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NORTH PACIFIC MARINE SCIENCE ORGANIZATION

PICES

Report of the Study Group on Encouraging Data Awareness and Increased Transmission and Accessibility

PICES Technical Report No. 2
2024

Towards a Data Management and Data Sharing Plan for the North Pacific Marine Science Organization (PICES)

Report of the Study Group on Encouraging Data Awareness and Increased Transmission and Accessibility

prepared by

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PICES Technical Reports

This report was developed under the guidance of the PICES Science Board and its Technical Committee on Data Exchange. All names, views and claims expressed in this report are solely those of the authors and do not represent those of the PICES Organization, nor those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

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Acknowledgements

The Chair of SG-DATA would like to express her gratitude to everyone who contributed to the development of this data management and sharing plan. Special thanks to Dr. Igor Shevchenko[1] for his dedication and support in advancing data management within PICES.

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[1] This report is dedicated to the memory of Dr. Igor Shevchenko (1954–2023).

Executive Summary

The Study Group on Encouraging Data Awareness and Increased Transmission and Accessibility (SG-DATA) was established in 2022 at the PICES Annual Meeting (Busan, Korea) for the purpose of investigating data and information management within PICES and identifying solutions for known problems and obstructions regarding the sharing of data within PICES and beyond.

SG-DATA proposes the formation of a Data Management working group under the direction of the Technical Committee on Data Exchange (TCODE) that will review the current PICES Data Policy, and provide data management and sharing recommendations.
SG-DATA also recommends that PICES committees and FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) program Scientific Steering Committee

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Box 1. Data strategy definitions

- **Data** is a set of values, symbols or signs (recorded on any type of medium) that represents one or more properties of an entity.
- **Metadata** is 'data about data' describing the content, quality, condition, and other characteristics of data that allows their inventory, discovery, evaluation or use.
- **Timely** in this context means the distribution of data and/or products sufficiently rapidly to be of value for a given application.
- **Openly** means data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike.
- **Product** means a value-added enhancement of data applied to a particular use.
- **Free and unrestricted** means non-discriminatory and without charge. "Without charge", in the context of this resolution means at no more than the cost of reproduction and delivery, without charge for the data and products themselves.
- **Non-commercial** means not conducted for profit, cost-recovery or re-sale.

(SSC) identify a point of contact for data-related business for connection with the proposed data management working group to help provide input relating to the role of PICES Expert Groups in data management and sharing.

Below are three priorities, adapted from SG-DATA's Terms of Reference (Appendix 1), that the SG (Appendix 2) will address and refine should the proposed working group be approved by Science Board and endorsed by Governing Council.

1. Revise and update the PICES Data Policy,
2. Promote a culture of data sharing within PICES, and
3. Recommend data management platforms, standards, technologies, and resources.

SG-DATA envisions that the process of refining and addressing these priorities will be a collaborative approach with PICES Expert Groups.

Introduction

Effective data and information management and sharing are essential to promote collaboration within the North Pacific Marine Science Organization (PICES). Development and utilization of a comprehensive data and information strategy will facilitate data-intensive science, advance scientific research, ensure long-term storage and security for all data and information, and increase the reach of PICES science to a wider international audience. The purpose of SG-DATA is to provide key considerations and recommendations to the Technical Committee on Data Exchange (TCODE) and Science Board for modernizing and streamlining data and information management and sharing within PICES. In order to effectively carry out the tasks outlined in this report, action will be needed by all PICES committees, FUTURE SSC and Expert Groups to implement best practices. PICES Expert Groups, summer school activities, and special projects generate data and information that represent unique international collaborations across the North Pacific. The resulting reports, documents, and manuscripts often cover information on regions with limited open data access. This underscores the importance of the information PICES scientists can offer at the global level. Data currently within PICES consists mainly of reports generated from Expert Groups, a small list of datasets stored in various repositories (Appendix 3), a searchable metadata catalog (TCODE Catalog) that includes PICES reports, cruise reports from various PICES member countries, information on some datasets in the North Pacific and beyond, and published manuscripts resulting directly from PICES collaborations (including Expert Group products and biannual PICES Press articles).

This data management and sharing plan recommends best practices for PICES committees, FUTURE SSC, and Expert Groups to ensure safeguarding, tracking, and efficient discovery, access, and sharing of all generated data and information emanating from PICES (for definitions see Box 1). The data management and sharing plan sets the stage for a more collaborative and data-driven future for PICES, ensuring that its scientific contributions continue to make a meaningful impact in PICES member countries and beyond.

With a focus on data openness, discoverability, accessibility, and collaboration, while aligning with international and community-developed standards and initiatives, and data sharing principles, this plan aims to enhance the effectiveness and impact of PICES projects and Expert Groups. The points outlined above are aimed at making it easier to share and find data generated by PICES and foster a culture of data sharing and stewardship within the PICES community. These modernization efforts will improve the reach of PICES data and information, advance long-term storage security, increase access to easily searchable information, and facilitate data-intensive marine science in the North Pacific region.

> ### *Box 2.* Goals of the strategy
>
> **Goal 1** – Revise and update the PICES Data Policy.
>
> **Goal 2** – Promote data sharing within PICES.
>
> **Goal 3** – Recommend data management platforms, standards, technologies, and resources.

