

SCIENTIFIC PROGRESS REPORT FOR YEAR 2 (APRIL 1, 2021 – MARCH 31, 2022)

1. BACKGROUND

PICES member countries have significant resources for monitoring environmental conditions and fisheries in coastal waters. At the same time developing nations are far more limited in their capacity for collecting data needed to advance their management practices in these waters. Citizen-based monitoring is an approach designed to improve the efficiency and effectiveness of monitoring efforts when technical and financial resources are not sufficient. There are many successful examples of citizen-based monitoring in developed countries. However, this approach has not been widely applied yet to the collection of environmental and fisheries data in developing nations.

The overall goal of the PICES/MAFF project, entitled “*Building Local Warning Networks for the Detection and Human Dimension of Ciguatera Fish Poisoning in Indonesian Communities*” (acronym [Ciguatera](#)), is to build the capacity of local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries. Creating community empowerment will benefit human health in Pacific Rim developing countries. As well, the project will create transferable knowledge for other coastal communities with similar climate or environmental stresses. This 3-year (April 1, 2020 – March 31, 2023) project is funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan (JFA), from the Official Development Assistance (ODA) Fund.

The project’s focus is to detect and monitor *Ciguatera Fish Poisoning* (CFP) in tropical reef fisheries, which globally has the most significant human health and economic impacts of any algal-based poisoning syndromes. CFP stems from the human consumption of fish containing toxins produced by benthic microalgae of the dinoflagellate genera *Gambierdiscus* and *Fukuyoa*, which are the initial sources of ciguatoxin. Ciguatoxin affects sodium transport channels in an organism by lowering the voltage-gated opening in their cells, thereby altering the nervous system in ways that negatively affect numerous aspects of fish and animal physiology. Ciguatoxin is lipophilic, meaning that it accumulates in fatty tissues and becomes concentrated up the food web. When present at sufficiently high concentrations in raw or cooked fish, ciguatoxin consumption leads to the onset of major CFP symptoms – vomiting, diarrhea, numbness of extremities, mouth and lips, reversal of the sensations of hot and cold, muscle and joint aches – within 1 to 3 hours of ingestion and may last for days, weeks or even months.

The impact of CFP on the human dimension extends far beyond the proximate health and economic outcomes. Chronically impacted communities tend to become fearful of local and other fish sources and transition from these traditional ways of life to one where all protein is imported from foreign sources.

Although CFP is recognized to occur in pristine environments, its emergence in new regions, and intensification in others, often is associated with anthropogenic pressures. There also is evidence that climate drivers may be expanding the geographic distribution of CFP. The primary concerns for local communities are first to identify reef regions where the causative organism is abundant and second, to manage their anthropogenic stressors to minimize increases in its presence.

The 2017–2020 PICES/MAFF project on “*Building Capacity for Coastal Monitoring by Local Small-scale Fishers*” (acronym [FishGIS](#)) has led to the development and implementation of smartphone-based tools for fisheries and environmental observations, such as water quality, phytoplankton, fish catch, floating garbage (plastics) and Illegal Unregulated and Unreported (IUU) fishing, by local small-scale fishers and community members in Indonesia. The new project aims to adapt and further refine these smartphone-based capabilities for measurement and automated reporting, with the addition of benthic toxic algae measurements, to empower

Indonesian coastal communities to minimize their CFP exposure in community-scale fisheries. Pandemic-related issues have strongly influenced the initial project strategy to utilize the “*Assess. Detect. Avoid!*” convention to protect communities against this emerging health concern:

- To *Assess* the state of the local coral reefs, a common ecosystem for ciguatoxic fish, community members are to monitor some aspects of water quality (turbidity and water color) of the reef, and document the outbreaks of eel-grass or the expansion of the dead coral (all factors associated with increased CFP presence) using the smartphone-based tools and approach developed during the FishGIS project.
- To *Detect* the presence of the toxin-containing dinoflagellates in the reef environment, two approaches are to be used: one that is developed within the project and is based on specialized smartphone-driven microscopes (Foldscopes) and community-appropriate protocols, and the other that employs a detection kit recently created by an international CFP working group (International Atomic Energy Agency ([IAEA](#)); see also FAO and WHO (2020)) to determine the presence of *Gambierdiscus* and *Fukuyoa* in the water column and measure their abundance. These two technologies will meld well to help develop predictive indices for reef regions susceptible to CFP.
- To *Avoid* the transfer of contaminated fish from the damaged environment to the tables of families, community members are to be trained to reduce risk – avoid eating fish from regions where *Gambierdiscus* and *Fukuyoa* numbers are high. This simple message requires an investment in socio-ecological scientists – a specialty of the MAFF mandate.

Consistent with the directives of the United Nations Decade of Ocean Sciences for Sustainable Development ([UNDOS](#)), the project focuses on three major initiatives:

1. Coastal ecosystem monitoring activities by local small-scale fishers and other community members to detect ecosystem changes (*e.g.*, changes in water quality and the presence and changes in the spatial distribution of dead coral and eel-grass benthic environments);
2. Detection of CFP toxin-containing dinoflagellates in the reef environment using smartphone-based observation tools developed during the FishGIS project, and new international standardized sampling protocols for toxic benthic algae;
3. Training of local fishers and community members to employ these tools for generating citizen-science data streams to be used in local decision-making on coastal fisheries regions to avoid a health risk associated with fishing until the presence of CFP toxin-containing dinoflagellates is minimized.

