

Recent advances in marine aquaculture research implications for Kenya and the region

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Nigel Preston Research Director Aquaculture CSIRO Australia

Australia's Maritime Jurisdiction



Australia's total area of marine responsibility covers 14 % of the world's oceans.



Aquaculture in the region



Six grand challenges for the marine world





- 1. Sovereignty, security, natural hazards
- 2. Dealing with climate change
- 3. Energy security
- 4. Food security
- 5. Biodiversity conservation
 - and ecosystem health
- 6. Optimal resource allocation







New tools for collecting and modelling data

BLUElink: Accurate forecasts of ocean conditions in the Australian region for the first time

OzClim: Climate change scenarios using the pattern of change for the whole 21st century, individually from each of 23 global climate models



Linking observation, models and strategy

Automated data collection



Data access



Data assembly



Management strategy



Physical models

Tide and Temperature



Ecosystem models



Grand challenges for coastal aquaculture

- 1. Site selection
- 2. Infrastructure
- 3. Domestication
- 4. Sustainable feeds
- 5. Disease control



1. Site selection: zoning , environmental management the lessons from rapid unregulated expansion in Asia



Prawn farming and the coastal environment most farms adjacent to Great Barrier Reef

Great Barrier Reef Marine Park World Heritage Area

Cairns Cardwell Cardwell

Mackay 🔍

Rockhampton

Brisbane



Responding to concerns about pollution

Environmental concerns

- Sediment discharge
- Nutrient discharge
- Impacts on environment

What are the impacts on the environment ?





What are the impacts on the environment ?

Harvest

Marine Botany The University of Queensland

∞ _

Monitoring water quality (Nitrogen)

increase no change



Available online at www.sciencedirect.com



Marine Pollution Bulletin 46 (2003) 1456-1469

MARINE POLLUTION BULLETIN

www.elsevier.com/locate/marpolbul

A synthesis of dominant ecological processes in intensive shrimp ponds and adjacent coastal environments in NE Australia

M.A. Burford ^{a,*}, S.D. Costanzo ^b, W.C. Dennison ^b, C.J. Jackson ^a, A.B. Jones ^b, A.D. McKinnon ^c, N.P. Preston ^a, L.A. Trott ^c

^a CSIRO Marine Research, P.O. Box 120, Cleveland, Qld. 4163, Australia ^b Department of Botany, The University of Queensland, St Lucia, Qld. 4072, Australia ^c Australian Institute of Marine Science, PMB No. 3, Townsville, Qld. 4810, Australia

- Shrimp pond discharges unique characteristics (higher phytoplankton)
- No detectable impacts on downstream sediment processes (tidal dynamics
- Significant potential for recirculation and nutrient recapture



Discharge treatment ponds introduced to all farms

All farms have between 10% & 35% of total pond area as treatment ponds

- Minimize flood risk
- Preserve viability of sugar industry
- Optimize land use economics
- No added environmental load (nitrogen, phosphorous, sediment)



No additional nutrients or sediment into river

Broad scale (whole coastline) spatial analysis



Australian prawn farms total ~ 1,000 ha



Grand challenges for coastal aquaculture

1. Site selection



- Optimal site selection well defined
- Broad and fine scale mapping and modelling well established



- Critical need for zoning
- Critical need for licence to operate





Grand challenges for coastal aquaculture

2. Infrastructure



 Top priority: good quality marine hatcheries and broodstock domestication systems



11 months 11 months 3 weeks 5 months



Challenge 3. Domestication



Short term (1-4 yr)	Medium (Years 5-10)	Long term (10-20)
Domestication & founder stock selection	Selected genotypes stocked on farm	Cumulative genetic gains to
• Molecular markers		increase value of Australian
 Genetic diversity 		industry by \$400 M
 Disease diagnostics 		by 2020
• Health status		
Database		
Image: Constraint of the second se		
Founder stocks Pilot breed	ling Commercial breeding S	cale up breeding

Selective breeding of Penaeus monodon



Exceptional yields from G8 stocks



New Australian P. monodon breed

Ace of crustacean The perfect prawn CSIRO prawn's new dawn

Black tiger prav

black pepper, to taste black pepper, to taste 1 tap harissa paste 25ml yuzu juice or lime juit 50ml extra virgin olive oi

THEY'RE being touted as the perfect prawn — a bigger, tastier shrimp that is the result of a decade of groundbreaking Australian research by the CSIRO

And they've been given the big thumbs up by Sydney's top chefs who have rushed to add them to their restaurant menus because of their flavour, size and sustainability Celebrity chef Luke Mangan says the black tiger prawn, grown on acquaculture farms on the Gold

'onst, is the best he has used. "They're sweet and have great avour, and that's what we're lookbut also the sustain ing tor, but also the sustainable aspect of them is important," Mangan, who has been using them for the past two months, said. "I think chefk will jump on board because they're such a great flavour and a great product. "If we're the first to do it, we're

helping sustainability and its a great thing as long as we're not compro-mising the quality of the product and in this product I think that's

what we haven't done." As well as Mangan's Glass res-taurant, Pier and Doyle's on the beach at Watsons Bay have also gun serving the prawns to diners. And Flinders Inn executive chef Morgan McGlone is a new convert after trialling them last week.