Key aspects of this plan (Box 2) are to:

1. Recommend revising and updating the PICES Data Policy aligned with the UNESCO Intergovernmental Oceanographic Commission's (IOC) Data Policy and Terms of Use, and UN Decade of Ocean Science Implementation Plan,
2. Highlight and provide recommendations on how to resolve barriers to data sharing within PICES, and
3. Recommend data management platforms, data and metadata standards, and technologies that can be adopted by PICES to enable open data sharing, discovery, access, interoperability, data (re)use, and licensing.

SG-DATA hopes that this strategy will evolve and the implementation developed in a second year of an Expert Group, preferentially as a PICES working group.

Recommendations

Goal 1: Revise and update the PICES Data Policy (2018/A/6: Data Management Policy)

PICES' Data Policy (2018/A/6) is a working draft with anticipated completion by summer 2024 (Appendix 4). The current policy refers heavily to managing data with scarce reference to sharing data, metadata, and information. The new PICES Data Policy should align with UN Ocean Decade goals, and the recent revisions to the IOC Data Policy revised and approved in March 2023. The PICES Data Policy should provide direction on wider access, sharing, and management of PICES data and information. Two data sharing principles that are currently recognized and are being implemented to varying degrees around the world are FAIR and CARE. The 'FAIR Guiding Principles for scientific data management and stewardship' were published in 2016 in *Scientific Data.* FAIR is an acronym for Findable, Accessible, Interoperable, and Reusable. CARE principles refer to Indigenous data and are meant to complement FAIR principles by ensuring that data are used ethically. CARE is an acronym for Collective benefit, Authority to control, Responsibility, and Ethics. SG-DATA suggests the following changes to the current PICES Data Policy.

- **Update PICES Data Policy** (see Appendix 4)
    o Incorporate **FAIR and CARE** principles,
    o Include language to help **facilitate a data-sharing culture** among PICES member countries.
- Recommend **specific data licenses** with minimal restrictions.
- Incorporate **plans for Expert Groups** to initiate data and information strategies at the onset of newly formed groups for where and how to store and share reports, data, and publications, etc. This should be stored and added to a searchable metadata catalog.
- **Develop a metadata catalog** that builds off the existing TCODE data catalog.
- **Communicate data storage and sharing** information on an easily accessed page on the PICES website.

Goal 2: Promote a culture of data sharing within PICES

The global ocean area and depth makes it difficult to sustainably and synoptically observe subsurface ocean processes and variability for subseasonal-to-decadal time-scales. Our understanding of the ocean is largely derived from compilations of historical and recent ocean data collected and shared by many countries and programs over many years. Sustained and routine international data sharing, quality control, and integration are necessary for all countries to document, understand, and model ocean climate variability and respond to its social impacts at relevant spatial and temporal scales. The following recommendations are intended to incentivize a culture of internal and external data sharing within and across participating groups in PICES and its partners, improve ocean data literacy, and foster community-adopted best practices and FAIR-compliant data discovery, accessibility, and reuse.

- **Identify** and **acknowledge barriers** to data sharing within PICES. Building on barriers identified at the PICES-2022 Workshop on "Openly discoverable, accessible, and reusable data and information in the UN Decade" (Appendices 5 and 6), an annual survey for PICES members is recommended to continue identifying barriers to data sharing and to monitor the adoption of data management and sharing practices, and familiarity with domain-specific repositories and standards.
- Create a **data management and stewardship resource webpage**. This could include updating the TCODE products [website](#) to include additional resources and/or migrating the TCODE website to a new platform.
- Provide **education and training** opportunities around **identified data sharing barriers** and needs. This could include a recommended list of resources, workshops, course material, or reference sites to improve ocean data literacy and data management practices (*e.g.*, through the Global Teacher Academy).
- Develop an adaptive and actionable **data management road map.** This will require 1) **documenting** the current data management lifecycle, data flows and management processes, and challenges for PICES projects and Expert Groups; and 2) **diagramming** a data management lifecycle to be used as a template, providing a checklist for current and future projects to adhere to this data management strategy.
- Create an **inventory table** to discover and access current PICES [data and information assets](#). A landing page on the PICES homepage could include guidance on how to find information on data discovery, access, quality control, resources, how to search the PICES data catalog, and any relevant links to TCODE.

- **Incentivize data sharing** within PICES, for example, by hosting an **annual 'Data Excellence' award – in honor of Dr. Igor Shevchenko[2]** – for PICES members who demonstrate effective and impactful data management and sharing practices within Expert Groups and projects. Recommended data sharing best practices can be further incentivized by PICES minting unique digital object identifiers (DOIs), or pointing individual researchers or Expert Groups to databases or repositories that offer this service.
- **Encourage 'data publications'** through PICES following data publishing requirements, recommendations for open data licensing such as Creative Commons public licenses (*i.e.*, Attribution 4.0 International — CC BY 4.0) and data DOI citation standards.

Goal 3: Recommend data management platforms, standards, technologies, and resources

Specific data management platforms that facilitate the recommendations above are needed so that researchers involved in PICES Programs, Projects, Committees, Working Groups, Study Groups, Sections, and Advisory Panels can easily apply these recommendations. This strategy has a strong focus on leveraging pre-existing tools recommended or supported by the International Oceanographic Data Exchange (IODE) of the IOC of UNESCO and that meet the needs of PICES with regard to effective data management and sharing. These recommendations are to:

- **Create a data management plan template** following the recommendations outlined in the IODE Guidelines for a Data Management Plan and host it on a free online tool such as https://dmptool.org.
- The Secretariat should continue to **publish PICES reports to digital literature resource databases** (*e.g.*, Aquadocs, EBSCO, ISAMSLIC, ProQuest) and recommend members **publish methods and protocols to the** Ocean Best Practices System **(OBPS)**: an open access, permanent, digital repository of community best practices in ocean-related sciences and applications maintained by the IODE. For PICES members to be able to contribute, an OBPS community collection should be established.
- **Assess free third-party data and metadata catalogs to transition the** TCODE Catalog **to,** *and* that uses ocean science specific standards recommended by the Global Ocean Observing System and the UN Decade of Ocean Science Data and Information Strategy Implementation Plan. Key criteria for selection include:

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[2] Member of TCODE from 1997-2023 and TCODE Chair from 2001-2007.

