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Stunting technique innovation for increasing milkfish production on traditional ponds in Usto Village, Mare District, Bone

Muhammad Yusuf [1, *], Jayadi [2], Agus Suryahman [3], Andi Dyna Riana [1], Malik [4], Nurdin Kasim [5], Budiyati [6], Ibrahim Saman [7], Muhtazib [7], Syamsul Bachri [7], Mahmud [8], Sri Hajriani AR [9] and Irfan Ramis [10]

[1] *Department of Agribussiness, Fisheries Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[2] *Department of Aquaculture, Fisheries and Marine Sciences Faculty, Universitas Muslim Indonesia, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[3] *Department of Aquaculture, Fisheries Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[4] *Department of Electrical Engineering, Fisheries Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[5] *Department of Fishing Techniques, Politeknik Kelautan dan Perikanan Bone, Jl. Sungai Musi, Kelurahan Waetuo, Pallette, Tanete Riattang Timur, Bone, South Sulawesi, Indonesia.*
[6] *Department of Aquaculture Engineering, Politeknik Kelautan dan Perikanan Bone, Jl. Sungai Musi, Kelurahan Waetuo, Pallette, Tanete Riattang Timur, Bone, South Sulawesi, Indonesia.*
[7] *Department of Management, Socio-Economic and Humanities Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[8] *Department of Public Relations Studies, Socio-Economic and Humanities Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[9] *Department of Agricultural Technology, Agriculture Faculty, Cokroaminoto University of Makassar, st. Perintis Kemerdekaan km.11, Makassar, South Sulawesi 90245, Indonesia.*
[10] *Department of Islamic Economics, Faculty of Economics and Business, Universitas Negeri Surabaya, Jl. Ketintang No.2, Ketintang, Kec. Gayungan, Surabaya, East Java 60231, Indonesia.*

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Abstract

Milkfish (*Chanos chanos*) is a fish of high economic value with nutritional content and good taste (savory) like milk, with an oblong flattened body shape which is ideal as a bait for skipjack, mackarel, and tuna fish. Various efforts were made to increase pond productivity, including changing the orientation of cultivation from the target of consumption milkfish production to feed milkfish production. One technique that can be done to increase pond productivity is stunting techniques for bait milkfish cultivation. The purpose of this study was to determine the effectiveness of stunting techniques for increasing production of bait milkfish on traditional ponds in Usto Village, Mare District, Bone Regency. The research method used is quantitative research with the type of experimental research, where the effectiveness of stunting techniques is measured through measuring fish growth starting from the initial cultivation phase (post-stunting) to the harvest phase (end cultivation). The study was conducted for three months, from August to October (early November). The results of the study found that stunting techniques can increase fish productivity, by triggering the growth rate of milkfish in the cultivation phase with an average growth of 0.85-1.5 cm per week or 0.12-0.20 cm per day. Stunting techniques also pose a high risk, especially in size and mortality inequality in fish and reduce survival rates, due to high density. The stunting technique with a stocking density of 100,000 seed per hectare, is able to produce

* Corresponding author: Muhammad Yusuf

bait milkfish measuring 100-200 grams per pieces, which is 6-8 tons per hectare with an Survival Rate (SR) rate of 80%. Thus, this technique is considered good enough to increase pond production, especially in cultivation of bait milkfish.

Keywords: Seed; Survival rate; Milkfish; Water quality

1. Introduction

Milkfish or bolu fish in the Bugis-Makassar language, is one of the fish that is widely cultivated by the people of Indonesia in general, and people in South Sulawesi, including fish farmers in Usto Village, Mare District, Bone Regency, South Sulawesi. According to Riana et al., (2022) that in addition to tiger shrimp farming, people in Usto Village also cultivate milkfish along with shrimp or known as the polyculture system. Polyculture is a method of cultivation by placing several species in one cultivation container with different eating habits that aim to minimize interspecific competition and increase production profits. The application of the polyculture system in fish farming activities aims to improve land and feed efficiency, minimize operational costs used and provide additional compression for farmers. The application of tiger shrimp and milkfish polyculture system has a positive side in the stability of pond waters. Milkfish function as five controllers of plankton growth, both plankton needed in waters and harmful plankton in ponds. Milkfish have a pattern of motion that is always clustered, so the character of this fish can increase the process of oxygen diffusion in waters (Murachman et al., 2010). However, not a few people have started cultivating fish or shrimp with a monoculture system. The monoculture cultivation system was chosen to maintain the focus of cultivated organisms so that they can increase the stocking density and special treatment, so that productivity can be increased. According to Mahmud et al., (2007) that cultivation with a monoculture system is generally one of the fish farming systems carried out by raising only one type of fish in one pond. This is intended to be easy to control, where with only one type, it will be easier to handle (maintain). With one type of commodity, the stocking density is high and finally the productivity is also high. The results of research by Mahmud et al., (2007) in Pinrang Regency, South Sulawesi on the study of traditional pond business showed that the profit of monoculture system cultivation patterns was higher by IDR15,489,000 compared to polyculture cultivation patterns which were only IDR4,365,000. The average profit per hectare per year obtained by traditional pond farmers with monoculture patterns was higher than polyculture pattern cultivation, due to high stocking density.

