

# Improving artisanal fisheries through community-based prawn stock enhancement in a mangrove estuary

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**Dr. Jon P. Altamirano** is a Scientist at the SEAFDEC Aquaculture Department in the Philippines. He leads the Program on “Maintaining Environmental Integrity through Responsible Aquaculture” and heads the Farming Systems and Ecology Section of the Research Division. He currently specializes on sea cucumber research for practical aquaculture applications. He also worked on the stock enhancement of shrimps that integrates environmental and social aspects. Along these fields, Dr. Altamirano is active in collaborative research with various national and international institutions and has, so far, led and co-authored more than twenty scientific journal articles, books and technical manuals. Aside from disseminating his research results in dozens of international conferences, Dr. Altamirano also lectures in technical training courses and academic symposia. He actively advises both graduate and post-graduate students in the fields of aquaculture and fisheries. Dr. Altamirano finished his bachelor’s degree in Fisheries from the University of the Philippines Visayas in 1999, and has sequentially completed his master’s and Ph.D. studies at the University of Tokyo, Japan from 2005 to 2010.



## ABSTRACT

Tropical seafood, especially prawns, have always been in high demand with high market prices. Because of this, wild prawn resources are often overfished as indicated by the increasing number of fishers, but with overall declining catch volume and sizes through the years. Prawn aquaculture has, as of course, significantly contributed to the total yield in the past decades. However, the expansion of farms and ponds has often negatively affected the natural nursery grounds in the estuaries and mangroves. The economic gains from aquaculture are limited only to those who invested. However, local communities and artisanal fishers are often deprived of such gains. They are still reliant upon the dwindling natural stocks of fisheries resources. This is where the concept of stock enhancement comes in, wherein hatchery-produced juveniles are released into the water body in order to increase capture fisheries yield for local fishers<sup>[1]</sup>.

In this talk, I will present the case of the tiger prawn *Penaeus monodon* stock enhancement in the New Washington Estuary (NWE), in Aklan, central Philippines. The NWE was a productive fishing ground providing >24 kg/gear/day of catch in the 1970s but steadily declined to <0.7 kg/gear/day in 2010s. Prawn catches declined both in quality and quantity<sup>[2]</sup>. Meanwhile, mangrove cover was reduced from 4800 ha in 1950s to only <800 ha in 2010s. Site-specific studies were conducted in NWE on prawn nursery rearing, small-scale release and monitoring experiments, as well as social assessments. Our studies produced essential scientific data to guide future stock enhancement activities in NWE. Even at an experimental scale, our releases showed significant increases in catch by at least 8% but can potentially increase daily income by >400%<sup>[3]</sup>. However, in order to sustain the prawn fisheries and optimize the benefits, long-term management plans by all stakeholders are needed, especially between the communities and the local government.

[1] Altamirano, J.P. & Meñez, M.A.J. (2021) Resource enhancement: Concepts, learnings, and future directions. In: Aya, F.A., de la Peña, L.D., Salayo, N.D., Tendencia, E.A. (Eds.) *Proceedings of the International Workshop on the Promotion of Sustainable Aquaculture, Aquatic Animal Health, and Resource Enhancement in Southeast Asia*. Iloilo, Philippines, 70-87.

[2] Altamirano, J.P. & Kurokura, H. (2010) Failing inshore fisheries in the Batan Estuary, Aklan, central Philippines. *Journal of Nature Studies* 9(1): 13-21.

[3] Altamirano, J.P. et al. (2015) Stock enhancement for coastal socio-ecological restoration. In: Eguia, M.R., Salayo, N.D., Estepa, F., Ramos, M.J.H. (Eds.) *Proceedings of the International Workshop on Resource Enhancement and Sustainable Aquaculture Practices in Southeast Asia*. Bangkok, Thailand. 159-167.



JIRCAS International Symposium 2022  
Artisanal Fisheries and Aquaculture in the Sustainable Food Systems  
21 November 2022 • Tokyo, Japan

**Improving artisanal fisheries through community-based shrimp stock enhancement in a mangrove estuary**

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**Background of project**


- 1993: Kuruma shrimp (*P. japonicus*) stock enhancement in Hamana Lake, Japan
- 1997: Dr. Kurokura visited New Washington Estuary, Philippines; saw similarity to Hamana Lake



Shizuoka, Japan  
HAMANA LAKE (69km<sup>2</sup>)



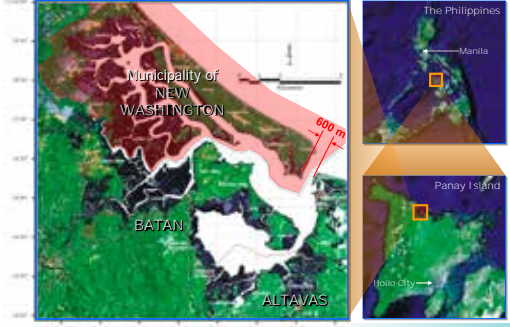
Aklan, Philippines  
NWE (2.6km<sup>2</sup>)



- 2003-2005: Dr. Kurokura & Dr. Fushimi initiate the project
- 2005-2010: J. Altamirano, assessment studies of NWE
- from 2012-2016... stock enhancement project continued with RIHN, SEAFDEC/AQD, Aklan Univ.

