Analysis of Carrying Capacity of Blekok Beach and Kerapu Beach Situbondo as Conservation Areas for Mangrove, Blekok Bird (*Ardidae*) and Grouper Fish Cultivation (*Epinephelus*)

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Abstract. This study aims to analyze the carrying capacity of the coastal waters of Blekok and the coast of Kerapu, Situbondo, East Java as a conservation area for mangroves, blekok birds and grouper fish cultivation. The study used the *in situ* observation method, carried out in January–February 2021. The sampling was on Blekok beach at latitude coordinates: -7.69742 and longitude: 113.92206, on Kerapu beach at latitude coordinates: -7.69568 and longitude: 113.89666. At each beach the data is taken at 3 stations, at each station 3 sub stations are taken. Parameters measured include physical (temperature, turbidity, TSS, TDS), chemical (pH, salinity, DO, BOD, Cu), and biology (total *Coliform*) were measured *in situ* and at the Environmental Laboratory, Situbondo Environmental Service. Analysis of Cu concentration using *Atomic Absorption Spectrophotometer* method. *Coliform* total analysis used the *Most Probable Number* method. The data were analyzed descriptively qualitative-quantitatively and compared with the quality standard of the Minister of Environment Decree No. 51/2004. The results showed that the physical, chemical, and biological parameters of the coastal waters of Blekok and Kerapu beaches were in accordance with quality standards so the carrying capacity as a mangrove conservation area, blekok birds, grouper cultivation and tourism is very good.

Keywords: Carrying capacity, Water parameters, Blekok and kerapu beaches, Mangrove conservation.

1 Introduction

Situbondo Regency, East Java is geographically located at 07°43'LS and 114°0.1'BT, has an area of 1.638.50 km² [1] with a beach length of 150 km stretching towards the waters of the Madura Strait [2]. This northern coastal area of Java has many beaches with various uses, ranging from ports, tourism, aquaculture, conservation areas and Baluran National Park. The potential of these marine resources needs to be preserved so that their economic value and benefits are maintained and can be inherited by future generations.

Blekok beach is located in Blekok Village, Klatakan Village, Kendit District, Situbondo Regency. On this beach there is a 6.3 hectare mangrove forest [3] which is used as a conservation area for mangroves and blekok birds. Being the habitat of thousands of water birds, especially the *Ardidae* species known as blekok, so it is called Blekok beach. In addition, this beach is also a habitat for various species of gastropods and bivalves (*shellfish*). One type of shellfish that is often sought after

and used as food is *Mercenaria*. On the beach Blekok developed marine tourism with the concept of community-based ecotourism (*community-based tourism*). This means that tourism is characterized by community participation starting from the process of planning, implementing, or implementing, monitoring, and utilizing the results. Local communities who build, own and manage tourism facilities and services [4], are expected to be able to improve the economy while preserving the environment.

Kerapu beach, which is located in Gundil, Klatakan Village, Kendit District, Situbondo Regency, is one of the favorite tourist destinations for Situbondo residents. Known as the grouper beach because it is an area that produces quality grouper seeds and fish in Indonesia. Grouper production in Situbondo district is 500 tons/year [5]. Kerapu beach is used as a center for grouper cultivation using floating net cages (FNC). The floating net cage is a combination of various buoys that are shaped in a rectangle and installed with nets as a means of keeping fish floating on the water. The buoy is

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then combined with other buoys to form a stretch of 150-200 square meters. These cages are then spread out and floated in the sea at a distance of about 100-500 meters from the shore so that they do not move with the ocean currents [6].

Marine ecosystems have various benefits for human life [7] including as the main source of salt production, fish farming, lobster, and seaweed as well as other environmental services. The use value of this aquatic ecosystem will be disturbed in the event of water pollution. Utilization of Blekok beach as a conservation area and tourist destination will produce a different impact from the Kerapu beach which is used as a center for grouper cultivation. Waste from tourism activities is certainly different from waste from aquaculture activities, where the rest of artificial feed is the most dominant. The waste generated from these two natural utilization activities needs to be monitored and controlled. This needs to be investigated in order to minimize the negative impact, so that the sustainability of the coastal ecosystem remains sustainable.

