Integrated pond culture for improved production and environmental performance.

Willett, D. and Palmer, P. (2008). Queensland Department of Primary Industries and Fisheries. PowerPoint of the oral presentation given at the World Aquaculture Society Conference entitled "Innovation in a global market", Brisbane, Queensland 3-6 August 2008.

Integrated Pond Culture…

for improved production and environmental performance

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Acknowledgements:

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Impediments to Profitability:

- Competition from cheap imports

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- Competition from cheap imports
- Strong reliance on wild caught fishmeal for feed
- Environmental compliance

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Allows farmers, using existing farm infrastructure, to…

(a) Improve economic security through crop diversification

(b) Improve nutrient use efficiency through nutrient recycling

(c) Comply with environmental regulations by limiting water discharge requirements

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The result…

- >12 tonnes ha^{-1} harvest of Sand Whiting (*Sillago ciliata*)
- 10 month production period using existing infrastructure
- zero water exchange throughout grow-out period

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Improved water management by creating Biofloc conditions:

Heterotrophic (biofloc) vs Autotrophic (phytoplankton)

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Improved water management by creating Biofloc conditions:

$$C_{add} = N_{ww} \times ([C/N]_{mic}/E)$$

Where:
C_{add} is the amount of C required
N_{ww} is the bio-available N in wastewater
$[C/N]_{mic}$ is the C:N ratio of bacterial biomass [typically about 5]
E is the bacterial C assimilation efficiency [assumed to be 0.4]

Therefore: for bacterial metabolism of available N:

DOC : TDN ratio > 12.5 : 1

(Adapted from Avnimelech 1999)

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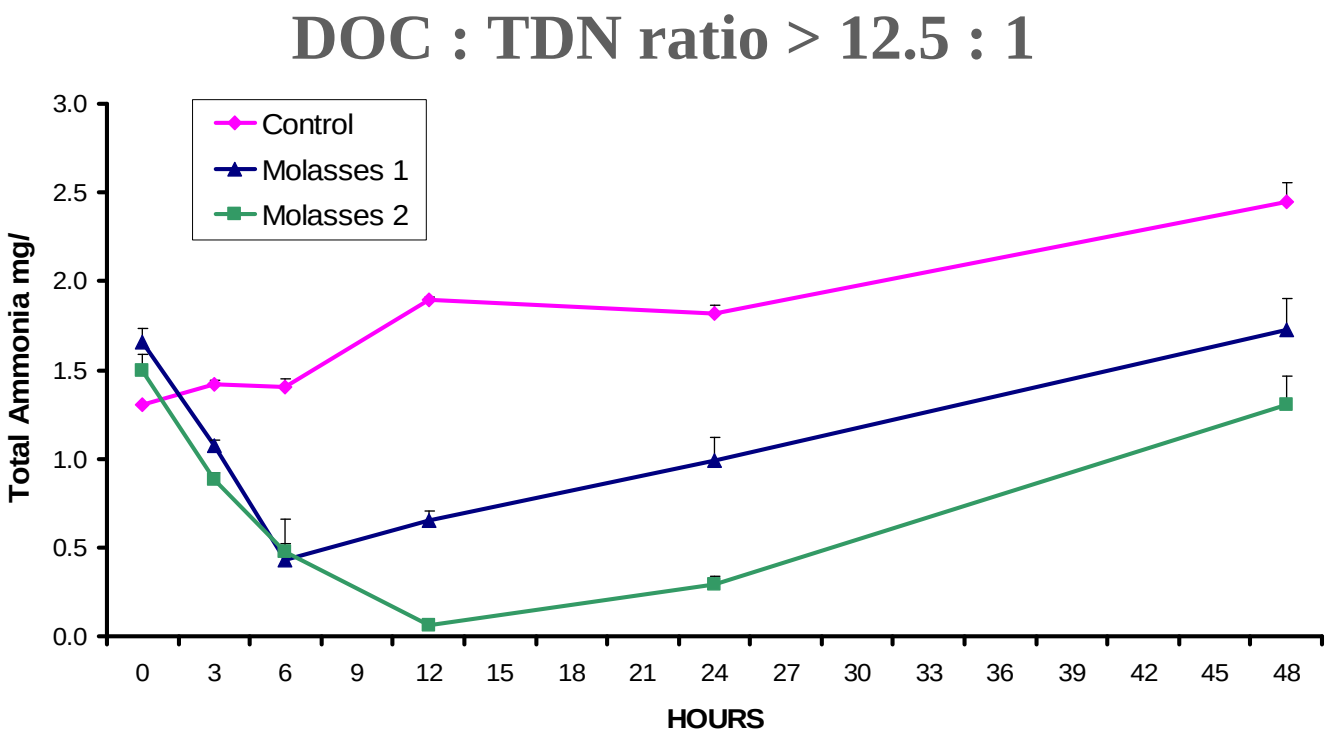

