

SHORT COMMUNICATION

Effectiveness of Predator Control Set-up for Aquatic Pest Control in Earthen Ponds for Extensive Culture of *Penaeus monodon* (Fabricius, 1798)

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ABSTRACT

The effectiveness of a conventional predator system for tiger prawn ponds consisting of a net barrier and fence interwoven around a modified pond gateway (set-up 1) was compared to an expanded system that directed water-borne pests to a fish compartment (set-up 2). The compartment had two confinement areas holding fifty, 5 g sea bass fingerlings and nineteen, 300-400 g tiger grouper juveniles separated by a fine mesh net gate secured to a sluice structure. Regardless of the set-up employed, after 88 days of culture, three pest categories were identified inside the ponds: prawn predators, opportunistic feeders, and benthic scavengers. Wet biomasses of fish pests were 1.92 kg and 2.12 kg, while that of mangrove snail was 29 kg and 80 kg in set-ups 1 and 2, respectively. Prawn length-weight frequency from 30% biomass manifested negatively skewed population curves with the highest frequency size range of 111-120 mm: set-up 2 had a smaller skewness value (-10.68) than set-up 1 (-20.64). A significant t-value of -1.39 ($p < 0.10$; df_{18} at t_{90}) indicated that prawns raised in set-up 2 were larger than those grown under set-up 1. Finfish pests collected from set-up 2 were fewer than those in set-up 1, consisting predominantly of smaller (81-120mm) *Megalops cyprinoides* and *Tilapia mossambicus*: pests with total lengths below 81 mm were presumed to have been eaten by the sea bass and tiger grouper in the fish compartment. In both predator control systems, the period where tiger prawns are most vulnerable to predation pressure was during the first two months of culture, at lengths less than 111 mm and weights below 12.9 g.

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Pesticides have been adopted by farmers in pond-based prawn culture to eliminate predators, increase post-larval survival, and harvest yield (Bocek 2015; Clearwater et al. 2008). Tea seed applied at a rate of 200 mg/L of pond water (Clearwater et al. 2008; Terazaki et al. 1980) or niclosamide at doses not exceeding 1.0 mg/L (Napaumpaiporn et al. 2012; Calumpang 1994) are commonly used in Asia. Chemical pesticides have been limited to pond preparation due to their increasing costs. Instead, structures such as filter box screens, bamboo fences, bag nets, pond liners, and dike fortifications have been installed as

cheaper alternatives. Nonetheless, albeit the number of resources invested, predators would enter ponds through leaks and cracks (Apud et al. 1983). This study investigated the effectiveness of predator control systems for *P. monodon* (tiger prawn) earthen ponds. The study site was a traditional aqua-farm practicing tiger prawn *cum* milkfish poly-culture (Hadie et al. 2014), encountering problems with aquatic pest infestation. Two earthen ponds with an area of 1,500 m² and an average mid-pond depth of 1 m were selected. A bamboo fence encircled the first pond's modified gateway with a fine mesh net interwoven over it (Fig.1). This

