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Study of Water Parameter Related to Catches of Small Pelagic Fishes at Pandeglang Waters, Banten

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Abstract. Pandeglang waters are noted as one of fishing ground areas for small pelagic fishes in Banten province. Since the water quality parameters are a significant factor to fish habitat, this study was aimed to determine the relationship between water quality parameters and small pelagic catch. The study was conducted from December 2016 - April 2017 at three fishing ground points namely Batu Hideung, Sumur and Panaitan. Water quality parameters were measured in situ. Sea surface temperature at the study sites ranging from 28.20-29.70 °C, current velocity 0.6-0.8 m/s, brightness 6-9 m, and salinity 30-32 g/L. Chlorophyll-a value showed fishing ground conditions were less fertile in December 2016 compared to February – April 2017. The catch during February-April was higher than the catch on December. It indicated that the waters quality condition of the fishing ground area were in accordance with the condition of small pelagic fish catch. Correlation analysis between temperature variable and small pelagic fishes catch was 0.776, which showed a fairly close relationship (p 0.000). The correlation between the brightness and the catch of the fish has less significant correlation (0.235, p 0.410) . Those were contrasted to salinity variable which possessed negative value of -0.750.

Keywords: catch, chlorophyll-a, Pandeglang, small pelagic fish, temperature

INTRODUCTION

Pandeglang sea waters belong to the Sunda Strait which is situated between Sumatra and Java Islands. The sea waters include to the fisheries management area (WPP) 572 and border with the Indian Ocean at the west [1]. The strait is one of the most dynamic and unique straits, due to the homogenization of the water mass of the Java Sea with Indian Ocean waters [2]. The warm homogenization of the Indian Ocean water mass positively impacts the quality of the water in the Sunda Strait, among increasing on nutrient, chlorophyll, phytoplankton and suspended solid / seston [3]. Local phenomena such as seasonal patterns and volcanic activity have significant influence on oceanographic characteristics in these waters.

Based on a report by the Ministry of Research and Technology Republic of Indonesia, the potency of fisheries especially small pelagic fishes in WPP 572 reached 412,945 tons/year on 2016. Unfortunately, this potency was applied with percentage of about 80%. Small pelagic fishes in the Java Sea and Sunda Strait have been exploited by 87.31% [4]. Some dominant pelagic fishes caught in Pandeglang waters are mackerel (*Rastrelliger* spp), fringescale sardinella (*Sardinella fimbriata*), yellowtail scad (*Atule mate*), frigate tuna (*Auxis thazard*) and Indian scad (*Decapterus ruselli*) [4]. Some factors like unenvironmentally and friendly fishing, inappropriate use of fishing gear, lack of regulation and supervision from related agencies, and no minimum size limits on captured fish possibly decrease the production of small pelagic fishes in their nature habitat.

The abundance of fishes can be influenced by optimal water environment condition as their habitat, feeding area and survival [6]. Environmental factors such as temperature, salinity, dissolved oxygen, sediment, brightness, sea current, upwelling and food availability are positively correlated to the length, weight, and survival rate of fish. Water temperature can be used as preference to understand the condition of other parameters such as currents,

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upwelling and front at sea [7]. The upwelling process will bring in nutrient-rich water masses that will increase the productivity of the waters thus supporting the process of life at sea [8]. Fish production is associated with concentrations of water chlorophyll pigments [9]. The distribution of primary productivity can be more appropriate indicator for the determination of fishing ground [10]. This study was aimed to study the parameters of waters and their correlation with the presence of small pelagic fish especially in the waters of Pandeglang regency.

METHODS

Study Area

The research was conducted in Pandeglang District waters with coordinates 06° 31' South Latitude – 105° 36' East Longitude (Panaitan Waters, Sumur and Batu Hideung – Fig. 1) from December 2016, up to February, March, April 2017.

