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Cobia (*Rachycentron canadum*) cage culture in the Mekong Delta, Vietnam: fish health management practice

Ly Van Khanh, Nguyen Thanh Long, Le Quoc Viet and Tran Minh Phu *

College of Aquaculture and Fisheries, Can Tho University, Viet Nam

***Corresponding Author: tmphu@ctu.edu.vn**

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ABSTRACT

To obtain insights into cobia cage culture in the Mekong Delta, Vietnam, 90 farmers were interviewed for technical information and fish health management practice. Results showed that the quality of artificial spawning fingerlings was unstable and become a major constraint for the development of cobia aquaculture. Most of the farmers (80%) reported having disease symptoms during cobia cultivation. The clinical signs included abnormal eyes (57.8%), parasite infection (45.6%), and ulcerated skin or external abnormality (32.2% of farmers reported). Farmers (48%) used five single antibiotics and one mixture of antibiotics to control the clinical sign by mixing with fresh water. The most common antibiotics were oxytetracycline (23.3% of farmers used), tetracycline (16.7%), and ampicillin (16.7%). Most of the farmers used chemicals following their own experience, 70% of farmers reported. None of the farmers reported being trained in the safety of handling chemicals and knowledge of chemical use. In general, there is an urgent need to train farmers on chemical use, disease diagnosis, and approach to fish health management services

INTRODUCTION

While freshwater aquaculture is generally dominated in inland areas of Deltas in Vietnam, marine finfish aquaculture has recently grown as a subsector (**FAO, 2014; Nguyen and Truong, 2005**). The marine finfish aquaculture consists mainly of small-scale farms, due to limited fingerling supply, domestic market demand only, and constraint export markets (**Kongkeo *et al*., 2010**). The small-scale aquaculture is appropriated to farmers who are limited in budget and knowledge because it is self-management, low capital investment, and operating cost. With the growth of marine fish aquaculture in Vietnam, better management practices or fish health management practice improvements could optimize and stabilize the sector in which more livelihoods become dependent upon the industry (**Boerlage *et al*., 2017**).

Cobia, *Rachycentron canadum* is one of the most potential marine fish for future aquaculture production in Vietnam (**Nguyen *et al*., 2011**). Since the late 1990s, cobia was targeted as an important aquaculture species because of its rapid growth rate, good flesh quality, and tolerance to variations in temperature and salinity. Cobia is a carnivorous fish, commonly feeding on crustaceans, pelagic fish, and other benthic invertebrates (**Ganga *et al*., 2012**). In the spawning season, cobia breeds more than once (**Sajeevan and Kurup, 2016**). In 2002, the first commercial batches of cobia fingerlings were produced at Research Institute Aquaculture No 1, Vietnam, co-funding by the Government of Vietnam and Norway (**Nguyen *et al*., 2011)**. Nhu **(2005)** first reported in detail cobia reproduction in Vietnam at the marine hatchery scale. The lack of local hatcheries in Vietnam led to the dominant use of wild-caught cobia fingerlings. The cobia cage aquaculture farmers experience problems regarding the quality and quantity of fingerlings, and thus collect locally wild-caught fingerlings or purchase fry from Taiwanese hatcheries (**Hasan, 2012**). Cobia aquaculture in Southern Vietnam is characterized by a higher level of intensification than in the North, represented by higher initial stocking density, the total number of fish stocked, number and size of cages, and quantity of feed used leads to significantly higher total costs, productivity, and profitability (**Petersen, 2014**). The main constraint of cobia farming in Vietnam includes market development and the lacking high-quality juveniles. The low temperature during winter in the North and frequent tropical typhoons in autumn in central Vietnam are also constraints for cobia rearing. In the grow-out stage, parasites, bacteria, viruses, feed quality, and management to keep the FCR low are challenges that cobia farmers in the North of Vietnam have to do with. Understanding cobia farming in Southern Vietnam would contribute to identifiication characteristics and management practices that may influence fish health management and facilitates future risk-based disease surveillance and mitigation strategies.