Dose rate: 720L molasses per hectare to remove 1mg/L of Ammonia!!

Benefits to water quality and production efficiency can be achieved with more realistic Carbon doses!

Virtues of (predominantly) Biofloc conditions:

- Lowers and stabilizes pH – in turn reduces % of un-ionised ammonia
- Buffers phytoplankton blooms – inhibits boom/bust cycles - leads to more stable DO levels
- Reduces (or eliminates) need to exchange water – reduced pumping costs; improved biosecurity; environmental compliance
- Bioflocs are food for grazing animals – nutrient recycling

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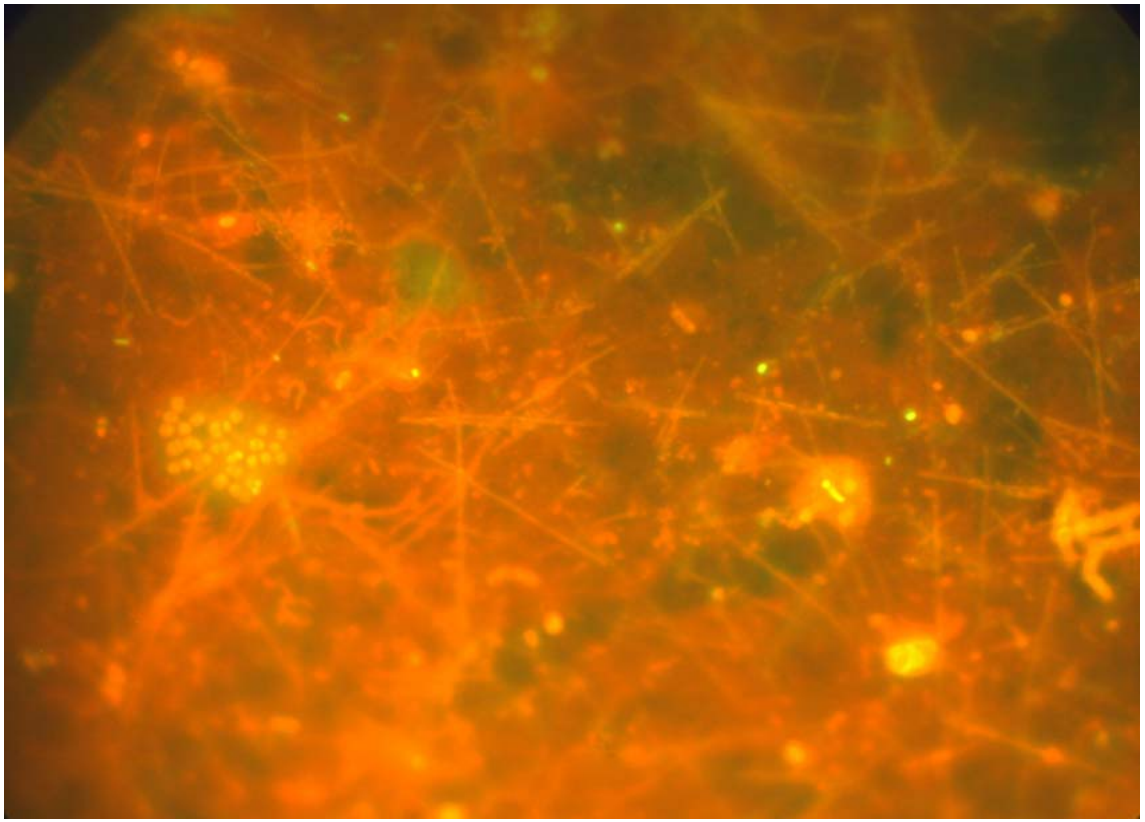
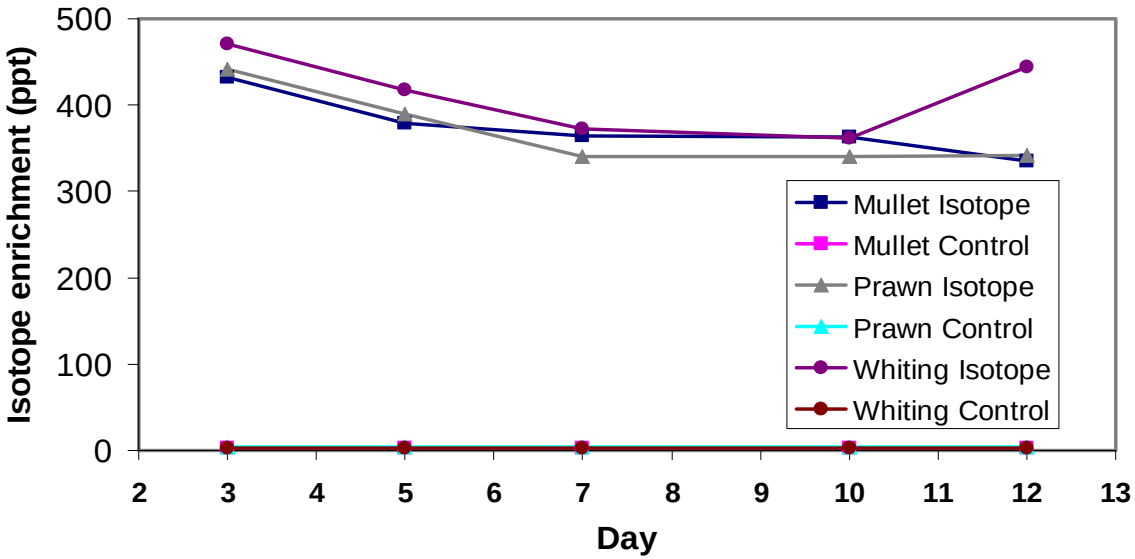
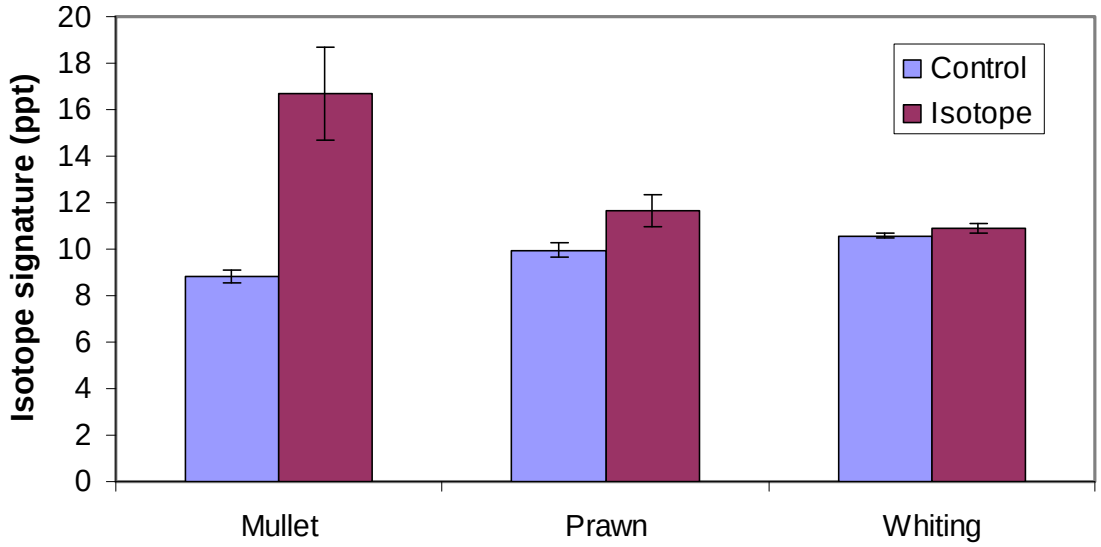
Typical Biofloc matrix…



