Here’s a more detailed breakdown of how this implementation strategy could be structured:

Year 1

- **Scoping:** Initial scoping activities can be divided among small groups to address concerns and unknowns before any implementation. For example, researching different secure data sharing platforms that work well with the assessment workflow, identifying a high-throughput/high-performance computing solution accessible to all ISC working group members, assessing the limitations and restrictions placed upon scientists by their agencies, and understanding the financial responsibilities of potential resources to be used.
- **Implementation:** Once agreements are reached about the desired resources to use, initial activities will focus on setting up the necessary tools (like GitHub Enterprise for version control) and developing a set of guidelines for use.
- **Training:** Conduct surveys to determine the current skill levels and knowledge gaps among the ISC members regarding open science practices and tools. Based on the needs assessment, develop training content and tailor the training modules to address specific skill gaps, ensuring relevance and efficiency. Training could be provided in a hybrid workshop in 2025 and/or supplemented by an in-person training session held immediately prior to the ISC plenary in 2025. Potential training topics include:
    - What is Git? What is GitHub? - understanding Git and GitHub, the uses and benefits of version control software
    - Introduction to GitHub - creating accounts and organizations within an Enterprise, basics of creating and interacting with a repository
    - Collaborating through GitHub - creating branches, dealing with merge conflicts, pull requests, and code review
    - Codespaces - how to create and use a codespace within a repository
    - Automated workflows with GitHub - creating GitHub Actions to run reproducible jobs

Year 2

- **Execution**: Participants will implement the agreed-upon tools and practices.
- **Training:** Provide training for using high-throughput/high-performance computing solutions in a hybrid or virtual format.

Challenges and Considerations

- **Data Privacy and Security**: While the proposal addresses the need for a framework that respects privacy and security, operationalizing these protections will be critical, especially when handling sensitive or proprietary data in ISC stock assessments.
- **Resource Allocation**: Implementing open science practices requires resources, including training for ISC members, development of new infrastructure for data sharing and collaboration, and ongoing management of open science tools. Ensuring funding and personnel support will be crucial.
- **Cultural Shifts in Science Practice**: Shifting to an open science framework involves significant changes in how ISC scientists operate. It will be important to manage these

changes sensitively to overcome potential resistance from those accustomed to traditional methods of developing stock assessments. Workshops about the Open Science mindset and creating spaces for community learning (such as a Google Space where anyone can ask a question in a low-pressure format) will be crucial in adopting this framework.