1) minimal maintenance required by PICES or TCODE members; 2) is actively developed by a third-party provider that ensures modern technologies and standards are used; 3) is user-friendly for PICES members to submit to; 4) is able to not only publish metadata but also provides a place to store data if required; and 5) offers DOIs for datasets and the ability to assign open licenses for data to be reused.

- **Encourage minting DOIs for PICES reports and datasets**. For simplified DOI issuance, explore free platforms such as zenodo.org in addition to the paid membership PICES has with DataCite Canada Consortium. To improve the accessibility of DOIs, consider a hybrid approach, depending on categories of research outputs that would need to be established: 1) the self-serve model on zenodo.org with a dedicated 'PICES community' for streamlined DOI issuance by data providers; and 2) PICES DOI minting services through the DataCite Canada Consortium. There should also be guidelines for including the PICES organization in appropriate DOI metadata fields.

- **Identify a cloud-based, collaborative word-processing platform available in all PICES member countries**. For example, Microsoft OneDrive collaboratively edits Word documents in the browser if the document is hosted on OneDrive.

- **Establish a PICES Data Stewardship Officer (DSO)** who would advise Science Board and implement the management and coordination of data across PICES and its partners. The DSO would be knowledgeable in scientific data sharing, management, FAIR principles and metadata best practices, and would be responsible for ensuring best practices are followed by PICES activities. For example, the PICES DSO could serve an advisory role to Science Board, interact with international programs such as the UN Decade of Ocean Science, be a chair/vice-chair in TCODE or officer in the PICES Secretariat.

Conclusion

In conclusion, this comprehensive data management and sharing plan is a vital step forward for PICES. Key recommendations include:

- ***Revise and update the PICES Data Policy.*** The existing policy needs to be updated to align with modern data management practices. This includes incorporating FAIR and CARE principles, promoting a culture of data sharing, recommending specific data licenses, and ensuring data storage and sharing strategies are initiated at the onset of newly formed Expert Groups.
- ***Promote a culture of data sharing within PICES.*** Encouraging a culture of data sharing is vital for PICES. This includes identifying and addressing barriers to data sharing, creating a data management and stewardship resource webpage, developing a data management roadmap, establishing an inventory table for discovering and accessing data assets, and incentivizing data sharing within PICES.
- ***Recommend data management platforms, standards, and technologies.*** PICES should adopt specific data management platforms, follow international standards, publish reports and protocols through recognized repositories, review and enhance the TCODE Catalog, encourage the use of DOIs, and identify a cloud-based, collaborative word-processing platform.

By adopting these recommendations, PICES will enhance data accessibility, collaboration, and the global impact of its scientific efforts. This plan will help PICES stay at the forefront of marine science, contributing significantly to our understanding of the North Pacific region and beyond.

References

Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* 2016. The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* **3**: 160018, https://doi.org/10.1038/sdata.2016.18

CARE Principles for Indigenous Data Governance: https://www.gida-global.org/care

Creative Commons data licences: https://creativecommons.org/about/cclicenses/

Ocean Decade Implementation Plan: https://unesdoc.unesco.org/ark:/48223/pf0000376780

Appendix 1

SG-DATA Terms of Reference

SG-DATA term: 2022–2023
Parent Committee: TCODE

1. To assess existing best practices, and complete a PICES data flow diagram;
2. To gather lessons learned from past, ongoing and planned projects, programs and initiatives;
3. To identify solutions for known problems and bottlenecks regarding sharing of data within PICES and beyond;
4. To facilitate harvesting of PICES metadata catalog records by UN Decade data platforms (like ODIS);
5. To draft a checklist of questions to promote data sharing and the reproducibility of results for paper/report submissions;
6. To consider what kind of infrastructure would be sufficient to enable those with "small" and "besides" science data who wished to contribute to a digital commons environment;
7. To consider how to make FUTURE, IPOD organic parts of the future UNDOS digital ecosystem;
8. To increase collaboration between TCODE and other PICES programs like Smartnet, in addition to external collaborations (ICES DIG);
9. To identify a digital platform that is accessible by all PICES member nations/constituents for use in simultaneous document editing and updates that can be used by all committees and expert groups for more efficient and effective communications and work;
10. To review the current PICES data management policy and forward any changes/edits to TCODE, SB, and GC for approval.

Appendix 2

SG-DATA Membership

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The following people contributed to the work of SG-DATA and the preparation of this report, but were not formally nominated as members by their national delegates within the life span of the SG.