Milkfish (*Chanos chanos* Forsskal), generally cultivated in pond areas which are estuarial areas. Milkfish is widely cultivated due to the high demand for milkfish consumption, both domestic and export. The high demand is due to the savory taste of milkfish meat (delicious), neutral meat taste (not salty like other sea fish in general) and not easily destroyed when cooked. The good taste is also supported by its nutritional content. According to Hafiludin (2015) that the nutrients contained in milkfish include protein, fat, vitamins and minerals. The protein content of milkfish ranges from 20-24%, amino acid glutamate 1.39%, unsaturated fatty acids 31-32% and contains macro and micro minerals namely Ca, Mg, Na, K, Fe, Zn, Cu and Mn. Meanwhile, according to Saparinto (2009) that in every 100 grams of milkfish, it contains various nutrients, such as: Protein (20 gr), Fat (4.8 gr) Calcium (20 mg), Phosphorus (150 mg), Iron (2 mg), Sodium (67 mg), Zinc (0.9 mg), Potassium (271.1 mg), Vitamin A (45 mcg), Thiamin (vitamin B1) (0.05 mg), Riboflavin (vitamin B2) (0.10 mg), and Niacin (vitamin B3) (6 mg). In addition, milkfish also contains saturated fatty acids (2.9 gr), cholesterol (57 mg), vitamin B12 (116% DV), vitamin B3 (44% DV), vitamin B5 (14% DV), and vitamin B6 (24% DV). Furthermore, Ahmad & Yakob (1998) milkfish is a potential source of animal protein for meeting the nutritional needs of the community. The nutritional content of milkfish is more complete with the presence of small amounts of riboflavin, folate and vitamin A as well as minerals including calcium, iron, potassium, and zinc. Milkfish is also rich in amino acids and fatty acids. There are about 17 types of amino acids that can be found in milkfish with the highest amino acid content is glutamic acid. In milkfish there are also six types of fatty acids identified, with the highest saturated fatty acid content is palmitic acid and the highest unsaturated fatty acid is oleic acid. Milkfish does contain a large amount of fat, but 60% of the fat is heart-healthy monounsaturated fats, including omega-3 fatty acids that have many benefits for general body health.

The high demand for milkfish is not only caused by the nutritional content in it, milkfish also has religious value, especially in the Chinese community, where at every Chinese New Year celebration, milkfish becomes the main dish in the New Year banquet. On the other hand, milkfish has also now been widely used to be a bait for TTC fish (skipjack tuna cob). This is as stated by Ismail & Pratiwi (2001) that milkfish farming today has also focused a lot on efforts to utilize milkfish as tuna bait, in addition to consumption. The same thing is also stated by Ghuffran & Kordi (2010) that milkfish has advantages over other fish, because milkfish can be produced as fish for domestic consumption, export, and as bait for catching tuna (Thunnus) and skipjack (Katsuwonus). Furthermore, it is stated that milkfish have advantages as bait, namely having a flattened and elongated body, and having shiny scales that can be an attraction for large fish, such as tuna and cobs (Dharma et al., 2019; Rinaldi et al., 2019).

The need for milkfish as bait is currently relatively high both to meet domestic and export needs. The destination countries for milkfish exports so far originating from South Sulawesi are; Taiwan (573,402 kg), Sri Lanka (189,000 kg), South Korea (171,500 kg), South Africa (133,000 kg), Vietnam (53,089 kg), Ghana (52,000 kg), China (26,000 kg), and the United States (10,837 kg). The demand for milkfish, especially bait milkfish, continues to increase every year. The demand for bait milkfish is still difficult to meet considering the low number of farmers who cultivate milkfish for bait, besides that due to different cultivation techniques, which are more in the monoculture system, as well as the lack of public knowledge about bait milkfish cultivation techniques. For this reason, various efforts and innovations are needed in the cultivation of bait milkfish, including stunting techniques. This is the purpose of this research, namely the innovation of stunting techniques in increasing the production of bait milkfish in traditional ponds in Usto Village, Mare District, Bone Regency, South Sulawesi. This is intended to increase the production of bait milkfish to meet domestic and export needs.

2. Material and methods

2.1. Time and Location of Research

The research was conducted for 3 (three) months, from early August to the end of October 2023, in a traditional pond in Usto Village, Mare District, Bone Regency, South Sulawesi.

2.2. Methods and Types of Research

The research method used in this study is a quantitative method with a type of experimental research. Quantitative research methods are considered appropriate and in accordance with the research design. According to Yusuf et al. (2021) that quantitative research methods are methods that rely on objective measurements and mathematical analysis (statistics) in the research conducted. Meanwhile, according to Sugiyono (2018) that quantitative research methods are research based on the philosophy of positivism (relying on empiricism) used to examine certain populations or samples, sampling techniques are generally carried out randomly (*random*), data collection using objective research instruments, and data analysis is number (quantitative) or statistical, with the aim of testing established hypotheses. The type of research used is the type of experimental research. According to Sugiyono (2018) is a type of experimental research is a research technique used to look for the influence of certain treatments on others under controlled conditions. In other words, that experimental research is research to find out the consequences of the treatment given to something under study. Meanwhile, according to Latipun (2015) that experimental research is predictive research, which predicts the consequences of a manipulation of the dependent variable. This means that this research is usually carried out with basic assumptions or hypotheses that have been predetermined, to then be proven true through controlled actions or conditions.

2.3. Research Hypothesis

The main hypothesis to be proven in this experimental study is that stunting techniques in milkfish can increase the production of bait milkfish in traditional ponds.

2.4. Research Design

The research design carried out was the construction of a pond with a size of 20 x 40 m^2 (for the cultivation of stunting period) and a pond size of 100 x 200 m^2 (for fish rearing), with a water depth of 80-120 m, with a rectangular pond shape with two sluice gates (inlet and outlet). In both ponds, water quality measurements were carried out including; temperature, salinity, pH, and Dissolved Oxygen (DO) levels. Water quality measurements were carried out twice in each pond, namely measurements at the beginning (D_0) and measurements at the end (D_1), so that 16 (sixteen) measurement data were obtained. Furthermore, the results of measuring these parameters are compared with pond water quality standards. Measurement of stunting technique testing was carried out after the fish were moved to a second, larger map/pond. Measurement of fish growth in the second plot is an indicator of the success of stunting techniques carried out in the first plot.

