Ciências Agrárias

***Scientia Amazonia*, v. 9, n. 1, CA12-CA16, 2020**
Revista on-line http://www.scientia-amazonia.org
ISSN:2238.1910

Aquaculture in the Central Amazon: experiencing stream cage fish farming at a remote community

Rogério Souza da Silva[1], Heitor Thury Barreiros Barbosa[2]

http://scientia-amazonia.org/wp-content/uploads/2020/04/v9-n1-CA12-CA16-2020.pdf

Abstract

We report an experience of matrinxã *Brycon amazonicus* farming in a stream cage at the farther rural community of Presidente Figueiredo city (Central Amazon). The operations followed the standard technical procedures of water analysis, biometry and handling. Result shows a bad crop performance, which we can say is mostly due to structural and economic deficiencies, a common problem among local farmers. We believe, however, this report to be important and interesting as a document of the difficulties and some practical solutions used by the fish farmers in theses far communities.

Key-words: Aquaculture. Matrinxã. Monitoring.

A piscicultura na Amazônia Central: experiências com viveiro em igarapé em comunidade distante. Relatamos uma experiência de cultivo de matrinxã *Brycon amazonicus* em viveiro de igarapé na comunidade rural mais distante de Presidente Figueiredo (Amazônia Central). As operações seguiram os procedimentos técnicos padrões de análise de água, biometria e manejo. Os resultados apontam baixo desempenho nesse cultivo, decorrente das deficiências estruturais e dificuldades econômicas, condição frequente entre os produtores rurais da localidade. Acreditamos que esse relato seja importante para documentar as dificuldades e algumas soluções práticas empregadas na piscicultura nessas comunidades distantes.

Palavras-Chave: Aquicultura. Matrinxã. Acompanhamento.

[1] Fishing Resources Technician
[2] Teacher at IFAM Campus Presidente Figueiredo, hthury@gmail.com

Scientia Amazonia, v. 9, n. 1, CA12-CA16, 2020
Revista on-line http://www.scientia-amazonia.org
ISSN:2238.1910
Ciências Agrárias

1. Introduction

Fish farming in stream cages has been practiced in the Amazon since the 1990s. It is attractive due to the considerable amount of small streams in the region, locally known as "igarapé", a tupi word for canoe path (*ygara* + *apé*). As an study object, however, this aquaculture model seems of a minor interest, with just a few manuals published in native language (Fim *et al.*, 2009; Izel & Melo 2003; 2004). This structure operates like a conventional cage, allowing continuous water exchange with the surrounding environment (Lekang, 2013), but, instead of floating, it is completely fixed to the waterbed. It requires low investment and skills, due to easy installation and maintenance. However, it also requires attention to the environmental conditions at the installation site as it is nearly impossible to manage water quality within the cage.

In Presidente Figueiredo, the county we are working with, this seems to be the most widespread aquaculture model (Souza, 2013). In 2012 alone local fish farms produced *ca.* 120 tons of fish in 10.000 m^3 of stream cages, *ca.* 10% of all fish produced in the county, reaching *ca.* 12 kg/m^3 productivity (Souza, 2013). Whereas this aquaculture model is traditionally intended for subsistence (Fim *et al.*, 2009), this seems a milestone for family fish farming, signaling the potential for high productivity in these structures.

In this context, we report the technical monitoring of a stream cage matrinxã *Brycon amazonicus* production cycle, flagship species of this aquaculture model in the Amazon (Lima *et al.*, 2015), at the most distant community of Presidente Figueiredo: Santo Antônio do Abonari. The property is located at lat.: 1.30° S, lon.: 60.40° W. This work was part of the first author's concluding project as a Fishing Resources Technician at the Federal Institute for Education, Science and Technology of Amazonas, *Campus* Presidente Figueiredo (IFAM-CPRF).

