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DISTRIBUTION OF TEMPERATURE AND SALINITY ON FISHING ZONE IN THE REGIONAL FISHERIES MANAGEMENT OF INDONESIA (WPP-RI) 573

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Abstract. The Fisheries Management Republik Indonesia (WPP-RI) 573 encompasses strategic waters in the southern Indian Ocean of Indonesia, playing a critical role in global ocean circulation through the Indonesian Throughflow (ITF). This study aims to examine the physical oceanographic characteristics, particularly sea surface temperature (SST), salinity, and marine ecosystem productivity in WPP 573, as well as the impacts of ITF variability on these parameters. Data utilized include SST, salinity, and current velocity obtained from satellite observations and numerical models. The analysis reveals that the ITF transports tropical water masses from the Pacific Ocean to the Indian Ocean, significantly influencing the spatial and temporal distribution of temperature and salinity in the region.

Keywords: Indonesian Throughflow (ITF), WPP-RI 573, Salinity, Sea Surface Temperature (SST), Ecosystem

Abstrak. Wilayah Pengelolaan Perikanan (WPP) 573 mencakup perairan strategis di Samudra Hindia bagian selatan Indonesia, yang berperan penting dalam sirkulasi laut global melalui Arus Lintas Indonesia (Arlindo). Penelitian ini bertujuan untuk menganalisis karakteristik oseanografi fisik, khususnya suhu, salinitas, dan produktivitas ekosistem laut di WPP 573, serta dampak variabilitas Arlindo terhadap parameter-parameter tersebut. Data yang digunakan mencakup suhu permukaan laut (SST), salinitas, dan kecepatan arus, yang diperoleh dari pengamatan satelit dan model numerik. Analisis dilakukan menggunakan metode statistik deskriptif, analisis spektral untuk memahami pola temporal untuk mengidentifikasi distribusi parameter oseanografi. Hasil penelitian menunjukkan bahwa Arlindo membawa massa air tropis dari Samudra Pasifik menuju Samudra Hindia, memengaruhi suhu dan salinitas secara spasial maupun temporal.

Kata Kunci: Arus Lintas Indonesia (Arlindo), WPP-573, Salinitas, Suhu Permukaan Laut, Ekosistem

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INTRODUCTION

The Fisheries Management Area 573 / WPP 573 encompasses a strategic marine region in the southern Indian Ocean, stretching from the southern coast of Java Island to the waters surrounding Timor Island. This area plays a vital role in global ocean circulation as one of the primary pathways for the Indonesian Throughflow (Arlindo), which transports tropical water masses from the Pacific Ocean to the Indian Ocean. As part of the global thermohaline circulation system, Arlindo significantly influences the physical oceanographic characteristics in WPP 573, including temperature, salinity, and ocean current dynamics. The movement of warm water masses from the Pacific also affects the physical conditions of the waters and supports nutrient distribution and the productivity of marine ecosystems in the region (Taufiqurrahman, et al., 2020).

Arlindo holds a key role in the distribution of temperature and salinity in WPP 573, which is highly relevant in the context of regional oceanography and ecology. By carrying warm water masses with salinity levels characteristic of tropical waters, Arlindo influences the increase in sea surface temperature, particularly in the upper layers. Additionally, this current enriches the waters with nutrients that drive primary productivity, such as phytoplankton growth. The changes in temperature and salinity induced by Arlindo exhibit seasonal patterns influenced by variations in monsoonal wind strength. These seasonal variations contribute to annual fluctuations in temperature and salinity in WPP 573, which impact the dynamics of local marine ecosystems (Cao & Zhang, 2017; Susanto & Song, 2015).

The oceanographic conditions in WPP 573, influenced by Arlindo, support the habitats of marine biota, including economically valuable pelagic fish species such as tuna. As a migration route, this current creates a nutrient-rich and thermally stable environment ideal for the development of plankton, which serves as a primary food source for these fish. Consequently, WPP 573 becomes a productive and strategic fishing area for the national fishing industry. However, fluctuations in current patterns and sea surface temperature caused by Arlindo also affect fish migration patterns, necessitating a thorough understanding of Arlindo's dynamics for sustainable fisheries management in the region (Budiman, et.al., 2021).