3. Result and Discussion

3.1. Water Quality

Water quality conditions greatly affect the production of milkfish (*Chanos chanos*) (Chang et al., 2018). Water quality parameters also greatly determine the success rate of milkfish farming (*Chanos chanos*) (Saraswati & Sari, 2017). The results of the study obtained measurements of pond water quality in 2 (two) ponds, with 4 (four) main parameters, namely; temperature, salinity, pH, and Dissolved Oxygen (DO) levels. The measurement results are detailed as follows:

Table 1 Pond water quality measurement results

No	Parameters	Unit	Stunting Ponds		Cultivation Ponds		Optimal (quality standard)
			Beginning(D_0)	End (D_1)	Beginning(D_0)	End (D_1)	
1	Temperature	°C	29.0	30.5	29.2	31.0	28-32
2	Salinity	ppt	27.0	25.5	28.0	24.5	15-28
3	pH	-	7.4	6.8	8.0	6.9	7-8.5
4	DO	ppm	10.0	3.0	10.5	4.0	>4

Source: Measurement results, 2023

3.2. Temperature

Water temperature is a measure (degree) of high and low heat of water in a container, including in ponds (Choeronawati et al., 2019). Temperature is one of the most important pond water quality parameters (limiting factors for the growth of farmed fish) (Boyd, 2019). Therefore, in every study temperature measurements are always carried out and become important parameters that must be studied. Water temperature affects the growth and development of reproduction and survival of milkfish (*Chanos chanos*) (Haser et al., 2018). The temperature in the water of fish/shrimp cultivation media in general plays a role in terms of the relationship with appetite and metabolic processes of fish/shrimp. If a pond location whose microclimate fluctuates indirectly, it will affect the water cultivation media for cultivated commodities. In some types of commodities in general, appetite is still normal at water temperatures between 26-31°C. The following are the results of water temperature measurements at the beginning and end of stunting.

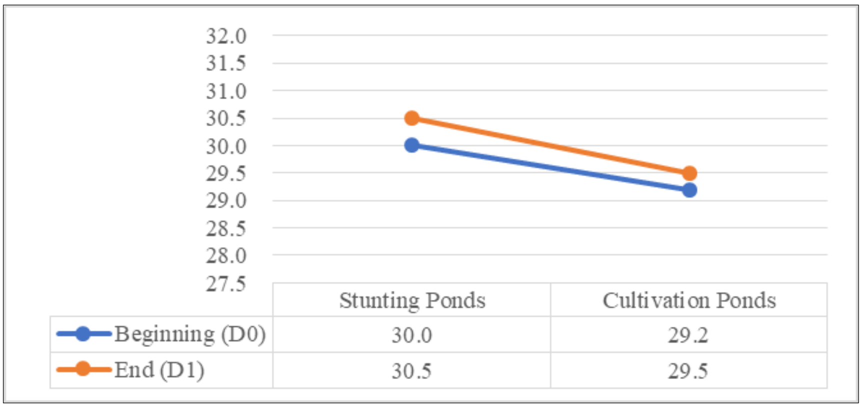

Figure 1 Water temperature measurement results (°C)

The results of measuring water temperature in both ponds (stunting and cultivation ponds), obtained that the temperature of the pond water is relatively stable and meets water quality standards for the cultivation of organisms in ponds, so it is safe for milkfish farming. Water temperature at the initial measurement before stocking fish fry ranges from 30-30.5 °C, while the final measurement of temperature shows a decrease in the range of 29.2-29.5 °C. The water temperature is high at the beginning of the measurement or before stocking because at that time there is high heat or the dry season experiences its peak, which is June to August. While the water temperature at the end of the measurement is in October and early November, slightly decreased as the air temperature from the dry season began to decrease marked by the occurrence of little rain. Water temperature is strongly influenced by solar irradiation factors (Georgiou et al., 2015). It is further stated that in summer, the water temperature is more risky (hotter) due to the intensity of solar irradiation, compared to the rainy season, where the water temperature is more stable (optimal), which ranges from 27-30.5 °C (Effendi, 2003). However, the water temperature, both at the beginning of the measurement and at the end of the measurement is still relatively safe and stable for fish rearing activities in pond milkfish farming, which is still within the range of pond water quality standards for aquaculture, which is 28-32 °C. According to Beltran et al. (2020) that the optimum temperature range for breeding milkfish (*Chanos chanos*) is 22-35 °C. Although milkfish can withstand temperatures of 32-35 °C, the temperature of pond water needs to be maintained, especially when fish are seed-aged, on the other hand generally pond water only has a depth of 1-1.5 m where the influence of sunlight is very dominant in generating heat in the water. Hot pond water conditions can trigger death in fish, so it takes several efforts and techniques so that fish fry can be maintained and protected, such as; Efforts to enter or add water, as well as efforts to provide foliage (coconut leaves, taro leaves and the like) as protection for fish.