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Trajce Alcinov (Environment and Climate Change Canada)
Igor Shevchenko (TINRO, Russia)
Hernan Garcia (NOAA, USA)
Jill Prewitt (AOOS, USA)

Appendix 3

PICES Data Inventory

Dataset/Data product name	Expert Group responsible	Report or publication	Current home/host for these data?	PICES contacts	Data URL
non-indigenous species database	WG 21 / AP-NIS	PICES Sci. Rep. No. 48, 2015 Report of Working Group 21 on Non-indigenous Aquatic Species	Held at the PICES Secretariat	Thomas Therriault	
PICES Metadata federation	TCODE	PICES Technical Report No. 1, 2007	PICES rented server	Igor Shevchenko	http://67.212.128.196/geonetwork/srv/en/main.home
CPR Survey	MONITOR	http://pices.int/projects/tcprsotnp/default.aspx	MBA/ Sonia Batten	Sonia Batten	http://pices.int/projects/tcprsotnp/data.aspx
NPESR data portal	MONITOR / WG 35		uses a commercial system (submittable)	Peter Chandler, Harold (Hal) Batchelder	https://pices.submittable.com/submit
Micronekton sampling intercalibration data	BIO/WG 23	PICES Sci. Rep. No. 38, 2010			published by report and paper
ADRIFT-Hawaiian Islands Marine Debris Aerial Imagery Surveys (2015–2016)	ADRIFT Project Team	Clarke Murray *et al*. 2018. Marine Pollution Bulletin: Special Issue Editorial, Volume 132, pp. 1–106. ADRIFT in the North Pacific: The movement, surveillance, and impact of Japanese tsunami debris.			http://histategis.maps.arcgis.com/apps/MapSeries/index.html?appid=e1e1464e56b14d80bf096b6e2fe132c4
ADRIFT-Webcam monitoring Webcam monitoring of marine/tsunami debris (2014–2017)	ADRIFT Project Team	Kako *et al*. 2018. Marine Pollution Bulletin: Special Issue Editorial, Volume 132, pp. 1–106.	Atsuhiko Isobe - by request		
ADRIFT-Development of life history database for Japanese Tsunami Marine Debris (JTMD) biota (2015–2016)	ADRIFT Project Team	Miller *et al*. 2018. Marine Pollution Bulletin: Trait-based characterization of species transported on Japanese tsunami marine debris:	Smithsonian Environmental Research Center	Greg Ruiz*	http://invasions.si.edu/nemesis/jtmd/index.jsp
ADRIFT - Japan Tsunami Debris species database (2012–2017)	ADRIFT Project Team	Carlton *et al*. 2017: Hansen *et al*. 2018; Hanyuda *et al*. 2018; Hansen 2013; Hansen *et al*. 2017a,b,c; Report to Ministry of Environment of Japan (MoE).	Dryad Oregon State University	Jim Carlton*	Supplementary material: www.sciencemag.org/content/357/6358/1402/suppl/DC1 Dryad open data resource https://datadryad.org/r

Dataset/Data product name	Expert Group responsible	Report or publication	Current home/host for these data?	PICES contacts	Data URL
					esource/doi:10.5061/dryad.rh01m
ADRIFT-BC Coast Marine Debris Aerial Imagery Surveys	ADRIFT Project Team	Report to MoE.; ADRIFT in the North Pacific: Special Issue Editorial, Volume 132, pp. 1–106 (July 2018)	Province of BC	Cathryn Clarke Murray	https://catalogue.data.gov.bc.ca/dataset/pices-tsunami-debris-aerial-photo-survey-map
Coral and Sponge data	WG 32/BIO	TBA	TBA	Janelle Curtis, Masashi Kiyota	TBA
Key environmental data	WG 32/BIO	TBA	TBA	Janelle Curtis, Chris Rooper, Anya Dunham	TBA
Well-being analysis in PICES nations and Indonesia	MarWeB Project Team	PICES Scientific Report. No. 52 Marine Ecosystems and Human Well-being	PICES (also MAFF - TBC)	Mitsutaku Makino	http://meetings.pices.int/publications/projects/MarWeB/PICES_7_well-being.xlsx
Data from 2014, 2015 and 2016 Indonesian Pond Aquaculture Experiments	MarWeB Project Team	PICES Scientific Report. No. 52 Marine Ecosystems and Human Well-being	PICES Others?		
Clicker survey data - Las Lisas	MarWeB Project Team	Marine Ecosystems and Human Well-being	PICES Others?		http://meetings.pices.int/publications/projects/MarWeB/Guatemala_LasLisasALL_English.xlsm
Clicker survey data - Monterrico	MarWeB Project Team	(MarWeb PICES Scientific Report	PICES Others?		http://meetings.pices.int/publications/projects/MarWeb/Guatemala_MonterricoALL_English.xlsm
Bibliographies (2) on the key concepts used in the project	MarWeB Project Team	(MarWeb PICES Scientific Report	PICES Others?		http://meetings.pices.int/publications/projects/MarWeb/well-being.xlsx http://meetings.pices.int/publications/projects/MarWeb/satoumi.xlsx
Dissolved iron data set in the North Pacific	WG 22/BIO	PICES Scientific Report. No. 42, 2013 Iron Supply and its Impact on Biogeochemistry and Ecosystems in the North Pacific Ocean	PICES Others?		https://meetings.pices.int/publications/other/members/WG22_dissolved_iron_dataset.pdf http://www.pices.int/members/working_groups/Disbanded_working_groups/products/Fe_data_set_Aug2012.xlsx

*Non-PICES member

Appendix 4

PICES Data Policy Draft

Proposed changes are included in red; anticipated completion – summer 2024.

Principles and Definitions

As stated in Article III of the Convention for the North Pacific Marine Science Organization (PICES) the Organization is to promote the collection and exchange of information and data related to marine scientific research in the North Pacific Ocean and its adjacent seas.

The PICES strategy on capacity development identifies the Technical Committee on Data Exchange (TCODE) as the committee responsible for the development of communication networks for exchange of data and information.