2. Methods

2.1. Workplace

The fish were farmed between 07/2016 and 01/2017 in a stream cage measuring 84.25 m^2 area and 58.22 m^3 volume. These measures are approximations due to the structural irregularities. The cage had no sidewalls for soil containment and nor system for water level control. The bottom was not leveled either. Moreover, we had unstable water quality and difficulty in performing control measures, e.g. applying limestone for acidity control would result in the current carrying the material away. From a technical standpoint, this structure was not suitable for fish farming. A pump was installed to aerate the water and try to mitigate the effects of water quality stress (Fig.1).

Figure 1: This study workplace: On the left, an overview of the stream cage. At the time, it only had the containment barriers at both ends to prevent animal escapes. For a complete cage, it lacked its sidewalls; On the right, the offhand pumping system for aeration; If accompanied by technician, this installation would have regularized its walls and bottom, removed trees from the waterbed and other improvements.

2.2. Technical procedures

Zootechnical performance was monitored using the standard procedures (Fim *et al.*, 2009; Alatorre-Jacome *et al.*, 2012): (1) animal concentration using trawlers; (2) sampling 20 animals at random; (3) biometrics using scale and ruler with accuracy of 5 g and 5 mm, respectively (Fig. 2).

Figure 2: Biometrics procedures: To the left, handmade trawler for animal collection; To the right, biometrics with digital scale and ruler.

Condition factor (Kn) was calculated as a function of total weight (W) and total length (L): Kn=W/a*L^b (Froese, 2006). All water analyzes were done at the IFAM-CPRF Multidisciplinary Laboratory. Water samples were carried in an opaque black bottle inside an isothermal box with ice. Transit from the property to the Laboratory

***Scientia Amazonia*, v. 9, n. 1, CA12-CA16, 2020**
Revista on-line http://www.scientia-amazonia.org
ISSN:2238.1910
Ciências Agrárias

takes between 2 to 3 hours. Water analyses were interrupted after month 5 due to the lack of funds for transport (transport was funded by the first author, a student-technician at the time).

3. Results and discussions

3.1. Growth

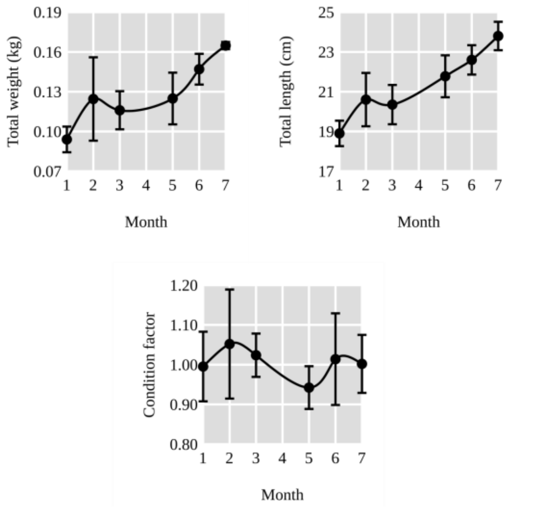

Figure 3: Matrinxã growth in our stream cage (mean ± standard deviation, n=20 per month): Months 1 to 7 correspond to months from 07/2016 to 01/2017; Growth dropped at month 3 and recovered at month 6; We made no collection at month 4 due to animal mortality and to prevent additional animal stress; Growth loss was probably due to stream flow reduction and water quality changes

Animal growth was unsatisfactory, reaching *ca.* 0,16 kg after 6 months (Fig.3). In comparison to zootechnical standards (Fim *et al.*, 2009; Izel & Melo 2003; 2004), this aquaculture model yield 1,5 kg after 8 months, equivalent to *ca.* 1,1 kg in 6 months. Growth dropped at month 3, and was partially recovered only at month 6. There was no collection in the month 4 due the animal mortality. We believe this scenario was caused by structural and management deficiencies combined with changes in water quality, which was caused in turn by a natural flow reduction at that period. Among the deficiencies, we cite (a) high stocking density (Ellis *et al.* 2002), (b) lack of feed management, (c) structure without sidewalls for siltation containment and (d) excess organic material at the cage bottom.