Sea water pollution occurs due to the entry or inclusion of living things, substances, energy and or other components into the marine environment by human or natural activities so that the quality decreases to a certain level which causes sea waters to no longer function according to their designation and are not in accordance with quality standards which has been determined [8]. Sources of marine pollutants include waste water from urban and industrial areas carried into the sea, domestic waste, dirt particles carried by the air, organic and inorganic chemicals, residues from fishing boat activities, water sports equipment, and radioactive waste materials [8]. This sea water pollution can cause a decrease in its quality so that it carrying capacity for marine life systems is disrupted.

Materials that cause sea water pollution can come from various sources [8]. Pollutants are materials that are foreign or materials that come from nature itself that enter the marine ecosystem so that it interferes with its designation. Based on the way of entry, pollutants are grouped into natural pollutants and anthropogenic pollutants. Natural pollutants are pollutants that enter the marine environment naturally, for example due to volcanic eruptions, landslides, floods and other natural phenomena. Anthropogenic pollutants are pollutants that enter the sea due to human activities, such as domestic, urban, and industrial activities [9].

Based on their toxicity, pollutants are divided into non-toxic and toxic pollutants [10]. Non-toxic pollutants are usually present in the marine ecosystem naturally. The destructive nature of this pollutant appears when it is in excessive quantities so that it can disrupt the balance of the ecosystem through changes in the physical-chemical processes of the waters. Non-toxic pollutants consist of suspended materials and nutrients. Excessive nutrients can stimulate the occurrence of enrichment (*eutrophication*) of waters and can spur the growth of microalgae and aquatic plants rapidly (*blooming*), so that it can disrupt the balance of the aquatic ecosystem as a whole. Meanwhile, toxic pollutants can cause death (*lethal*) and do not cause death (*sub lethal*), for example, interfere with the

growth, behavior, and morphology of aquatic organisms. Toxic pollutants are usually in the form of non-natural materials such as pesticides and detergents [10]. To maintain the sustainability of the conservation and cultivation functions of the two beaches, it is necessary to monitor their carrying capacity. The three main parameters in measuring water quality are physical parameters including temperature, turbidity, TSS (*Total Suspended Solids*) and TDS (*Total Dissolved Solid*), chemical parameters include pH, salinity, DO (*Dissolve Oxygen*), BOD (*Biological Oxygen Demand*), and heavy metal content, and biological parameters of *total coliform* content in seawater [11].

Temperature is one of the most important parameters for the survival of aquatic organism because it affects the growth of plankton and other aquatic organism. Temperature plays a role in controlling the process of respiration and metabolism of aquatic organism which can affect the behavior, growth, and reproductive cycle [8], because changes in temperature affect the physical, chemical and biological processes of the waters. The increase in water temperature according to [12] will cause dissolved oxygen levels in the water to decrease, the speed of chemical reactions increases, so that the life of aquatic organism is disturbed. If the lethal temperature limit is exceeded, fish and other aquatic animals will die. Water temperature affects the metabolism of aquatic animals, where the higher the temperature at the optimum limits, the metabolism of aquatic animals increases. Water temperature also affects the activity of microorganisms in the decomposition of organic materials, the higher the temperature, the activity of microorganisms increases which causes dissolved oxygen consumption to increase. According to [13], the natural temperature for tropical waters suitable for living organisms ranges from 23-32°C.

Turbidity is an optical property of water or the large number of particles in water that affect the process of respiration and photosynthesis. The nature of the particles gives a color effect to the water while the concentration of the particles affects the level of transparency of the water. Turbidity is caused by the presence of suspended and dissolved organic and inorganic materials (mud and fine sand) and organic matter (plankton, microorganisms, animals and or aquatic plants) as well as inorganic such as weathering of rocks and metals [14].