Sampling

Fishes were collected at the beginning and end of the month according to operational standard based on [11]. Numbers of fishes caught were noted together with their length and weight. Water quality parameters were measured in situ from each station during the study. The parameters measured were temperature, salinity, brightness, and current velocity. Data about chlorophyll-a distribution along the waters was obtained from the aqua satellite image of MODIS.

Data Analysis

Multivariate dendogram and principle component analysis (PCA) were used to determine the degree of relationship between variables. Correlation analysis was carried out to determine the relationship between parameters of waters with the presence of small pelagic fish. Statistical analysis was performed using Microsoft Excel and Minitab software version 17.

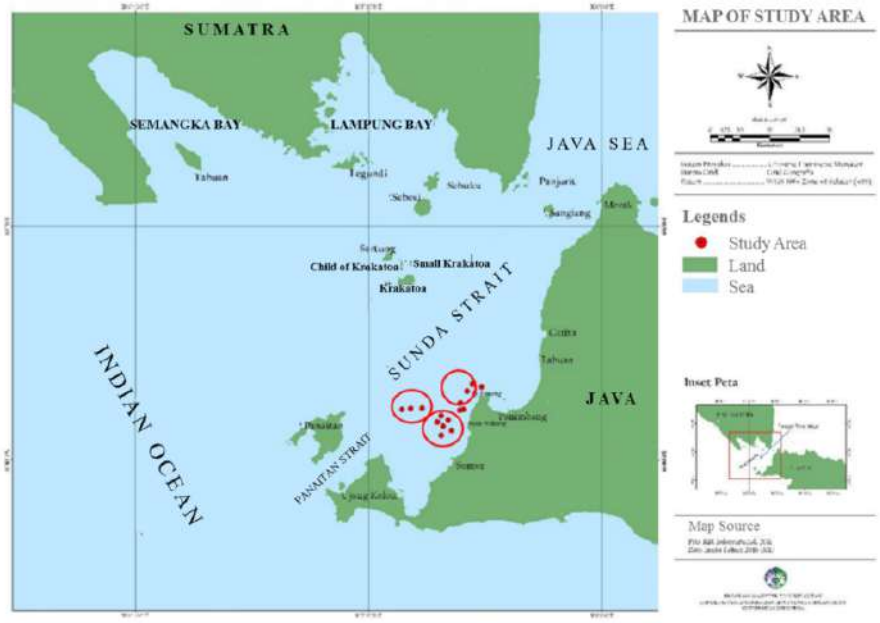

FIGURE 1. Research location

RESULTS AND DISCUSSION

Sunda Strait generally experienced considerable wave fluctuations in certain season. The variability of water mass motion and current patterns occurring in these waters is primarily related to seasonal changes [12]. The topography of Sunda Strait waters shows that the strait has a depth gradient from northeast to northwest. In the northern part of the strait, the depth is only about 40 m, then gradually goes deeper about 75 - 100 m to the seabed.

Water Parameters of Pandeglang Seawater

Water quality is characterized by chemical characteristics that are strongly influenced by the interaction between input sources from the land and from the surrounding sea. The quality of the waters of Pandeglang Regency was still below the threshold. Temperature and salinity are the parameters that determine marine biota can live and thrive in the habitat. Suitable range of water temperature for living place for marine biota ranges from 20-30 °C [13]. The waters' salinity is largely influenced by the mixing of seawater and freshwater masses. Suitable waters salinity range corresponding to the marine biota is 28-33 g/L [14].

The sea surface temperature in Pandeglang waters during the observation month ranged from 28-30 °C. The pattern of sea surface temperature distribution in the fishing ground area is influenced by the water mass from the Karimata Strait, Java Sea and Indian Ocean. Water mass mixed in Sunda Strait cause warmer temperature. Changing temperature were detected in December and April. This possibly due high and intense rainfall in December and transition time from wet to dry season in April. Sea current on the surface of fishing ground area ranged from 0.6-0.8 m/s. This current is strongly influenced by the monsoon wind (munson). The current will support fish distribution, especially in the spawning time by diverting the eggs and fish larva to the nursery ground area. Fishing ground in the waters of Pandeglang possesses high fertility since the current is enable the mixing process of between water masses from the Indian Ocean and the Java Sea [2]. The mixing gives a positive impact on plankton abundance and fish habitat during spawning.

