North Pacific Fisheries Commission

NPFC-2025-SSC BFME06-OP02

Recommendation to Endorse Approaches for Identifying Vulnerable Marine Ecosystems (VMEs) from Imagery and Species Distribution Models in the NPFC Convention Area

by

The Deep Sea Conservation Coalition

December 2025

Please find below recommendations for the endorsement of by the NPFC for approaches to identifying vulnerable marine ecosystems (VMEs) from imagery and species distribution models in the NPFC Convention Area along with two papers attached:

1. **Baco et al., (2023)** provides a consensus method for using imagery data to identify VMEs; and,
2. **Tong et al., (2023)** provides species distribution models that can be used to identify locations of VMEs likely to occur for reef-forming scleractinian corals in the NPFC Convention Area.

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Under United Nations General Assembly (UNGA) resolutions 59/25, 61/105, 64/72, 66/68, 71/123, and 77/118 (UNGA 2004, 2006, 2009, 2011, 2016 & 2022), as well as the multilaterally agreed UN FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009), Regional Fisheries Management Organizations (RFMOs) managing fisheries in areas beyond national jurisdiction should identify locations where vulnerable marine ecosystems (VMEs) are 'known or likely to occur' and assess whether one or more forms of bottom fishing are causing, or are likely to cause, significant adverse impacts (SAIs) on these ecosystems. The FAO Guidelines define internationally accepted criteria for identifying deep-sea areas, species, and communities that are particularly vulnerable to human impacts and slow to recover, especially from bottom-contact fishing. These criteria include uniqueness or rarity, functional significance, fragility, life-history traits that hinder recovery, and structural complexity—any one of which is sufficient for an area to qualify as a VME (FAO, 2009). Similar designations, such as the Convention on Biological Diversity's Ecologically or Biologically Significant Areas (EBSAs) (CBD COP9, 2008) and OSPAR's list of Threatened and/or Declining Species and Habitats (OSPAR Commission, 2019), have also been applied in areas beyond national jurisdiction and in national waters by many States.

The Deep Sea Conservation Coalition (DSCC) would like to present two recent scientific publications for endorsement by the NPFC. These papers provide peer-reviewed methods of identifying areas where VMEs are known or likely to occur:

3. **Baco et al., (2023)** provides a consensus method for using imagery data to identify VMEs; and,
4. **Tong et al., (2023)** provides species distribution models that can be used to identify locations of VMEs likely to occur for reef-forming scleractinian corals in the NPFC Convention Area.

1. Baco et al., (2023): Seafloor imagery data from scientific surveys offers a less destructive alternative to traditional methods, which rely heavily on fisheries bycatch data to identify the presence of VME indicator species or taxa. Bycatch data from trawls or longlines are not intended for mapping VMEs, often fail to capture the full diversity of indicator species or taxa, and can introduce compositional biases, as many species are not retained by fishing gear. More critically, trawl-based sampling methods risk damaging or destroying VMEs during data collection (Auster et al., 2011; Gros et al., 2022; Heifetz, Stone & Shotwell, 2009; ICES, 2010; Jones & Lockhart, 2011; Knudby et al., 2013; Pitcher, Du Preez et al., 2016; Watling & Auster, 2017; Wassenberg, Dews & Cook, 2002).

In contrast, seafloor imagery data from scientific surveys offers a much less destructive way to map VMEs locations and gather detailed information on their characteristics. It is also increasingly available for seafloor areas likely to host potential VMEs and can support the development of predictive models to map their distribution.

A 2023 peer-reviewed scientific paper by Baco et al., presents the first cross-regional consensus guidelines for a quantitative approach to identifying VMEs from imagery. Developed by an international working group of 35 benthic ecologists from 15 countries under the Deep-Ocean

Stewardship Initiative (DOSI), the framework shows that VMEs can be clearly and confidently identified from imagery, with certain VMEs identifiable at the scale of a single image or frame (Baco et al., 2023) and incorporates all of the FAO VME identification criteria.

2. Tong et al., (2023): Tong et al., (2023) developed global ensemble species distribution models for ten coral species, including six reef-forming scleractinians and four large gorgonian octocorals, all recognized as VME indicator taxa. The models used environmental data at a 500 m resolution, representing the highest spatial resolution yet applied in global deep-sea coral modeling.

During the SWG VME meeting in September 2024, participants noted that among all existing global models, the "goodness-fit-measures for the Tong et al., (2023) models when compared against the observations from Members showed good performance with AUC ~0.75-0.78" (SWG VME, 2024)." Since their predictive power is supported by this ground-truthing effort, the Tong et al., (2023) species distribution models may be used to predict scleractinian coral distributions in the NPFC Convention Area.

Of the species analyzed, three octocorals and two scleractinians occur only in the Atlantic. The remaining octocoral, *Paragorgia arborea*, is primarily a high-latitude species and can help predict likely occurrences in the northern part of the western half of the NPFC Convention Area. Of the scleractinians, *Goniocorella* is typically found in the South Pacific but also shows some suitability on the shallower sections of seamounts such as Koko and Kammu. *Solenosmilia* is also native to the South Pacific but has been recorded on seamounts in the Northwestern Hawaiian Islands (NWHI), and shows weak to moderate suitability across most seamounts in the western half of the NPFC Convention Area. In general, the highest suitability areas for most species are located below the Main Gap of the Emperor Seamount Chain (at 37-39ºN), though *Enalopsammia* also shows moderate suitability north of the Gap. A consensus model across five species (*Paragorgia* + four scleractinians) indicates that all seamounts have areas of high suitability (>75%) for at least one species, with most seamounts below the Gap showing extensive areas of high suitability for three to five species (Tong et al., 2023).

To better operationalize the precautionary approach, the DSCC **recommends that the SSC BFME and the SC formally endorse the methodology outlined in 2023 scientific paper by Baco et al., submitted and previously presented to the NPFC as (NPFC-2023-SSC BFME04-IP01; NPFC-2022-SSC BFME03-OP02) as well as the methodology described by Tong et al., (2023), previously presented at the June and September 2024 SWG VME meetings, as approved NPFC approaches for identifying VMEs alongside the existing approved frameworks.** The less invasive VME identification approach developed by Baco et al., is grounded in the most recent, best available science, and reflects a peer-reviewed international consensus on the best approach to VME identification from imagery. Both methods represent innovative advances beyond the density-based approaches currently employed by the NPFC, which address only a single VME criterion (structural complexity). The Baco et al., (2023) methodology integrates all five VME criteria from the FAO Guidelines into a comprehensive framework for applying them to imagery-based assessments. In parallel, and consistent with UNGA Resolution 77/118 (2022), which recognizes the importance of benthic ecosystem and predictive modeling for identifying areas where VMEs are likely to occur, the Tong et al., (2023) ensemble species distribution models have demonstrated strong regional applicability and the ability to generate valuable data for VME identification.

Formally endorsing these approaches as NPFC-approved frameworks, alongside NPFC's existing VME methodologies, can enable Members to more effectively designate VMEs and prevent significant adverse impacts, consistent with the NPFC's mandate to protect the marine ecosystems of the North Pacific (NPFC Convention Article 2, 2015).

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