These three initiatives are to be supported by a series of capacity building workshops led by scientists from PICES member countries. The purpose of the workshops is to work with local communities to increase the sustainability of their fishing resources by providing them with CFP information. The combination of training and citizen-science contributions in the project is expected to: (1) generate the needed capacity for monitoring CFP hotspots in Indonesian waters, (2) provide valuable datasets for the study of *Gambierdiscus* and *Fukuyoa* and the factors controlling their abundance in reef systems, and (3) increase human wellness by identifying fishing regions where the health of community members is at risk.

In addition to the primary initiatives, early steps will be taken to explore two secondary initiatives: modifying the FishGIS application to incorporate (1) artificial intelligence-based assessment of fish stocks from the collective catch data reported by the local fishers, and (2) a tsunami early warning notification for remote fishing communities, with the goal of laying the foundation for future full development of these capabilities.

Indonesia was chosen as a developing Pacific Rim country to implement the project. The importance of having more effective fisheries management practices is widely recognized in Indonesia, and this has led to support by the federal government and the willingness of stakeholders to consider new approaches such as the development and implementation of a citizen/fisher-based observation system linked with fisheries scientists and managers. The basis for the project is the strong collaboration PICES scientists have developed with the Indonesian government agencies and research institutions during previous PICES/MAFF projects – “*Development of the prevention systems for harmful organisms’ expansion in the Pacific Rim*” (2007–2012), “*Marine ecosystem health and human well-being*” (2012–2017; [MarWeB](#)), and “*Building capacity for coastal monitoring by local small-scale fishers* (2017–2020; [FishGIS](#)).

The longer-term intent of this work is to transfer the knowledge gained and technology developed to other developing regions. In conjunction with the UNDOS, there is substantial interest within PICES in sharing knowledge with other southern hemisphere locations, particularly in under-represented nations.

2. PROJECT ORGANIZATION AND MANAGEMENT

PICES Governing Council approved the request to undertake the project in February 2020. The project principles agreed to by MAFF/JFA and PICES are listed in Appendix 1. In accordance with these principles:

- The project has strong connections and interactions with, and supports the relevant activities of, the PICES Scientific Committees on Human Dimensions – HD, Marine Environmental Quality – MEQ (through the Section on *Ecology of Harmful Algal Blooms in the North Pacific* – S-HAB) and Fishery Science – FIS, PICES Technical Committees on Data Exchange – TCODE and on Monitoring – MONITOR, and the PICES FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) Science Program (specifically, Research Theme 3 on “How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?”) (Fig. 1). The HD Committee is the parent committee for the project.

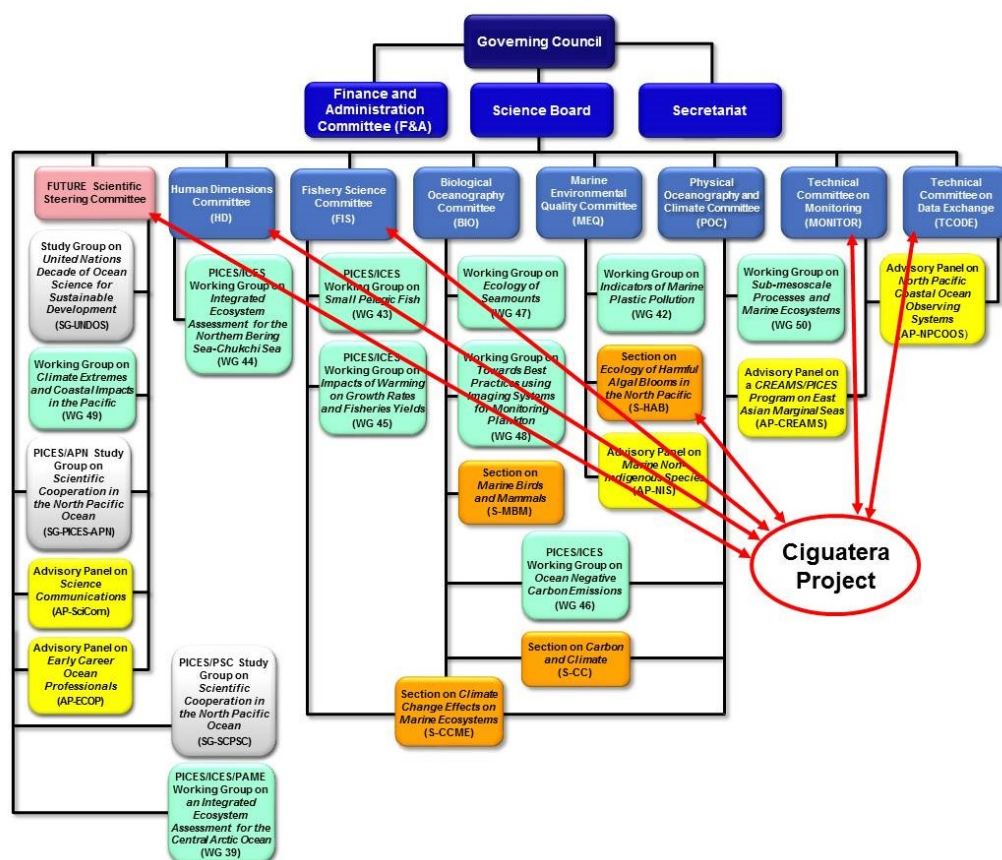


Fig. 1 PICES (North Pacific Marine Science Organization) structure for 2021–2022 showing links between the Ciguatera project and PICES expert groups and committees.