Moreover, Arlindo significantly impacts the regional climate patterns in WPP 573. The current transfers heat from the Pacific Ocean to the Indian Ocean, influencing thermal balance and rainfall patterns along Indonesia's southern coastal regions. Global climate phenomena such as El Niño and La Niña also affect the intensity of Arlindo, which in turn impacts sea surface temperature and wind patterns in the area. For instance, during El Niño events, the flow of Arlindo tends to weaken, potentially reducing sea surface temperatures in WPP 573 and altering weather patterns, which could affect fishing activities and marine ecosystems (Susanto & Song, 2015; Wyrtki, 1987).

Overall, the dynamics of Arlindo contribute significantly to the physical oceanographic characteristics and ecosystem productivity in WPP 573. As a transport pathway for water masses, Arlindo not only influences the physical properties of the waters but also supports the sustainability of economically valuable marine biota. Therefore, a comprehensive understanding of Arlindo's flow patterns and impacts in WPP 573 is crucial for developing adaptive and sustainable marine resource management policies. This study aims to analyze the flow patterns of Arlindo and their impact on the physical oceanographic parameters and ecosystem productivity in WPP 573, providing insights that are essential for the development of adaptive and sustainable marine resource management policies. Further research is needed to evaluate the long-term effects of Arlindo's variability on marine ecosystems and the fisheries sector, particularly in the face of climate change and environmental variability (Fenge et. al., 2018).

METHOD

This study employs a quantitative descriptive method aimed at analyzing the physical oceanographic characteristics and the influence of the Indonesian Throughflow (Arlindo) in Fisheries Management Area (WPP) 573, focusing on parameters such as temperature, salinity, and ocean currents. The research utilizes secondary data from global and regional oceanographic data sources, as well as numerical models, to analyze Arlindo dynamics. The research methodology consists of the following stages data collection, Oceanographic Data Analysi

The data used in this study include sea surface temperature (SST), salinity, current velocity, and marine nutrients. The data sources comprise satellite data from NOAA (National Oceanic and Atmospheric Administration) and reanalysis data from climate models such as the Copernicus Marine Service and Ocean Data View (ODV) model. Data spanning the last 10–20 years will be collected to understand the long-term trends and seasonal variability of Arlindo in WPP 573. The collected data on temperature, salinity, and ocean currents will be analyzed spatially and temporally using software such as Ocean Data View (ODV). This analysis will include vertical and horizontal distributions of temperature and salinity, helping to understand the water mass distribution patterns from the Pacific Ocean to the Indian Ocean through WPP 573. Spatial interpolation methods will be employed to examine temperature and salinity variations across the study area. Numerical models will be utilized to map and predict the movement of Arlindo in WPP 573. Hydrodynamic models will be employed and calibrated with observational data to improve prediction accuracy. The modeling aims to depict Arlindo's flow patterns and its interactions with Indian Ocean currents, as well as to assess the impact of annual and seasonal variability on current patterns.

To analyze the influence of Arlindo on marine ecosystems, particularly on the distribution of plankton and large pelagic fish, oceanographic data will be correlated with primary productivity data obtained from satellite chlorophyll measurements. Regression methods will be used to explore the relationship between temperature and salinity variability and chlorophyll distribution as an indicator of plankton productivity. Additionally, fish catch data from local fisheries agencies will be analyzed to investigate the correlation between Arlindo's current patterns and the availability of pelagic fish stocks in WPP 573. The analysis results for each parameter will be evaluated using descriptive and inferential statistical analyses. Correlation or linear regression tests will determine the relationship between oceanographic parameter variability and plankton and fish distribution patterns in WPP 573. Data visualization will be presented in the form of spatial distribution maps, time-series graphs, and vertical profile diagrams of temperature and salinity to comprehensively illustrate the oceanographic conditions in WPP 573.

RESULTS

Temperature Distribution in WPP 573

The temperature distribution in WPP 573 exhibits significant spatial and temporal variations. Key influencing factors include the movement of the Indonesian Throughflow (Arlindo), seasonal climatic patterns, and interactions with water masses from the Indian Ocean. Based on analyses of sea surface temperature (SST) satellite imagery and oceanographic models, sea surface temperatures in this region generally range from 26°C to 30°C, with fluctuations influenced by wind seasons and the dynamics of Arlindo.