Total Suspended Solids (TSS) are suspended materials with a diameter of less than 1µm in a Milipore sieve with a pore diameter of 0.45 µm [12]. Suspended solids are suspended materials that cause water turbidity consisting of particles in the form of solid mud, fine sand and micro-organisms mainly caused by erosion, phytoplankton, zooplankton, as well as dead components in the form of detritus and inorganic particles [15], or a mixture there of [13]. The higher the concentration of suspended solids in the water, the higher the level of turbidity of the water so that it can block the penetration of sunlight and inhibit photosynthesis and reduce dissolved oxygen levels [14]. TSS is one of the important factors in decreasing water quality, causing physical, chemical and biological

changes [16]. The amount of TSS in the waters can reduce the availability of dissolved oxygen, if it lasts a long time it will cause the waters to become anaerobic, so that aerobic organisms will die. The high TSS can also directly disturb aquatic organism such as fish because they are filtered by the gills. The TSS value can be one of the water biophysical parameters that dynamically reflects changes that occur on land and in the waters. TSS is very useful in the analysis of polluted waters and domestic effluents and can be used to evaluate water quality, as well as determine the efficiency of sewage treatment units. A high TSS value in a water indicates that the water contains a lot of particles of sediment, mud, fine sand, soil erosion carried to water bodies, organic materials (decomposed detritus), as well as phytoplankton cells and living micro-organisms others [12]. According to [17], the high value of TSS indicates the presence of materials and solids from the mainland that enter the waters so that it disrupts the balance of the aquatic ecosystem.

The content of solids in waters can be measured based on total dissolved solids (TDS) and total suspended solids (TSS). Total dissolved solids are physical parameters of raw water and the size of dissolved substances, both organic and inorganic substances [14]. TDS contains various solutes (both organic, inorganic, or other materials) with a diameter of $< 10\text{-}3\text{ }\mu\text{m}$ [18]. The most common ions present in water are calcium, phosphate, nitrate, sodium, potassium, magnesium, bicarbonate, carbonates and chlorides. Chemicals can be cations, anions, molecules or agglomerations of thousands of molecules. The main sources of TDS in waters are agricultural, household and industrial wastes. Changes in TDS concentration can be dangerous because it will cause changes in salinity, ionic composition and ions, and the toxicity of each ion so that it can disrupt the balance of aquatic organism, biodiversity, cause species that are less tolerant, and cause toxicity bag high in the life stage of an organism [19]. The content of TDS in water can also give a taste to the water, namely the water becomes like salt [20]. In seawater the TDS value is high because seawater contains salts which causes high dissolved solids values [13]. The TDS value of the waters is strongly influenced by weathering of rocks, runoff from the soil and anthropogenic influences (*domestic and industrial waste*) [17].

The degree of acidity (pH) states the concentration of hydrogen ions in waters [21] and can be used as an indication of pollution, especially contamination of organic matter. The breakdown of organic matter by microorganisms will produce carbon dioxide. An increase in carbon dioxide will result in a decrease in the pH value if the carbonate buffer system in the water is low. The pH value greatly affects the biochemical processes of the waters, for example the nitrification process will end at a low pH [18]. The pH of the water affects the biogeochemical processes of the waters so that it affects the life of aquatic organism [14]. pH can provide an idea of the balance of acids and bases which is determined by the concentration of hydrogen ions (H^+) in the water. In general, aquatic organism will live optimally at a neutral pH, which is between 6-7 which

is the best habitat for fish life [9]. [22] stated several factors that affect the pH value in the waters, among others: the concentration of dissolved gases such as CO_2 , carbonate and bicarbonate salts, as well as the decomposition process of organic matter at the bottom of the waters. The pH value is close to neutral indicating the decomposition process of organic matter by microorganisms is going quite well [21]. pH is an important ecological factor to control the activity and distribution of aquatic organisms because it affects respiration, enzyme systems, nutrient content and productivity. The high and low pH is influenced by several factors, including photosynthetic activity of marine organism, temperature, and water salinity. The pH range of seawater between 7-8.5 is very beneficial for the animals that live in it.