The timely, free and unrestricted international sharing of oceanographic data, metadata, products, and services is essential for a wide variety of purposes and benefits, including the prediction of weather and climate, the operational forecasting of the marine environment, the preservation of life, economic welfare, safety and security of society, the mitigation of human-induced changes in the marine and coastal environment, as well as for the advancement of scientific understanding that makes this possible.

Data, metadata, and products should be accessible, reproducible, interoperable, and freely and openly shared with minimum delay and restrictions. Such sharing of data in both real-time and delayed mode facilitates scientific research and innovation.

Data gathered as a result of PICES activities will be responsibly managed to guard against loss and to ensure continued accessibility. The management of data using external data management systems is preferred to using internal PICES resources. Data should be quality controlled, accompanied by metadata and, when possible, it is best to

be stored in an openly accessible data repository and made accessible and discoverable through a web interface and machine-to-machine protocols. PICES members shall, where possible, use IODE data centres linked to the IOC Ocean Data and Information System (ODIS) as repositories for oceanographic data and associated metadata.

For any data provided to PICES, PICES will respect the ownership rights and any restrictions placed on these data by the provider.

- Data include data products and model outputs related to PICES activities. Metadata are data about data.
- End users include a person, organization, group (including PICES expert groups) using data.
- Data providers include a person, organization, group (including PICES Expert Groups) providing data.
- The data inventory refers to data for which PICES has the primary responsibility to manage.

Roles and Responsibilities

TCODE is responsible to:

1. Manage the PICES data inventory and promote service through the TCODE data catalog (or other new repository as determined by PICES TCODE and/or working group) within PICES and to the general public.
2. Communicate and disseminate data and metadata to all PICES members as well as to the general public through the TCODE Catalog (or new option, TBD).
3. Assist Expert Groups to identify data that are to be included in the data inventory.
4. Assist Expert Groups in the development of data management options and strategies.
5. Make recommendations to Science Board on PICES data management and priorities, with particular emphasis on correcting or mitigating any known or anticipated deficiencies.

The PICES Secretariat is responsible to:

1. Support TCODE in the maintenance of the data inventory.
2. Support TCODE to correct or mitigate any known or anticipated deficiencies.

Science Board is responsible to:

1. Include data management requirements in the Terms of Reference of each PICES Expert Group.
2. Review the recommendations proposed by TCODE and provide recommendations to Governing Council as necessary.

Expert Groups are responsible to:

1. Identify any data developed during the activities of the Expert Group and inform TCODE and PICES Secretariat.
2. Develop, with assistance from TCODE, strategies or options for managing data used by the Expert Group.

Data Produced by PICES

All data produced by PICES are considered to be publicly available unless explicitly specified otherwise.

Results, conclusions, or recommendations derived from the data associated with PICES do not imply endorsement from PICES.

Contributions of data from PICES Expert Groups will adhere to the Expert Groups' Terms of Reference and be submitted to TCODE for inventory while the group is active.

All data, including metadata, should be archived using standard codes, formats, and protocols.

Data Provided to PICES

The quality assurance of data is the responsibility of the data provider.

In the event that PICES becomes aware that there may be quality issues in the data, PICES will inform the data providers as soon as possible.

Data providers should inform the PICES Secretariat of any policies that may place special conditions on their redistribution.

End users are responsible for the proper use of the data and metadata provided.

PICES may reformat data or metadata but will never change the data provider's original record.

Data use must be acknowledged, preferably using a formal citation.

To support knowledge discovery and innovation both by humans and machines, data should meet FAIR Guiding Principles (Findable, Accessible, Interoperable and Reusable) to the greatest extent practicable.

Citation

Data citations should facilitate giving scholarly credit and normative and legal attribution to all contributors to the data, recognizing that a single style or mechanism of attribution may not be applicable to all data.

Where DOIs (Digital Object Identifiers) exist, they should be included in the citation.

Reference

Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* 2016. The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* **3,** 160018. https://doi.org/10.1038/sdata.2016.18

Appendix 5

Workshop and Meeting Report from Past Annual Meetings

PICES-2022

September 23–October 2, 2022, Busan, Korea

Science Board/TCODE/MONITOR/ FUTURE Workshop (W10)
Openly discoverable, accessible, and reusable data and information in the U.N. Decade

Duration: 1 day

Convenors: *Jeanette Gann (USA), Fangfang Wan, (China), Hernan Garcia (USA), Shelee Hamilton (Canada), Brett Johnson (Canada), Jill Prewitt (USA)*

Invited Speakers
Rob Bochenek (Axiom Data Science, USA)
Chunhya Han (Associate Research Fellow from NMDIS, China)
Yutaka Michida (IODE/University of Tokyo, Japan)
Igor Shevchenko (TINRO, Russia)
Tim van der Stap (Hakai Institute, Canada)
Kate Wing (Intertidal Anagency, USA)

Ocean data in all forms contribute to understanding and informing management and sustainability of the world's oceans and its ecosystems. Open sharing of that data and information across international boundaries remains a formidable challenge. The overarching motto of the U.N. Decade of Ocean Science is 'the science we need for the ocean we want'. To obtain this, we need to share data openly across all regions, continents, and countries. There are many efforts at regional, national, and international levels working towards this goal. As the international community works towards this goal, it is unclear where redundant efforts may be occurring. For example, there are many organizations working towards the same goal of data sharing under the 'transparent and accessible ocean' theme for the U.N. Decade (examples listed at the end of this proposal). PICES is in a unique position to engage scientists and data managers from countries around the north Pacific to help facilitate open data sharing. In addition, some institutions may have data to share that don't have ready access to usable data-sharing platforms. TCODE could facilitate a conversation about open data sharing and promote the connection of new data suppliers with known public data repositories. Inviting a wide range of participants, we will share histories, successes, and challenges of open data. This workshop will guide TCODE to an actionable role in facilitating data

sharing between PICES member nations for the U.N. Ocean Decade. We will discuss potential areas of redundancy and identify entities that could be approached by TCODE for inclusion in broader data-sharing platforms. TCODE will identify suitable points of contact and summarize the national data archival strategies and data sharing policies for each member nation and expand upon this during the workshop. TCODE seeks to develop a set of recommendations for further discussion and action.