$^{15}NH_4$ Isotope Trial:





Benefits of Whiting as an alternative species for prawn farmers:

- Viable diversification option to spread risk without major changes to current protocols
- Fit seamlessly with existing hatchery and growout infrastructure
- Broodstock easy to source & spawn. Larvae reared in traditional GWC tanks
- 21-d old fry packed, transported and stocked like prawn PLs and grown at high densities
- No disease issues encountered
- Omnivorous - thrive in Biofloc conditions!

Benefits of Whiting as an alternative species for prawn farmers:

- Sand (Summer) whiting highly regarded by consumers
- Markets already exist for wild-caught stout whiting
- High retail prices for value-added butterfly fillets
- Fish for butterfly fillet market only 40 – 50g: takes 8-10 months

Disadvantages:

- Requires on-site processing equipment

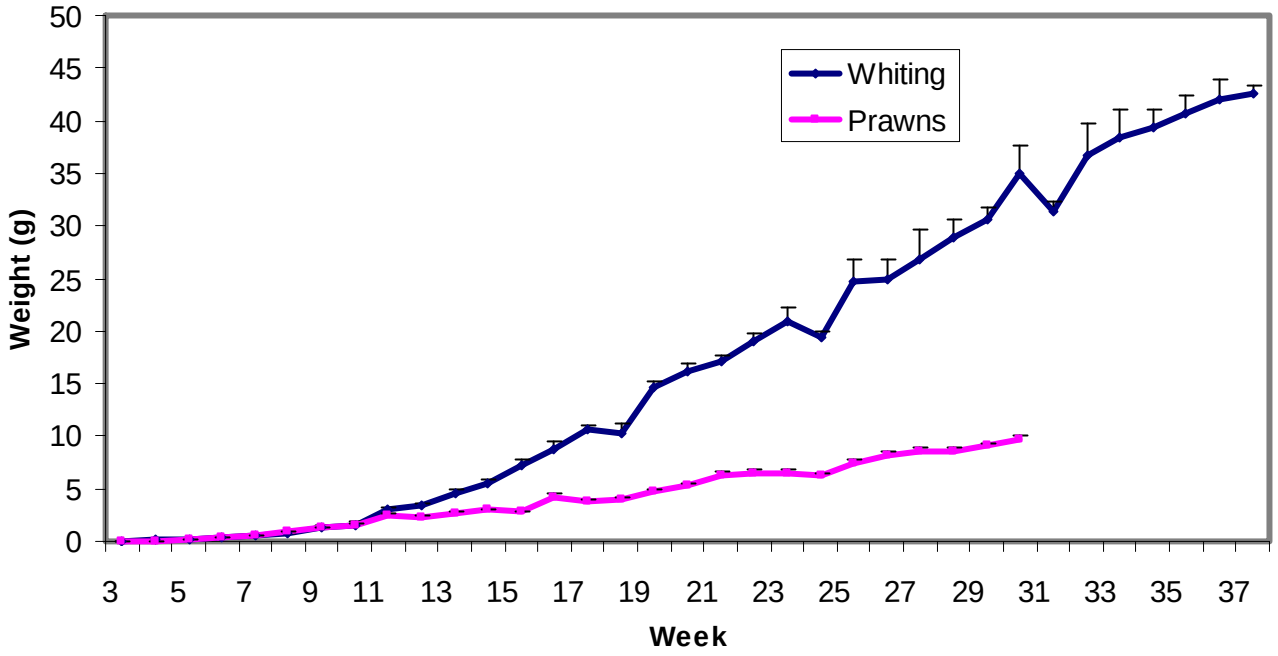
Potential benefits of Whiting / prawn polyculture:

- Oversea precedent with vannamei / tilapia
- Taking advantage of complementary feeding habits to produce potentially greater yields per area and per feed input
- Disease control: shrimp culture pathogens predominantly gram –ve; fish culture gram +ve.