- The project is being directed by a Project Science Team (PST), co-chaired by Dr. Mitsutaku Makino (Atmosphere and Ocean Research Institute, The University of Tokyo, Japan; mmakino@aori.u-tokyo.ac.jp) and Dr. Mark Wells (University of Maine, USA, mlwells@marine.edu). The PST Co-Chairs are responsible for the detailed planning and execution of the project, and annual reporting on scientific progress to MAFF/JFA and to PICES Science Board through the HD Committee.

- Dr. Alexander Bychkov (bychkov@pices.int) was appointed by the PICES Executive Secretary to serve as the Project Coordinator and is responsible for the management of the fund and annual reporting on its disposition to MAFF/JFA and to PICES Finance and Administration Committee.
- Annual progress and financial reports to MAFF/JFA must be submitted within 90 days after the close of each project year ending March 31. The reports for Year 1 (ended March 31, 2021) were submitted to JFA in mid-June and officially accepted on June 27, 2021, and then posted on [the project website](#). Within PICES, Science Board takes the responsibility for informing Governing Council on the progress and achievements of the project, and the Finance and Administration Committee takes the responsibility for reporting to Governing Council on the financial and management aspects of the project.

This progress report summarizes the activities carried out for Year 2 (ended March 31, 2022) and includes a workplan for Year 3 (April 1, 2022 to March 31, 2023), which is the final year of the project.

3. ACTIVITIES AND PROGRESS DURING PROJECT YEAR 2

3.1 Project Science Team meetings

The Project Science Team (PST) was established by Science Board based on principles and procedures detailed in [the PICES Policy for approval and management of special projects](#) (Decision 2017/A/7). All PICES member countries and all groups mentioned in Project Principle 3 (see also Section 2 above) are represented on the PST. The majority of the PST members were involved in the [FishGIS](#) project. As the leading Indonesian collaborators are also those who participated in the previous PICES/MAFF projects, retaining a core group of FishGIS PST members is important to facilitate efficient implementation of the project. PST membership is shown in Table 1 and contact information for PST members is provided in Appendix 2.

Table 1 Membership of the Project Science Team

Name	Affiliation	Country/Group
Daisuke Ambe	Japan Fisheries Research and Education Agency	Japan/TCODE
Seung Ho Baek	South Sea Research Institute, KIOST	Korea/S-HAB
Vladimir Kulik	Pacific Branch of VNIRO (“TINRO”)	Russia/MONITOR
Mitsutaku Makino*	Atmosphere and Ocean Research Institute, The University of Tokyo	Japan/HD
Shion Takemura	Japan Fisheries Research and Education Agency	Japan/HD
Naoki Tojo	Hokkaido University	Japan/FIS
Vera Trainer	Northwest Fisheries Science Center, NOAA	USA/SB
Charles Trick	University of Toronto	Canada/S-HAB
Pengbin Wang	Second Institute of Oceanography, Ministry of Natural Resources	China/S-HAB
Mark Wells*	University of Maine	USA/S-HAB

* Project Co-Chairs

Due to the COVID-19 pandemic, all PST meetings in Year 2 were held virtually, similar to [the first PST meeting](#) on March 9, 2021:

- The main objectives for [the second PST meeting](#) on July 13, 2021 (Japanese Standard Time – JST) were to: (1) review the updates in the FishGIS smartphone application, (2) discuss the draft Project Design Matrix (PDM) and further steps in the development of this framework, and (3) reassess and modify the project implementation planning.
- The main objectives for [the third PST meeting](#) on August 31, 2021 (JST) were to: (1) review existing data on benthic HABs (bHAB) in Indonesia, (2) evaluate the developed PDM (ver. 1) and Plan of Operation (PO; ver. 1), and (3) discuss research ethics issues (Fig. 2).

- The main objective for [the fourth PST meeting](#) on September 16, 2021 (JST) was to discuss the PDM and PO development with emphasis on the inputs from the PST members and from our Indonesian colleagues, and on the anticipated outcomes.

In addition, there were several virtual meetings involving the PST Co-Chairs, PST member Dr. Shion Takemura, and the Project Coordinator Dr. Alexander Bychkov, and our leading Indonesian colleagues (Drs. Suhendar I Sachoemar and Arief Rachman) to: (1) explore revisions to the implementation plan for the PICES/MAFF project under the Indonesian pandemic restrictions of national and international travel, (2) review the overall design and field program for the Ciguatera Indonesia project, and (3) discuss and develop a justification and framework for initiating a new formal collaboration between PICES and the Indonesian Institute Technology.