3.3. Salinity

Salinity is defined as the weight in grams of all solids dissolved in 1 kilo gram of seawater (Zan et al., 2019). Salinity is closely related to the adjustment of osmotic pressure of aquatic organism (Varsamos et al., 2005). Salinity is a level of salt dissolved in water. The unit of salinity is parts per thousand (ppt) or interpreted as a representation of the ratio of salts dissolved in water (Juniarti & Jumarang, 2017). Salinity for shrimp should not exceed 35 ppt, if more than 35 ppt it will make shrimp die (Talley et al., 2002). While milkfish can live in the range of 60 ppt, but the optimal salinity for milkfish is in the range of 15-35 ppt. The results of salinity measurements are obtained as follows:

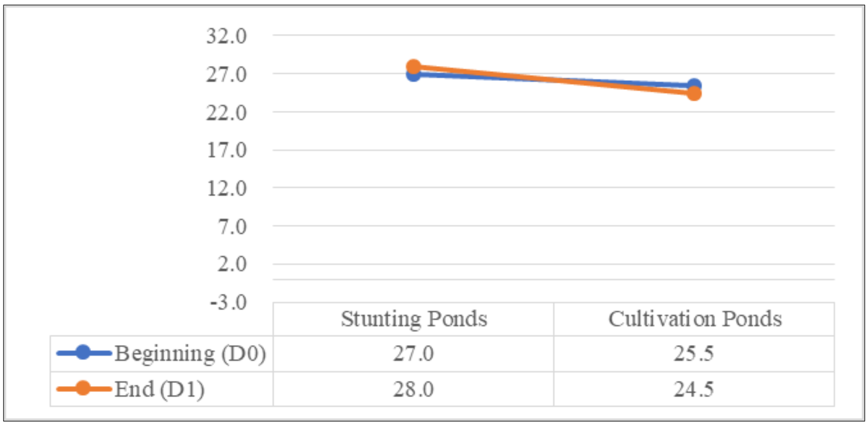

Figure 2 Salinity measurement results (ppt)

The salinity measurement results showed that the salinity concentration at the beginning of the measurement was relatively higher at 27-28 ppt, compared to the salinity measurement results at the end of cultivation, which was 24.54-25.5 ppt. The level of salinity determines the growth of organisms in waters, including in ponds. Water salinity needs to be considered in maintaining the growth of milkfish and shrimp. During the dry season, the salinity level of pond water will rise high, along with high evaporation, thus inhibiting the growth of fish in the pond (Ferreira et al., 2011). Similarly, in the rainy season, salinity will decrease due to relatively high freshwater supply. Salinity can change at any time both morning and evening, dry season and rainy season. However, the salinity level of pond water (stunting and cultivation ponds) is still relatively safe for the growth of bait milkfish, which is still within the optimal tolerance limit of 15-28 ppt. This salinity level is what milkfish are most happy to grow well (Supono, 2015). Further, Budiasti et al., (2015) that milkfish (*Chanos chanos*) is a euryhaline fish that can adapt to wide salinity, can live in fresh, brackish and marine waters. A good salinity range for milkfish (*Chanos chanos*) is 10-25 ppt (Barman et al., 2012). Beside, sufficient salinity levels of hyperhaline are thought to adversely affect the rate of feed assimilation and osmoregulation systems of organisms (Su et al., 2010).

3.4. pH

pH is defined as the degree of acidity used to express the level of acidity or wetness of a solution (Boyd et al., 2018). The degree of acidity or pH describes the potential activity of hydrogen ions in a solution expressed as the concentration of hydrogen ions (mol/l) at a given temperature, or pH = - log (H+) (Koparan et al., 2018). Brackish water generally has a neutral pH value, but in some areas, especially areas that have dominant nypa plants, brackish water has a pH below 7 or is acidic, and vice versa in brackish areas that are dominant seawater, it is more alkaline (>7) (Qin et al., 2018). Normal brackish water has a pH ranging from 7-9 (Boyd & Tucker, 1998; Chien, 1992). The degree of acidity or pH is one of the chemical parameters that is quite important in monitoring the stability of waters (Kale, 2016). The degree of acidity is a limiting factor that influences and determines the speed of metabolic reactions in consuming feed (Simanjuntak, 2009; Chang et al., 2019). The following are the results of pH measurements in both pools.

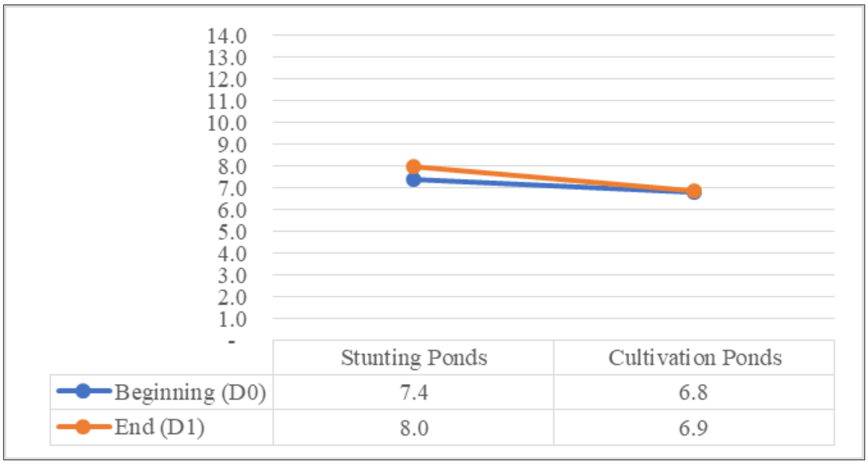

Figure 3 Measurement results of pH

The results of pH measurements obtained values ranging from 6.8-8.0 which indicate that the pH of pond water is in neutral conditions and good for the growth of farmed fish. The pool water at the beginning of the measurement appeared higher (7.4-8.0) than the pH concentration at the end of the measurement (6.8-6.9). This can be caused by various factors including high photosynthetic activity and respiration of aquatic organisms in ponds (Ching, 2007). The research results by Schuler (2008) show that the pH value can be lower due to high organic matter content. The pH value of water may decrease due to the process of respiration and decay of organic substances. The decrease in water pH at the end of the measurement is more due to high respiration factors and metabolic processes which produce high ammonia, and then the ammonia content causes a drastic decrease in the pH value of water. Nevertheless, the pH value of the water can still be tolerated, considering that the value is still within the tolerance limit of cultivated organisms. According to Beltran et al., (2020) that the optimal range of pH for milkfish (*Chanos chanos*) rearing is 6.8 – 8.7.

