



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

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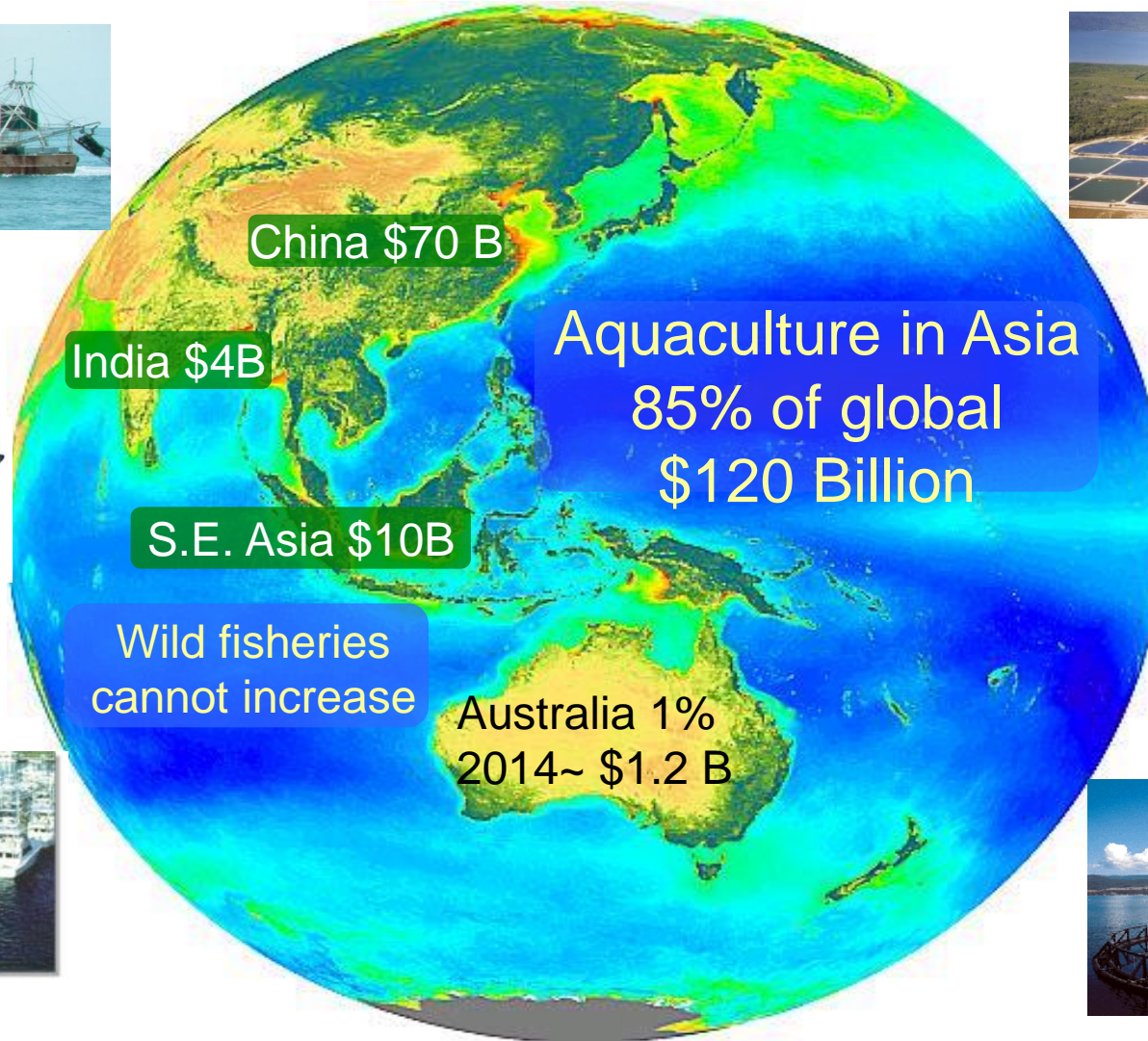
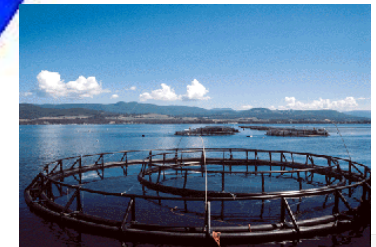
Nigel Preston Research Director Aquaculture CSIRO Australia

