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The Dynamics of Water Quality Soft-Shelled Crab Aquaculture in Pemalang Regency, Middle Java, Indonesia

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Abstract: ***The purpose of this study to determine the dynamics of water quality soft-shelled crab aquaculture in Pemalang Regency in 2011-2013. The results showed that the water quality conditions are not suitable for media live crabs. This is demonstrated by the increased organic matter from 85.68 - 119.93 mg / l, dissolved carbon dioxide range of 4.8 - 17.9 mg / l, phytoplankton density increased from 33.8 * 10^4 to 39.3 * 10^4 cells / cc, dissolved oxigen range 2.5 - 5.4 mg / l, pH 5.6 - 6.8, salinity 22-28 ppt (median range 24-26 ppt), and temperature 23 - 32 degrees Celsius (median range 26-29 ^{o}C). The production decreased from 1340 - 1190 kg/ 0,35ha.***

Keyword: Aquaculture, Soft-Shelled Crab, Water Quality.

1. Introduction

The Soft-shelled crabs are soft-shell crab that has undergone a change of skin (molting). Pemalang Regency is a soft-shelled crab aquaculture centers in Middle Java of Indonesia, with production of 2500 kg/0,35ha in 2005. The production of soft-shelled crabs decreased 1810 kg / 0.35 ha in 2011, and production only reached 1180 kg / 0.35 ha in 2013. The management of soft-shelled crab aquaculture in Pemalang Regency conducted semi-intensive, Kroyo stocking densities, the young crabs that are used as seed, reached 4-5 crab / m^3. Trash fish feed by 10% / BB / hr. Water circulation system is gravity ranging from 13-16% per day, let in and let out ponds using 4 pieces of PVC pipe 8 ', the mean volume of 3500 m^3 pond. Agus (2008) states, Kroyo ideal stocking densities up to 3 ekor.m-3, it is based on the ability carryng capacity of ponds in the Pemalang Regency. The results of research Agus (2008; 2010; 2013) that the water quality aquaculture of soft-shelled crabs in Pemalang Regency in 2005 in the range of feasible for farming crabs are DO (4.6 - 5.1 mg / l), CO_2 (7.6 - 8.2 mg / l) , pH (7.3 - 7.9), Organic Matter (9.83 mg / l), NO_3 (1.8 mg / l), total phosphorus (0.05 mg / l), the density of phytoplankton (7.1 * 10^4 - 8.1 * 10^4 cells / cc). The growth and survival of the crab is strongly influenced by the physiological and metabolic optimum, while water quality conditions as the medium of live crab is very influential on the physiological and metabolic (Huberman, 2000; Erner et al, 2001; Bocking et al, 2002; Sorta and Yuwono 2005; Karim, 2006; Mykles, et al, 2010). The purpose of this study to determine the relationship dynamics of water quality soft-shelled crab aquaculture to the decline in production.

2. Materials and Methods

Study Area

This study was conducted in 24 ponds, which are used for the aquaculture of soft-shelled crabs in the village Mojo Ulujami in Pemalang Regency as the centra of soft-shelled crab aquaculture in middle Java of Indonesia

Water Quality and Production Yield Analysis

The Present investigation is made between January 2011 and January 2013. The water quality data and production results were analyzed descriptively while relations were analyzed with regression correlation. The analyzable in some parameters for water quality that is organic meters, dissolved carbon dioxide (CO_2), phytoplankton density, dissolved oxigen, pH, salinity and temperature. The water quality samples were collected from soft-shelled crab pond aquaculture by Spectrophotometer for organic meters, dessolved carbon dioxide (CO_2), Sedgwick-rafter for cell counting phytoplankton, walklab digital oxygen meter for dissolved oxygen, pH digital meter for water pH, refractometer for water salinity and thermometer (Hg) for temperature. The production results is calculated based on the total weight of the molting crabs.