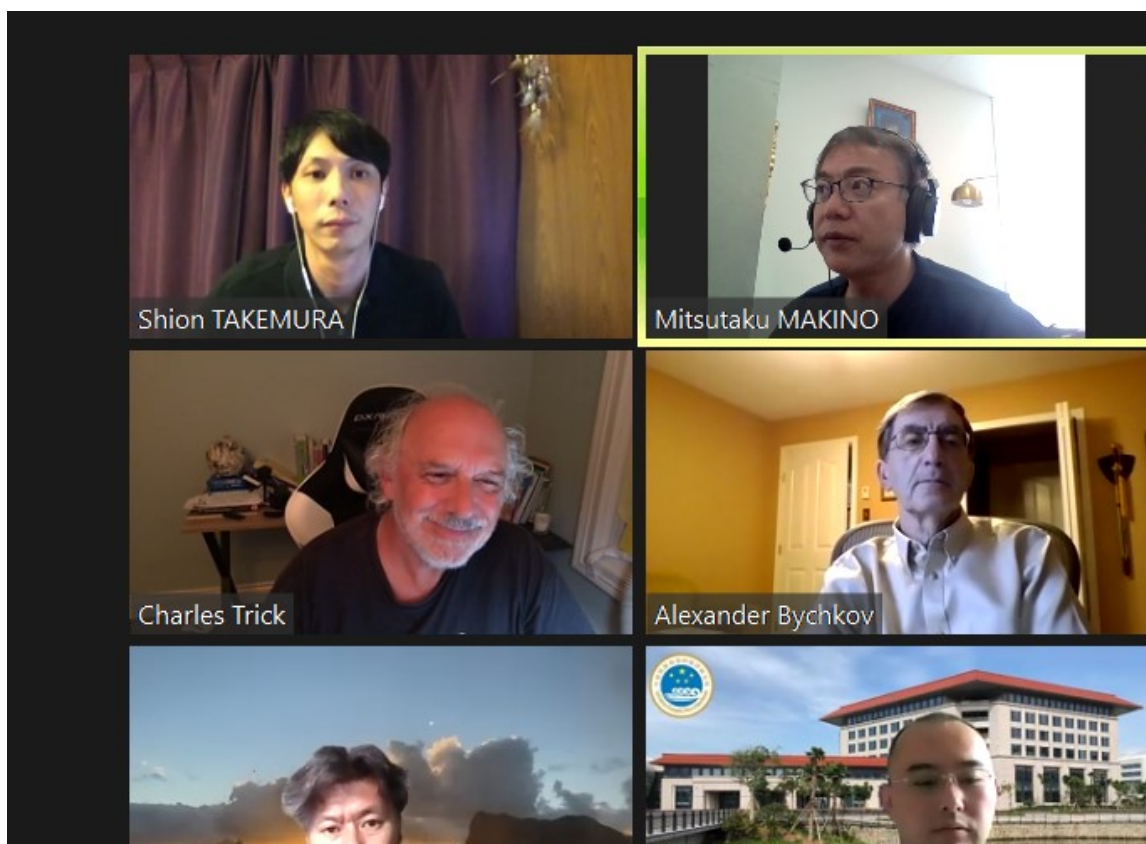


Fig. 2 Ciguatera project meeting participants at their third virtual meeting on August 31, 2021 (JST). Seung Ho Baek and Vladimir Kulik missing from photo.

3.2 Partners in Indonesia

One of the first, and strongest, lessons learned from the previous PICES/MAFF projects is the importance of connecting with organizations in a developing country which can facilitate and advance the project. Such organizations and the key people are needed to understand the project and to translate it into the local context. The Indonesian Agency for the Assessment and Application of Technology (BPPT) and the Indonesian Institute of Sciences (LIPI) have been our major partners in Indonesia for more than a decade. On March 19, 2018, during a visit by PST members to Indonesia, a Letter of Intent (LOI) between BPPT and PICES was signed as a basis for collaboration on the [FishGIS](#) project.

Recently, BPPT and LIPI have been incorporated into the National Research and Innovation Agency of Indonesia ([BRIN](#)), which better enables the collective collaboration in the [Ciguatera](#) project. In addition,

PICES has established a Memorandum of Understanding (MOU) with the Indonesian Institute of Technology (ITI) with the goal of integrating both faculty expertise and student involvement into the project to enhance its longer-term sustainability. A virtual meeting held on March 11, 2022 (JST) served as the first opportunity to meet faculty members of ITI and to learn about their various research and teaching programs. Their focus on the application of technology across environmental science and industry is well suited as a framework for supporting current and future PICES/MAFF projects in Indonesia. This initial meeting set the stage for the MOU, and a virtual MOU Signing Ceremony took place on March 23, 2022 (JST) (Fig. 3). The MOU was signed by Mr. Marzan A Iskandar (ITI Chancellor) and Dr. Sonia Batten (PICES Executive Secretary).