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**Study site: New Washington Estuary (NWE)**




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**Why tiger shrimp? It is the most important species.**

Shrimp fisheries in the [NWE] estuary is the most important livelihood... (Ingles *et al.*, 1992).

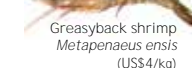
**Important shrimps in the NWE**




**Tiger shrimp**  
*Penaeus monodon*  
(US\$10/kg)



**Banana prawn**  
*Penaeus merguensis*  
(US\$6/kg)



**Greasyback shrimp**  
*Metapenaeus ensis*  
(US\$4/kg)



**Sergestids**  
*Acetes* sp.  
(US\$3/kg)

SOURCE:  
Altamirano, J.P. and H. Kurokura. 2010. Failing inshore fisheries in the Batan Estuary, Aklan, central Philippines. *Journal of Nature Studies* 9(1): 13-21.

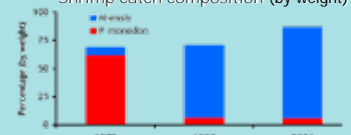
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**Why tiger shrimp? It is declining fast.**

**Trend in CPUE of tigbakol (fish corral) in NW Estuary**

Year	CPUE (kg/gear/day)	Reference
1970	24	Altamirano, 2010
1980	10	Altamirano, 2010
1991	7.66	Ingles <i>et al.</i> , 1992
2000	5	Altamirano, 2010
2000	3.44	Babaran <i>et al.</i> , 2000
2006	1.65	Altamirano, 2010
2013	0.73	current project

**Shrimp catch composition (by weight)**




SOURCE:  
Altamirano, J.P. and H. Kurokura. 2010. Failing inshore fisheries in the Batan Estuary, Aklan, central Philippines. *Journal of Nature Studies* 9(1): 13-21.

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**Intense fishing efforts: Too many fishing gears**



**Fixed fishing gear distribution (2006)**



**Fishing Gears**

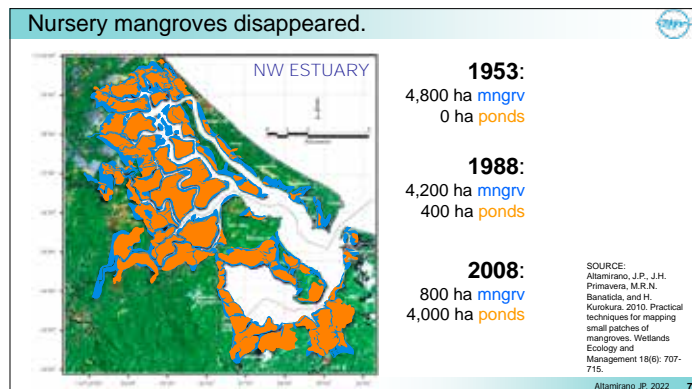
1991: 426+  
2000: 2,077  
2006: 2,309

Registered (2007): 1,701

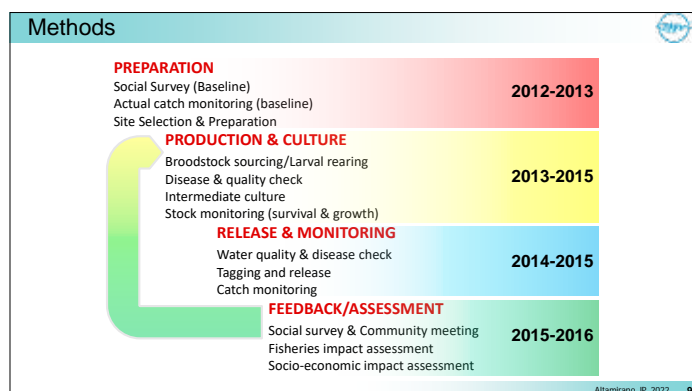



SOURCE:  
Altamirano, J.P. and H. Kurokura. 2010. Failing inshore fisheries in the Batan Estuary, Aklan, central Philippines. *Journal of Nature Studies* 9(1): 13-21.

