Gamitana (*Colossoma macropomum*) and Paco (*Piaractus brachypomus*) culture in floating cages in the Peruvian Amazon

Fernando Alcantara B.[1], Carlos Chávez V.[1], Luciano Rodríguez C.[1], Christopher C. Kohler[2], Susan T. Kohler[2], William Camargo N.[2], Marco Colace[3] and S. Tello

In April 1999, the Institute for Investigations of the Peruvian Amazon (IIAP) located in Iquitos (Loreto region) with the Italian NGO Terra Nuova and Southern Illinois University at Carbondale (SIUC), through the auspices of the PD/A CRSP-USAID program, initiated the Food Security Program for Familiar Productive Units (PROSEAL) between the Iquitos-Nauta Road and the Tigre River (Santa Helena and Huayococha; Figure 1). The goal of this program was to produce fish in ponds and floating cages as a way of providing tools to improve the animal protein intake of the Quichuas indigenous populations and other rural poor.

Fig. 1. Location of Tigre River (see red arrow), a tributary of Marañón River, Peru (South America) (modified from http://geography.about.com/library/cia/blcperu.htm)

This article is restricted to the experiences gained through a demonstration project on floating cages. Fish culture in cages floating directly in the natural environment in the Peruvian Amazon has not been reported previously; thus, many issues had to be resolved for it to be successful. The two predominant concerns were: 1) the behavior of major predators, such as dolphins (*Inia geofroensis* and *Sotalia fluviatilis*), crocodiles (*Cayman sclerops*), and pirañas (*Serrasalmus nattereri*) towards the unprotected floating cages containing large numbers of fish; and 2) the sociological fact that natives of the region possessed a strong traditional hunting and gathering tradition, with fish culture activities being alien to them.

The fishes selected for cage culture were the gamitana (*Colossoma macropomum* - also known as black cachama or tambaquí), and paco (*Piaractus brachypomus*), also known as pacú, white cachama, pirapitinga or morocoto. The two species have the advantage of being well known to the local population, although, recent captures have decreased dramatically as a result of excessive fishing pressure on natural stocks by the Iquitos-based commercial fishing fleet. In this article, we report preliminary results obtained from gamitana and paco culture in floating cages in the Tigre River.

Floating Cage Culture

The fish were cultured in floating cages located in two old meanders or oxbows of the Tigre River: Santa Helena still connected to the river and Huayococha not-connected. Santa Helena, is located one hour by boat downstream from Intuto village, the capital of the Tigre district and Huayococha is located close to Huacachina village, a smaller village in the same district.

The cage dimensions were 10 x 10 x 1 m. They were kept afloat through the use of highly buoyant balsa wood. Each cage had a rigid wood structure with bottom and sidewalls lined by 3-cm diameter hardwood rods nailed to the main 5 cm structural hardwood supports. Additionally, the cages had an internal plastic mesh with 7 mm openings to retain the small fingerlings and to prevent the entrance of predators. The cages were anchored in the proximity of the shoreline of each meander in areas of 3 m depth, or greater, to allow free circulation of the water (Figures 2 and 3).

The cages were stocked with 2,000 paco or gamitana fingerlings (7 cm average total length), with paco produced in controlled conditions at IIAP, under SIUC guidance, and gamitana at Fondo Nacional de Desarrollo Pesquero (FONDEPES), also in Iquitos. Two hundred fingerlings were transported per 5 L, double-layered plastic bag, along with an oxygen chamber to last the 16 hour boat journey. The plastic bags were placed individually in a balsa wood box. After stocking, the fish were fed, in variable amounts, a combination of balanced food, prepared at IIAP, of diverse fruits (Figure 4), agricultural by-products and termites (Isoptera). The fruits and roots were: pijuayo (*Bactris gasipae*), aguaje (*Mauritia flexuosa*), plantain (*Musa paradisiaca*), mullaca (*Physalia angulata*) and yucca (*Manihot sculenta*), cooked including the rind. The feeding frequency was variable. The cages and fingerlings were provided by the program, free

of cost, with the agreement that the beneficiaries produce fish for their own consumption.