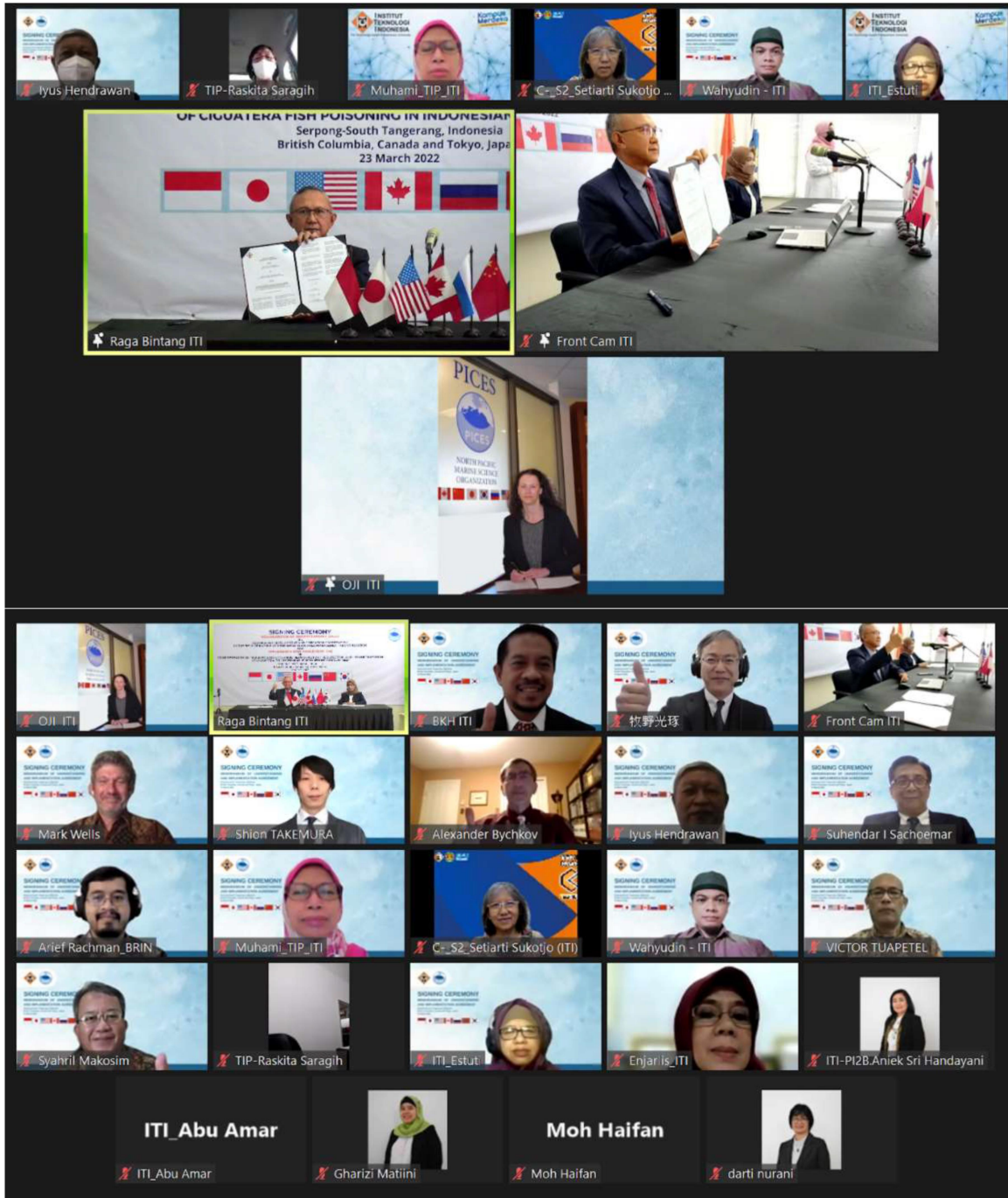


Fig. 3 Participants of the virtual Signing Ceremony for the MOU between ITI and PICES held on March 23, 2022.

3.3 Case study site selection and field sampling program

During [the implementation of the FishGIS project](#), special relationships had already developed with local communities at several case study sites – Muara Gembong, Indramayu District, Serang and Pelabuhan Ratu. Although the intention has been to continue our collaboration in these communities within the current project, pandemic restrictions have prevented this from happening. We continue to hope that we will be able to re-connect in the near future.

Based on recommendations from our Indonesian colleagues, three possible case study sites were identified – Lombok and Gili islands (West Nusa Tenggara Province), Bali, and Lembah Strait (Bitung). For reasons of logistics, the focus will be on Lombok and Gili islands, which has developed as a proximal site of interest for BRIN. The two main criteria for selecting this site were the existence of a well-established local fishing community and an active BRIN research station, facilitating project implementation. This site also benefits from close contacts between BRIN and the Provincial government as well as the existence of a program by the Ministry of Marine Affairs and Fisheries in the development of the Gili Matra Marine Tourism Park, an important conservation and tourism area for the local people and marine biota in West Lombok (conservation area of ~2.273,56 ha) that can support the implementation and sustainability of the Ciguatera project.

The pandemic-related delays to the planned on-site training workshops led to a decision to facilitate project data collection by augmenting and expanding the BRIN-planned surveys of waters surrounding the Gili islands region (Gili Trawangan, Gili Meno, and Gili Air). The initial survey design by our Indonesian colleagues was shared with the PST, and modifications were jointly decided. Year 2 Ciguatera project funds were re-directed to support this expanded survey to include a total of five field sampling trips to be conducted from May 2022 through February 2023 (see Section 4.2 for details). Although these field samplings do not have as broad a community involvement as originally intended, they provide a unique opportunity to broaden the scope of parameters measured and thereby better enable the linkages of the FishGIS and Hydrocolor observation tools to general environmental conditions.

3.4 FishGIS smartphone application

Work continued during Year 2 to add improvements to the smartphone FishGIS application. Steps were taken to make the user interface more intuitive and user friendly. The application was also updated to be supported by iOS10 or later and Android 5.1 or later. The new version of the application (ver. 1.0) will be released on Apple Store and Google Play early in Year 3. Further development of the application to include CFP-related data reporting is expected to progress after the start of the field program in May 2022.