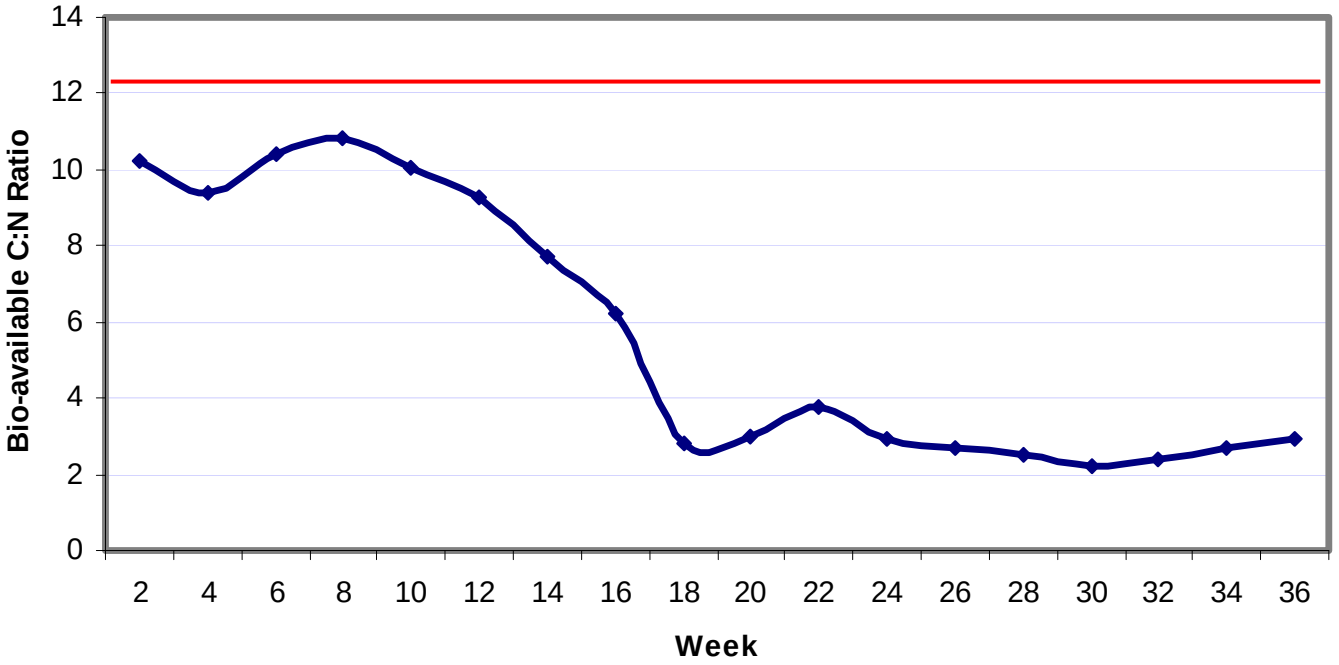
Risk:

- Fish eat the prawns!