The waters brightness at the fishing ground area were detected from 6-9 m. Salinity in the fishing ground ranged from 30-32 g/L. Fluctuations in salinity are affected by season conditions during observation. Low salinity was detected in December as rainfall went high and intense. Low salinity also found in April, as changing period from wet to dry season.

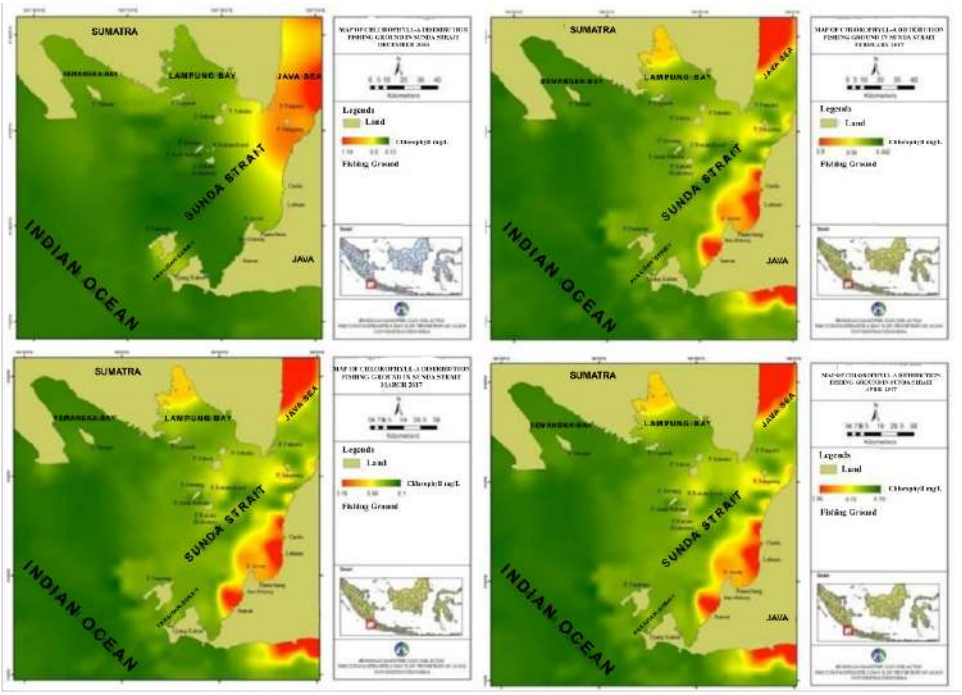

FIGURE 2. Chlorophyll-a in the fishing ground during observation month

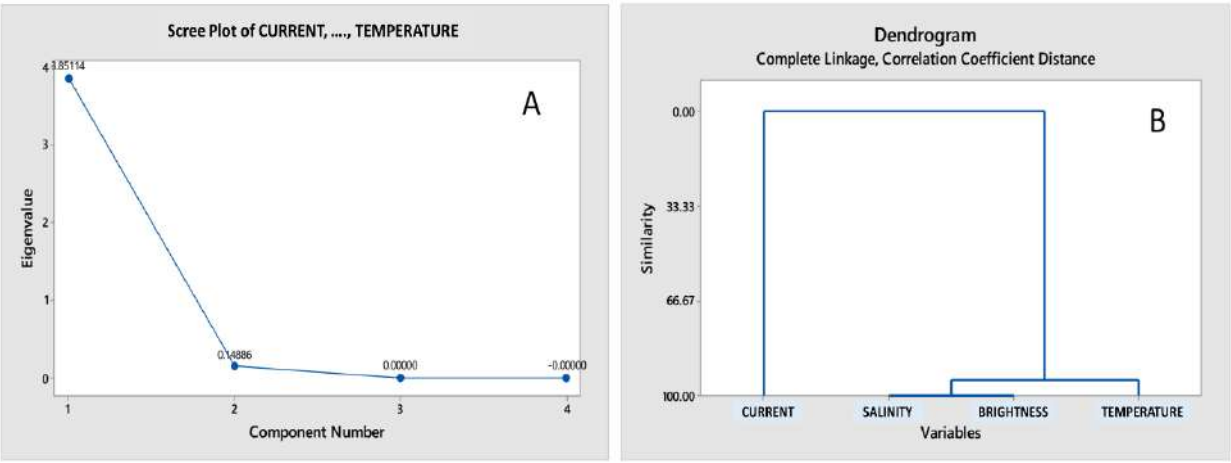

FIGURE 3. Eigenvalues from main component and dendogram between water quality parameters

Chlorophyll – a on December was 0.13 mg/m^3. This was lower compared to February to April 2017 which ranged from 0.9 – 2.0 mg/m^3 (Fig. 2). During those month fishing area of Batu Hideung and Sumur were fertile.

Multivariate Analysis of Water Quality

Principal component analysis (PCA) is statistical multivariate used to describe the variation of a non-correlated set of parameters into several stand-alone parameters (main components). The total PC produced shows that only one major component plays an important role i.e. PC1, with a cumulative total percentage of 96.3%. PC determination based on an eigenvalue greater than 1 [15]. The eigenvalues can be seen in Fig. 3 (A) while the result of analysis of the main components of aquatic parameters in Pandeglang waters can be seen in Fig. 3 (B).

PC 1 wreas determined by salinity, brightness, and temperature (0.507, 0.505 and 0.480 respectively). The results of cluster analysis showed a strong relationship between salinity and brightness (99.95%) and their relation with temperature (99.92%). Increased salinity is strongly influenced by the intensity of light which encounters waters. Higher the intensity of light enlarges the evaporation process as salinity goes up. Temperature and salinity distribution in the waters including