The specific objectives of the workshop are to:

1. Assess the potential for a new study group to recommend improvement strategies on data sharing between member nations, including creating a framework for data sharing for the future and open data sharing among PICES countries
2. Develop a recommended list of available data as well as repositories for open access to data.
3. Develop recommendations for updated TCODE data policy to include more specific information on data sharing.
4. Investigate barriers to open data sharing and exchange.

2023 Report of Study Group on
Encouraging Data Awareness and Increased Transmission and Accessibility

The Study Group on *Encouraging Data Awareness and increased Transmission and Accessibility* (SG-DATA) meeting on September 12/13 was held virtually since many members were not able to attend the annual meeting this year. This was the 6th meeting of SG-DATA for 2023, although members of SG-DATA were only confirmed following our final meeting, so we have included both official and unofficial members below (*SG-DATA Endnote 1*).

AGENDA ITEM 1
Welcome and overview

The final meeting commenced with a warm welcome to participants and a brief overview, followed by initial updates by the SG Chair, Dr. Erin Satterthwaite (*SG-DATA Endnotes 2* and *3*).

AGENDA ITEM 2
PICES Data Strategy

The group thoroughly reviewed the current draft Executive Summary in the PICES Data Strategy document, laying the foundation for subsequent discussions.

AGENDA ITEM 3
Proposal for a working group

The interest of current members in continuing to work on the data strategy was assessed, and a deadline of September 22 was set for the submission of the WG proposal. Dr. Satterthwaite led the drafting and subsequent sharing of the proposal with the SG (*SG-DATA Endnote 4*)..

AGENDA ITEM 4
Presentation opportunities

Discussions centered on identifying programs that could benefit from the SG's presentation, with Jeanette Gann assigned to compile a slide from the group's output. Additionally, considerations were made for presenting at meetings of relevant groups such as the FUTURE SSC and AP-ECOP.

AGENDA ITEM 5
Review of EG achievements and requests/proposals

Fifteen minutes were focused on PICES business, evaluating the achievements of various groups against their Terms of Reference, and addressing requests/proposals to parent committees and Science Board.

AGENDA ITEM 6
PICES Data Excellence Award

The SG discussed establishing a PICES Data Excellence Award in honor of Dr. Igor Shevchenko, past Chair and member of SG-DATA's parent Committee, TCODE, who passed away July 15, 2023. The SG spent 10 minutes refining and finalizing the draft proposal for the PICES Open Data Excellence Award. Dr. Satterthwaite requested any final edits to the draft proposal by September 22.

AGENDA ITEM 7
Igor Shevchenko memories for Year in Review

A brief portion of the meeting was dedicated to collecting memories, quotes, and contributions for Dr. Shevchenko. These were curated and included in the Year in Review section, presented by the Science Board Chair, Dr. Sukyung Kang, at the Opening Ceremony.

AGENDA ITEM 8
Next steps

The meeting concluded with a discussion on next steps, particularly proposing an official working group for Science Board review, and defining new terms of reference for the proposed group. Discussions covered requests and proposals to parent committees and Science Board, addressing matters such as travel support fund, changes in members/chairs/TORs, extension of WG terms, planning of capacity development events, and new expert goup ideas. Action items were specified, including finalizing and editing proposals and documents by September 21, along with communication tasks assigned to Ms Gann.

SG-DATA Endnote 1
SG-DATA participation list

Members   Members unable to attend

Erin Vera Satterthwaite (USA, Chair)   China: Chunhua Han, Fangfang Wan
Shelee Hamilton (Canada)   Japan: Daisuke Ambe, Daiki Ito
Brett Johnson (Canada)   Korea: Cholyoung Lee
Tim Van Der Stap (Canada)   USA: Jill Prewitt

                                                     Observers

                                                     Jeanette Gann (USA, TCODE Chair)
                                                     Hernan Garcia (USA)

SG-DATA Endnote 2

SG-DATA meeting agenda

1. Welcome & overview of the meeting & initial updates
2. PICES Data Strategy
3. PICES Business
4. PICES Data excellence award - in honor of Igor
5. Igor memories to be included in section of the Year in Review, given by the SB Chair at the opening ceremony
6. Next steps & next meeting
7. Action items

SG-DATA Endnote 3

Proposal for a Workshop on
"*Co-creating a shared framework for ocean data management*"
at PICES-2024

Conveners: Erin Satterthwaite (USA), Naomi Boon (Canada), Jeanette Gann (USA)

Duration: 1 day

In an era of burgeoning ocean data, this workshop will bring together ocean professionals interested in and working with ocean data across a range of experience levels (e.g., early career professionals, data managers, researchers) to establish a unified framework and shared language for effective ocean data management. With data's pivotal role across marine disciplines, cultivating a harmonized approach becomes imperative. Through interactive discussions, the workshop will collaboratively construct a common vocabulary of key ocean data concepts, and establish a comprehensive data framework – from collection to utilization. Additionally, the workshop will explore next steps, such as effective strategies to share the resulting terminology and framework and the potential development of a training. In doing so, the workshop aims to lay a foundation for improved data management practices within and across PICES, UN Ocean Decade actions, and the broader marine science community. By creating a common understanding of key data science terminology and data frameworks, the workshop seeks to enhance science collaboration, streamline processes, and elevate data utilization.