The data storage, originally based on a server in Japan, was migrated over to a server in Indonesia (provided by Google). The Indonesian government allows access to these data.

3.5 Project Design Matrix and Plan for Operation

A common organizational approach for complex projects is to define a Project Design Matrix (PDM) to comprehensively describe the project. The PDM provides the logical structure of the project (the links between objectives and activities under given assumptions) as well as the major quantitative data that will be obtained. This framework assists in the planning process, facilitates communication of the “why” and “how” of the project, and forms a basis for common understanding of the project progression. It is structured to list the *Project Goals* (to codify the overriding objectives), the *Project Purpose* (the intended impacts and anticipated benefits), the *Results/Outputs* (the objectives the project management must achieve and sustain), and the *Activities* (steps taken to achieve the desired results/outputs).

The idea of creating a formal PDM for the Ciguatera project was expressed at the first PST meeting late in Year 1. There were five steps taken in Year 2 to developing the PDM and Plan for Operation (PO): (1) gathering thoughts about CFP issues (from PST members and Indonesian colleagues), (2) grouping and structuring these

CFP issues, (3) obtaining an *Objective and Problem Tree*, (4) identifying goals, purpose, output and activities (PDM), and (5) detailing research activities (PO). The core information and perspectives of the project were reviewed, discussed and revised during the Year 2 PST meetings, and the latest PDM and PO are posted under “Products” on [the project website](#). This PDM provides a framework of metrics for (1) refining the project structure based on wider opinions and problem recognition by the PST, Indonesian officials and researchers, and community members (people in the Lombok and Gili islands region), (2) better focusing project efforts and communication of key aspects of the project to community members, and thereby (3) helping to instill a sense of ownership of this project by the participants. Further refinement of the PDM and PO should take into consideration the pandemic-related impediments to implementation of all aspects of the project.

4. WORKPLAN FOR YEAR 3

4.1 Project Science Team meetings

The fifth PST meeting (the first PST meeting in Year 3) will be held virtually in late April 2022, with invitations to our Indonesian colleagues, in order to: (1) review the current state of the FishGIS application and suggested improvements, and discuss the Terms of Use and Privacy Policy of the application, (2) reassess and modify, if needed, plans for the enhanced field sampling program in the Gili Island region (see Section 4.2), (3) evaluate the sampling and data acquisition strategies using FishGIS and HydroColor applications during this field program, and (4) discuss the next steps in the development of the PDM and the PO. Based on the knowledge and experience gained in the previous MAFF projects, and the input to date from our Indonesian colleagues, we are confident that the current project implementation plan is reasonable, but this meeting will help us to better focus the effort on specific outcomes.

The sixth PST meeting (also virtual) will occur soon after completion of the first field survey scheduled for late May 2022 to: (1) review the outcomes and assess whether alternate strategies are needed for the follow-up surveys, and (2) discuss plans for introducing [Planktoscope](#) (see Section 4.3 for details) into the field surveys in summer and early fall. This timing will provide the opportunity for training local BRIN staff on the operation of Planktoscope thereby enabling continued data collection after the broader scale field sampling efforts. Additional virtual PST meetings, if needed, might be arranged after each field survey to evaluate the outcomes of the completed survey and to reexamine the plan for the next one.

The seventh PST meeting is currently planned to be in-person and to take place on September 22, a day before the start of the 2022 PICES Annual Meeting in Busan, Korea. The main objectives for the meeting will be to: (1) review overall progress on the field sampling program in the Gili Island region to date and examine the results of the pilot Planktoscope operation, (2) evaluate the latest version of the FishGIS application (ver. 2.0), (3) initiate planning for a community training workshop to be held in early 2023, (4) discuss the latest PDM and further steps in the development of this framework, and (5) generate a list of tasks for the preparation of a final scientific report and other project outcomes.

The final in-person PST meeting is tentatively expected to be convened in Indonesia in early 2023 as part of a community training workshop, with the assumption that travel restrictions will be lifted to a reasonable extent by that time. The main objectives of the meeting will be to: (1) review the outcomes of the field sampling program in the Gili Island region and examine data collections, (2) evaluate the results of the training workshops, (3) review the timelines and finalize tasks for the preparation of a final scientific report and other project products, and (4) discuss directions for modifying and refining smartphone-based observation tools (applications and protocols) developed within the FishGIS and Ciguatera projects for use in a new MAFF/PICES project.

4.2 Field sampling program

The goals of the BRIN-supported Ciguatera Indonesia project are comparable to those of the PICES/MAFF Ciguatera project: (1) to conduct research on the benthic dinoflagellate communities which could potentially

cause CFP and their relationship with habitat condition, (2) to study the level of anthropogenic pressures and potential economic loss that might be caused by HABs and/or CFP, and (3) to disseminate information and increase local public awareness on the potential danger of HABs and CFP.