Pandeglang area is influenced by the intensity absorption of sunlight heat, rainfall, marine water connectivity with rivers and circulation patterns of currents. SPL is influenced by atmospheric conditions and the intensity of solar irradiance into the ocean [16], geographic factors and current dynamics [17]. The rise in temperature can decrease oxygen solubility and increase pollutant toxicity [18].

Catch of Small Pelagic Fishes

Small pelagic fish around the waters of Pandeglang which caught during the month of observation were dominated by rosy threadfin bream, mackerel, yellowtail scad, frigate tuna and Indian scad (Fig. 4).

Indian scad belongs to fast swimmers, pelagic, non-settling and clustered. This type is stenohaline, living in relatively high saline waters (32-34 g/L) with a narrow range and prefer clear waters. Yellowtail scad is found at tropical waters with warm temperature. Spawning happens at night with salinity range 31-33 g/L. These fish consume on smaller fish and shrimp. Frigate tuna are pelagic fish which prefer temperature from 18 – 29 °C. Mackerel is small pelagic fish which distributed along coastal and offshore waters, living in clusters and entering estuary waters for foraging. These fish consume on plankton, detritus and filament algae (184 - 300 μm), living at sea surface temperatures ranging from 28-29,39 °C and salinity for spawning in the range of 32-34 g/L.

The number of small pelagic fish catch by gillnet gear on December 2016 tended to be a fewer (80.5 kg) compared to February – April 2017 (111.7, 112.6, and 125 kg) (Fig. 4). This possibly because in that on December, wet season is on highest level compared to other three months. Furthermore, inline with chlorophyll-a measurement, the number of catch by weight unit was rise as the chlorophyll-a went higher (0.19 on December and increase to 0.9 – 2.0 from February to April).