3.5. DO (Dissolved Osygen)

Is the amount of oxygen dissolved in water that comes from photosynthesis or absorption from the atmosphere/air (Xu & Xu, 2016). Dissolved oxygen (DO) in water is one of the water quality parameters that affect milkfish farming activities (*Chanos chanos*) (Mwangamilo & Jiddawi, 2003). Dissolved oxygen largely determines the life of organisms present in an aquatic body, especially in the biological function of growth (Pörtner, 2009; Kale, 2016). According to Boyd et al., (2018) that the value of DO which is usually measured in terms of concentration indicates the amountoxygen (O2)available in a body of water. DO measurements also aim to see to what extent water bodies are able to accommodate Biota water such as; fish or shrimp (Song, 2019). In addition, the ability of water to clean pollution is also determined by the amount of oxygen in the water (Huang et al., 2019). The DO value, which is usually measured in terms of concentration, indicates the amount of oxygen (O2) available in a body of water. The greater the DO value of the water, indicating that the water has good quality. Conversely, if the DO value is low, it can be known that the water has been polluted. The results of the DO measurement are obtained as shown below:

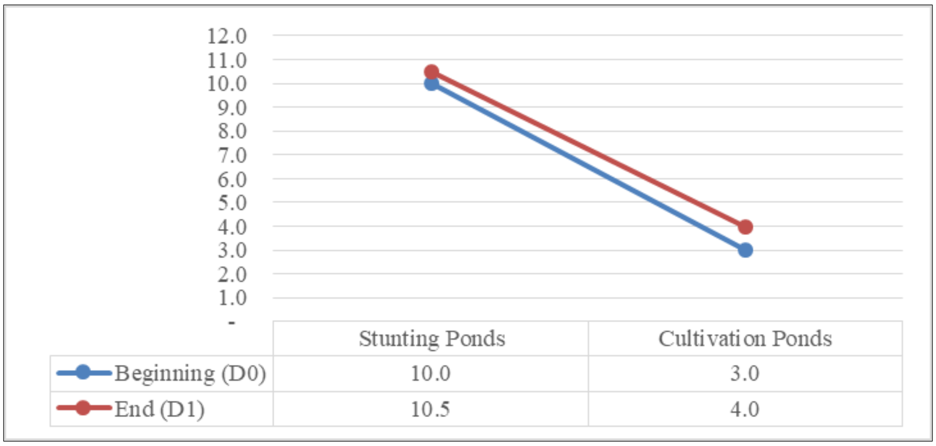

Figure 4 Dissolved Oxygen measurement results (ppm)

The results of DO measurements were obtained that the DO content at the beginning (before stocking) was higher than the DO content after stocking. The decrease in DO content is due to metabolic activity, and respiration for growth and reproduction (Salmin, 2005). While the increase in DO can be sourced from the results of photosynthesis that produces O2 or the results of absorbs from air (Allbab et al., 2016). The high density level carried out in milkfish stocking causes high respiration and metabolism processes as well as ammonia levels produced. High ammonia levels will cause a decrease in dissolved oxygen levels in water. However, dissolved oxygen levels at the final measurement are still relatively safe for cultivated organisms. In its implementation, to anticipate a decrease in dissolved oxygen levels, the replacement or addition of pool water is carried out. In cultivation systems with high stocking densities, it will increase oxygen consumption (Mmochi & Mwandya, 2003). Further, Beltran et al., (2020) that the optimal range of dissolved oxygen (DO) for the cultivation of milkfish (*Chanos chanos*) is >3 mg/l.

3.6. Fish Growth

The results of fish growth measurement were carried out with 4 (four times), namely, stocking size (G0), final size of stunting phase (G1), initial size of cultivation (G2) and final size of harvest (G4). The following are the results of measuring the average milkfish, starting from the initial phase (stocking) to the final phase (harvesting).

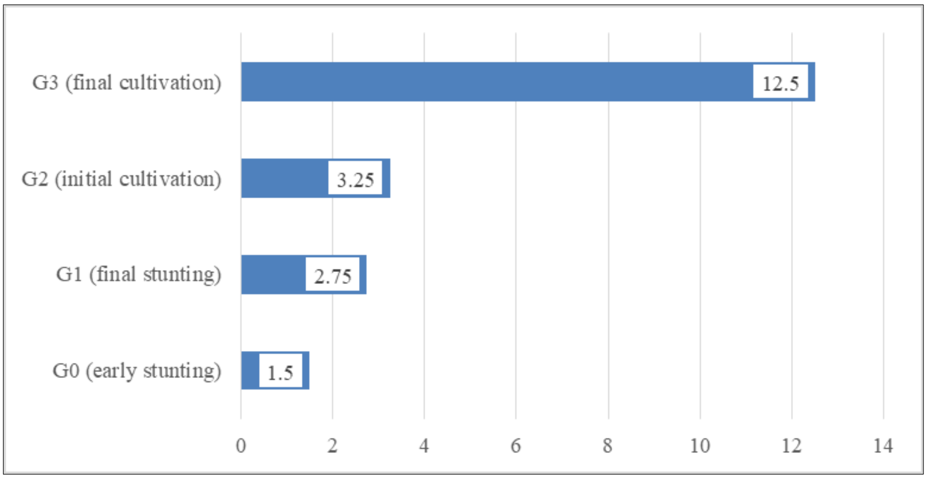

Figure 5 Fish length (cm)