Salinity is the concentration of dissolved salts in one kilogram of seawater [21]. Salinity is a parameter that describes the total ion concentration of a waters with the main constituent ions are sodium, potassium, magnesium, chloride, sulfate and bicarbonate. Salinity is very influential on the survival of marine organisms. According to [14], salinity is directly proportional to TDS. This means that if the salinity is high, the TDS value is also high. The salinity of the waters has an impact on the magnitude of the osmotic pressure of seawater, the higher the salinity, the greater the osmotic pressure [14]. Waters with normal salinity range from 34 to 35 ppt [23]. Changes in salinity can affect intertidal zone organisms in two ways. First, because the intertidal opens at low tide, it is then flooded with fresh water or rainwater, resulting in a decrease in salinity. In certain circumstances the decrease in salinity will exceed the tolerance limit so that the organism can die. Second, tidal inundation, which is an area that holds sea water when it recedes. This area may be inundated with fresh water that flows in during heavy rains, thereby reducing salinity or may show an increase in salinity if there is very high evaporation during the day. [24] stated that the factors that affect water salinity include rainfall, water circulation patterns, river flow, and evaporation.

Dissolve oxygen (DO) indicates the level of dissolved oxygen in water that is needed for the process of respiration, photosynthesis and metabolism of aquatic organisms [14]. The organism's need for dissolved oxygen varies and depends on the type, stage, and activity of the organism [25]. DO is influenced by temperature and water minerals, the lower the temperature, the higher the DO and the better the water conditions [14]. The higher the temperature and salinity of the waters, the lower the DO level, and vice versa the DO value will be high if the water has a low temperature and salinity. The main source of oxygen in water comes from the process of diffusion from free air and the results of photosynthesis of aquatic organisms. Generally, oxygen is abundant in the surface layer because the air can be dissolved directly, diffuse into seawater and the rate of photosynthesis of marine plants [26]. According to [27], the ideal oxygen content in water is 3-7 ppm. DO content in waters is closely related to the level of pollution, type of waste, and the amount of organic matter [14] and is one of the most important determinants of water quality characteristics in the life

of aquatic organisms. The presence of organic waste, which in its degradation process requires oxygen, will reduce oxygen levels in the water [28] so that it affects the function and slows growth, and can even result in the death of fish [29].

Biological Oxygen Demand (BOD) is the amount of dissolved oxygen required by microorganisms to decompose organic matter aerobically [30]. The BOD value does not indicate the actual amount of organic matter, but only measures the amount of oxygen needed to decompose the organic matter [31]. BOD is an index number for benchmarks of pollutants in a water. The greater the BOD, the higher the concentration of organic matter in the water [32] and indicates that the water has been polluted [14]. The high value of BOD resulted in a decrease in the dissolved oxygen (DO) content of the waste so that the content of organic compounds produced was high and resulted in an increase in the value of suspended solids [33].

Metals are naturally found in aquatic environments, some of which are essential for aquatic organisms. Biologically, some metals are needed by living things at certain concentrations and will turn into poison if the amount is excessive. In water, metals are generally in the form of ions, either as ion pairs or in the form of single ions [34]. Sources of metal pollution in the waters include: (a) rocks and volcanic lava spills; (b) industrial waste ores and metals as well as other industries containing heavy metals such as the dyeing industry; and (c) garbage and solid waste. Heavy metals have a certain effect when they bind or enter the body of organisms. Heavy metals are divided into two types, namely essential and non-essential heavy metals. Essential heavy metals are metalling whose presence in certain amounts is needed by organisms, but if in excessive amounts it can cause toxic effects. Examples are Zn, Cu, Fe, Co, and Mn, while non-essential heavy metals are toxic heavy metals such as Hg, Cd, Pb, and Cr [34]. Copper (Cu) in significant amounts in water can pollute the environment. Cu usually comes from coloring and printing processes such as wood preservatives and anti-rust paint on ships, from the erosion of mineral rocks, dust, and Cu particles in the air layer carried by rain, and from human activities such as industrial waste containing preservatives, and household waste [34].