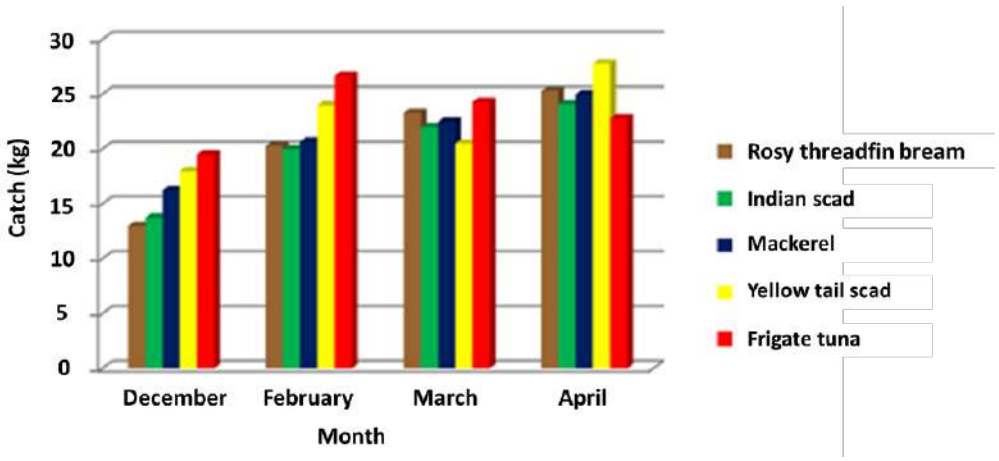

FIGURE 4. Small pelagic fishes catch

Relationship between Water Quality Parameters with Catch of Small Pelagic Fishes

Principle component analysis (PCA) found that the parameters, which influence the existence of small pelagic fish in Pandeglang waters, were salinity, brightness and temperature. Strong correlations between oceanographic parameter with catch were temperature (0.776) and salinity (-0.750). P-value for temperature equal to 0.000. This value showed that temperature has significant effect to fish catch compared to brightness. The coefficient for salinity variable was negative, indicating this parameter has contrast effect on the catch. The sign of the correlation coefficient for salinity with the fish catch in the correlation output and the regression output results show the negative equation, so there was no multi collinear indication in the model.

Temperature can be applied to determine and assess fishing area. In sea, temperature directly affect photosynthesis rate and animal physiology especially their metabolism level and reproduction cycle. Indirectly temperature influence solubility of oxygen for marine biota respiration [19]. Fish is very sensitive to temperature changes even though only 0,03 °C. The effect of temperature on fish behavior will be seen clearly during the spawning period. Each fish has a certain temperature range for their spawning even with a particular seasonal cycle too [20]. Extreme temperature fluctuations will force the fish to spawn in other areas. The temperature at the surface layer is more homogenous because of the mixing by the wind and the waves. This layer supports the life of pelagic fish, passively floats the plankton, fish eggs, and larvae. The cold layer below thermoclin supports the life of benthic and deep-sea animals [20]. Salinity is mainly deal with biological processes such as growth rate, amount of feed consumption and fish survival [21]. Fish tend to select areas with salinity levels which corresponding to osmotic pressure. Salinity also affects the distribution of eggs, larvae, juveniles and adult fish, migration orientation and reproduction success [22].

The brightness level in the waters indicates the rate of phytoplankton distribution and the fertility of the waters. The productivity of plankton will increase as the intensity of light entering into the waters. The abundance of chlorophyll-a was likely influenced by west monsoon occurs from December to February. In this season, the surface temperature tended to be low due to rain intensity. In the transition season I (March-May) an increase in SPL values which affect the abundance of chlorophyll-a. The influence of the Indian Ocean water mass to the Java Sea affected the fluctuation of the distribution of chlorophyll-a concentration in the waters of Pandeglang as it passed so that there was mixing of water masses from two different seas [2].

CONCLUSIONS

During December 2016 to April 2017, there was increasing on catch of small pelagic fishes by weight units. Temperature is strongly correlated to brightness and salinity in determining water quality. Temperature also performed significant correlation with number and presence of catch of small pelagic fish.

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