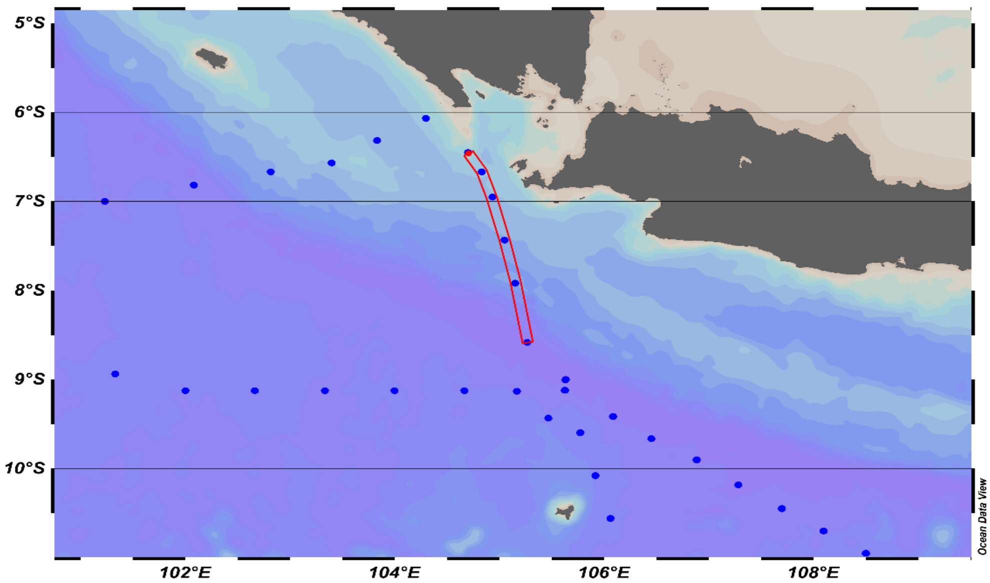

Figure 1. WPP 573 research location

During the west monsoon season, which spans from December to March, sea surface temperatures in WPP 573 tend to be higher, particularly in the southern waters of Java and Bali. This phenomenon occurs due to the strong flow of Arlindo transporting warm water from the Pacific through the Makassar Strait and the Flores Sea toward the Indian Ocean, accelerating heat transfer from north to south. Temporal temperature graphs indicate that sea surface temperatures reach their peak during this season, especially in waters near Java and Bali.

Conversely, during the east monsoon season (June to September), sea surface temperatures decrease. This is attributed to the weakening of Arlindo and the reduced transport of warm Pacific waters. Additionally, the influx of cooler water from the Indian Ocean, reinforced by upwelling along the southern coasts of Java and Bali, enhances the cooling effect. In the upwelling process, cooler subsurface water rises to the surface, resulting in significantly lower temperatures in the southern part of WPP 573 compared to other seasons.

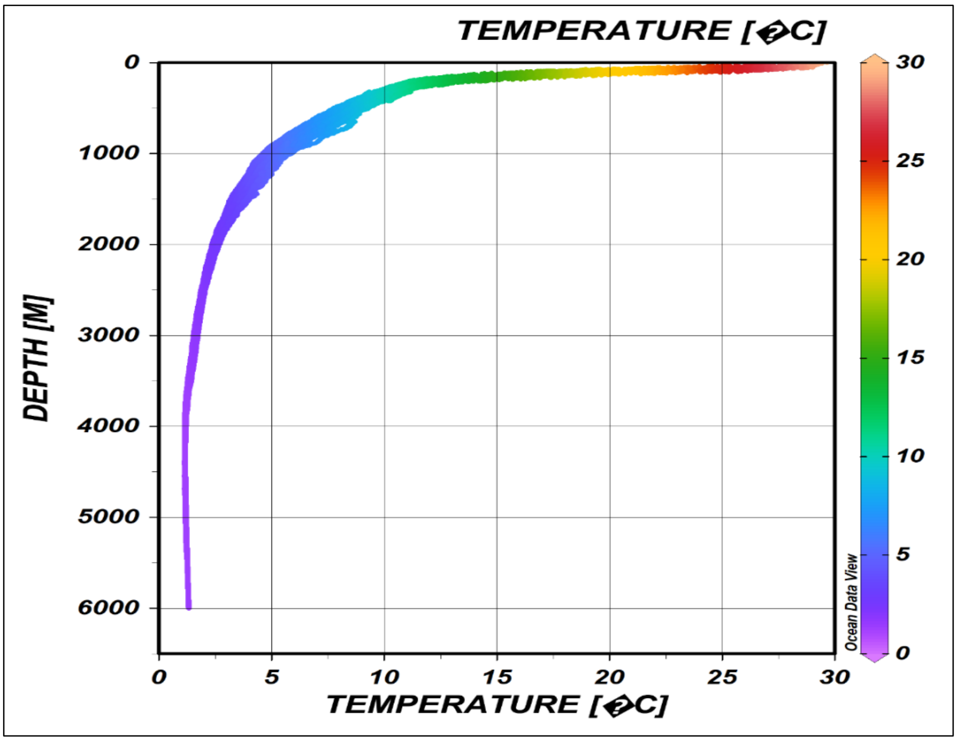

Figure 2. Temperature vs. depth graph constructed from all temperature measurements

