SCIENTIFIC COMMITTEE
TWENTIETH REGULAR SESSION

Manila, Philippines
14-21 August 2024

ADDITIONAL OCEANIC ENVIRONMENTAL DATA

WCPFC-SC20-2024/ST-IP-07

The FFA and SPC-OFP Secretariats[1]

[1] Forum Fisheries Agency and Oceanic Fisheries Programme of the Pacific Community

Abstract

Oceanographic data collected during normal fishing operations worldwide are now used for a diversity of scientific, security and industrial applications. This includes applications to improve the understanding of climate-induced impacts on the marine ecosystem. This knowledge, which links fisheries and distribution of fish resources to ecosystem health and oceanographic conditions, improves our understanding of the environmental conditions that control distribution of fish populations in space and time. It also supports conservation and management decisions by regional fishery management organisations (RFMOs) in their efforts to secure the ecological and economic sustainability of fisheries and supports decisions by fishing companies to improve operational efficiency, which can be made with more confidence.

This paper provides early information on an initiative by FFA members to acquire additional oceanic environmental data collected by commercial tuna fishing vessels. The data acquired will be applied to improve and validate stock assessments and to strengthen ocean models used to measure current and predict future ocean conditions and associated distribution of tuna in response to a changing ocean environment.

Complementary to work already underway by FFA members, the work plan for 2024/2025 includes areas of direct relevance to the WCPFC, including potential revisions to:

i) the WCPFC Record of Fishing Vessels (CMM 2018-06) in relation to details for on-board echosounder, sonar or Acoustic Doppler Current Profiler (ADCP) equipment, and

ii) *Scientific data to be provided to the Commission*.

No changes are anticipated to the current version of *Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the Commission* at this time.

The proposed revisions will be tabled for consideration at the Regular Session of the Scientific Committee in 2025.

Introduction

Ocean observations of salinity, currents, temperature, wind speed, wave height and length, atmospheric pressure and other ocean conditions are currently collected via increasingly sophisticated sensors mounted on a growing array of mobile and fixed platforms, including autonomous underwater vehicles (AUVs), floats, buoys, drones, FADs, ships of opportunity (SOOPs, including fishing vessels), marine animals and satellites.

The initial SOOP design for the Pacific Islands, being implemented by SPC-OFP, encourages suitably equipped commercial tuna fishing vessels to volunteer in a program that involves continuous transects between ports or regions allowing seasonal and annual datasets to be established.

Industry collaboration will supplement efforts by SPC to acquire the biological and oceanographic information required to continue to develop existing models that will result in increased confidence in short-term forecasting and long-term projections for climate-induced impacts on the redistribution of tuna in the Western and Central Pacific Ocean (WCPO) across 1-to-10-year time frames. Eventually, this modelling will generate information sufficient to characterise EEZ-scale changes in tuna distribution as opposed to current projections which are predominantly basin scale.

The SOOP value-adds to similar pre-existing programs implemented in other global regions and taps into their expertise and infrastructure. The data collected are used in an array of ocean modelling applications, from model validation to operational assimilation. In the WCPO this includes the Spatial

Ecosystem And Population Dynamics Model (SEAPODYM) which, since 1995, has increasingly been utilised to inform on the population dynamics of tunas responding to climate-related ocean environment and fishing influences across the WCPO.

The SEAPODYM modelling framework is designed to assist stock assessment needs. An advantage of this model is that fishing impacts can be discriminated from the effects of environmental variability on the modelled population. For example, the model can provide an understanding of observed relationships, such as relations between changes in tuna catches and ENSO events, through quantitative descriptions of the habitats and population dynamics. Provided that reliable measures of ocean environmental variables are available, SEAPODYM offers opportunities for seasonal and decadal forecasting which is of paramount importance to economies and food security of Pacific Island countries.

Ocean modelling applications are increasingly supported by systems and workflows for instigating the development of 'fit-for-purpose' instrumentation and systems that integrate seamlessly to the electronics installed on fishing vessels. Most modern purse-seine vessels active in the WCPO are equipped with integrated subsurface data collection systems and sophisticated communication capabilities. In many cases, some of the oceanographic data that can inform climate modelling, including bio-acoustic data, are already collected by these vessels as part of their normal operations, but those data are not currently assimilated and made available to science. This program aims to increase access to those data for oceanographic and fisheries modelling purposes. Where additional data are required, with the cooperation of vessel operators, fishing vessels can also be appropriately instrumented with no adverse implications for normal fishing operations.

The roll out of the SOOP will commence with a focus on temperature profiling and bioacoustics.

Temperature Profiling

In-situ measurements of sea surface temperature (SST) are important for ocean, weather, seasonal and climate models. These models rely on satellite measured SST however cloud cover and other operational factors can restrict the extent of satellite coverage. Validation of satellite inferred SST is derived from moorings and drifting buoys, however, there are significant restrictions on the spatial coverage provided by these platforms alone. In order to provide the validation of satellite measured SST and ocean models in the Pacific Islands region, there is a need for high quality, in situ SST observations. Voluntary participation by vessels regularly operating in the Pacific Islands region can provide the much needed, high quality and, extensive spatial coverage of SST data needed for this validation. Simple hull contact sensors are placed on the ship's hull, below the waterline and away from any heat source, providing reliable and continuous SST data.