Australia's Maritime Jurisdiction



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

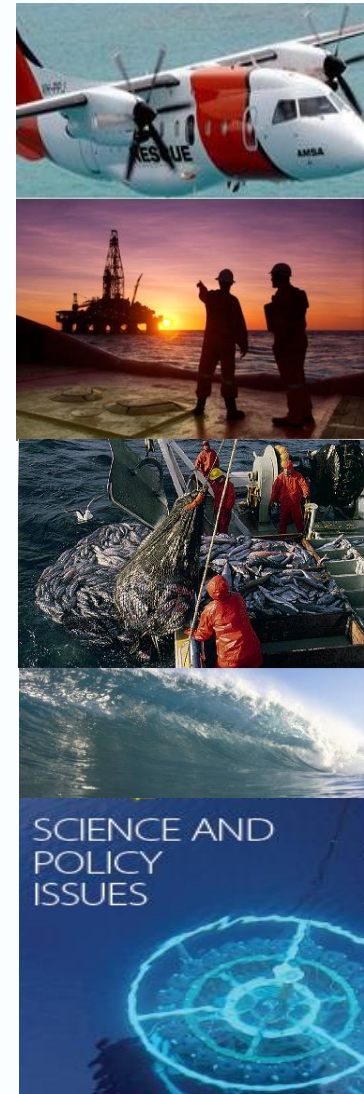
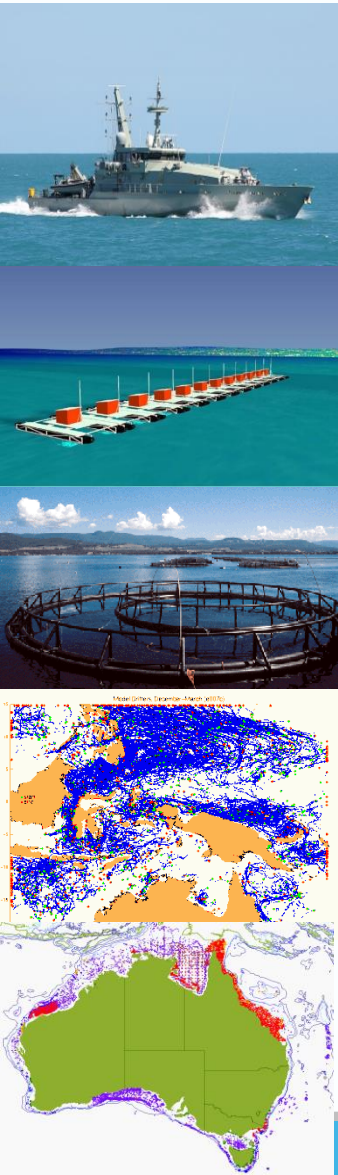
Aquaculture in the region



FISHING - - - - - **AQUACULTURE**

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

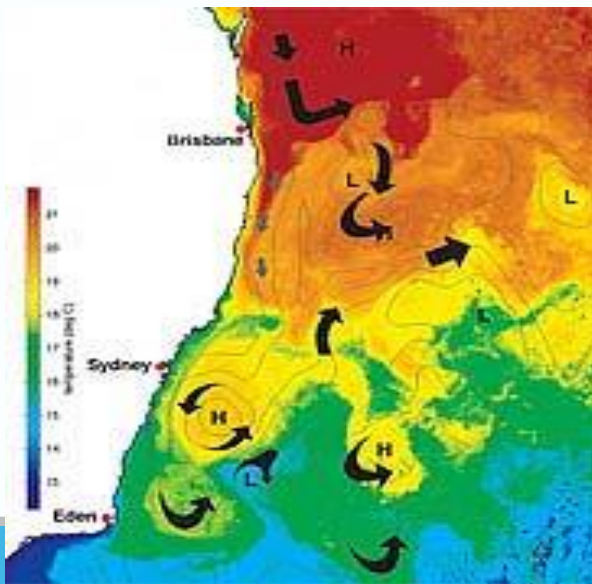


New tools for collecting and modelling data

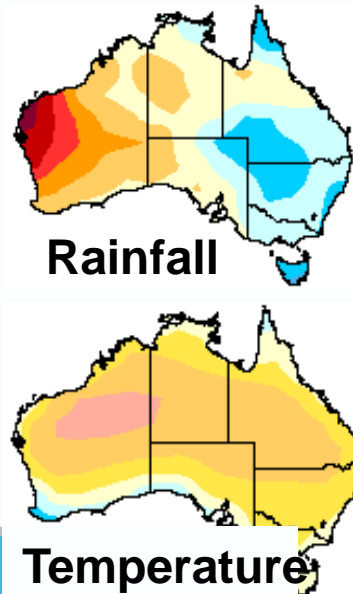
BLUElink: Accurate forecasts of ocean conditions in the Australian region for the first time

