Relating frontal features and fishing activity in the Bohol Sea using multi-sensor chlorophyll-a and VIIRS night light data

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The spatiotemporal patterns and relationship between frontal features and fishing activity in the Bohol Sea were examined utilizing remotely sensed satellite data. Fronts are narrow high-gradient zones in the ocean that can act as bioaccumulation mechanisms that lead to increased levels of productivity. This would imply an adequate supply of biomass to support larger marine animals up the food chain including fish. Previous studies have reported a strong relationship between frontal features and fish distribution and abundance. These findings encouraged a growing use of frontal data in elucidating potential fish aggregations for a more practical and ecosystem-based fisheries management. However, this approach of using frontal data remains to be largely unexplored in the Philippines due to the lack of continuous data. Thus, in this study, the main objective was to assess the relationship and spatiotemporal patterns between the frontal features and fishing activity in the Bohol Sea area, which is one of the primary fishing grounds in Central Visayas and a known biodiversity hotspot for large marine vertebrates. To evaluate this, multi-sensor chlorophyll-a (CHL) concentrations and VIIRS night light boat detection data were extracted and processed using the Belkin-O'Reilly frontal algorithm and HDBSCAN density clustering algorithm to produce frontal frequency maps and dense fishing area maps. Subsequently, the spatial and temporal aspects were evaluated through the collocation frequency, seasonal map overlays, long-term monthly time series, and the Spearman correlation analysis applied to Areas of Interest (AoIs) in the study domain.

From the spatial analysis, collocation frequencies of the various AoIs showed that only 5 (out of 17) AoIs had a high degree of collocation with only 7 AoIs being moderately collocated while the rest had low to no collocation. Seasonal map overlays revealed that majority of the areas with high to moderate collocation frequencies were generally found to either coincide or occur close to the dense fishing areas (DFAs). Analysis from a more temporal perspective from the long-term time series depicted that the trends showed seasonal patterns and general trends over the study period; however, no distinct relationship between the frontal frequency (FF) nor the frontal

gradient magnitude (FGM) and the fishing activity. The Spearman correlation analysis showed that for the frontal frequency and fishing activity, only 5 AoIs (AoIs 5, 7, 9, 10, and 12) were statistically significant while also having a weak correlation. For the frontal gradient magnitude and fishing activity, only 5 AoIs (AoIs 2, 5, 9, 10, and 12) were statistically significant and weakly correlated as well. These results showed that the collocation of frontal features and fishing activity was observed spatially; however, the correlation was not observed temporally. The results also suggested that other localized factors and processes influence the frontal features (in terms of the frequency and gradient magnitude) and fishing activity in the study domain such as bathymetry, physical oceanographic factors, fishing grounds, or fishing vessel accessibility among others. Overall, this study provides significant insight into the relationship between frontal features and fishing activity in the Philippine context which can be useful for guiding management strategies and decisions for monitoring the country's marine ecosystems and fisheries.