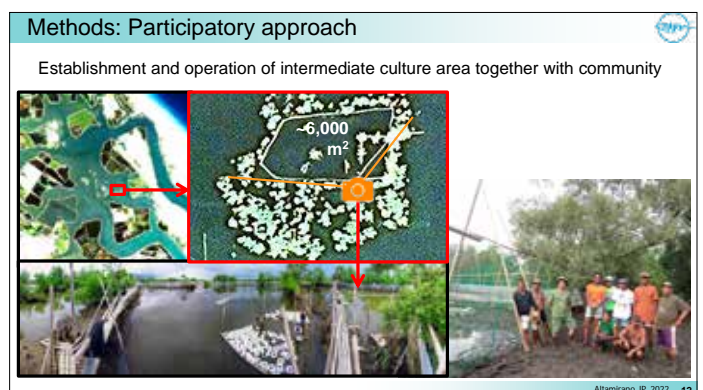
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- Project objectives**
- 1. Increase fisher's income**  
- tiger shrimp is most important (expensive)
  - 2. Reduce number of fishing gears**  
- even with less gears, sales can be improved by more expensive tiger shrimps
  - 3. Promote mangrove rehabilitation**  
- awareness of nursery function of mangroves
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- Methods: Scientific evaluations**
- Site- & species-specific studies:**  
(New Washington Estuary (NWE) using *P. monodon*)
- 1. Source of stocks?**  
Field surveys → confirmed presence of local shrimp hatcheries
  - 2. Location for intermediate culture?**  
Life stage and environmental profiling → upper mangrove estuary
  - 3. Size/age at release?**  
Intermediate culture trials → 30 d to grow >0.5 g shrimps
  - 4. Stocking density for initial rearing?**  
Multiple culture trials → 30-60 shrimps m<sup>-2</sup> for 30 d
  - 5. Schedule and timing for release?**  
Climate review → April-June (lesser chance of typhoon)
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## Methods: Participatory approach

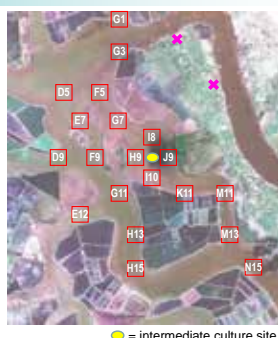
Monitoring catch from  
20 monitoring zones  
with local fishers (□)



Set Net (*tigbakol*)

Parallel monitoring:

1. Other fishing gears
2. Catch landings at 3 sites (✕)



● = intermediate culture site

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## Results: Baseline shrimp catch per day



SOURCE:  
Altamirano, et al., 2015.  
Community-based  
shrimp stock  
enhancement for coastal  
socio-ecological  
restoration in the  
Philippines. In: IWRESA  
2014 Proceedings (159-  
167)

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## Results: How to increase income?

## Present status:

Min. target income: PhP 235/d (Poverty Line, 2013)

Sales from shrimp: **PhP 34**/gear/d (ave.)

Ave. gears/family: 5 gears @ P34/gear  
(PhP 170 total income)



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## Results: How to increase income?

Present status: P34/gear (total shrimp sales)

## Hypothetical\* catch of tiger shrimp after stock enhancement

Shrimp Size (CL, BW)	Price (PhP/kg <sup>1</sup> )	Scenario 1: 2 months after release (pieces) weight, price	Scenario 2: 3 months after release (pieces) weight, price
3-4cm, 15-35g	300		(15) 450g, PhP 135
2-3cm, 5-15g	150	(40) 900g, PhP 135	
1-2cm, 1-5g	60		
<1cm, <1g	20		
<b>TOTAL:</b>		<b>900g, PhP 135</b>	<b>450g, PhP 135</b>

At 4% recovery  
after 2 months

At 1% recovery  
after 3 months

NOTE:  
In Japan,  
recovery rates  
for shrimp  
releases was  
only about 5%  
(Hamasaki and  
Kitada, 2006).

Note: US\$1 = PhP42.50 (2013 annual average) \*Assumptions: 500,000 shrimps released; 330 potential fishers

Altamirano, et al., 2015. Community-based shrimp stock enhancement for coastal socio-ecological restoration in the Philippines. In: IWRESA 2014 Proceedings (159-167)

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## Results: How to reduce number of gears?

## Present status:

Min. target income: PhP 235/d (Poverty Line, 2013)

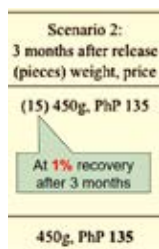
Sales from shrimp: **PhP 34**/gear/d (ave.)