The results of the average measurement of milkfish obtained that the size of the stocking fry ranged from 1-2 cm, and was maintained by stunting techniques or cultivation of feeding (food), with a high stocking density, so that the fish became starving within a certain period of time (1 month). Physically, the results of stunting techniques will appear on the head of an enlarged fish with a small body size. This is so that the fish become hungry and increase their hunger level. The stunting technique is a technique of dwarfing fish with a high level of stocking density and no additional feeding so that fish experience slow growth (Murnyak et al., 2015; Lingam et al., 2019). According to Faisyal et al., (2016) that the cultivation system with high stocking density is very understanding of the growth of milkfish (*Chanos chanos*). Further, Murnyak et al., (2015) and Lingam et al., (2019) states that high stocking density causes the growth of milkfish (*Chanos chanos*) is not uniform, even some of them experience stunting which is a condition where fish experience slow growth. This happened in research, where the size of the fish beinh that was initially stocked measuring 1-2 cm generally only increased to 2-3.5 cm in a cultivation period of 1 month (30 days), and in the pond found several dead fry. High density levels cause high competition and cause death in unhealthy seeds. This is due to the high stocking density and no feeding. This is reinforced Ofori-Mensah et al. (2018) and Adineh et al. (2019), that the stocking density of fish also affects the degree of survival and growth of fish. The growth that occurs also affects changes in the cells that make up the tissue (Arisandi et al., 2011). These cell changes, can occur in gill organs, muscles, and intestines (Benjamin et al., 2019).

Although stunting techniques pose risks such as; Fish size non-uniformity, fish mortality, etc., but this technique can trigger fish growth in later periods, when fish are transferred to rearing ponds, where the nature of fish that are greedy for food then appears after being domesticated in conditions of lack of food. The stunting technique then triggers the fish to continue eating and eventually accelerates growth (weight and length of the fish). This happened in research, where the results of fish measurements, namely the length of fish after being in the cultivation pond increased dramatically, namely from the size of 2-3 cm at the end of the stunting phase, increasing to a length of 10-15 cm within 1 to 2 months of cultivation, with an average weight of 100-200 grams per head. Thus, stunting techniques can trigger the average growth of milkfish which is 0.85-1.5 cm per week in the rearing phase. Through stunting techniques with a stocking density of 100,000 heads per hectare, the production of bait milkfish measuring 100-200 grams per head with an SR rate of 80%, which is 6-8 tons per hectare, which increases drastically when compared to milkfish production with conventional techniques that can only produce 2-3 tons per hectare.

4. Conclusion

Stunting techniques can increase fish productivity, by triggering milkfish growth rates in the cultivation phase with an average growth of 0.85-1.5 cm per week or 0.12-0.20 cm per day. Stunting techniques also pose a high risk, especially in size and mortality inequality in fish and reduce survival *rates*, due to high density. The stunting technique with a stocking density of 100,000 seed per hectare, is able to produce bait milkfish measuring 100-200 grams per pieces, which is 6-8 tons per hectare with an SR rate of 80%. Thus, this technique is considered good enough to increase pond production, especially in cultivation fish for bait.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Adineh H, Naderi M, Hamidi MK, Harsij M. (2019). Biofloc technology improves growth, innate immune responses, oxidative status, and resistance to acute stress in common carp (Cyprinus carpio) under high stocking density. Fish and Shellfish Immunology, 95: 440–448. DOI: 10.1016/j.fsi.2019.10.057

[2] Ahmad T, MJR Yakob. (1998). Intensive Milkfish Cultivation in Ponds. Prosiding Seminar Teknologi Perikanan Perikanan Pantai Bali.

[3] Allbab U. (2015). Study of Analysis of the Distribution Value of Dissolved Oxygen Levels in the Stream (DO) in the Upstream and Downstream of Weir Buildings in the Overlapping Irrigation Area of Malang Regency. [Thesis]. Universitas Brawijaya. Malang.

[4] Arisandi A, Marsoedi, Nursyam H, Sartimbul A. (2011). The influence of different salinities on morphology, cell size and number, carrageenan growth and yield Kappaphycus alvarezii. Ilmu Kelautan, UNDIP 16(3): 143-150

[5] Benjamin KB, Co EL, Competente JL, de Guzman DGH. (2019). Histopathological Effects of Bisphenol A on Soft Tissues of Corbicula fluminea Mull. Toxicol. Environ. Health. Sci., 11(1) : 36-44. DOI: 10.1007/s13530-019-0386-4

[6] Beltran Jr. A, Lontoc Z, Conde B, Juan SR, Dizon JR. (2020). World Congress on Engineering and Technology; Innovation and its Sustainability 2018. EAI/Springer Innovations in Communication and Computing. DOI: 10.1007/978-3-030-20904-9_10

[7] Barman UK, Garg SK, Bhatnagar A. (2012). Effect of Different Salinity and Ration Levels on Growth Performance and Nutritive Physiology of Milkfish (*Chanos chanos* Forsskal) – Field and Laboratory Studies. Fisheries and Aquaculture Journal, 53: 1-11.

[8] Budiasti RR, Anggoro S, Djuwito. (2015). Osmotic Workload and Growth Properties of Milkfish (Chanos chanos Forskal) Cultivated in Traditional Ponds in Morosari Village and Tambakbulusan Village, Demak Regency. Diponegoro Journal Of Maquares, 4(1): 169-176.