The Real Ages mores which is the real of the second of the second of the second of the second

The reference They're not wateringen and the new anax togers at the or the new anax togers at th van," he said "You can just tell the

Bigger and better: Nick Moore, of Gold Coast Aquaculture, with a female black tiger prawn Picture: Damen England They taste really, really clean, they're viruses, so we're making sure they're sweet. They're a really nice prawn." The new strain of black tiger prawn grows 20 per cent faster than other

to the best growing parents with the best genes and they haven't caught a cold." a CSIRO spokesman said Instead of producing the industry average of five tonnes per bectare. Gold Coast Aquaculture produced a record.Imstan 125 tomas per bac prawns and has the potential to more than double Australian production from acquaculture at a time when the annual prawn catch is under pressure. And the new Aussie "super"

record-breaking 175 tonnes per hec-tare of the new black tigers, a total of

1 tsp gartic SERVES 6 NEW-AGE BLACK TIGER PRAWN Method TABBOULEH SALSA Dice cucumber, tomato ani onion into small pieces. Comix well; Season to taste Take your 1.5kg of pee veined prawns. Pan-fry tter and a splash of lemo ook until opag

1/4 cup finely o fint-leaf parsle





THE perfect prawn, 10 years in the breeding, is on the menu courtesy of the CSIRO and DNA. tasty and tender black tiger

adding \$120 million to the industry by 2020.

THE black tiger prawn has been

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industry partners which, according to farm data, is already breaking productivity records

So much better: black tiger prawn.

need to go into the wild each season for breeding stock. "It took a long time to over-

come the hurdles of domestica-CSIRO molecular biologist tion," said Dr Sellars, "Once we Dr Melony Sellars said one of were able to rear them in captiv- Australia are imported from the main differences between - ity, we were able to start select-- such countries as China and the new animal and its wild ively breeding them -- choosing Vietnam. The new breed will counterpart was its ability to large prawns to breed with large provide local farmers with a

a creature ideal for aquaculture. "They have improved survival rates. They have faster growth rates. They have lower feed requirements. They're

to breed to maintain those genetics in the population,

A decade since the project

began, Dr Sellars said the team

now had "the perfect prawn" --

generation after generation."

more environmentally sustainable. They taste better and they have better colouration," said Dr Sellars,

CSIRO data reveals that about half the prawns bought in

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generations. Try it of Mech.

GRM EVILLE sebeen GRAPTIVILE is becoming quite the facility deviation with the restanged Superior Find and now new buicks on the block, Confort B Lenton (gh 107) 42001. Propario the Built shop for a state of Dash traffic le partner some of Chins Pitnewith's sould er version.

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gaal or retainm. The above the rabbit and be

Prawn breeding breakthrough tivity, which means prawns, and choosing the ones with good colour and body form The tark and taken, underlans. More add takens, underlans. More add take

Australia's prawn industry has its best chance to fight back spainst im-ports with the successful domestica-tion of the black tiger prown. The prowns had not been succes fully bred in Australian farms until

cooked, cooled in cybrine hath

ioverraght), frozen individually, pacheid and blaed, -40C blaet

heater for 24 hours, -300 houtes

Number for 24 hours, engoed an

But a combined industry and Trawn tenurs and linkrimin Mr Mocre. work together, wir'r not at kögger. CSBO scientist Nigel Preston, heads like we used to be," he sid, who is researching food futures, sid "We recognise our common opposi-tion, which is the imported prawn." form. CSIRO research program has pro-duced farming pends full of the prowes, which are highly rated due to their size and flavour mially, techniques developed Those imported prawns, often from Asia, kept prices low in Aus-

Gold Coast Marine Aquaculture PAGE 19: Street talk

No stan down the back, because

of the other surface is shown

the provents to chorated the films

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recently

with black tigers can be transferred to other aquaculture such as talmon, systers, abalone and barramondi. The ratio as they preter are in the second state the ratio and the ratio to other againstitute teach anamandi. One of the key ployers in the years grain has been been even of Coll. Coast Marine Aquesculture. This of provins Linear Linear Linear Linear Linear Linear Linear Version Michael Coast Marine wents of which years and has been as wents of which Coast Coast Aquesculture and CSIRO. Aquesculture and CSIRO. Aquesculture and CSIRO.

"This is actually a new variety, although they look like those from

"Prices for prawns haven't gote up an insur in the future. With such a mussive coastline. Australia can look to produce more food from the sea for the domestic market and export?

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a 10-year tale

The latest award-winning, big

prawn is the product of selective breeding and research. Annual production could double to 12,500 tonnes a year,

is increased by heat \$100. \$157 million branched · Inner Ann Starting Start

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he said. "With this it could grow to





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Challenge 4 : Finding alternatives to use of wild harvest fish and fish oil to feed farmed fish and prawns

Fish	Fish meal	Fish oil	Other	
	40 %	25 %	35%	
Shrimp				
	25% 2%	73%		
-		40 00		
0	20	40 60	δU 100	



Novacq[™] Production

Raw materials



Solid or liquid wastes

27

Bioconversion to Novacq

Bioreactor





The solution

 After 10 years of research, CSIRO has delivered the Novacq[™] shrimp feed additive technology. Shrimp fed with Novacq[™] grow on average 20-30% faster, are healthier and can be produced with no fish products in their diet, a world-first achievement in sustainability.











Global market for Novacq technology



National and global focus





Challenge 5. Disease control via RNAi

• Short pieces of double stranded RNA that are identical to parts of the viral genetic code





How do the anti-virals work?

• The presence of short pieces of RNA blocks the replication of the virus

Virus







How do we administer the anti-virals?







Recent advances in shrimp anti-virals

 Protection against viral disease demonstrated by tailmuscle injection of dsRNA anti-virals



Sellars, M.J., Rao, M., Arnold, S.J., Wade N., Cowley. J. 2011. *Penaeus monodon* is protected against gill-associated virus by muscle injection but not oral delivery of bacterially expressed dsRNAs. Diseases of Aquatic Organisms 95(1): 19-30.

We are now working on how to coat the anti-viral RNA so that we can feed it to shrimp instead of injecting it



Grand challenges for coastal aquaculture

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Thank you