3. Result and Discussion

The condition of the water quality in aquaculture ponds soft-shelled crabs are not suitable for media live crabs. The condition of the water quality in aquaculture ponds soft-shelled crabs are not suitable for media live crabs. This is demonstrated by the increased organic matter from 85.68 - 119.93 mg / l, dissolved carbon dioxide range of 4.8 - 17.9 mg / l, phytoplankton density increased from 33.8 * 10^4 to 39.3 * 10^4 cells / cc, dissolved oxigen range 2.5 - 5.4 mg / l, pH 5.6 - 6.8, salinity 22-28 ppt (median range 24-26ppt), and temperature 23 - 32 degrees Celsius (median range 26-29 ^{o}C). Production results decreased from 1340 - 1190 kg / 0,35 ha.
The organic material in the pond increases with the soft-shelled crab aquaculture activities. The linkage relationships soft-shelled crab aquaculture period to increase positive linear patterned organic material ($Y = 1,387X - 16.58$ $R^2 = 0.83$). The increasing the organic matter due to the accumulation of food remains and feces of crabs were cultivated. Stocking density crab 4-5 crab / m3 belonging to exceed the ideal stocking density ranging from 2 -3 tail / m2. (Agus, 2008). The content of organic material in aquaculture depends on the stocking density, efficiency of feed

utilization, and the amount of water circulation daily. The Kultivan high stocking density followed by feeding high anyway, so that feces and waste feed will also increase. Minimal water circulation conditions resulted in an imbalance of water quality, especially the growing organic material impact on kultivan stress to cause a decrease in the efficiency of feed utilization. The organic materials are ideal pond waters range in 20-40 mg / l. Otherwise overly fertile waters when the organic matter content of> 75 mg / l. (Bardach et al, 1973; Zonneveld, 1991; Effendi, 2004; Bulanin and Ronal, 2005; Agus, 2005; 2008; 2009; 2013; 2014). Circulation of water with a range of 13.6 to 16.1% have not been able to degrade organic matter, so that the organic material in the water in the range of 85.68 - 119.93 mg / l. This value has been exceeded the threshold for eligibility.

The density of phytoplankton in the pond waters shelled crab aquaculture reached 33.8 * 10^4 to 39.3 * 10^4 cells / cc. Phytoplankton in the pond waters ideal range between 5 * 10^4 -10 * 10^4 cells / cc, the range has no impact on fluctuations in dissolved oxygen which is quite wide, but the density of phytoplankton> 20x104 cell / cc lead to fluctuating oxygen is very wide, even that range often cause of death in kultivan because oxygen at night in critical condition. The high growth of phytoplankton is caused by an increase in organic material that produces nutrients for phytoplankton growth. The existence of phytoplankton in the waters is affecting the concentration of dissolved oxygen and dissolved CO_2, so that there is a relationship between these parameters causalistik, photosynthesis by phytoplankton will increase and decrease the oxygen content of CO_2 in the water. (Boyd, 1992; Viyard, 1999; Effendi, 2003; Marsambuana et al, 2008).

High density of phytoplankton causing quite wide fluctuations in dissolved CO_2. Photosynthesis during the day led to the use of CO_2 dissolved in the pond water so that dissolved CO_2 decreases to 4.8 mg / l, and in the evening dissolved CO_2 production from the rest of the metabolism, respiration, and penguaraian organic materials increased to 17.9 mg / l. The ideal CO_2 dissolved in the pond waters between 5-15 mg / l. Dissolved CO_2 reaches 20-60 mg / l is not a point of lethal concentration in crab cultivation, but it is a compound for crab in taking O_2 dissolved through the gills. (Agus, 2015). The presence of CO_2 dissolved in water can be an indicator of the amount of dissolved O_2 and pH, it is because the amount of CO_2 in the water is always inversely proportional to the amount of dissolved O_2 and pH value (Alert and Symmetry, 1984; Boyd, 1992; Effendi, 2003; Avnimelech, 2004).

The dissolved oxygen is one of the important parameters in the soft-shelled crab aquaculture activities in ponds. The presence of oxygen in the water is very important in relation to a variety of aquatic biological chemical processes. Oxygen is required in the process of oxidation of various chemical compounds and respiration of aquatic organisms (Dahuri, et al., 2004). Oxygen is needed in the body of the crab to feed the combustion of which produces energy for activity, the process of osmoregulation, growth, moulting, and reproduction. (Bardach et al, 1973; Zonneveld et al, 1991). Phytoplankton photosynthesis during the day can help supply the dissolved oxygen up to 5.4 mg / l, so that the physiological and metabolic activity of crab met. Molting crab can perfectly when energy sufficiency and dissolved oxygen of at least 4 mg / l. (Karim, 2006). Increased organic matter, phytoplankton, dissolved CO2, and the high density of the crab population led to the use of oxygen to the fullest until the dissolved oxygen in the range of 2.5 mg / l.