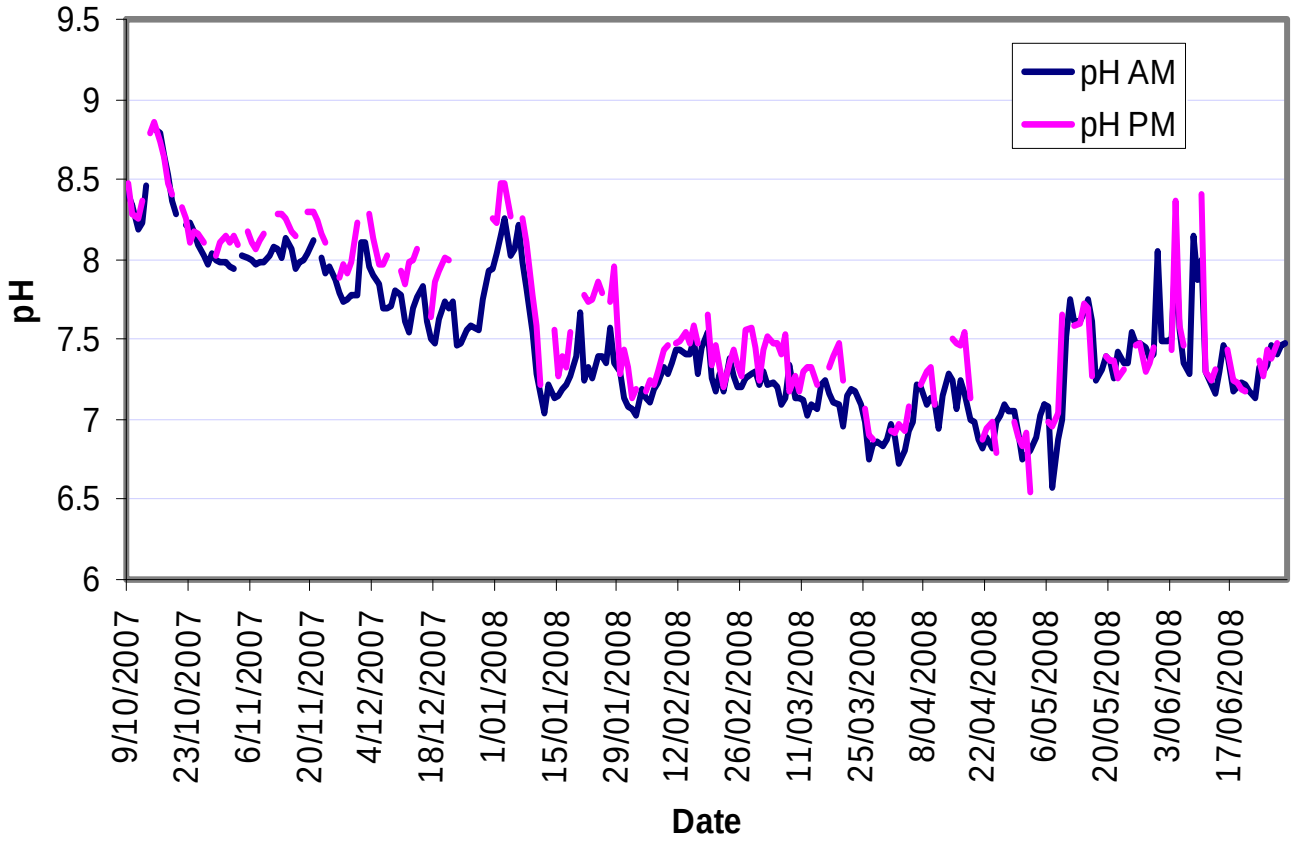
Whiting and Banana Prawn growth…



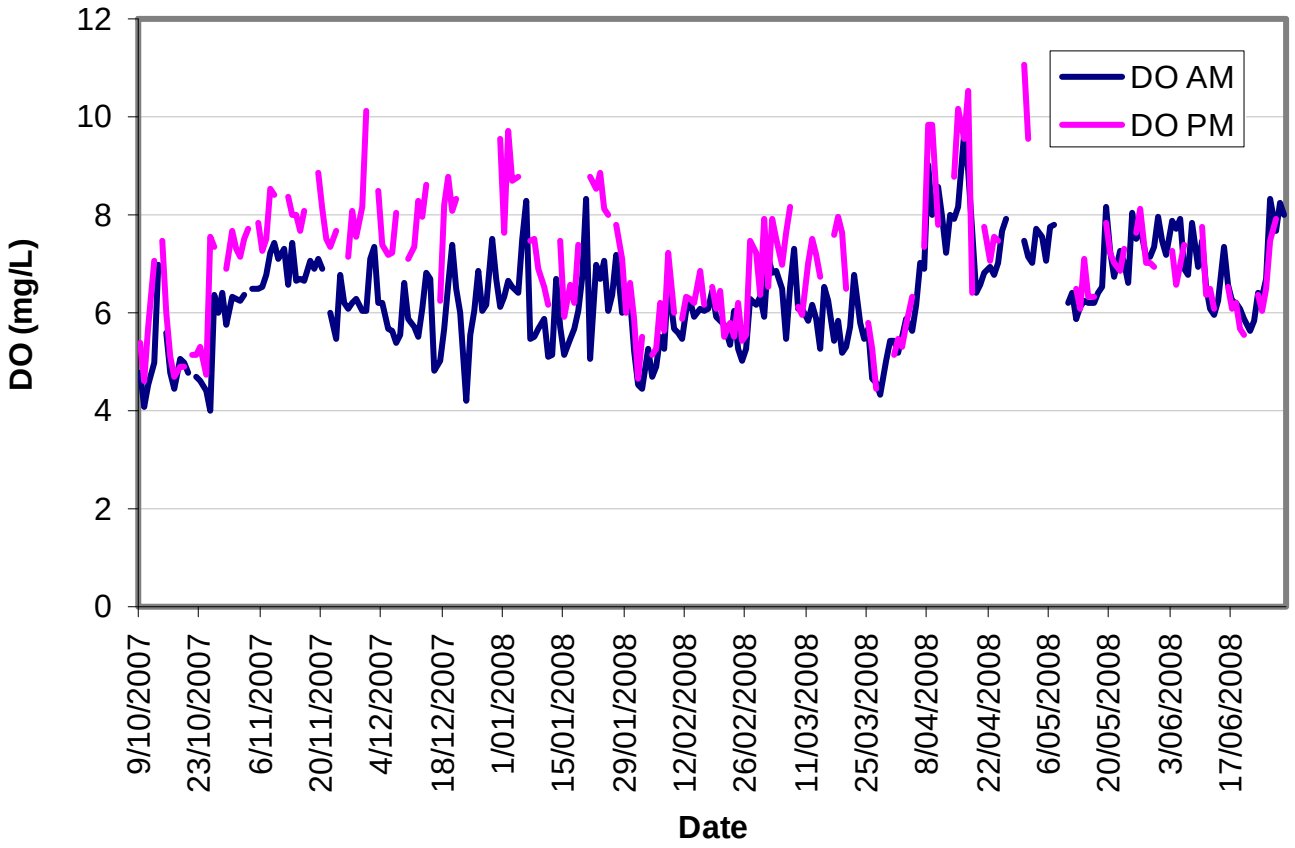
Pond DOC : TDN ratio over trial…



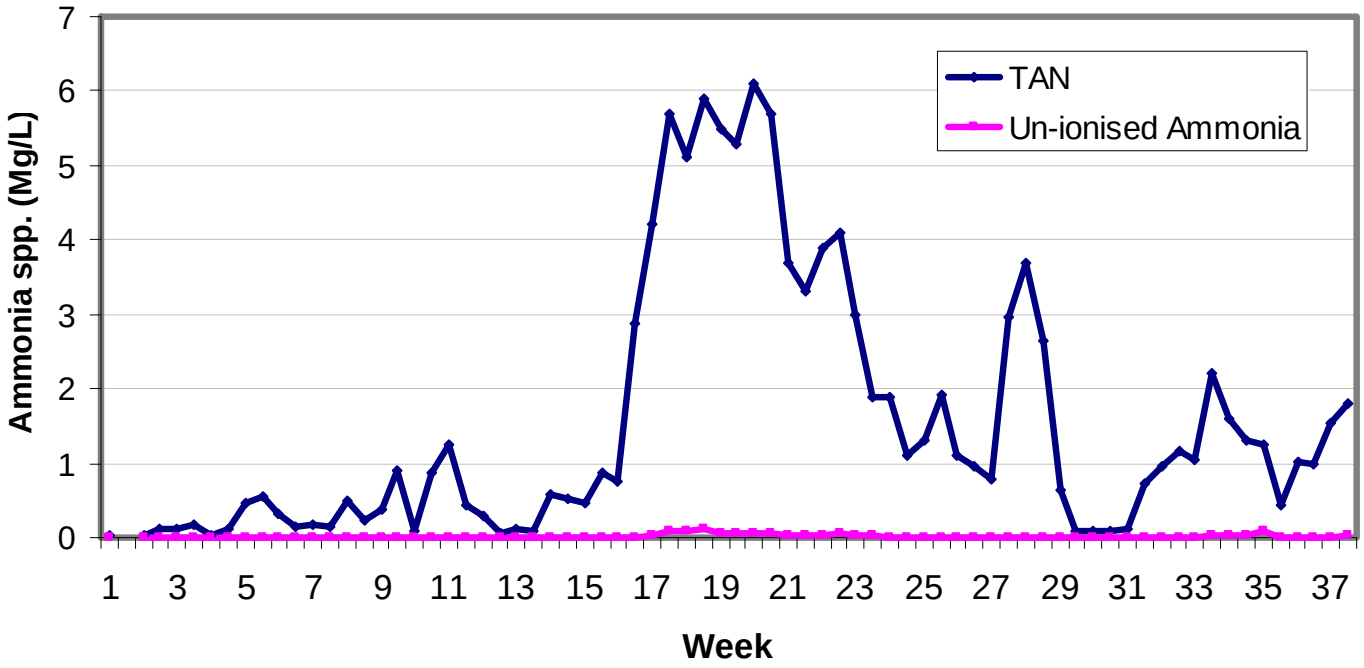
Pond pH over trial…



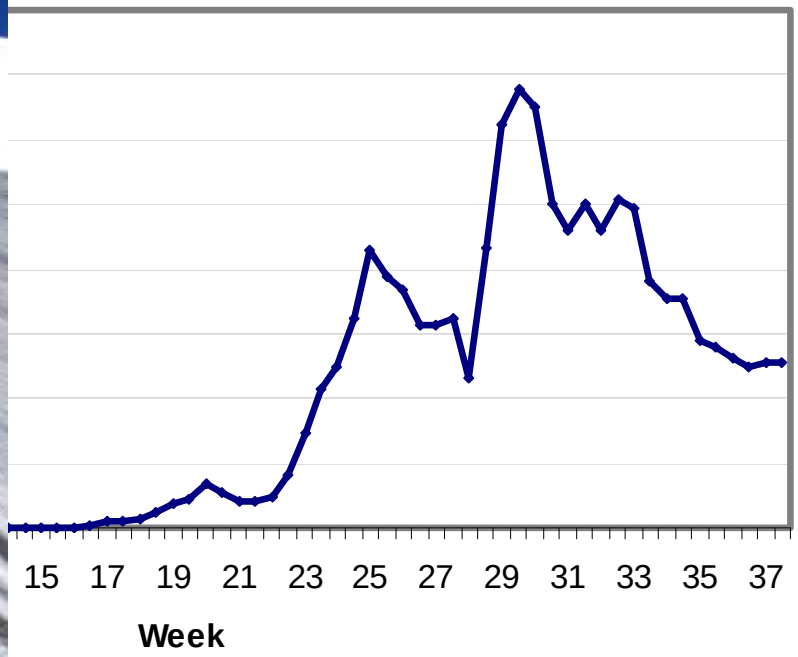
Pond DO over trial…



Pond TAN over trial…



Pond NO_2 over trial…



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Summary:

- Creating predominantly heterotrophic conditions regulates water quality, limiting (eliminating) the need for discharge until harvest
- Production in biofloc ponds improves nutrient use efficiency through nutrient recycling
- Whiting a viable diversification option to spread risk without major changes to current protocols:
    - substitute for prawns in almost all aspects of production
    - 10 month production period using existing infrastructure
    - Requires on-site processing equipment to value add
    - >12 tonnes ha^{-1} harvest of Sand Whiting (*Sillago ciliata*)
    - Whiting learn to eat prawns!

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