MATERIALS AND METHODS

The study was carried out from November 2019 to May 2020 in three districts (Kien Hai, Phu Quoc, Kien Luong) of Kien Giang province, Mekong Delta, Vietnam (Fig. 1). Cobia cage culture in Southern, Vietnam is dominated by the sea areas, belonged to the Gulf of Thailand. The cobia is reared in cages surrounding islands such as Phu Quoc, Nam Du, and Hon Tre. Therefore, this study is focused on the farmers rearing cobia in cages, considered a small-scale operation.

A total of 90 farmers (30 farmers in each district) were randomly selected from the list of provincial aquaculture Departments. Face-to-face interviews on-cage with observation were done by semi-structured questionnaires. The pilot questionnaire was done with two farmers and adjusted for appropriate data collection. Collected information included farmer experience and education, cage structure for cobia rearing, and technical information about cobia cage aquaculture e.g. stocking density, fingerlings, feed conversion ratio, survival rate, and harvest size. In this study, we also focused on fish health management practices such as clinical signs described by farmers, disease diagnosis, chemical use, and knowledge of chemical use including the safety of handling and decision-making.

Results are expressed in descriptive statistics e.g., percentage of farmers reported, frequency of occurrence, mean value, and standard deviation. One-way ANOVA with a significance level of 95% was used to analyze the statistically significant difference among technical indicators in three different survey districts.

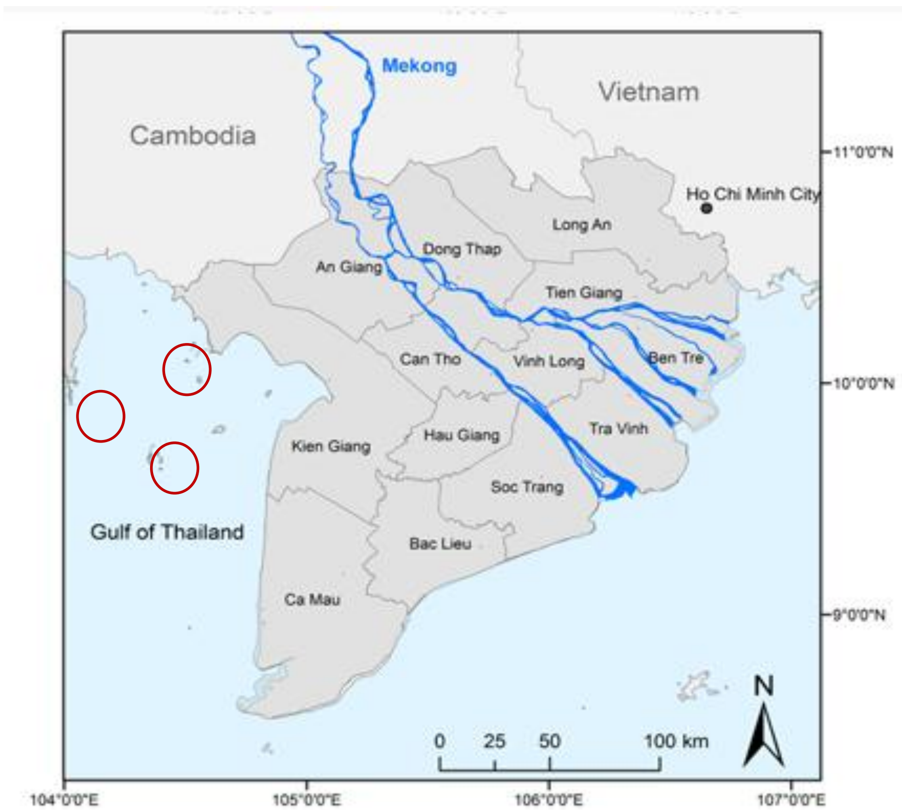

Figure 1. A map of the Vietnamese Mekong Delta

RESULTS AND DISCUSSIONS

1. Farmer

Farmers rearing cobia in the cage had 45-year-olds on average (44,6±8,8) with 8,24±3,10 years of rearing cobia. The education level of the farmers was two-thirds of secondary education, and the others primary education. Compared to the farmers in the North of Vietnam, education level and age are similar while all farmers did not have specific aquaculture education (**Boerlage *et al*., 2017**). It is noted as a challenge for small-scale farmers to adapt to the new technology as well as fish health management practice which required training in aquaculture technology.

