EXECUTIVE SUMMARY

Benthic harmful algal bloom (HAB) species, such as the causative organisms underlying Ciguatera Fish Poisoning (CFP), arguably have the greatest 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*. Although ciguatera and other toxin-producing benthic HABs can occur in pristine environments, anthropogenic pressures and climate change are leading to its emergence in new regions, and intensification in others. Currently the human health and socio-economic effects of benthic HABs are poorly understood. This was the motivation for PICES (North Pacific Marine Science Organization) to accept a request from the Japanese government to undertake a project entitled "*Building local warning networks for the detection and human dimension of Ciguatera Fish Poisoning in Indonesian communities*" (acronym Ciguatera) and funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan, from the Official Development Assistance Fund. The project started in April 2020 and was completed in March 2023.

The objective of the project was to build the capacity of local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries to benefit human health. The project's focus was to detect and monitor benthic HAB species in tropical reef fisheries to ensure seafood safety. Consistent with the directives of the United Nations Decade of Ocean Sciences for Sustainable Development (UNDOS), the project included three major initiatives:
1. Coastal ecosystem monitoring activities by local small-scale fishers and other community members to detect ecosystem changes using smartphone-based technology;
2. Detection of CFP toxin-containing dinoflagellates in the reef environment using two approaches: (a) implementing smartphone-based tools developed during the FishGIS project, and (b) employing internationally-standardized sampling protocols for toxic benthic algae.
3. Training of local fishers and community members to utilize these tools for generating citizen-science data available for local decision-making on coastal fisheries to avoid the transfer of contaminated fish to the tables of families.

COVID-19 seriously affected the project activities because travel limitation largely prevented the planned training workshops in Indonesian communities. However, several important outputs were produced.
- A Project Design Matrix (PDM) was developed to effectively manage the project. Though we were unable to fully benefit from this approach due to pandemic restricted interactions, applying the Project Cycle Management strategy and the PDM will accelerate progress in future projects.
- A smartphone-based tool (FishGIS application) that enables local communities to collect environmental observations and fisheries data to aid in the development of fisheries management strategies was updated, with major modifications, and made available on Apple Store and Google Play.
- Planktoscope, a low-cost microscope platform that allows automated image collection of phytoplankton cells for species identification and enumeration, was deployed in the Gili Matra region.
- Scientific planning input and funding support were provided for five field sampling surveys in Gili Matra waters, led by our Indonesian colleagues. Indonesian researchers also collected fundamental socio-economic data in the area using the same methodology as in the previous PICES-MAFF projects (on-site surveys, questionnaires, and focus group discussions). Analysis of samples is still ongoing, but preliminary results indicate that the threat of CFP in this area currently is low.
- A community training and knowledge dissemination workshop was held in January 2023, in Lombok, Indonesia. Workshop and research activities in the Gili Matra region were widely reported by the Indonesian mass media.
- Finally, a (bow-tie) CFP risk assessment model was constructed that summarizes the connections among the coastal environment, ciguatoxins, human exposure to these toxins, and the CFP risk.

Although not all of the originally planned activities of the Ciguatera project were implemented due to the COVID-19 pandemic, a new 3-year PICES-MAFF project has been approved, with expectation that a major case study site will be the Gili Matra region, where a field sampling protocol has been developed, preliminary network of local people and researchers has been established, a basic understanding of potential CFP impacts has been

communicated to local communities and the regional government, technical training has been initiated, and technologies have been disseminated among the key local individuals. The Provincial Government of West Nusa Tenggara has indicated strong interest and political will to assist in supporting the new project, which will be essential for sustaining the planned observation and response activities after completion of the project.