Coliforms are bacteria that live in the digestive tract of man. Coliform bacteria are gram-negative rod-shaped bacteria, are anaerobic or facultative aerobic, do not form spores, can ferment lactose to produce acid and gas at a temperature of 35-37°C [35]. The presence or abundance of coliform bacteria is most commonly used as an indicator of water contamination by feces. Called coliform bacteria because they represent *Escherichia coli* bacteria, which normally live in the human digestive tract. The presence of *E. coli* in the waters in abundance illustrates that the waters are polluted by human waste, which may also be accompanied by contamination of pathogenic bacteria. The total coliform bacteria consisted of *Escherichia coli*, *Citribacter*, *Klebsiella*, and *Esterobacter*. Coliforms can survive only a few hours or a few days outside their host, depending on environmental conditions [35]. Not all

coliform bacteria come from human feces. Different types of coliforms can be separated from one another by biochemical tests.

Based on the description above, this study aims to determine the quality of sea water in the mangrove and blekok conservation areas of Blekok beach and Kerapu beach based on physical, chemical, and biological parameters.

2 Method

This research is a descriptive study with *in situ* observation method, the data is taken in the field directly to the object of research, namely sea water at Blekok beach and Kerapu beach, Situbondo Regency, East Java. This research was conducted in January–February 2021. On the coast of Blekok, the sampling location was at the coordinates of latitude: -7.69742 and longitude: 113.92206, while at the Kerapu beach at the coordinates of latitude: -7.69568 and longitude: 113.89666. At each beach samples were taken at 3 stations, at each station 3 sub stations were taken. The research parameters measured included physical parameters (temperature, turbidity, TSS, TDS), chemical parameters (pH, salinity, DO, BOD, Cu concentration), and biological parameters (total Coliform bacteria). Measurements of temperature, pH, salinity, and DO of seawater were carried out *in situ*. Measurements of turbidity, TSS, TDS, BOD, analysis of copper (Cu) concentration and total *Coliform* of seawater, were carried out at the Environmental Laboratory, Situbondo Environmental Service. Analysis of copper (Cu) concentration using the AAS (*Atomic Absorption Spectrophotometer*) method. The total *Coliform* analysis used the *Most Probable Number* (MPN) method [35]. The data obtained were analyzed descriptively qualitative-quantitatively and compared with quality standards [36].

3 Results and Discussion

3.1 Physical Parameters of Marine Water at Blekok Beach and Kerapu Beach, Situbondo

The results of the measurement of physical parameters of sea water quality indicate that the waters in the Blekok coastal area and the Kerapu beach, Situbondo have a good carrying capacity for marine life. The mean value of each parameter is still within the range of quality standards [36] (**Table 1**). The water temperature ranges from 28.3-28.4°C, turbidity 4.6-4.9 NTU, TSS 88-26 ppm, and TDS 23.073-22.940 ppm. In general, Blekok coastal waters have higher TSS and TDS than Kerapu beaches, this is due to the high production of mangrove litter on Blekok beach which contributes to detritus in the waters.

Table 1. Physycal Parameter of Waters Quality at Blekok Beach and Kerapu Beach, Situbondo

Parameters	The Beach of		Quality Standards*)
	Blekok	Kerapu	
Temperature (°C)	28,3	28,4	28-32
Turbidity (NTU)	4,60	4,93	<5
TSS (ppm)	88	26	80
TDS (ppm)	23.073	22.940	-

The sea water temperature on the Blekok beach is on average 28.3°C and on the Kerapu beach 28.4°C. According to [36], the seawater temperature quality standard for marine organisms is 28-32°C for mangroves, and 28-30°C for seagrass. This indicates that the temperature of the two waters is included in the normal temperature and is good for the growth and development of marine life. This is in accordance with [13], the natural temperature for tropical waters suitable for living organisms ranges from 23-32°C. In aquatic organisms, temperature plays a role in controlling respiration and metabolic processes which can affect the behavior and growth processes as well as their reproductive cycle [16].