[9] Boyd CE, Torrans EL, CS Tucker. (2018). Dissolved oxygen and aeration in ictalurid catfish aquaculture. The Journal of the World Aquaculture Socciety. 49 (1): 7-70.

[10] Boyd CE. (2019). Water Quality: An Introduction. Springer Nature. 440.

[11] Boyd CE, Tucker CS. (1998). Pond aquaculture water quality management. Kluwer Academic Publishers, Boston, Massachusetts, USA, 1998.

[12] Chien YH. (1992). Water quality requirements and management for marine shrimp culture. in Wyban J, editor. *Proceedings of the Special Session on Shrimp Farming*. USA" World Aquaculture Society. hlm.144-156, 1992.

[13] Ching CA. (2007). Water alkalinity in the cultivation of marine shrimp. Boletines Nicovita 3:1-3.

[14] Chang C, Huang J, Yeh C, Tang C, Hwang L, Lee T. (2018). Salinity Effects on Strategies of Glycogen Utilization in Livers of Euryhaline Milkfish (*Chanos chanos*) under Hypothermal Stress. Frontiers in Physiology, 9(81). DOI: 10.3389/fphys.2018.00081

[15] Choeronawati AI, SB. Priyono, Haeruddin. (2019). Feasibility study of pond cultivation in coastal land of Purworejo Regency. Jurnal Ilmu dan Teknologi Kelautan Tropis 11(1): 191-204.

[16] Chang B, Chao W, Yeh S, Kuo D, Yang C. (2019). Biodegradation of Sulfamethoxazole in Milkfish (*Chanos chanos*) Pond Sediments. Appl. Sci., DOI: 10.3390/app9194000

[17] Dharma TS, Wibawa GS, Alit AA, Sumiarsa GS. (2019). Biological Performance of Milkfish Parents (*Chanos chanos* Forskall) Selection results in supporting domestication and development of aquaculture in ponds. Biotropika: Journal of Tropical Biology, 7(2) : 82-86.

[18] Effendi H. (2003). Water Quality Review. Yogyakarta: Kanisius.

[19] Faisyal Y, Rejeki S, Widowati LL. (2016). The effect of stocking density on the growth and survival of milkfish (*Chanos chanos*) in floating net cages in abrasive waters Kaliwlingi Village, Brebes Regency. Journal of Aquaculture Management and Technology, 5(1): 155-161.

[20] Ferreira, NC, C. Bonetti, WQ. Seiffert. (2011). Hydrologicaland Water Quality Indices as Management Tools in Marine Shrimp Culture. Aquaculture 318 (3-4): 425–33.

[21] Georgiou S, Mantziafou A, Sofianos S, Gertman, Özsoy E, Somot S, Vervatis V. (2015). Climate variability and deep water mass characteristics in the Aegean Sea. Atmospheric Research 152: 146-158.

[22] Ghuffran MH, Kordi K. (2010). Milkfish Farming for Bait. 184 halaman.

[23] Hafiludin H. (2015). Analysis of nutritional content in milkfish from different habitats. Jurnal Kelautan: Indonesian Journal of Marine Science and Technology, 8(1): 37-43.

[24] Haser TF, Febri SP, Nurdin MS. (2018). The effect of temperature differences on milkfish survival (*Chanos chanos* Forskall). Prosiding Seminar Nasional Pertanian dan Perikanan, Vol 1: 239-242.

[25] Huang Yuwei, Chun Yang, Chengcheng Wen, Gang Wen. (2019). S-type Dissolved Oxygen Distribution along Water Depth in a Canyon-shaped and Algae Blooming Water Source Reservoir: Reasons and Control. nternational Journal of Environmental Research and Public Health. Vol.16, 987. DOI:10.3390/ijerph16060987

[26] Ismail W, E. Pratiwi. (2001). Development of Comparative Aquaculture Adapted to the Type of Land Available (Sea, Pond and Fresh Waters). Warta Penelitian Perikanan Indonesia 7 (2): 18-23.

[27] Juniarti L, M. Ishak Jumarang. (2017). Analysis of temperature and salinity conditions of western Sumatran waters using Argo Float data. Phys. Commun., Vol. 1, No. 1, pp. 74–84, 2017, doi: 10.15294/physcomm.v1i1.9005.

[28] Kale VS. (2016). Consequence of temperature, Ph, turbidity and dissolved oxygen water quality parameters. Int J Adv Res Sci Eng Technol 3:186–190

[29] Koparan Cengiz, Ali Bulent Koc, Charles V. Privette, Calvin B. Sawyer. (2018). In Situ Water Quality Measurements Using an Unmanned Aerial Vehicle (UAV) System. Water, 10, 264. DOI:10.3390/w10030264

[30] Latipun. (2015). Experimental Psychology. Malang: UMM Press.

[31] Lingam SS, Sawant PB, Chadha NK, Prasad KP, Muralidhar AP, Syamala K, Xavier KAM. (2019). Duration of stunting impacts compensatory growth and carcass quality of farmed milkfish (Chanos chanos Forsskal, 1775) under field conditions.Scientific Reports, 9:16747. DOI: 10.1038/s41598-019-53092-7

[32] Murachman. (2019). Polyculture Model of Windu Shrimp (Penaeus monodon Fab), Milkfish (Chanos-chanos Forskal) and Seaweed (Gracillaria Sp.) Traditionally. Jurnal Pembangunan dan Alam Lestari Vol. 1 No.1 Tahun 2010 No. ISSN. 2087 – 3522.