2. Cage

Cages for cobia rearing are typically designed with a length of 4-10 m, a width of 3-4 m, and an approximate depth of 4 m (Table 1).

Table 1: Cage structure for cobia rearing

Cage information	Kien Hai (n=30)	Phu Quoc (n=30)	Kien Luong (n=30)	Average (n=90)
Number of cages per farmer (cages/household)	4,13±2,58[a]	4,33±2,62[ab]	6,13±3,87[b]	4,87±3,18
Length (m)	3,90±0,72[b]	3,10±0,32[a]	4,00±0,07[b]	3,67±0,60
Width (m)	4,63±0,80[b]	10,1±0,83[c]	4,03±0,08[a]	6,25±2,82
Depth (m)	4,20±0,54[b]	3,92±0,50[a]	3,88±0,22[a]	4,00±0,46
Water level (m)	3,65±0,42[b]	3,44±0,37[ab]	3,40±0,22[a]	3,50±0,36
Cage volume (m^3)	67,9±29,5[b]	109±22,5[c]	54,5±3,92[a]	77,0±31,4
Mesh size of the net (2a) (mm)	40,0±0,00[a]	45,0±5,09[b]	40,0±0,00[a]	41,7±3,75
Distance from the bottom of the cage to the sea bed (m)	5,60±0,76[b]	4,57±1,14[a]	4,62±0,57[a]	4,93±0,97
Distance between two cages (m)	0,89±0,19[a]	1,24±0,18[b]	0,93±0,07[a]	1,02±0,22

Cages are made of wood and one layer net (40-45 mm mesh size) placed underneath the floating cage by a series of 200 L cylinder plastic containers (35-50/cage). Four corners of the net at the bottom were stressed and tightened with rock at the seabed. Cages are placed surrounding small islands with a distance of 100 to 200 m from the islands and 3 to 6 m from the seabed and 0.5 m above sea level. Farmers owned from one to ten cages in each household with an average of five cages ranging from 50 to 120 m^3, 77 m^3 on average. The cage structure for cobia rearing is unchanged compared to the previous survey by **Hien *et al*. (2016)**.

3. Cobia aquaculture

Cobia was reared for approximately 300 days to get a harvest size of 5 to 8 kg, 6.80±0.97 kg on average, from an initial fingerlings size of 111 g/fish on average. The stocking of fingerlings was mostly from February to April because of the stable water salinity, the less rain, and the high survival rate after stocking at this time according to farmers. In addition, the cobia spawning season is from September to March in the South of Vietnam (**Hai *et al*., 2017**). Stocking density was slightly increased compared to 5 years ago, 1.9-2.3 fish/m^3 (**Hien *et al*., 2016**) compared to 2.41±0.67 fish/m^3 in this study.

Cobia fingerlings are mainly obtained from wild-caught, reported by 67.4% of farmers, because of high disease resistance, high growth, and low mortality after stocking. However, the wild-caught fingerlings showed a high variation in supply sources and fish size. For artificial breeding fingerlings, 45.5% of farmers reported a high quality. Many studies on cobia breeding (**Arnold *et al*., 2002; Stieglitz *et al*., 2012**) and the nutritional requirements of fingerlings (**Zhao *et al*., 2020; Marques *et al*., 2021**) have been done. However, the quality of artificial spawning fingerlings was unstable and become a major constraint for the development of cobia aquaculture.

Rearing cobia is not a challenge to farmers because of feeding by marine fish as trash fish and monthly net cleaning. Farmers reported that at the beginning they fed commercial pellets for a month (for artificial breeding fingerling only) and later on fed fresh trash fish (97.5%) once a day. The trash fish are all time available because of the fishing activities of the region. Marine fish used for cobia consisting of threadfin bream (*Nemipterus tambuloides*), conger eel (Muraenesox spp.), mackerel (*Decapterus* spp.), bartail flathead (*Hoplichthys gilberti*) lizardfish (*Saurida tumbil*), and other small pelagic fish. The feeding conversion ratio calculated based on the amount of trash fish used showed that cobia rearing in Phu Quoc and Kien Hai was significantly higher than the cobia rearing from Kien Luong district ($p<0.05$). The difference could be due to the quality of fingerlings and trash fish, and harvested size. The harvest size of cobia showed the same patterns as FCR. The survival rate of cobia was relatively high, 88.9% on average. The survival rate of cobia rearing in Phu Quoc was significantly higher than those of other places ($p<0.05$). The survival rate of cobia rearing in the South was much higher than cobia aquaculture in North Vietnam. This can be explained by the higher temperature in the South compared to the North, Vietnam where cobia had the most abnormal clinical signs compared to other marine species (**Boerlage *et al*., 2017**).