Combining funding from the PICES/MAFF project (a portion of Year 2 project funds were re-directed for this activity) and from BRIN will allow to carry out the enhanced field program in the Gili Island region, with a total of five 6-day long sampling surveys: in May (Transition I), July (Dry Season), September (Transition II) and November (Rainy Season) 2022 and in February (end of Rainy Season) 2023. These surveys will be conducted within selected zones around the Gili Trawangan, Gili Meno, and Gili Air. Data collections will actively use the smartphone-based FishGIS and Hydrocolor observation tools, and include:

- Water column sampling for temperature, salinity, dissolved oxygen, pH, turbidity, nutrients, chlorophyll-a, plankton and e-DNA;
- Benthic microalgal sampling in the water column and at seagrass-bed and coral reef sites (on both natural and deployed artificial substrates); molecular analysis of benthic dinoflagellates and analysis of benthic and planktonic microalgae will be performed in the laboratory.
- Fish sampling for ciguatera analysis from purchases of fish from a local market (target – coral reef fishes that were caught locally around Gili Matra or Lombok);
- Social-economy sampling/data collection using the same methodology as in previous PICES/MAFF projects (on-site surveys, questionnaires, and focus group discussions).

Considering that one of the main goals of the PICES/MAFF project is capacity building, the PST has agreed to support six undergraduate students from the University of Indonesia, Mataran University and ITI (two from each) to participate in the field sampling program by providing them partial tuition (a portion of Year 2 project funds were re-directed for this activity).

4.3 Observation tools

FishGIS smartphone application

The version of the FishGIS application updated in Year 2 (ver. 1.0) will be available on Apple Store and Google Play in May 2022. Work on modifying and refining the application will continue in Year 3, guided by consultations with BRIN and ITI colleagues and communities in Lombok and Gili islands. The release of the renewed version (ver. 2.0) is anticipated in August 2022. The current modification plan includes:

- Adding a new function to map Ciguatera field survey data from the Gili Island region and to accumulate fisheries-related data (as photos of fish species in local fish markets) in order to reach a numerical target set for the number of data reports (at least 1,000);
- Linking the FishGIS application with Info BMKG (official application provided by [BMKG](#) – Indonesian government agency for Meteorology, Climatology, and Geophysics) to better incorporate a tsunami early warning notification for remote fishing communities;
- Adding a new function allowing the launch of the HydroColor water quality application directly from the FishGIS application.

The Indonesian government has established a national repository (Data Repository of Indonesia) for research data, and all data collected during the Ciguatera project will be stored in this repository. The *Terms of Use and Privacy Policy* for the FishGIS application (who owns the copyright/right for the data collected using this application) will be discussed among PST members, Indonesian partners and PICES Technical Committee on Data Exchange (TCODE), while data collection proceeds, and is expected to be finalized by February 2023.

Planktoscope - High-Throughput Microscope Platform

[Foldscope](#), introduced as one of observation tools in the FishGIS project, is a very low cost (\$3 US) folded paper (origami) microscope that can interface with any smartphone camera. It empowers non-science trained community members to collect photos of phytoplankton in their local waters, and send these images to the

specialists trained in phytoplankton identification. It serves as a remote detection method for toxic (harmful) algal blooms where monitoring is otherwise not done (which is for the vast majority of Indonesian coastal waters).

The developers of this remarkable product have now introduced [Planktoscope](#); a more sophisticated, but still low cost (<\$500 US) microscope platform that allows automated image collection of phytoplankton cells in a simple flow-through system. These images then can be uploaded to a dedicated server where artificial intelligence software can be trained to identify and quantify the composition of the phytoplankton assemblage.

Planktoscope is a tool that is expected to revolutionize low cost plankton monitoring, and is particularly suited to the Ciguatera project. The developer of Planktoscope, Prof. Manu Prakash (Stanford University, USA) has been approached about employing several of these devices in monitoring for CFP, and has expressed great interest. Providing low cost tools to enable science in developing nations is his primary goal, and he has been looking at Indonesia as one of his target sites. Though discussions are at an early stage, we envision a pilot deployment of one or more Planktoscopes in the Gili Islands region during Year 3.

4.4 Community training workshop

During the preparation of the Ciguatera project proposal, the intention was to conduct training exercises at least at two case study sites in Indonesia (see Section 3.3). The purpose was to increase the capacity building footprint and provide a more extensive *in-situ* experience to guide the development of observational and mitigation efforts. Given the pandemic-related delays, this goal was reassessed and, at the moment, a plan is to organize a community training workshop in the Lombok and Gili islands region in late February or early March 2023. The capacity building needs and opportunities will be reviewed, and the training program and logistics for the workshop will be optimized as guided by the PDM, in on-line consultations with our BRIN and ITI colleagues. If the situation allows, a short visit by a small group of PICES experts will be arranged in late 2022 to facilitate workshop planning.

4.5 PICES-2022

In addition to holding a 1-day in-person PST meeting immediately prior to the start of the 2022 PICES Annual Meeting (see Section 4.1), it is expected that at least two papers will be presented at [PICES-2022](#) based on the results from the PICES/MAFF Ciguatera project and from the Ciguatera Indonesia Project:

- A paper entitled “Strategic planning Ciguatera research to achieve SDG’s on marine coastal resources, ocean environment and human health in Indonesia” at the HD Paper Session;
- A paper entitled “Potential threats of harmful algal blooms (HABs) and Ciguatera fish poisoning (CFP) in the marine tourism park of Gili Matra islands, Indonesia” at the MEQ Paper Session.