Results and Discussion

The stocking density used (20 fish/m^3) was similar to the 25 fish/m^3 used by Hauschild and Salaya (1986) with a South American cichlid (*Petenia kraussii*) and the 16 to 32 fish/m^3 used by De Souza *et al*. (1986) with a species (*Colossoma mitrei*) similar to the ones cultured in this project.

In the 225 to 240 days of culture, fish reached weights from 310 to 350 g in Santa Helena, with 80 percent survival, excluding one cage, No. 10, in which a shorter culture period of 180 days occurred (Table 1) because of an early harvesting needed to feed the owners of this cage. The estimated production of 5 kg/m^3 was far superior to that reported by Hauschild and Salaya (1986) for *Petenia kraussii* (0.97 to 1.67 kg/m^3). In addition, the production was greater than that of De Souza *et al*. (1986), which in 180 days attained production ranging from 1.43 to 2.29 kg/m^3.

Mérola and De Souza (1986) reported that gamitana cage culture presented a great potential in the Latin-American region. The previous authors, in a gamitana culture experiment, obtained a net production of 153 and 211 kg at two densities: 100 and 150 fish/m^3, in 6.5 m^3 floating cages. They fed a balanced ration of 40 percent crude protein during the first five months and 30 percent crude protein during the six subsequent months. The lower productivity reached in our project, relative to that of Mérola and De Souza (1986), was probably the result of the low density used and the variable sources of food.

In Huayococha, three floating cages were stocked with gamitana and three with paco. The gamitana reached a weight of 280 to 310 g in 270 days, whereas paco grew slightly better, reaching 300 to 330 g in the same culture period (Table 2). Despite the traditional hunting and gathering vocation of the indigenous population of Santa Helena and Huayococha region, the communities are slowly assuming the role of fish producers. The communities show a great sense of satisfaction because of the good production results so far attained, and by having learned a novel production alternative using local resources, with the exception of the balanced food and the synthetic mesh. Further, they show interest in continuing this beneficial practice. However, the wooden structure of some floating cages is beginning to show signs of rapid deterioration after the eighth month of deployment, though the synthetic mesh has remained in good condition for reuse.

To assure sustainable fish production in these cages, a continu-

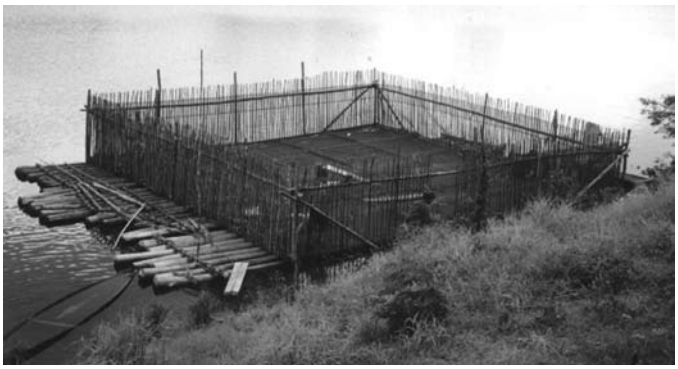

Fig. 2. Floating cage structure for pacu and gamitana fish culture (provisionally on a balsa wood raft) used by the Indian communities from the Tigre River, Peru (photo by L. Rodríguez).

Fig. 3. Floating cages in Santa Helena, Tigre River (photo by L. Rodríguez).

Fig. 4. Native displaying one of the fruits (aguaje Mauritia flexuosa*) utilized to feed Gamitana (*Colossoma macropomum*) and Paco (*Piaractus brachypomus*) cultured in floating cages (photo by L. Rodríguez).*

Table 1. Gamitana (*Colossoma macropomum*) culture in floating cages in Santa Helena, Tigre River (Stocking number 2000 fish/cage).