Vertically, the thermocline layer in WPP 573 becomes shallower during the east monsoon season, with a depth of approximately 50–100 meters. This shallowing intensifies the upwelling process, bringing cold water to the surface and supporting primary productivity in the coastal waters of Java and Bali.

Salinity Distribution in WPP 573

The salinity distribution in WPP 573 exhibits a complex pattern, influenced by water masses from the Pacific, seasonal rainfall, and freshwater input from coastal rivers. Based on oceanographic model data and satellite observations, surface salinity in this region ranges from 33 to 35 PSU (Practical Salinity Unit), with variations driven by the strength of Arlindo and seasonal cycles.

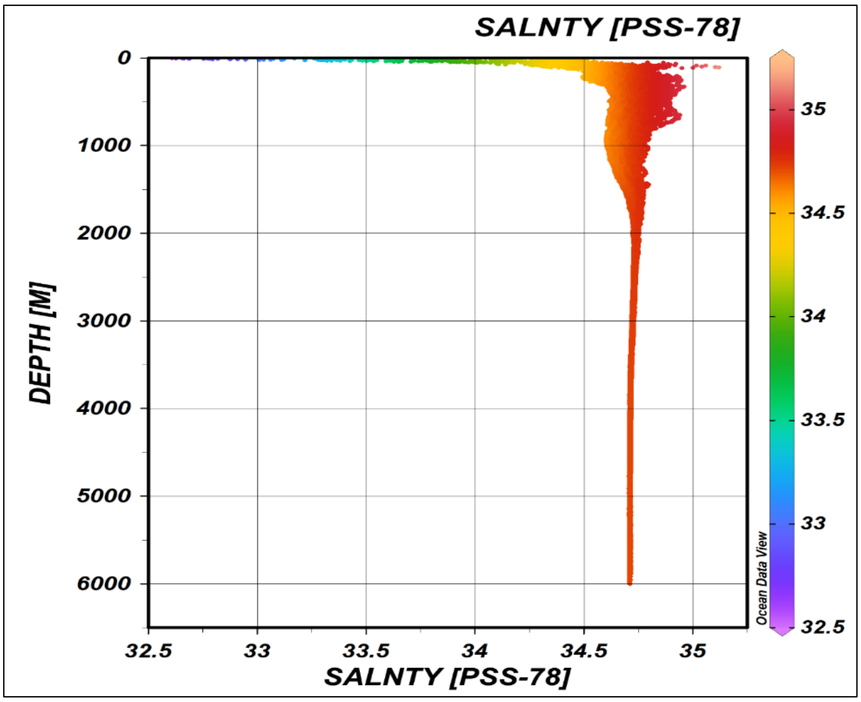

Figure 3. Salinity vs. depth graph constructed from all salinity measurements

During the west monsoon season, high rainfall in the region causes a decrease in surface salinity due to the dilution effect of freshwater from rivers in Java and Bali. However, water masses transported by Arlindo from the Pacific, which are generally saltier, maintain relatively high salinity levels in the middle and lower layers. In the lower layers, the influence of saline water from the northern Pacific is dominant, sustaining higher salinity concentrations compared to the surface. In the east monsoon season, surface salinity increases, particularly in southern areas. This is due to the influx of drier water masses from the Indian Ocean, while the weakened Arlindo allows Indian Ocean waters to dominate. Reduced rainfall and lower river discharge during this season further decrease freshwater input, leading to higher surface salinity.

Vertically, the highest salinity levels are observed at depths of 100–300 meters, reflecting the movement of saline water masses from the northern Pacific via Arlindo. Water masses from the southern Pacific are typically found in deeper layers, particularly around the Halmahera Sea and Makassar Strait. These findings align with previous research (Gordon, 2005), which highlights the significant role of saline water from the northern Pacific in maintaining the salinity distribution in WPP 573. This analysis underscores that the distribution of temperature and salinity in WPP 573 is heavily influenced by seasonal variations and the strength of Arlindo. These fluctuations in temperature and salinity significantly impact the region's ecosystem, particularly in supporting primary productivity and plankton distribution, which form the foundation of the marine food chain in WPP 573.