Table 2: Technical information on cobia cage aquaculture

Contents	Kien Hai (n=30)	Phu Quoc (n=30)	Kien Luong (n=30)	Average (n=90)
Crop periods (days/crop)	268±45.6[a]	305±14.8[b]	310±37.2[b]	294±39.4
Number of crop per year (crop/year)	1.40±0.24[b]	1.20±0.05[a]	1.20±0.16[a]	1.27±0.19
Stocking density (fish/m^3)	2.17±0.87[a]	2.52±0.49[a]	2.54±0.54[a]	2.41±0.67
Fingerling size (g/con)	105±43.8[a]	109±25[a]	118±20.4[a]	111±31.5
Survival rate (%)	86.2±10.2[a]	94.6±2.95[b]	85.8±11.4[a]	88.9±9.79
Feed conversion ratio	10.3±2.10[b]	8.98±0.85[b]	8.15±0.60[a]	9.14±1.61
Harvested size (kg/con)	7.35±0.85[b]	6.85±0.46[b]	6.21±1.14[a]	6.80±0.97
Productivity (kg/10 m^3/crop)	135±53.7[a]	163±32.0[b]	133±28.9[a]	144±41.6

4. Fish health management practices

4.1 Clinical signs

Most of the farmers (80%) reported facing disease symptoms during the cultivation of cobia. The clinical signs included abnormal eyes (57.8%), parasite infection (45.6%), and ulcerated skin or external abnormality (32.2% of farmers reported). Abnormal eyes were described as eyes hemorrhage, changing eyes color to milky white, and small parasites attachment. **Hich *et al*. (2018)** stated that the abnormal eyes could be caused by *Streptococcus inniae*. The abnormal-eyes symptom could cause massive mortality if non-treatment was applied (**Khanh *et al*., 2017**) and caused by multi factors such as bacterial infection, fungi, and parasites.

Parasite infection was seen as fish rubbing along the nets and slowdown and abnormal moving activities. **Dung *et al*. (2017)** detected nine groups of parasites, six ecto- and three endo-parasites. *Amyloodinium ocellatum* and *Pseudorhabdosynochus* sp. were found in fish gills only while *Cryptocaryon iritans* and *Trichodina* sp. were attached in both skin and gill. *Neobenedenia* sp. was isolated in skin and eyes with high prevalence while *Parapetalus* sp. was in and gill. *Leptorhynchoides* sp. and *Procamalanus* sp., internal parasites, were found in the cobia intestine while *Anisakis* sp. attached to the abdomen cavity and intestine wall. *Leptorhynchoides* sp. was dominated in the cobia intestine with 95% infection. The infection of parasites in cobia is highly related to the environment and trash fish infected with parasites (**Dung *et al*. 2017)**.

Ulcerated skin in cobia could cause high mortality if improper treatment is applied. It is easy to recognize abnormal swimming, hemorrhage in pelvic and anal fins and tail, and ulcerated skin. **Liu *et al*. (2004)** concluded that ulcerated symptoms caused by groups of Vibrio e.g. *V. anguillarum, V. alginolyticus, V. vulnificus, V. parahaemolyticus and V. ordalii*; and may be associated with fungi and parasite infection. In a previous study, the main diseases in cobia rearing in Kien Giang province were reported as ulceration (72%), hemorrhage (64%), and exophthalmia/abnormal eyes (100%). Compared to this study, the clinical symptoms reported by farmers significantly reduced five years ago. All farmers applied freshwater soaking with or without antibiotics (52%) to control abnormal eyes, parasite infections, and ulceration. This kind of practice was similar to rearing cobia in North Vietnam, where 83% of the cases, were done with freshwater treatment only. The main reasons attributed to mortality were, from most to least important, pollution, multifactorial, disease, temperature fluctuations, and unknown (**Boerlage *et al*., 2017**).