SG-DATA Endnote 4

Terms of Reference for a Proposal for a Working Group on *Data Management*

Acronym: WG-DATA

Parent Committee: TCODE

Rationale and Goals

The PICES Data Management Working Group (WG-DATA) is established to address the need for an enhanced data, metadata, and information management and data sharing plan within the North Pacific

Marine Science Organization (PICES). The WG-DATA will build upon the recommendations of the Study Group on Encouraging Data Awareness and Increased Transmission and Accessibility (SG-DATA) and provide a comprehensive strategy for modernizing and streamlining data and information management and sharing practices within PICES. By aligning with international standards and promoting a culture of data sharing, PICES aims to enhance the accessibility, reach, and utility of its scientific data, fostering collaboration and advancing marine science in the North Pacific region.

Terms of Reference

1. **Revise and update the PICES Data Policy.** Revise and update the PICES Data Policy to align with international standards (UNESCO IOC and UN Decade of Ocean Science), incorporate FAIR and CARE principles, promote data sharing culture, and recommend data repositories and open data licensing options.

2. **Promote a culture of data sharing within PICES.** Promote a culture of data sharing within PICES such as by identifying and addressing data sharing barriers through an annual survey to PICES members and other related organizations, offering education and training resources, developing a data management road map, creating an inventory of data assets, identifying novel ways to incentivize data sharing, and encouraging 'data publications' adhering to open data licensing and DOI citation standards.

3. **Recommend data management platforms, standards, and technologies.** Identify, recommend and support data management platforms, standards, and technologies aligned with open data principles and internationally supported ocean data standards. Modernize PICES data management by developing accessible data management templates, facilitating report publication to repositories, evaluating the TCODE Catalog, promoting DOIs and data licensing, identifying collaborative word-processing tools, and establishing a PICES Data Stewardship Officer (DSO) for coordinated data management.

4. **Develop a data, metadata, and information (reports/pubs) flow diagram** from expert groups, PICES members, summer schools, and other associated initiatives across the PICES network to a final repository (*e.g.*, recommended databases, searchable catalogs, and metadata catalogs).

Appendix 6

PICES Press Article

PICES-2022 W10: A TCODE Workshop on "Openly Discoverable, Accessible, and Reusable Data and Information in the U.N. Decade"
*by Jeanette Gann, Jill Prewitt, Shelee Hamilton, Brett Johnson, Wan FangFang, Hernan Garcia*

Digital ecosystem

- incorporate both already existing and newly constructed digital management platforms and tools
- contribute to understanding the ocean using historical, contemporary and modelled data to describe the past and current conditions and predict future ocean conditions
- data sources also include industry or citizen-science data, as well as indigenous and local knowledge
- a working group ensures the quality and fitness for purpose (not always scientific) of data and information assets (it needs to consider metadata catalogs as core elements of data management)

Dr. Igor Shevchenko (PICES and TINRO Center) talked about *"Lessons learned from TCODE metadata federation activities"*. He discussed the many barriers to data sharing on an individual level, between various organizations and across international boundaries. His discussion points provided ideas on how PICES could benefit from better resources and focus on taking care of data and metadata, how PICES will need to add metadata into our data policy, and that UNDOS presents a good opportunity to increase data sharing and management in general.
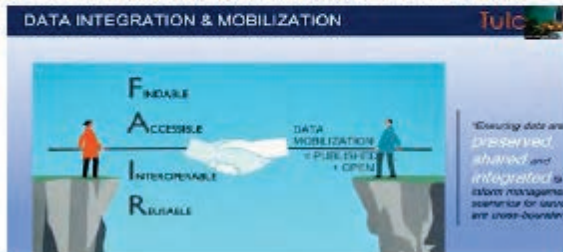
Mr. Tim Van der Stap and **Mr Brett Johnson**, both ECOPs from Hakai Institute in Canada, presented *"Mobilizing international salmon data from open ocean to open access"*. Points made during this talk include how scientists often have limited funding and that using resources to manage and mobilize data for purposes of sharing tend to go to the bottom of the project list. The *Basin Scale Events to Coastal Impacts project* (BECI) was introduced, which plans to mobilize data to increase its value, and utilize a data science team helpful for mobilization, coordination, data exchange, and standardization.

Dr. Yutaka Michida, an ex-officio member of TCODE and a former Co-Chair of IODE, presented a talk on *"Oceanographic data and information sharing towards goals and outcomes of the UN Decade of Ocean Science"*. His presentation highlighted past data sharing conferences, and encouraged PICES to participate in upcoming meetings: 2nd International Ocean Data conference, 20-21 March 2023, and the IODE XXVII ocean data meeting, 22-24 March 2023 in Paris, France.

Summary of workshop findings:

Barriers to data sharing:
- 3 categories: 1) social/cultural 2) technical 3) legal constraints organizations
- Language barriers add to data sharing blockages
- Scientists not generally awarded for sharing their data (opposite)
- Lack of Financial/Specialist/Admin support for proper management of data/metadata!