Based on the data obtained, the turbidity of Blekok coastal waters is 4.60 NTU and Kerapu beach is 4.93 NTU. According to [36], the quality standard of seawater turbidity for marine organisms is <5, thus, the turbidity value of the two waters is still within the quality standard range so that it is safe for marine life. Turbidity is an optical property of water or the number of particles in water that affect the process of respiration and photosynthesis. The nature of the particles gives a color effect to the water while the concentration of the particles has an impact on the level of transparency of the water. Turbidity is caused by the presence of suspended and dissolved organic and inorganic materials (mud and fine sand) and organic matter (plankton and microorganisms as well as aquatic animals and plants) as well as inorganic such as weathering of rocks and metals [14]. The relatively high turbidity on both beaches was due to the production of mangrove litter on the Blekok beach and detritus from leftover feed from floating net cages on the Kerapu beach.

Total Suspended Solid (TSS) are suspended materials with a diameter of less than 1 µm in a Milipore sieve with a pore diameter of 0.45 µm [12]. Based on the data, the TSS value of Blekok coastal waters of 88 ppm exceeds the quality standard, while on the Kerapu beach 26 ppm is still below the quality standard [36]. According to [36], seawater TSS quality standard for marine organisms is 20 ppm for coral, 80 ppm for mangrove, and 20 ppm for seagrass. The TSS level of Blekok coastal waters is higher than that of Kerapu beach because on Blekok beach there is a mangrove ecosystem with high detritus production, while on Kerapu beach it is not. Thus the two waters both have a TSS value slightly above the quality standard. A large TSS value indicates that these waters contain a lot of sediment particles, mud, fine sand, soil erosion, organic matter (decomposed detritus), phytoplankton cells and other microorganisms [12]. In addition, according to [17], the high value of TSS indicates that there are

materials and solids from the land that enter the waters so that they disrupt the balance of the aquatic ecosystem. This is in accordance with the fact that in the waters of Blekok and Kerapu are the estuaries of the rivers in Situbondo so that indirectly the flow also carries particles from the land which then ends up in the sea and causes high TSS in both waters.

Total Dissolved Solid (TDS) is a dissolved substance, both organic and inorganic substances with a diameter of < 10-3 µm [18]. TDS includes a number of materials in water, which can be carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, calcium, magnesium, sodium, organic ions and other ions. The content of TDS in water can also give a taste to the water, namely the water becomes like salt [20]. Based on the data obtained, the TDS value of Blekok coastal waters is 23,073 ppm and Kerapu beach is 22,940 ppm, so it is safe for marine life. According to [14], TDS values in the range of 10,000-100,000 are classified as salty waters. In seawater the TDS value is high because seawater contains salts which causes high dissolved solids values [13]. The TDS value of the waters is strongly influenced by weathering of rocks, runoff from the soil and anthropogenic influences (in the form of domestic and industrial waste) [17]. The designation of Blekok beach as a conservation and tourism area certainly has a different impact from the Kerapu beach which is used as an aquaculture area.

3.2 3.2. Chemaical Parameters of Marine Water at Blekok Beach and Kerapu Beach, Situbondo

The results of measurements of the chemical parameters of sea water quality indicate that the waters in the coastal area of Blekok and Kerapu beaches Situbondo have a good carrying capacity for marine life. The mean value of each parameter is still within the range of quality standards [36]. (Table 2). The pH of the water is 7.8 at Blekok beach and 7.7 at Kerapu beach. The salinity in both waters is 35 ppt so that it is in accordance with the quality standard. Dissolved oxygen levels on both beaches were above the quality standard (5 ppm) and BOD was slightly above the quality standard, respectively 2.26 ppm at Blekok beach and 2.42 ppm at Keraapu beach. This is due to the high organic matter produced by the mangrove ecosystem on the Kerapu beach and the remaining feed from grouper cultivation activities in floating net cages on the Kerapu beach. Heavy metal copper (Cu) was not detected in the waters of both coasts, this is possible because this coastal area has not been affected by industrial activities that produce Cu waste.