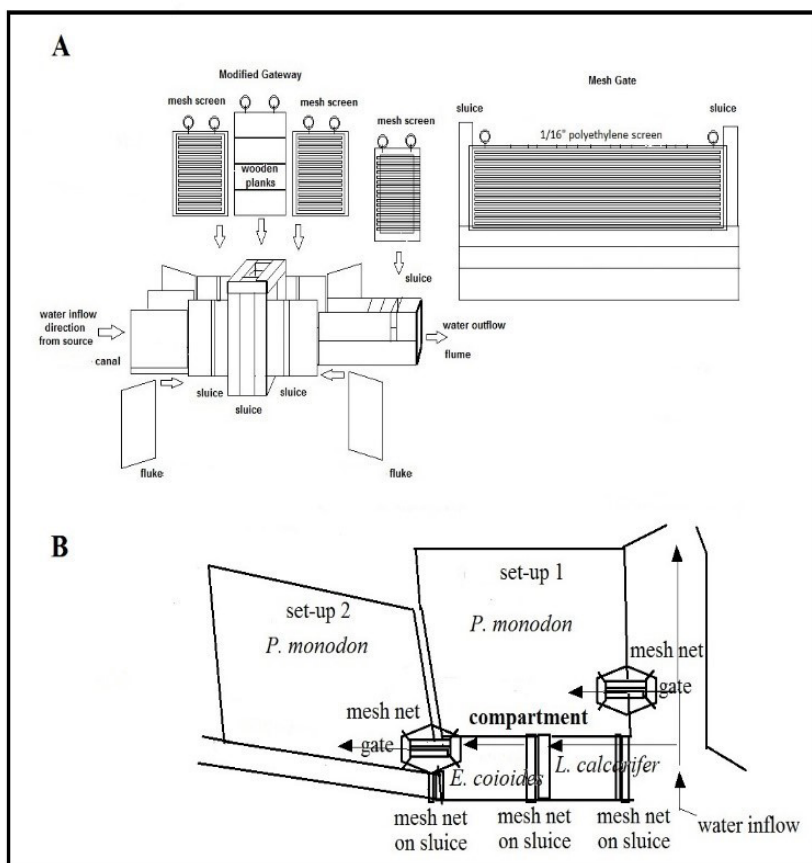


Figure 1. Components of the modified gateway, mesh gate, “biocontrol” compartment (A), and place where structures were situated in set-up 1 and 2 (B). Both set-ups used the modified gateway for pond water entry. In set-up 2, the 1/16” polyethylene screen mesh net gate (top right image) provided separation for *E. coioides* and *L. calcarifer* in the “biocontrol” compartment.

conventional predator control system was designated as predator control set-up 1. Predator control set-up 2 was termed expanded predator control system.

Other than having a modified gateway, set-up 2 was also provided with a “biocontrol” compartments placed to discourage water-borne pests from entering the pond (Fig.1B). The 1/16” polyethylene screen mesh net gate separated fifty, 5g *L. calcarifer* and nineteen, 300-400 g *E. coioides* within the compartments. Pond preparation included pond drying, muck removal, furrowing, fertilizing, tea seed application, and water filling until the mid-depth of 1 m was reached.

Stage 12 post-larval *P. monodon* were obtained from a private hatchery, acclimated, and directly seeded into the ponds at 6,000 post-larvae per pond (4 post-larvae per m³). Farm-made feeds utilizing local ingredients were used wherein crude protein level was limited to 20% due to the presence of natural food (aufwuchs). Effectiveness of predator control set-up 1

versus 2 was determined by collecting the total harvest biomass and the pests. The frequencies and size ranges of prawns were compared using the one-tailed, independent T-test to determine if tiger prawns in set-up 2 were larger than those raised in set-up 1. Frequency distributions of prawns grown in the two ponds were also constructed based on size ranges of total length (mm) derived from one-third of the prawn population. Population curves were subjected to the Skewness formula. Total length or carapace length ratios were derived to providing insight into the morphology of the prawns raised under the two set-ups.

On the 88th day of harvest, three major pest types were categorized: prawn predators (*Megalops cyprinoides*), opportunistic feeders/competitors (*Tilapia mossambicus* and *Chanos chanos*), and benthic mangrove snails/scavengers (*Cerithidea cingulata*). Mangrove snails comprised the largest pest biomass in both set-ups (Table 1). Snail biomass in set-up 2 was only 36.25% the amount of set-up 1. In set-up 2, prawn

Table 1. Contribution of pests and tiger prawns to pond biomass.

Harvested Species	Set-up 1		Set-up 2	
	Biomass (g)	g/m ³	Biomass (g)	g/m ³
Finfishes	2,121.50	1.41	1,921	1.42
<i>M. cyprinoides</i>	1,106		1,100	
<i>T. mossambicus</i>	331.50		116	
<i>C. chanos</i>	684		705	
Mangrove Snails	80,000	53.33	29,000	21.48
<i>C. cingulata</i>	80,000		29,000	
Tiger prawn	882	0.59	3,906	2.89
<i>P. monodon</i>	882		3,906	
Totals	83,003.50	55.33	34,827	25.79

harvest increased by as much as three-fold compared to set-up 1 (3.90 vs. 0.88 kg).