The pH value tended to decline with soft-shelled crab aquaculture activities in ponds, the pH value in the range of 5.6-6.8. The magnitude of the pH value indicates that the pond water aquaculture soft-shelled crabs are dominated NH3 than NH_4, high in organic matter and dissolved CO_2 concentration also affects the pH value decreasing, it is a very resulted in increased respiratory activity so that the dissolved oxygen will be a lot of unutilized. Low dissolved oxygen causes a decrease in appetite, and increased mortality crab. Pond pH value of less than 6 can cause death on the crab. pH in acidic conditions contributed to the increased activity of breathing and decreased appetite, pH on the acidic conditions caused damage to gill tissue (hyperplasia branchia), and increase the concentration of toxic gas (H2S). (Bowman's Lannan, 1995; Boyd et al, 2002; Williams, 2003; Avnimelech, et al, 2004).

The salinity in aquatic ecosystems act as masking factor composed of dissolved ions which include sodium, potassium, calcium, magnesium, chloride, sulfate and salinity bicarbonat.Peran in the aquacultureof soft-shelled crab is very important, because it affects the process osmoregulasi, metabolism, phase molting and growth. Optimal salinity (24-28 ppt) and supported by the dissolved oxygen > 4 mg / l greatly assist the smooth phase of molting maintain osmoregulation processes, metabolism and growth. (Erner et al, 2001; Bocking et al 2002; Sorta and Yuwono, 2005; Karim, 2007; Fujaya, 2008). The Salinity of pond water in the aquacultureof soft-shelled crabs ranges from 22-28 ppt, (median range 24-26 ppt), so that the range of the stretcher in the normal range for crabs in the hold of physiological activity (osmoregulasi and molting) and metabolic activity, but because of dissolved oxygen which is only around 2.5 mg / l and a high concentration of CO_2 dissolved in water is in the range of 17.9 mg / l, and the condition is relatively close to a pH value of acid, have an impact on the crab's ability to carry out activities of each phase of molting into abnormal, in addition to the conditions it also causes metabolic processes feed on crabs are also not optimal, it as a cause of declining production. Optimal salinity for molting crabs ranged from 24 ppt - 28 ppt nevertheless dissolved oxygen is also a limiting factor in the growth and molting crabs, it is because the dissolved oxygen used for respiration not only alone but also used for other physiological processes. (Sorta and Yuwono (2005); Karim (2007); Agus (2008).

The temperatur in waters act as a controlling factor, all the processes in the aquatic ecosystem balance is controlled by the temperature. Water temperature orgnisme affect physiological processes such as respiration, metabolism, feed intake, growth, behavior, reproduction, detoxification and bioaccumulation speed and survival. (Boyd, 1992; Effendi, 2003; Cholik, 2005; Fuad, 2005). Temperatures in the waters of soft-shelled crab aquaculture in ponds range from 23 - 32^{o}C. Temperatures during the day ranging from 27°C to 32 °C, while during the night of 24 to 26 °C. Temperature range is feasible for the life of the crab, physiology and metabolic activity will run normally when the conditions of pH, CO_2, dissolved oxygen, salinity and optimal condition parameters. Crabs are under stress and loss of appetite at temperatures <18 °C and> 32 °C. (Cholik, 2005).