Ave. gears/family: 5 gears @ P34/gear  
(PhP 170 total income)

## New scenario: (catch of tiger shrimps)

Sales from 1 gear: **PhP 135/d** (tiger shrimp only)

Reduced gears: **2 gears (PhP 270/d)**



At 1% recovery  
after 3 months



## Results: intermediate culture, tagging, release

- 2013 July: 1st rearing (129,000 stocked)  
Aug: No release (high mortality)
- 2014 Feb: 2nd rearing (390,000 stocked)  
April: **15,000 released** (4%); 100 tagged
- 2014 June: 3rd rearing (270,000 stocked)  
July: **120,000 released** (44%); 240 tagged
- 2014 Nov: 4th rearing (400,000 stocked)  
Dec: Series of typhoons caused mortality
- 2015 Apr: 5th rearing (483,000 stocked)  
May: **250,000 released** (51%); 250 tagged

Different color tags for different release batches

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## Results: Catch monitoring

Recapture info (5<sup>th</sup> batch)

Released: May 2015  
Total released: 250,000  
Shrimp tagged: 250 (0.1%)

Total recovery: 20 pcs (8%)\*  
Details: July (8 pcs), 5 g (3%)  
Aug (4 pcs), 15 g (1.6%)  
**Sep-Oct (8), 55 g (3%)**

Estimated total potential harvest:  
(4 months after release):  
**1,100 kg (PhP220,000)**

NOTE:  
In Japan,  
recovery rates  
for shrimp  
releases was  
only about 5%  
(Hamasaki and  
Kitada, 2006).

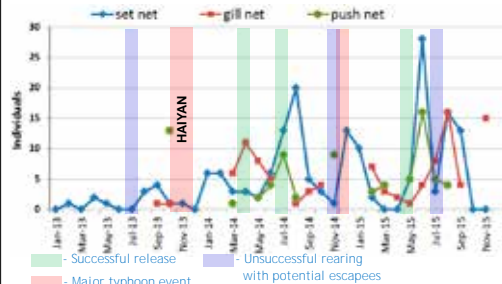
\* Many more recaptured shrimps may not have been reported by other fishers

Altamirano, et al., 2016. Aquaculture-based Restoration and Stock Enhancement of Tiger Shrimps in the Philippines.  
In: Proceedings of the Symp on Strat for Fish Res Enhance in the SEA Region. 166-170.

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## Results: Catch monitoring

## Monthly catch data of tiger shrimps



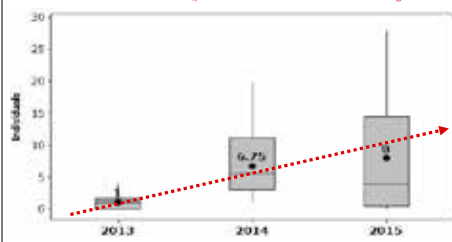
- Baseline data, only <2 shrimps/per gear
- Typhoons reduced catch
- Successful releases increased catch (>20), but temporary
- Unintentional escapees increased catch (4-13)
- Haiyan (super typhoon) reduced number of gears; improved catch

Altamirano, et al., 2016. Aquaculture-based Restoration and Stock Enhancement of Tiger Shrimps in the Philippines.  
In: Proceedings of the Symp on Strat for Fish Res Enhance in the SEA Region. 166-170.

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## Results: Catch monitoring

Overall improvement of shrimp catch after stock enhancement (experimental scale)  
(pooled from 20 fixed set net/tigbakol stations)



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## Results: Community life conditions improved!

## Perceived conditions (1 &lt; 10 scale)\*

	2013	2015
Average income (month)	~PhP 7,000	~10,000
Living condition	4.9	5.1
Catch (Shrimps)	2.6	2.9
Catch (Fish / Shells)	3.1	3.7

\*Salayo et al., 2015 RIHN Project Update

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## Summary

- ❑ NWE was overfished and mis-regulated fishery
- ❑ Shrimp stock enhancement can (1) increase income; and (2) promote reduction of fishing gears
- ❑ Stock enhancement trials increased catch with higher recovery (8%+) than expected (1-4%)
- ❑ Community perceived an increase in life condition



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## Recommendation

- ❑ Partnership with a local community organization with strong leadership
- ❑ Sufficient social preparation and capacity building
- ❑ Active community participation (planning → implementation)
- ❑ Reliable scientific baseline information
- ❑ Site-specific and species-specific assessments and studies
- ❑ Multi-institutional/sectoral collaboration (e.g. community; government)
- ❑ Long-term management plans (fisheries management)
- ❑ Long-term commitment of partners (technical and financial support)
- ❑ Government support for large-scale sustained releases

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