The modal range of 111-120 mm had the highest prawn frequencies from samples harvested in set-up 2 (28.57% at n=84) and 1 (52.94% at n=34) (Table 2). Population curves of prawn lengths were asymmetrical for both ponds resembling a curve leaning toward the left (Fig. 2). The negative skewness value (-20.64) of set-up 1 produced a narrow curve, wherein 26.47% were situated at the larger size ranges above 120 mm. Consequently, skewness value (-10.68) of set-up 2 produced a wider curve, wherein 61.90% of prawn samples were distributed to larger size ranges of 121-170mm. Ninety percent (90.47%) of prawns raised in set-up 2 weighed from 13 to 27 g per individual. In contrast, prawns from set-up 1 did not exceed 19 g. In both ponds, prawns with lengths below 111 mm were scarce due to predator pressure on smaller prawns (20.59 and 9.52% under set-ups 1 and 2, respectively).

With regard to independent t-test prawn frequencies for ten size ranges for length (N=10) at $p < 0.10$, the calculated t-value = $|-1.39585| = 1.39585$ exceeded the tabular value $t_{90} = 1.33$ ($t_{90} = 1.33$ at df_{18} , $p\text{-value} = 0.089871$) indicating that prawns in set-up 2 were larger than those in set-up 1. Total length or carapace length (tl/cl) ratios indicated that prawns from set-up 2 had a larger carapace and a shorter, well-rounded body compared to those harvested in set-up 1 (2.28 vs. 2.36, respectively). Fin fish pests collected in set-up 2 were fewer than those in set-up 1 (Table 3). Slower, more sluggish *T. mossam-*

bicus would easily fall prey to the carnivorous fish within the “biocontrol” compartment.

Megalops cyprinoides brought about significant harvest losses to both ponds regardless of the predator control set-up employed to shield the ponds against pests. The main diet of *M. cyprinoides* consists of live insects, copepods, and prawns (Mathew 1988; Kuthalingam 1958); after that, shifting from copepods to prawns when they reach a length of 24.6 mm (Kuthalingam 1958). Prawn population curves of both ponds displayed a negatively-skewed curve, with fewer smaller prawns at the left side of the modal size range as a result of predation pressure by *M. cyprinoides*. Curve shape was influenced by the abundance of smaller *M. cyprinoides* juveniles with lengths between 41-160mm (54.17 and 62.50% for set-ups 1 and 2, respectively). Prawns with short lengths (<111 mm) and weights below 10 g were easily targeted by smaller *M. cyprinoides*, reducing their frequencies in their respective pond populations. Biomass of finfish pests that infiltrated the ponds was the same in both set-ups at 1.4 g of finfish per m³ of pond water. Installation of a “biocontrol” compartment in set-up 2 resulted in smaller (<120 mm) and fewer (37 in set-up 1 vs. 5 in 2) *T. mossambicus* that reduced grazing of natural food, resulting in a higher prawn harvest biomass of 3.9 kg. In set-up 1, *T. mossambicus* and *M. cyprinoides* were more abundant, resulting in higher prawn predation pressure that reduced the harvest to only 0.88 kg. In both predator control systems, the period where prawns were most vulnerable to predation pressure was during the first two months of culture at

Table 2. Tiger prawn length and weight frequencies.