(Near) real-time ocean observations help inform atmospheric weather and climate forecasts. Accurate representation of the upper ocean heat content supports numerical weather prediction and seasonal forecasting. For example, measurement of upper heat content is necessary for predicting intensification of tropical cyclones as they travel over anomalously warm coastal waters. Subsurface ocean temperature is also a key parameter for dynamic and ecosystem-based management strategies and for understanding fish stock health and distribution (e.g. for standardising catch rates). However, correctly simulating the top of the thermocline (a critical piece to predicting upper heat content) is challenging and difficult in operational oceanography without observational data. Large-scale subsurface ocean observing initiatives have relied on instruments deployed either from research vessels or via autonomous platforms like floats, moorings, or drifters to capture measurements of the physical ocean state (e.g. Argo, GO-SHIP). While these programs provide global spatial and temporal coverage of in situ ocean temperature and salinity, significant gaps persist in the subsurface observation at regional and EEZ scales.

Fishing activity in the WCPO is concentrated in many of the regions where significant observational gaps exist. Fishing gear-based observing systems can provide high-resolution information below the

ocean surface as most fishing gear, such as nets and lines, can inherently serve as a profiling mechanism for sensors since fishing activities send gear from the surface to some ocean depth, followed by retrieving it from depth back to the vessel to catch fish. The Moana Project (www.moanaproject.org) and technology partner ZebraTech, Ltd (Nelson, New Zealand) have developed a purpose-built, cost-efficient, fully automatic temperature and pressure sensor. The sensor was specifically designed to be mounted on a wide range of commercial fishing gear, as well as other types of equipment, requiring minimal human intervention for operation. Inclusion of these observations in regional ocean models has resulted in improvements of around 40% for thermocline depth definition and estimation of ocean heat content. With partners and fishing companies that volunteer, SPC plans to trial this on locally-based longliners over the next 12 months.

Bioacoustics

Small fish, zooplankton and squid are important components of all marine ecosystems, however quantifying their abundance, distribution and behaviour over large spatial scales is difficult using traditional net sampling methods. Bioacoustics uses vessels, mostly purse seiners, equipped with suitable echosounders at single and multiple frequencies to estimate the abundance and distribution of these mid-trophic level organisms. These data are important for providing observed distribution and abundance information for ecosystem models in addition to providing a point of validation to predictions made by these models. SPC plans to trial this on locally-based purse seiners that volunteer to participate, over the next 12 months.

Data transmission, processing, and dissemination framework

Data collection on board the vessels is automated through vessel-independent storage infrastructure (small in size) placed on board the vessel. Transmission of data is undertaken remotely either using mobile or internet services (typically in port but can be undertaken during vessel operations). Data are then processed and quality controlled. Raw and processed data are then returned to the vessel owner. In parallel these data are anonymised and provided to the Global Ocean Observing System (GOOS) for dissemination to meteorological and operational oceanography service providers and fisheries and natural resource management service providers (Figure 1). Data uses and users is summarised in Table 1.

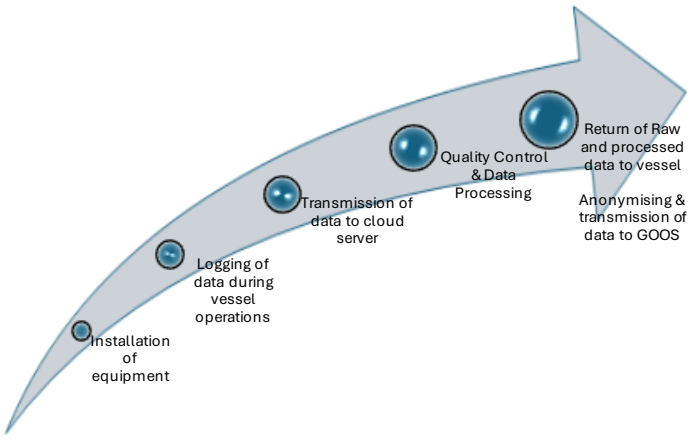

Figure 1. Schematic illustrating the work flow associated with the collection of oceanic environmental data by commercial tuna fishing vessels operating as SOOPs.

Data uses and users

Table 1. Data types, uses and users

Data	Uses	User
SST, thermocline and Upper Ocean Heat Content	Weather forecasts	Meteorological services
	Severe weather alert	
	Climate modelling	Operational Oceanography Services Pacific Community Pacific Regional Environment Programme
	Marine heatwave forecast	Operational Oceanography Services Pacific Community
	Fisheries forecasting	Pacific Community (SPC) Forum Fisheries Agency (FFA)
	Stock Assessment	Pacific Community (SPC) National fisheries agencies
Bioacoustics	Validation of tuna prey models	Operational Oceanography Services Pacific Community (SPC) Ocean Science Providers
	Biodiversity Monitoring	Operational Oceanography Services Pacific Regional Environment Program

In future, expansion will aim to collect a wider variety of data and increase the number of participating vessels. Any equipment deployed on vessels is designed to ensure minimal to no disruption to commercial activities with data collection and transmission undertaken remotely without the need for vessel crew intervention.

No non-compliance issues with coastal State legislation governing fisheries access arrangements have been identified to date. Data generated will be subject to the same data protection and confidentiality conditions as other data contributed by the commercial tuna fishery. Data collected from individual vessels will be made available to them in summary and raw format depending on the vessel's preferences.

2024/25 program of work

Through 2024 and 2025, the initiative involves:

- voluntary collaboration with suitably equipped tuna fishing vessels to collect additional oceanic environmental data,
- research relating to national and regional legislation and policy to assess requirements to provide for the acquisition of additional oceanic environmental data,
- considerations of revisions to the FFA Vessel Register and the Harmonised Minimum Terms and Conditions (HMTCs) to support the acquisition of additional environmental data from fishing vessels authorized to operate in FFA member EEZs, and
- considerations of revisions to WCPFC CMM 2018-06, the WCPFC Record of Fishing Vessels and the WCPFC's *Scientific data to be provided to the* Commission, to support the acquisition of additional environmental data from fishing vessels authorized to operate in the WCPFC Convention Area planned for submission to SC21 in 2025.