Note: The uncertainties surrounding the global COVID-19 outbreak are a major consideration in the project plan. The Year 3 workplan depends critically on international travel and in-person meetings, which continues to be a problem. Although we are hopeful that conditions will improve by the end of 2022, public health recommendations of PICES member countries and Indonesia may require further modifications or delays in the planned activities.

5. REFERENCES

FAO and WHO. 2020. *Report of the Expert Meeting on Ciguatera Poisoning. Rome, 19–23 November 2018.* Food Safety and Quality No. 9. Rome. <https://doi.org/10.4060/ca8817en>.

APPENDIX 1

PROJECT PRINCIPLES

1. The overall goal of the project entitled “*Building Local Warning Networks for the Detection and Human Dimension of Ciguatera Fish Poisoning in Indonesian Communities*”, funded by the Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF), through the Fisheries Agency of Japan (JFA), is to build the capacity of local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries to benefit human health in Pacific Rim developing countries. The focus of this project is to detect and monitor *Ciguatera Fish Poisoning* (CFP) in tropical reef fisheries, which globally has the greatest human health and economic impacts of any algal-based poisoning syndromes. The aim of the project is to adapt smartphone-based observation tools developed in the 2017–2020 PICES/MAFF project on “*Building Capacity for Coastal Monitoring by Local Small-scale Fishers*” (acronym [FishGIS](#)) to empower Indonesian coastal communities to assess, detect, and minimize their exposure to CFP in community-scale fisheries. The project also is intended to foster partnerships with non-PICES member countries and related international programs and organizations. The MAFF contribution is from the Official Development Assistance (ODA) Fund and therefore, involvement of developing countries in project activities is required.
2. The duration of the project is 3 years, with the ending date set as March 31, 2023.
3. The following organizational principles agreed to by MAFF/JFA and PICES apply to the project:
 - The project will have strong connections and interactions with, and support relevant activities of, the PICES Scientific Committees on Human Dimensions – HD, Marine Environmental Quality – MEQ (through the Section on *Ecology of Harmful Algal Blooms in the North Pacific* – S-HAB) and Fishery Science – FIS, PICES Technical Committees on Data Exchange – TCODE and on Monitoring – MONITOR, and the PICES FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) Science Program (specifically, Research Theme 3 on “*How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?*”). The HD Committee will serve as the parent committee for the project.
 - The project will be directed by a Project Science Team (PST) formed based on principles and procedures detailed in [the PICES Policy for approval and management of special projects](#) (Decision 2017/A/7). All the above-mentioned groups and all PICES member countries are expected to be represented on PST.
 - The PST will be co-chaired by PICES members, with one Co-Chairman from Japan, representing the Human Dimensions Committee, and the other from the USA, representing the Section on *Ecology of Harmful Algal Blooms in the North Pacific*. These Co-Chairmen will provide the geographical balance and the balance of expertise between the human dimension and harmful algal bloom components of the project. The PST Co-Chairmen are responsible for the scientific implementation of the project and for the annual reporting to MAFF/JFA and to PICES Science Board through the HD Committee. This report should be submitted to JFA within 90 days after the close of each project year ending March 31, and include a summary of the activities carried out for the year, with an evaluation on the progress made, and a workplan for the following year.
4. The following financial principles agreed to by MAFF/JFA and PICES apply to the project:
 - A separate bank account shall be established to deposit the remitted funds.
 - The PICES Executive Secretary or a Project Coordinator designated by the Executive Secretary is responsible for the management of the fund and for the annual reporting on its disposition to MAFF/JFA and PICES Governing Council, through the Finance and Administration Committee, within 90 days after the close of each project year ending March 31.

- The main elements of the budget are organized into the following categories:
 - Travel and meetings – this category covers travel costs associated with project activities such as field studies, organizational trips, project meetings, workshops, scientific sessions and public events.
 - Contracts – this category covers grants/fees to be paid to consultants and experts employed to implement the project. Tasks and deliverables for contractors are to be determined by the PST Co-Chairs. To support the objectives of the project and to ensure that its activities have minimal impact on the workload of the existing staff of the PICES Secretariat, the Project Coordinator can employ additional staff as required.
 - Publications – this category covers costs associated with publishing findings of the project in special issues of peer-reviewed journals, reports and brochures, and dissemination of these materials.
 - Equipment – this category covers purchases and shipment of equipment for laboratory/field data/sampling processing/analysis, computer hardware/software for the development of database(s) and the project website.
 - Miscellaneous – this category covers expenses associated with the project (mail and phone charges, bank charges, *etc.*) and includes contingencies such as fluctuations in currency exchange rates.
 - Transfers of up to 10% of allocations between the budget categories are allowed based solely on the decision by the PICES Executive Secretary or the Projects Coordinator. In special cases, transfers up to 20% between the budget categories can be authorized by JFA. All transfers shall be reported at the end of the fiscal year.
 - A 13% overhead on the annual budget shall be retained by PICES to offset expenses related to the Secretariat's involvement in the project.
 - The interest earned by the fund shall be credited to the project and used in consultation with JFA.
 - Any funds remaining after the completion of every fiscal year of the project shall be reported and disposed of in consultation with JFA.
5. Ownership of the outcomes of the project, including materials, data, copyright and intellectual property rights, will be vested to PICES and the Government of Japan. Either Party may use those outcomes, but will give full credit to their source.

APPENDIX 2

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