[33] Mahmud U, Sumantadinata K, Pandjaitan N. (2007). Study of Traditional Windu Shrimp Causeway in Pinrang District, South Sulawesi. Jurnal MPI (2): 70-85.

[34] Murnyak DF, Murnyak MO, Wolgast LJ. (2015). Growth of Stunted and Nonstunted Bluegill Sunfish in Ponds. The Progressive Fish-Culturist, 46(2): 133-138. DOI: 10.1577/1548- 8640(1984)462.0.C O;2

[35] Mmochi AJ, Mwandya AW. (2003). Water quality in the integrated mariculture ponds systems (IMS) at Makoba Bay, Zanzibar, Tanzania. Western Indian Ocean Journal of Marine Science, 2: 15-23.

[36] Mwangamilo JJ, Jiddawi NS. (2003). Nutritional Studies and Development of a Practical Feed for Milkfish (Chanos chanos) Culture in Zanzibar, Tanzania. Western Indian Ocean J. Mar. Sci. 2(2): 137–146.

[37] Ofori-Mensah S, Nunoo FKE, Atsu DK. (2018). Effects of stocking density on growth and survival of young Gulf killifish in recirculating aquaculture systems, Journal of Applied Aquaculture, 30(4): 297-311. DOI: 10.1080/10454438.2018.1468295

[38] Pörtner HO. (2009). Oxygen- and capacity-limitation of thermal tolerance: a matrix for integrating climate-related stressor effects in marine ecosystems. J. Exp. Biol. 213: 881–893. DOI: 10.1242/jeb.037523

[39] Qin Yiheng, Arif U. Alam, Si Pan, Matiar MR. Howlader, Raja Ghosh, Nan-Xing Hu, Hao Jin, Shurong Dong, Chih-Hung Chen, M. Jamal Deen. (2018). Integrated water quality monitoring system with pH, free chlorine, and temperature sensors. Sensors and Actuators B: Chemical. Vol.255(1), 781-790. DOI:10.1016/j.snb.2017.07.188

[40] Riana AD, Sunarti, Yusuf M. (2022). NPV and Net B/C Analysis on Windu Shrimp Pond (Penaeus monodon) Traditional System in Tempatue Village, Bone Regency. Jurnal Akuatiklestari, 5(2): 91-96. DOI: https://doi.org/10.31629/akuatiklestari.v5i2.452

[41] Rinaldi AC, Adhawati SS, Mallawa A. (2019). Feasibility of Pole-and-Line Fishery:Comparison of Milkfish (Chanoschanos,Forskal) and Anchovy (Stolephorussp.) as LiveBait. IJEAB, 4(5): 1567-1572

[42] Salmin. (2005). Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) as one of the indicators to determine the quality of waters. Jurnal Oseana,Vol. XXX. No.3 (2005):21-26.

[43] Saparinto C. (2009). Milkfish without Thorns and How to Process It. Semarang (ID): Dahara Prize.

[44] Song H, Wignall PB, Song H. (2019). Seawater Temperature and Dissolved Oxygen over the Past 500 Million Years. J. Earth Sci. 30, 236–243. DOI:10.1007/s12583-018-1002-2

[45] Sugiyono. (2018). Quantitative, Qualitative, R&D, Research Methods. Bandung: Alfabeta

[46] Supono. (2015). Environmental Management for Aquaculture. Plantaxia. Yokyakarta.

[47] Schuler DJ. (2008). Acute toxicity of ammonia and nitrite to white shrimp (L. vannamei) at low salinities. Master's thesis. Virginia Polytechnic Institute and State University, Blacksburg, 2008

[48] Simanjuntak M. (2009). The relationship of physical chemical environmental factors to plankton distribution in the waters of East Belitung, Bangka Belitung. Journal of Fisheries Sciences, 11(1): 31-45

[49] Su Y, S. Ma, C. Feng. (2010). Effect of salinity fluctuation on the growth and energy budget of juvenile Litopaneus Vannamei at different temperatures. The Journal of Crustacean Biology. 30 (3):430-434.

[50] Saraswati SA, Sari AHW. (2017). Water quality assessment and pond suitability assessment in efforts to develop milkfish farming (*Chanos chanos* Forskal) in Pemuteran Village, Gerokgak District, Buleleng Regency. Samakia: Jurnal Ilmu Perikanan, 8(2): 01-05

[51] Talley LD., MC. Maccracken, JS. Perry, T. Munn. (2002). Salinity Patterns in the Ocean Editor-in-Chief. in Encyclopedia of Global Environmental Change, vol. 1, M. C. MacCracken and J. S. Perry, Eds. Chichester, UK: John Wiley & Sons, Ltd, 2002, pp. 629–640.

[52] Varsamos S, Nebel C, Charmantier G. (2005). Ontogeny of osmoregulation in postembryonic fish: A review. Comparative Biochemistry and Physiology, Part A 141: 401– 42

[53] Xu Z, YJ Xu. (2016). A deterministic model for predicting hourly dissolved oxygen change: development and application to a shallow eutrophic lake. Water 8(2):41. DOI:10.3390/w8020041

[54] Yusuf M, Wijaya M, Surya RA, Taufik I. (2021). MDRS-RAPS: Sustainability Analysis Techniques. Tohar Media, Makassar.

[55] Zan J, Y. Dong, W. Zhang, W. Xu, J. Li, B. Gao, F. Hu, Q. Wang. (2019). Distribution characteristics of dissolved oxygen and stable isotope compositions of shallow groundwater in the vicinity of an inland nuclear power plant, HK, China. E3S Web Conference 09035: 1-5.