The results of the production in this study is defined as the weight of the final result that has been molting crab biomass. Molting is a continuous process and a central place in the life of crab. crab growth will not happen without their molting events. Enducitis steroid hormone stimulation is for molting. Crab molting process requires high energy. (Erner et al, 2001; Bocking et al, 2002; Gunamalai et al, 2003; Fujaya, 2008). Survival, crab molting and growth are influenced by physiological and metabolic processes are optimized, while the dynamics of the water quality affects the metabolic and physiological processes including the formation of molting hormone. The production of soft-shelled crabs in the pond aquaculture has decreased from 1340 into 1190 kg / 0.35 ha, this result is far below production in 2005 reaching 2400 to 2500 kg / 0.35 ha. The decline in production is due to the condition of the water quality is not optimal to support molting. crab looks dead if it fails molting. acidic pH conditions (5.6), CO_2 dissolved 17.9 mg / l and the dissolved oxygen in the critical value of 2.5 mg / l, is the cause of failure of molting crabs. Failed molting crabs as experienced by physiological and metabolic processes are not perfect. The pH value of 5.6 had an effect on the increase in the crab respiration, other things look red gill tissue (damaged). Dissolved CO_2 reaching 17.9 mg / l is already causing a decrease in dissolved oxygen exchange in the gills, so the need dissolved oxygen to ecophysiological processes are not optimal, it is exacerbated by the dissolved oxygen in the water is only about 2.5 mg / l.

4. Conclusion

The water quality in aquaculture ponds soft-shelled crabs in Pemalang Regency already in conditions unfit for life crabs as seen from the high organic matter reaching 119.93 mg / l, dissolved carbon dioxide range of 17.9 mg / l, phytoplankton density increased from 39.3 * 10^4 cells / cc, dissolved oxigen range 2.5 mg / l, pH 5.6, and therefore contributes to a decrease in production from 1340 into 1190 kg / 0.35ha. This value is below the production of 2005 to 2500 kg / 0.35 ha.

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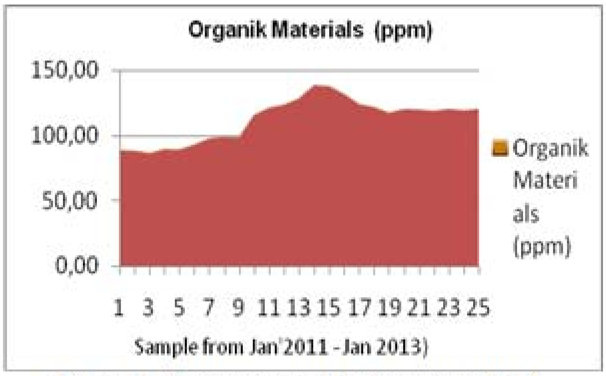