Variables/cage	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Culture period (days)	240	240	240	240	225	225	225	225	225	180
Initial length (cm)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	3.5
Final length (cm)	26.0	25.0	25.0	26.0	26.0	17.0	26.0	28.0	25.0	20.4
Initial weight (g)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	6.5
Final weight (g)	330	315	315	320	325	350	330	355	310	160
Final condition factor	1.9	2.0	2.0	1.9	1.8	1.8	1.9	1.6	2.0	1.9
Production (kg/m^3)	5.28	5.04	5.04	5.12	5.20	5.60	5.28	5.68	4.96	2.56

Table 2. Gamitana (*Colossoma macropomum*) and paco (*Piaractus brachypomus*) in floating cages in Huayococha, Tigre River (stocking number 2000 fish/cage).

Variables/Cage	1	2	3	4	5	6*
Species	G	G	G	P	P	P
Culture period (days)	270	270	270	270	270	15
Initial length (cm)	7	7	7	3	3	4
Final length (cm)	27	28	26	26	25	-
Initial weight (g)	12	12	12	6	6	7
Final weight (g)	310	310	280	330	300	-
Final condition factor	1,6	1,4	1,6	1,9	1,9	-
Production (kg/m^3)	4,96	4,96	4,48	5,28	4,8	-

** Some fish escaped*

ous fingerling supply should be secured. Accordingly, the Regional Loreto Fisheries Bureau located in Iquitos is planning to establish a fingerling production center in Intuto, near Santa Helena and Huayococha, to cover the future demand.

With regard to the impact of predators on the floating-cage fish culture operations, a dolphin made a hole in a cage wall, consumed some fish and allowed others to escape. Most of the cages provided suitable security to retain the fish in confinement, even though dolphins were often seen in the area. Similarly, in another case there was an invasion by fingerlings of another predator fish, the peacock cichlid (*Cichla ocellaris*) that swam through the mesh, but those fish did not interfere with the culture of the similar-sized paco or gamitana fingerlings. Further, the indigenous people of the region readily consume peacock cichlids.

Conclusion

The positive results obtained from this project open new possibilities throughout the Amazon region for the development of fish culture in floating cages constructed at relatively low cost and with readily available materials.

Notes

[1]Instituto de Investigaciones de la Amazonia Peruana, Programa de Ecosistemas Acuáticos Av. Abelardo Quiñónez Km. 2.5. Iquitos, Peru. A.P. 784. Corresponding author: e-mail: fab_001@hotmail.com

[2]Fisheries and Illinois Aquaculture Center, Southern Illinois University at Carbondale Carbondale, IL 62901, USA

[3]NGO Terra Nuova Av. Abelardo Quiñónez Km. 2.5. Iquitos, Peru

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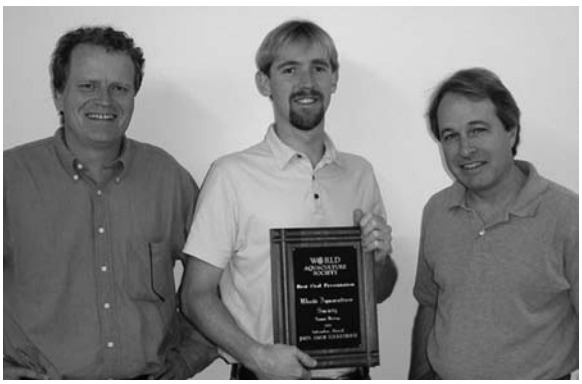
Luckenbach receives student award

Adam Luckenbach, a PhD student at North Carolina State University, received the Best Student Oral Presentation Award at World Aquaculture '03 for "Effect of temperature on sex determination and growth in southern flounder *Paralichthys lethostigma*."

Luckenbach's dissertation research focuses on breeding biotechnology for improved production of the southern flounder. His co-advisors are Dr. Russell J. Borski and John Godwin, both from the NC State Department of Zoology.

Luckenbach hopes to continue post-doctoral applied research after he graduates in May 2004.



Dr. Russell J. Borski, J. Adam Luckenbach and John Godwin, all from North Carolina State University Department of Zoology.