DISCUSSION

Temperature Variations and Seasonal Patterns

The seasonal changes in sea surface temperature across WPP 573 are closely tied to the strength and flow direction of Arlindo. During the west monsoon (December to March), the intensified flow of warm Pacific waters into the area leads to elevated temperatures, particularly in the southern waters near Java and Bali. This heat transfer from north to south is evident in time-series temperature data, which shows a seasonal peak during this period. In contrast, the east monsoon (June to September) is characterized by cooler sea surface temperatures. This cooling effect is driven by the reduced influence of Arlindo and the influx of cooler water from the Indian Ocean. Additionally, upwelling along the southern coasts of Java and Bali contributes to this phenomenon by bringing colder subsurface water to the surface. The observed shallower thermocline during this season facilitates stronger upwelling, enhancing nutrient availability and supporting primary productivity, which is vital for sustaining fisheries in the region.

Salinity Dynamics and Freshwater Contributions

Salinity distribution in WPP 573 also exhibits significant seasonal changes influenced by rainfall, river discharge, and water mass origins. During the west monsoon, surface salinity decreases due to the dilution effect of heavy rainfall and freshwater input from rivers. However, the subsurface layers maintain higher salinity levels due to the inflow of saline Pacific waters transported by Arlindo. The seasonal fluctuations in temperature and salinity have critical implications for marine ecosystems in WPP 573. Upwelling during the east monsoon, driven by thermocline dynamics, enhances nutrient concentrations, fostering primary productivity and supporting plankton populations. These plankton serve as the foundation of the marine food web. Additionally, salinity variations caused by monsoonal precipitation and freshwater inflows impact the distribution and behavior of marine species sensitive to salinity changes.

These observations emphasize the pivotal role of Arlindo and seasonal climatic forces in shaping the oceanographic conditions of WPP 573. Understanding these interactions is crucial for sustainable fisheries management and the preservation of marine biodiversity in the region. Future studies should prioritize high-resolution monitoring to capture spatial and temporal variability more accurately. Combining satellite data with advanced oceanographic models could further elucidate the effects of climate variability and long-term changes on the region's marine environment. By acknowledging the interdependence of physical and ecological processes, this discussion highlights the necessity of a comprehensive approach to managing WPP 573 as a critical marine resource.

CONCLUSION

The temperature and salinity dynamics in WPP 573 are significantly influenced by the Indonesian Throughflow (Arlindo), seasonal monsoons, and interactions with water masses from the Pacific and Indian Oceans. Warmer sea surface temperatures occur during the west monsoon due to strong Arlindo flow, while cooler temperatures prevail in the east monsoon, driven by reduced flow, Indian Ocean water intrusion, and upwelling. Salinity patterns shift seasonally, with lower levels during the west monsoon due to rainfall and river discharge, and higher levels in the east monsoon due to reduced freshwater input. These variations are critical for sustaining marine ecosystems, particularly through upwelling processes that enhance primary productivity and support fisheries. This highlights the need for ongoing monitoring management to maintain the ecological and economic sustainability of WPP 573.

REFERENCES

Budiman, A.S. (2021). The Spatio-Temporal Variability of Chlorophyll-A and Its Physical Variables in the South Java Sea Shelf. *IOP Conf. Series: Earth and Environmental Science.*

Cao, L., & Zhang, X. (2017). Phytoplankton dynamics based on satellite inherent optical properties and oceanographic conditions in a patagonian gulf frontal system in relation to the adjacent continental shelf waters. *Marine Environmental Research Volume* 173, January 2022, 105516

Taufiqurrahman, et al. (2020). The Indonesian Throughflow and its Impact on Biogeochemistry in the Indonesian. *ASEAN Journal on Science & Technology for Development* Vol 37, No 1, 2020, 29–35.

Gordon, A. L. (2005). Oceanography of the Indonesian Seas and its impact on global thermohaline circulation. *Oceanography* 18(4):13-13

Feng, M.., et al. (2018). The Indonesian throughflow, its variability and centennial change. *Geoscience Letter*. (2018) 5:3

Susanto, R. D., & Song, T. (2015). Indonesian throughflow proxy from satellite altimeters and gravimeters. *Journal of Geophysical Research: Oceans* 120 (4), 2844-2855