FLOATING CAGES AS AN EXPERIMENTAL TOOL FOR SHRIMP CULTURE STUDIES: FIRST ATTEMPTS TO CHECK THEIR RELIABILITY.

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Abstract

The first aim of this study was to evaluate on a technical basis the rearing of shrimps in floating cages set up in earthen ponds. Shrimps reared in and outside the cages presented comparable growths and survival rates. Then it was concluded that shrimp culture in floating cages did not present zootechnical biases comparing to pond culture. The second objective of this study was to assess the present method as a statistical point of view. We found that for expected differences of 20% to the control mean, 3 and 6 floating cages per treatment will be reasonable to determined statistical differences for growth parameters and survival. Furthermore, we showed a significant pond effect as regard as survival and growth between both sets of cages. This results illustrated the within farm variability among the ponds, and confirmed that specific characteristics of each ponds from a same farm make difficult to use them as experimental unit. The study demonstrates that floating cages rearing is an economical, powerful, and sensitive experimental tool for shrimp culture studies specifically undertaken under close to semi-intensive production conditions.

Introduction

Some constraints for carrying out experiments under semi-intensive farm's conditions using pond as experimental unit must be considered:
- the delivery of a high number of post larvae (PL) coming from the same batch which will have to be seeded at the same time in all the experimental ponds;
- the approximation done on the initial seeded PL and final survival rate calculation;
- the supply of experimental feeds at an industrial scale:
- the high within-pond variability of zootechnical responses.

Moreover the cost per replicate ponds in such cases would be high, both in terms of capital required to purchase and house the animals, and of labour needed to rear them and to collect representative data.
The study undertaken focused on the zootechnical and statistical assessment of shrimp, *Litopenaeus stylirostris*, rearing in floating cages immersed in earthen ponds as an experimental tool.

Materials and Methods

Shrimps were pregrowed in two 7 ha earthen ponds (pond A and pond B) at a density of 17-18 post larvae.m^{-2} of a semi-intensive farm located in Bourake, New Caledonia.
The experiment design with 5 cages of 14m² of net surface each (Pic. 1) has been duplicated in the two earthen ponds (cages-A and cages-B) given a total of 10 floating cages. Each cage was stocked with 400 pregrowed animals (density of 29.m^{-2}) coming from the corresponding pond. Shrimp initial body weights were respectively 3.4±0.6 g (ds) and 2.7±0.7 g (ds) in cages-A and in cages-B sets. Shrimps were sampled weekly in one cage. Each cage was sampled only once in the course of the trial by catching 30 shrimps with a cast net.
Shrimps were fed twice a day with a commercial formulated feed, and the ration was adjusted weekly according to the body weight, survival rate and amount of remaining feed.
The final survival rates, growth rate, final biomass and feed conversion ratio (FCR) were calculated for each cage. *A priori* power, *post hoc* power and sensitivity calculations were achieved (Faul et al., 2007), in order to assess sensitivity and to determine the number of replicates that would be necessary to set up, based on the variability of the zootechnical responses.