Table 2. Chemical Parameters of Waters Quality at Blekok Beach and Kerapu Beach, Situbondo

Parameters	The Beach of		Quality Standards *)
	Blekok	Kerapu	
pH	7,8	7,7	7,0-8,5
Salinity (ppt)	35	35	s/d 34
DO (ppm)	5,86	5,66	>5
BOD (ppm)	2,26	2,42	2,0
Cu (ppm)	0	0	0,008

The pH value in the coastal waters of Blekok is 7.8 and Kerapu is 7.7 and includes a neutral pH range. The degree of acidity (pH) states the concentration of hydrogen ions in water [21]. The higher the pH, the higher the acidity of the waters. According to [36], the pH standard of seawater for marine organisms is 7-8.5. This indicates that the pH of the water on the Blekok and Kerapu beaches is still in accordance with the quality standards so that it is safe for the growth and development of marine life. The pH range of seawater between 7-8.5 is very beneficial for the animals that live in it. The pH condition indirectly affects the biogeochemical process of the waters [14]. [22] states that there are several factors that affect the high or low pH value in the waters, including: the concentration of dissolved gases such as CO₂, carbonate and bicarbonate salts, photosynthesis of marine life, temperature, salinity, and the process of decomposition of organic matter in the bottom waters.

Salinity is the concentration of dissolved salts in one kilogram of seawater [21] which describes the total concentration of ions in the waters with the main constituent ions being sodium, potassium, magnesium, chloride, sulfate and bicarbonate [14]. The salinity of Blekok and Kerapu beach water is 35 ppt. According to [36], seawater salinity quality standards for marine organisms are 33-34 ppt coral, 34 ppt mangrove, and 33-34 ppt seagrass, thus the salinity of these two waters is slightly above the quality standard but is still classified as salinity normal. According to [23], waters with normal salinity have values ranging from 34 ppt to 35 ppt. On the other hand, the slightly high salinity of seawater on these two beaches could be due to the high levels of TDS in both waters. According to [14], salinity is directly proportional to TDS, meaning that if the TDS value is high, the salinity is also high. This is in accordance with the results of the study that the TDS value of the coastal waters of Blekok was 23,073 ppm and Kerapu beach was 22,940 ppm followed by the high salinity of the two waters, which was 35 ppt. Salinity is very influential on the survival of marine organisms. [24] stated that the factors that affect salinity include: rainfall, water circulation patterns, river flow from the mainland, and the evaporation process.

Dissolved oxygen (DO) indicates the level of dissolved oxygen in water that is needed in the process of respiration, photosynthesis and metabolism of aquatic organisms [14]. The results showed that the DO levels in the coastal waters of Blekok and Kerapu were 5.86 ppm and 5.66 ppm, respectively. According to [36], the DO quality standard for seawater for marine organisms is >5 ppm, thus the DO levels of the two waters are in accordance with the established quality standard and are safe for the life of marine organisms. DO levels are influenced by several factors, namely the diffusion of oxygen from the air and the rate of photosynthesis of phytoplankton and marine plants [26], as well as temperature and water minerals. The lower the temperature, the higher the DO and the better the water conditions [14]. This is in accordance with the results of research that has been carried out, namely the Blekok coastal waters have a lower temperature of 28.3°C

compared to the Kerapu beach at 28.4°C, therefore the DO water on the Blekok beach is higher at 5.86 ppm than the DO water on the coast of Kerapu which is 5.66 ppm. According to [27], the ideal dissolved oxygen content in water is 3-7 ppm.