4.2 Chemical use

Farmers (48%) used five single antibiotics and one mixture of antibiotics to control abnormal eyes, parasite infections, and ulceration by mixing with fresh water. This practice is similar to cobia farming in the North of Vietnam where the most common treatment compounds were antibiotics and $KMnO_4$ (12% as a single compound or in combination with freshwater and other compounds) (**Boerlage *et al*., 2017**). The most common antibiotics were oxytetracycline (23.3% of farmers used), tetracycline (16.7%), and ampicillin (16.7%). All antibiotics used for the treatment of cobia clinical signs did not belong to the banned chemicals used for aquaculture, proposed by the Vietnamese Ministry of Agriculture and Rural Development (**MARD, 2016**). Few farmers used iodine and copper sulfate to disinfect the water in the cage covered by nylon sheets during application. This mode of application seems inadequate because the infection can be spread out from the neighbor after treatment as well as the diluted concentration of the compound in the water. Few farmers used fenbendazole to control the endoparasite while the prevalence of endoparasite was quite high according to the examination of **Dung *et***

***al*. (2017)**. The use of nutritional-supplied products was limited because of the use of trash fish and marine fish as the main feed leading to unable to mix into the feed.

Table 3: Chemical use in cobia cage culture

Antibiotic	Reported farmers (n=90; %)
Oxytetracycline	23.3
Tetracycline	16.7
Ampicillin	16.7
Penicillin	3.3
Sulfamethoxazole + Trimethoprim	3.3
Florfenicol	3.3
Disinfectants	
Iodine	6.7
Coper sulfate	6.7
Endoparasite control	
Fenbendazole	3.3
Nutritional supplied	
Mixture of vitamins	3.3
Minerals (Premix)	3.3

4.3 Handling of chemical, guidance and safety

Most of the farmers used chemicals following their own experience, 70% of farmers reported, while the remaining were based on their own experience (Table 4). Different from other fish commodities, farmers rearing cobia missed the guidance and support from technicians in the chemical shop and feed company. This could be explained by the promoting areas of aquaculture where it is a challenge for visiting from inland. The less use of chemicals could be the reason for less attractant of chemical companies. It is also noted that lacking support from authorities e.g. extension services, and the local aquaculture department because of the few officers in the region. Most farmers bought the chemical and stored it in the cage where most of them lived and stayed for caring for the cobia. Thus, it may affect their health due to the chemical placed there. For the safety of handling chemicals and knowledge of chemical use, none of the farmers reported being trained. Recording chemical use during cobia rearing was done simply by 30% of farmers which is only for payment purposes only. One remark in terms of food safety could be seen that there was no testing for antibiotic residue before harvest which could a pose high risk to consumer health. It is common to test antibiotic residue in catfish and shrimp before exported, however, for domestic fish consumption, it is not well carried out. The antibiotic residue testing done by authorities through a quality control program has been done but limited to a number of sampling because of labor sources and financial issues.

Table 4: Handling of chemical, guidance and safety

	Reported farmers (n=90; %)
Making decision on chemical use	
Extension service	30
By their own experience	70
Record chemicals and others	30
Purchase and store the chemicals	33,3
Using gloves, masks during handling	0
Knowledge on chemical regulation	0
Common clinical manifestations following use of chemicals (skin lesion, coughing)	0

CONCLUSION

The quality of cobia fingerlings, especially artificial breeding was unstable and become a major constraint for the development of cobia aquaculture. The frequency of clinical signs of abnormal eyes, parasite infections, and ulceration reported by farmers reduced compared to five years ago. Farmers used antibiotic mixing with fresh-water for the treatment of clinical signs which uncertainty of the effectiveness. Antibiotics used in cobia farming did not belong to the banned antibiotic, however, testing residue before the harvest was not done, posing a high risk to human health. The role of private sector stakeholders, including chemicals shops and existing government extension centers in providing knowledge services to such farmers, could be an innovative approach.

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