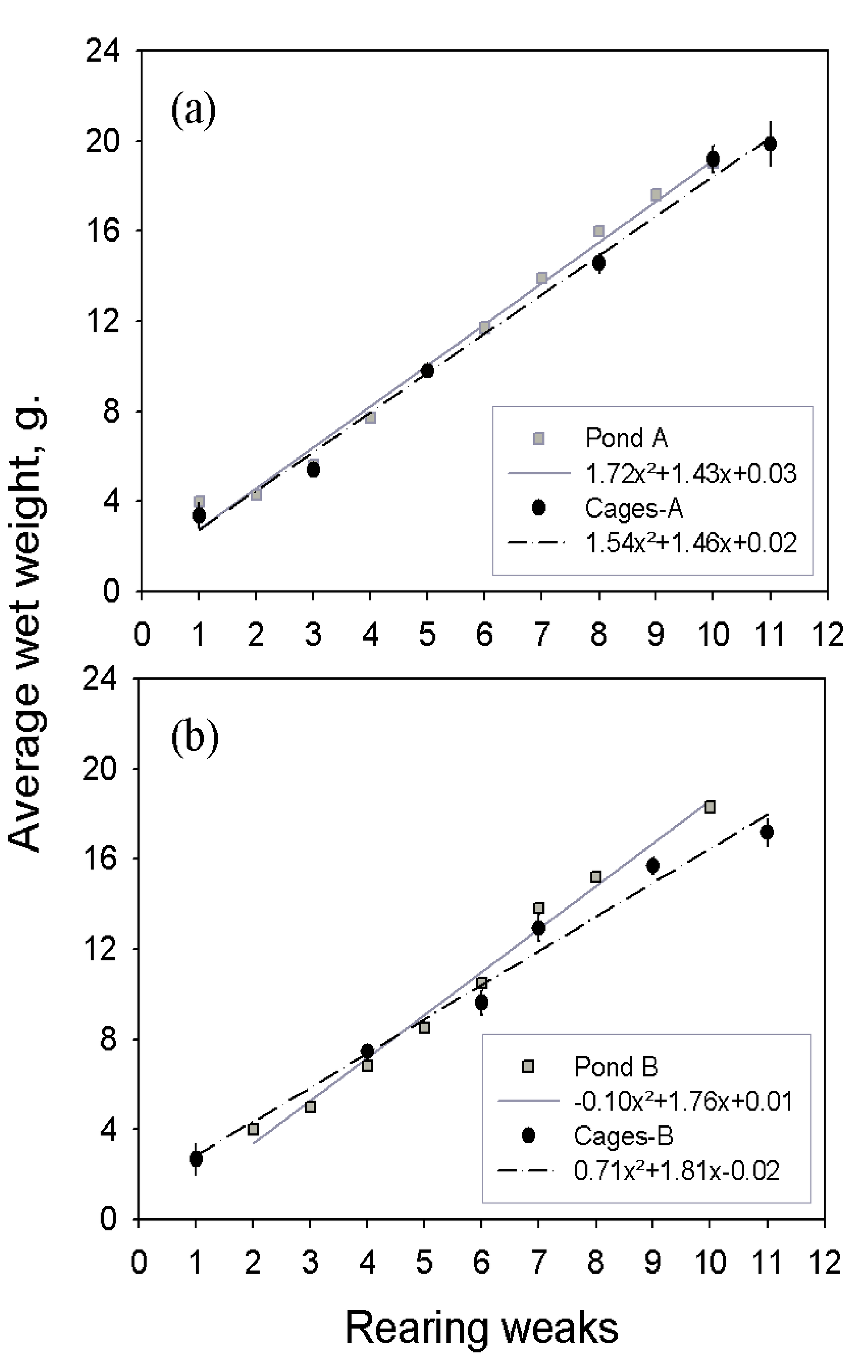

Figure 1. Comparative weekly average wet weight of shrimps reared in *Cages-A* (a) and *Cages- B* (b) and in their respective ponds. Straight lines equations obtained by linear regressions of average wet weight function of the rearing weeks are indicated. Error bars indicate standard errors.

Results and discussion

The estimated survival rates of the shrimps reared in the ponds were 30.7 % and 31.3 % respectively in ponds A and B. FCR were of 2.67 and 2.57 for pond A and pond B respectively.
Shrimps reared 10 weeks in cages-A and cages-B sets presented growths comparable to those raised in the respective ponds (Fig. 1). Table 1 gives zootechnical results and estimations of the amounts of variability for the zootechnical parameters between cages (experimental unit), for both sets (cages-A and cages-B). For each parameter recorded, no significant difference has been shown between variances.
Based on average CV, the requisite number of replications necessary to determine a treatment effect (5, 10, 15, 20, 25 and 30 % of the mean) according to the considered parameter has been calculated for each experiment design, "cage as experimental unit" or " pond as experimental unit " (Table 2).

Low survival rate during this study was a consequence of high mortalities the first 3 weeks of the trial. These mortalities affected at the same time shrimps reared inside as well as outside the cages and can be related to the "summer syndrome"(Castex et al., 2007)
Despite of the high mortalities recorded during the trial, the FCR for cages-A and cages-B sets approached 2 and were, 13% and 17% lower than those obtained in the respective ponds.
With final average body weight of 18.5±1.7 g and final biomass of 140.0 ± 17.5 g.m^{-2}, the results after 10 weeks grown out in floating cages, were comparable to those generally observed in semi intensive ponds in New Caledonia.

Table 1. Zootechnical results of rearing in cages for both sets in pond A and B. (1) Different superscript letters within the same line indicate significant differences among treatments variance with Fisher test for variance equality.

	Survival (%)		Biomass (g.cage^{-1})		Final body weight (g)		Growth rate (g.day^{-1})		FCR	
Cages	A	B	A	B	A	B	A	B	A	B
n	5	5	5	5	5	5	5	5	5	5
Mean	31.1	37.8	2291	2408	19.91	17.22	0.226	0.199	2.29	2.28
SD	3.4	4.2	346	299	0.99	0.63	0.014	0.009	0.19	0.13
Variance[1]	0.001[a]	0.002[a]	120323[a]	89707[a]	0.98[a]	0.4[a]	0.0002[a]	0.0001[a]	0.036[a]	0.016[a]
Coef Var	0.108	0.111	0.151	0.124	0.05	0.04	0.06	0.044	0.083	0.056
Mean CV* (%)	11.0		13.7		4.4		5.4		7.0	

[1] Fisher test for variance equality
* Coefficient of variation (CV) = (pooled standard deviation / mean) x 100

Table 2. Estimated number of replications needed in shrimp experiments depending of which rearing system is considered as experimental unit [a].

Experimental design	Parameters	Average CV[b]	Expected differences, % of mean[a]					
			5	10	15	20	25	30
Cages	Survival (%)	11	71	20	10	7	5	4
	Final body weight	5	18	6	4	3	3	2
	Daily growth rate	6	23	8	4	3	3	3
	Final biomass	14	126	32	15	9	7	5
	FCR	7	32	9	5	4	3	3
Pond	Survival (%)	16	207	48	21	12	8	6
	Final body weight	8	43	12	6	4	3	3
	Daily growth rate	5	21	6	4	3	3	3
	FCR	8	40	11	6	4	3	3

[a] Assumes a randomized with two treatments, two-tailed test of significance, and power of 80% at P<0.05

Thus, floating cages rearing method do not present zoo technical biases, making it a tool of choice for the experiments in ponds. However, it is important to be aware of two differences compare to pond's conditions:
- animals raised in the floating cages have no access to the sediment of the pond but the present results and the successive trials achieved with floating cages to evaluate dietary probiotic effects on shrimps in commercial ponds did not argue for a potential bias due to sediment free conditions.
- the net represents a substratum for the development of periphyton and associated benthos which can both contribute to shrimp nutrition.

Once aware of those limitations, trials in floating cages are most probably more representative than laboratory trials in clear water and offer in this way a good compromise. Moreover, we showed that floating cages design is a statistical powerful and sensitive experimental tool for studies undertaken in practical pond conditions (Chim et al., submitted).

Conclusion

This study demonstrates that floating cages is a reliable method to achieve powerful experiments under close to pond conditions, and makes it a good experimental tool in order to assess on a pilot scale scientific results obtained under laboratory controlled conditions.

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