Biological Oxygen Demand (BOD) is the dissolved oxygen level required by microorganisms to decompose organic matter under aerobic conditions [30]. Based on the data obtained, the BOD levels in the coastal waters of Blekok and Kerapu were 2.26 ppm and 2.42 ppm, respectively. According to [36], the BOD quality standard of seawater for marine organisms is 2.0 so that the BOD value in both waters is still in accordance with the quality standard and is safe for aquatic life. BOD that is too high is not good for waters because the higher the BOD value, it indicates the concentration of organic matter in the water is high [32] and indicates that the waters have been polluted. According to [33], the high value of BOD resulted in a decrease in dissolved oxygen (DO) content. This is in accordance with the results of the research conducted, namely the BOD value of the Kerapu coastal waters which is 2.42 ppm higher than the BOD value of the Blekok coastal waters of 2.26 ppm, causing the DO level of the Kerapu coastal waters to be 5.66 ppm lower than Blekok beach at 5.86 ppm.

Copper (Cu) is one of the parameters to determine the quality of a water. In water, metals are generally in the form of ions, either as ion pairs or in the form of single ions [34]. Copper (Cu) is an essential heavy metal whose presence in certain amounts is needed by organisms, but if the amount is excessive it can cause toxic effects [34]. Copper (Cu) in significant quantities in water can pollute the environment. Cu usually comes from coloring and printing processes such as wood preservatives and anti-rust paint on ships, industrial waste containing preservatives, household waste, and so on [34]. Based on the data obtained, in the coastal waters of Blekok and the coast of Kerapu, no copper (Cu) heavy metal was detected. According to [36], seawater Cu metal quality standard for marine tourism is 0.008 ppm. This indicates that the two waters are not polluted by heavy metals so that they are safe for the life of aquatic organisms, aquaculture, and tourism activities.

3.3 Biological Parameters of Marine Water at Blekok Beach and Kerapu Beach, Situbondo

The results of measurements of the biological parameters of sea water quality indicate that the waters in the Blekok coastal area and the Kerapu beach Situbondo have a good carrying capacity for marine life. The mean value of total *coliform* from each beach is still within the range of quality standards [36], which is <1.8. (Table 3).

Table 3. Biological Parameters of Marine Water Quality at Blekok Beach and Kerapu Beach, Situbondo

Parameters	The Beach of Blekok	Kerapu	Quality Standards *)
Total Coliform (MPN/100 ml)	<1,8	<1,8	1000

In this study, the biological parameter measured was total *coliform*. *Coliform* bacteria are gram-negative rod-shaped bacteria, are anaerobic or facultative aerobic, do not form spores, can ferment lactose to produce acid and gas at a temperature of 35-37°C [35]. The total *coliform* bacteria consisted of *Escherichia coli*, *Citribacter*, *Klebsiella*, and *Esterobacter* [35]. Based on the data obtained, the total *coliforms* in both Blekok and Kerapu coastal waters are the same, which is <1.8. According to [36], the total quality standard for seawater coliforms for marine organisms is 200 MPN/100 ml. This shows that the two waters are safe for life, growth and development of marine life, as well as tourism activities.

4 Conclusion

Based on the results of the research that has been done, it can be concluded as follows:

The carrying capacity of the coastal waters of Blekok and Kerapu beach, Situbondo in terms of physical parameters including temperature and turbidity according to quality standards, while the TSS and TDS values are slightly above the quality standards. When viewed from the chemical parameters including pH, DO, BOD, and Copper (Cu), the quality of the two waters is still in accordance with the quality standard, while the salinity is slightly above the quality standard but is still classified as normal. Judging from the biological parameters, the total *coliform* showed a value below the quality standard. Thus, in general, the quality of sea water in the coastal waters of Blekok and Kerapu beaches is classified as good and supports the life of marine organisms, aquaculture activities, and tourism activities.

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