3.2. Water quality

The results are shown in Fig.4. Along the production cycle, ammonia was always above the recommended limit (Queiroz & Boeira, 2007; 2008). To worsen the situation, starting at the critical month 3 we discussed in the previous section, CO_2 also increased above the safe levels. In natural and aquaculture environments, CO_2 conditions like this are usually associated with environmental degradation and organic matter accumulation and causes water acidity (Esteves, 2011, p.209-212). CO_2 build up, however, did not affect pH, probably due to emergency liming management, whose effects can be seen in Total Alkalinity.

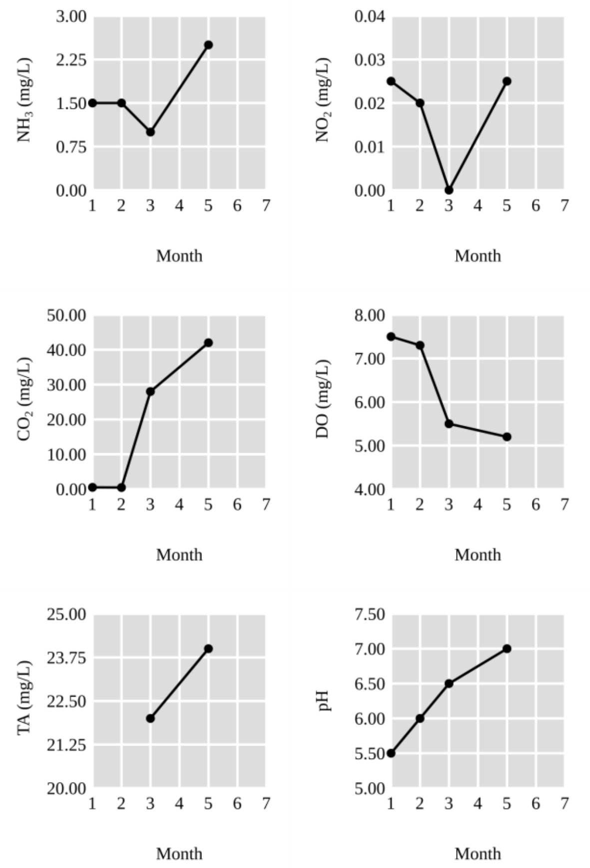

Figure 4: Water quality in our stream cage (only mean, no replication): The upper panels group nitrogen compounds, total ammonia (NH_3) and nitrite (NO_2). The central panels group dissolved gases, carbon dioxide (CO_2) and dissolved oxygen (DO); The bottom panels group water buffer indicators, Total Alkalinity (TA) and pH; NH_3 was above safe levels along all production cycle; CO_2 level was hazardous after month 3

3.3. Emergency actions

We faced many problems arising from management deficiencies (Fig. 5). Bad signs manifested in month 2, when the animals developed labial extensions, a physiological

***Scientia Amazonia*, v. 9, n. 1, CA12-CA16, 2020**
Revista on-line http://www.scientia-amazonia.org
ISSN:2238.1910

Ciências Agrárias

response of matrinxã to oxygen depletion (Soares *et al.*, 2006), despite DO remaining above 5.0 mg/L (review Fig.4). The property owner was aware of the situation but deferred the adoption of better management practices to month 4, after an acute mortality event. In fact, stubbornness is a very common trait among local farmers and patience is much required from any technician. Our first immediate action was to reduce the animal stock from 2000 to 500 animals. Positive effects could be seen two months later (review Fig.3).

Figure 5: Inadequate management conditions: On the right, labial extension in matrinxãs, sign of oxygen depletion in the water; On the left, fish harvesting to reduce stock and ameliorate conditions; After readjusting the stock density, mortality ceased and the fish could recover partially its growth.

4. Final considerations

Despite this (nearly) bad experience, stream cages are still an interesting aquaculture model, especially for matrinxã, which adapts well to stream conditions. Like other aquaculture models, this also requires care and attention, from planning to harvest. We also observe that, facing adverse events, time for decisions are very short. For successful family fish farming, we think a trained or experienced member is highly required. Lastly, we hope this report may provide some learning and insights for professionals and so contribute for aquaculture development in the Central Amazon.