Incentives to data sharing:
- Possibly create PICES (or other) award on data management/sharing/interoperability
- Incentives for some are different than for others (industry vs gov vs academic, etc.)
- Have data management strategy ready at beginning of projects instead of an 'afterthought'

Other findings:
- PICES Data flow diagram has gaps (needs focused discussion)
- Culture of dealing with data is lacking. UN Decade >> fuel new culture, better management, sharing, mobilization.
- ECOPs could be very helpful in changing this culture!
- Study group would be very helpful to further improvements of data culture in PICES

As a direct result of this workshop, a new study group was formed on *encouraging Data Awareness and increased Transmission and Accessibility (SG-DATA)*,(see TOR below). Anyone interested in joining is encouraged to contact the Chair, Dr. Hernan Garcia (Hernan.Garciea@noaa.gov).

SG-DATA Terms of Reference:
- To assess existing best practices, and complete a PICES data flow diagram
- To gather lessons learned from past, ongoing and planned projects, programs and initiatives;
- To identify solutions for known problems and bottlenecks regarding sharing of data within PICES and beyond;
- To facilitate harvesting of PICES metadata catalog records by UN Decade data platforms (like ODIS);
- To draft a checklist of questions to promote data sharing and the reproducibility of results for paper/report submissions;
- To consider what kind of infrastructure would be sufficient to enable those with "small" and "besides" science data who wished to contribute to a digital commons environment;
- To consider how to make FUTURE, IPOD organic parts of the future UNDOS digital ecosystem;
- To increase collaboration between TCODE and other PICES programs like Smartnet, in addition to external collaborations (ICES DIG).
- To identify a digital platform that is accessible by all PICES member nations/constituents for use in simultaneous document editing and updates that can be used by all committees and expert groups for more efficient and effective communications and work.
- Review the current PICES data management policy and forward any changes/edits to TCODE, SB, and GC for approval.

PICES-2022 W10: A TCODE Workshop on "Openly Discoverable, Accessible, and Reusable Data and Information in the U.N. Decade"

*Jeanette Gann, Jill Prewitt, Shelee Hamilton, Brett Johnson, Wan FangFang, Hernan Garcia*

Ocean data in all forms contribute to understanding and informing management and sustainability of the world's oceans and its ecosystems. Open sharing of that data and information across international boundaries remains a formidable challenge. The overarching motto of the United Nations Decade of Ocean Science for Sustainable Development (UNDOS) is *'the science we need for the ocean we want'*. To obtain this, we need to share data openly across all regions, continents, and countries. There are many efforts at regional, national, and international levels working towards this goal. Keeping apprised of UNDOS data activities is paramount for PICES data and information management. Encouraging the facilitation of data mobilization and sharing across international boundaries and private institutions will help to bring UNDOS data goals to fruition.

PICES is in a unique position to engage scientists and data managers from countries around the North Pacific to help facilitate discussions about open data sharing. Inviting a wide range of participants, we discussed histories, successes, and challenges of open data. This workshop helped to guide TCODE to an actionable role in facilitating data sharing between PICES member nations for the UNDOS . Additionally, it helped to form a new study group devoted to investigating data and information management within PICES that will identify gaps, mishandling, or roadblocks for data flow, among other issues.

Workshop goals included the following:
- Assess barriers to open data sharing and/or exchange (i.e. FAIR-compliant)
- Draw a PICES data flow diagram
- Identify incentives to open data sharing
- Identify appropriate UNDOS-endorsed data platforms for PICES data and reports
- Assess the need for a study group to further increase PICES data management and sharing
- Update PICES data policy for submission to science board and general council
- Strategize ways in which TCODE can integrate with FUTURE and Smartnet, and include ECOPs into TCODE membership

Participation in the workshop included a hybrid format with invited speakers for our morning session (listed below), and an afternoon of discussion on a number of topics related to our goals for the workshop (above). Additionally, guest speakers (Drs Raphael Roman, and Steven Bograd) addressed the workshop regarding related PICES programs and ECOP initiatives where potential TCODE overlap/ membership could occur.
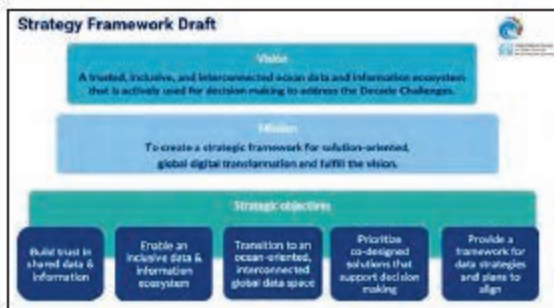
Ms. Kate Wing, founder of the Intertidal Agency, and Co-Chair of the IOC Ocean Decade Data Coordination Group (DGC), gave a presentation entitled *"Data coordination across government, private industry, and non-profit entities: increasing access through the U.N. decade."* Ms. Wing's presentation touched on a variety of topics regarding large scale data coordination efforts and included the introduction of the Ocean Data and Information System (ODIS) catalog that could improve communication of PICES data, information, and projects to a wider international audience.

Ms. Han Chunhua from the National Marine Data and Information Service (NMDIS), presented a talk on *"China's practice on marine big data management and sharing."* Her talk centered on China's largest ocean data and information system and included information on understanding, management, sharing, and prospects of big data. Additionally, she discussed specifics of how data is collected, quality assured and quality-controlled (QA/QCd), and ultimately managed from the outset of each project. And finally, the NMDS marine observation data sharing and service platform plan to expand to greater international data sharing.