Group	Range of total length (mm)	Set-up 1		Set-up 2	
		prawn frequency	average wet weight (g)	prawn frequency	average wet weight (g)
1	71 - 80	1	4.90	0	
2	81 - 90	4	6.31	1	6.97
3	91 - 100	2	7.91	0	
4	101 - 110	0		7	10.75
5	111 - 120	18	11.65	24	12.96
6	121 - 130	4	13.79	22	15.38
7	131 - 140	3	16.13	21	18.02
8	141 - 150	2	18.64	7	20.87
9	151 - 160	0		1	23.94
10	161 - 170	0		1	27.22
Totals		34		84	

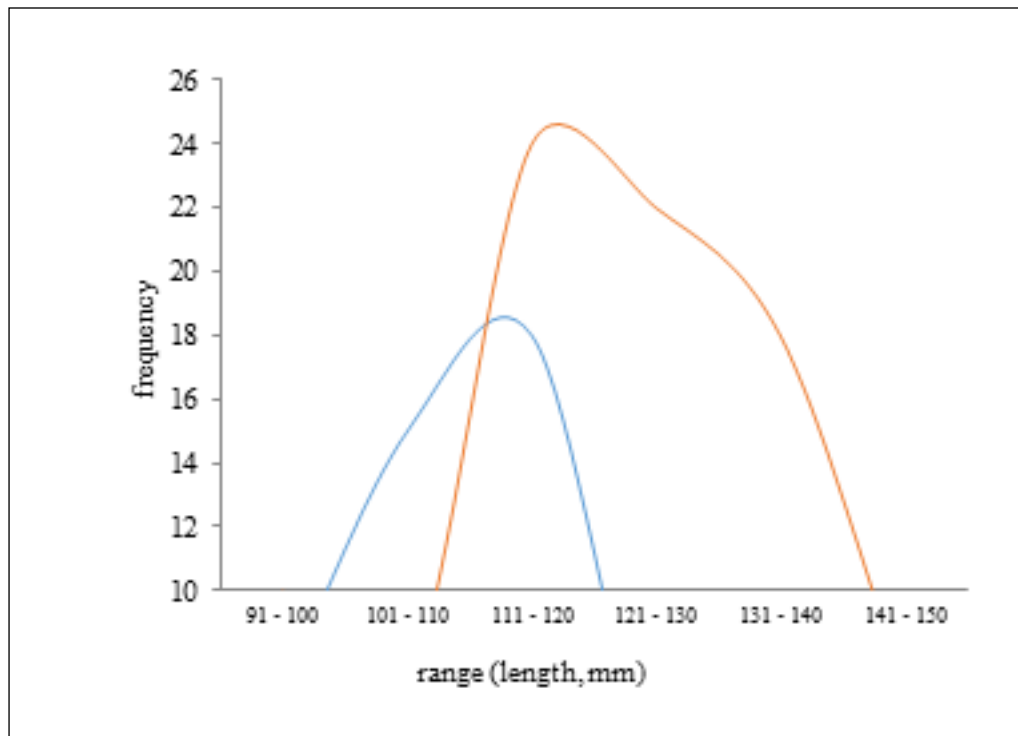


Figure 2. Asymmetrical population curves of tiger prawns in set-ups 1 (blue) and 2 (red).

Table 3. Number and frequency of finfish predators in ponds with a predator control set-up.

Total Length (mm)	Set-up 1					Set-up 2				
	TM	MC	CC	Total	Percent	TM	MC	CC	Total	Percent
41 - 80	24			24	38.10		1		1	2.38
81 - 120	11	3		14	22.22	4	14		18	42.86
121 - 160	2	10		12	19.05	1	5		6	14.29
161 - 200		7		6	9.52		7		7	16.67
201 - 240		3		3	4.76		5		5	11.90
241 - 280		1	1	2	3.17			5	5	11.90
281 - 320			2	2	3.17				0	0.00
Totals	37	24	3	63	100.00	5	32	5	42	100.00

legend: TM= *T. mossambicus*; MC= *M. cyprinoides*; CC= *C. chanos*

lengths less than 111 mm and weights below 12.9 g.

Direct stocking of hatchery-reared prawn post-larvae into extensive prawn ponds resulted in significant losses due to predation and feed competition by aquatic pests. The extent of finfish pest infiltration was the same in both ponds at 1.4 g of finfish pest per cubic meter of pond water. Installation of predator control compartments with *E. coioides* and *L. calcarifer* fish serving as biocontrols, or setting up traditional fine mesh nets fronting the gate of ponds did not prevent the entry of unwanted pests.

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