Acknowledge

This article is unpublished and is not being considered for any other publication. The authors and reviewers did not report any conflict of interest during their review. Therefore, the journal *Scientia Amazonia* owns the copyright, has the approval and permission of the authors to publicize this article by electronic means.

Divulgation

This article is unpublished and is not being considered for any other publication. The author(s) and reviewers did not report any conflict of interest during their evaluation. Therefore, the Scientia Amazonia magazine owns the copyrights, has the approval and the permission of the authors for disclosure, of this article, by electronic means.

References

A. C. U. Izel and L. A. S. Melo. *Criação de matrinxã (Brycon cephalus) em barragens no Estado do Amazonas*. Number 20 in Comunicado Técnico. Embrapa, Manaus, 2003. URL http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/676197.

A. C. U. Izel and L. A. S. Melo. *Criar matrinxã (Brycon cephalus): atividade econômica potencial para o agronegócio amazonense*. Number 31 in Documentos. Embrapa, Manaus, 2004. URL http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/674415.

F. A. Esteves. *Fundamentos de Limnologia*. Interciência, Rio de Janeiro, 3 edition, 2011.

J. D. I. Fim, S. F. Guimarães, A. Storti, A. G. Bobote, and G. R. Nobre. *Manual de criação de matrinxã (Brycon amazonicus) em canais de igarapés*. INPA, Manaus, 2009.

J. F. Queiroz and R. C. Boeira. *Boas práticas de manejo (BPMs) para reduzir o acúmulo de amônia nos viveiros de aquicultura*. Number 44 in Comunicado Técnico. Embrapa, Jaguariúna, 2007. URL http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/15489.

J. F. Queiroz and R. C. Boeira. *Determinação do percentual de troca de água em função do acúmulo de amônia (NH3) nos viveiros de piscicultura*. Number 47 in Comunicado Técnico. Embrapa, Jaguariúna, 2008. URL http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/31730.

J. P. Lima, S. M. Santos, A. T. Oliveira, R. L. Araújo, J. A. L. Silva, and P. H. R. Aride. PRÓ-RURAL Aquicultura: relato das principais ações de extensão tecnológica e um panorama do setor aquícola do estado do Amazonas, Brasil. *Nexus*, 1(1):35–45, 2015. URL http://200.129.168.183/ojs_proex/index.php/Nexus/article/view/6.

Scientia Amazonia, v. 9, n. 1, CA12-CA16, 2020
Revista on-line http://www.scientia-amazonia.org
ISSN:2238.1910

M. G. M. Soares, N. A. Menezes, and W. J. Junk. Adaptations of fish species to oxygen depletion in a central Amazonian floodplain lake. *Hydrobiologia*, 568(1):353–367, 2006. doi: 10.1007/s10750-006-0207-z.

O. Alatorre-Jacome, F. G. Trejo, G. M. Soto-Zarazua, and E. Rico-Garcia. Techniques to assess fish productivity in aquaculture farms and small fisheries: an overview of algebraic methods. *Journal of Applied Sciences*, 12(9):888–892, 2012. doi: 10.3923/jas.2012.888.892.

O.-I. Lekang. *Aquaculture engineering*. John Wiley & Sons, Pondicherry, 2 edition, 2013. doi: 10.1002/9781118496077

R. Froese. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22(4):241–253, 2006. doi: 10.1111/j.1439-0426.2006.00805.x.

R. S. Souza. Produção de pescado no município de Presidente Figueiredo, Amazonas, 2013. Monografia (Tecnologia em Produção Pesqueira) — Universidade do Estado do Amazonas, Presidente Figueiredo, 2013.

T. Ellis, B. North, A. P. Scott, N.R. Bromage, M. Porter, and Gadd, D. The relationships between stocking density and welfare in farmed rainbow trout. *Journal of Fish Biology*, 61(3):493-531, 2002. doi: 10.1111/j.1095-8649.2002.tb00893.x.