Figure 1: Organic materials dinamic in Pond

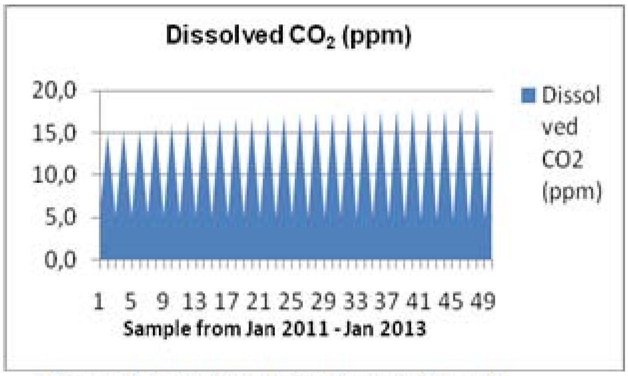

Figure 2: Dissolved CO_2 dinamic in pond

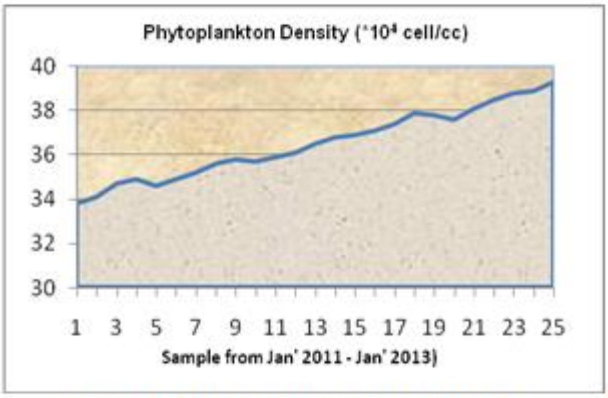

Figure 3: Phytoplankton density in pond

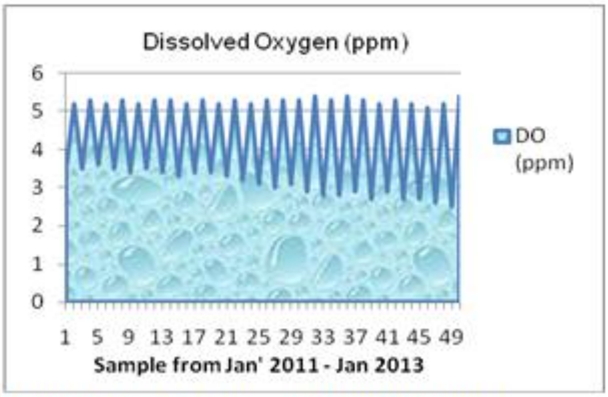

Figure 4: Dissolved oxygen dinamic in pond

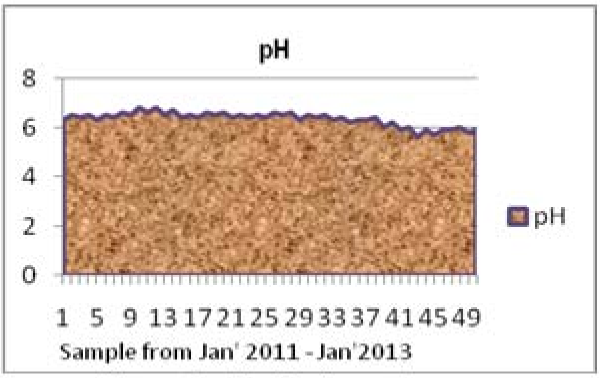

Figure 5: pH value in pond

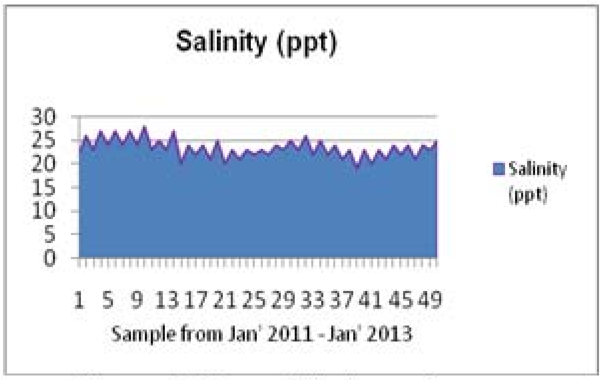

Figure 6: Water salinity in pond

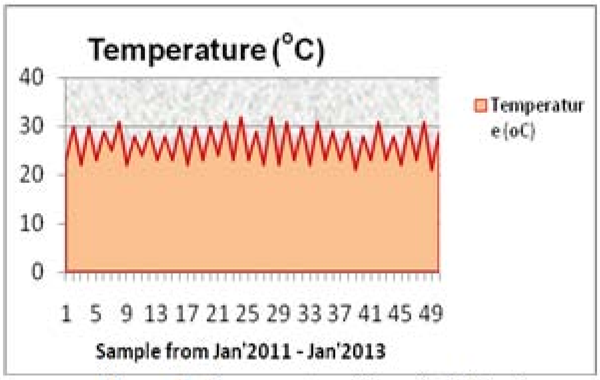

Figure 7: Temperature dinamic in Pond

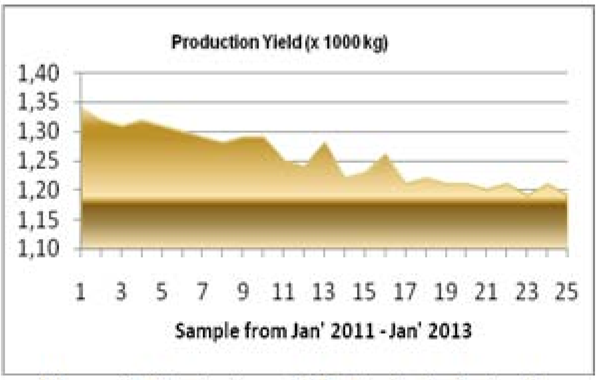

Figure 8: Production yield of soft-shelled crab