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

Ocean currents



Climate change



Coastal impacts



Grand challenges for coastal aquaculture

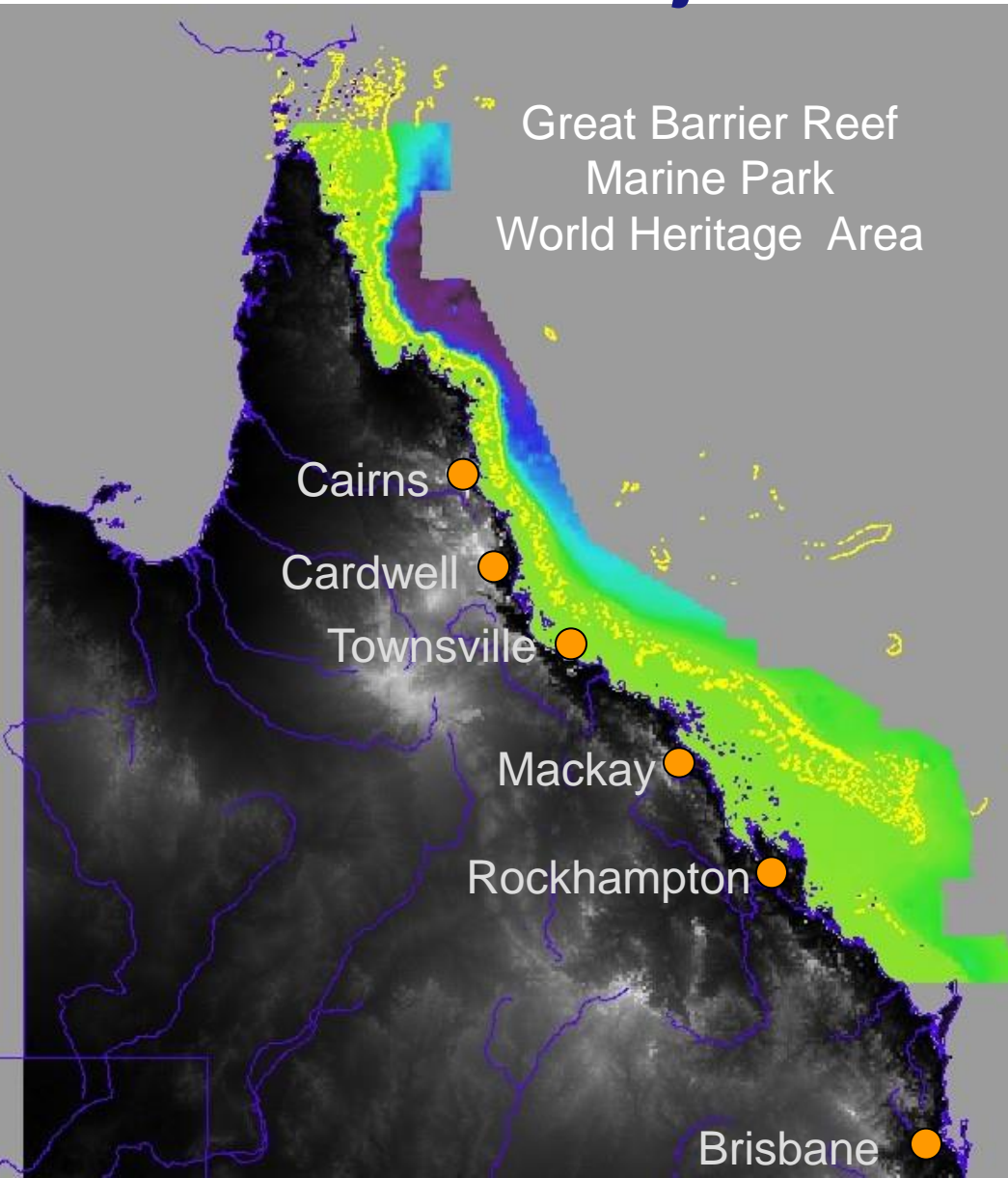
1. Site selection
2. Infrastructure
3. Domestication
4. Sustainable feeds
5. Disease control



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



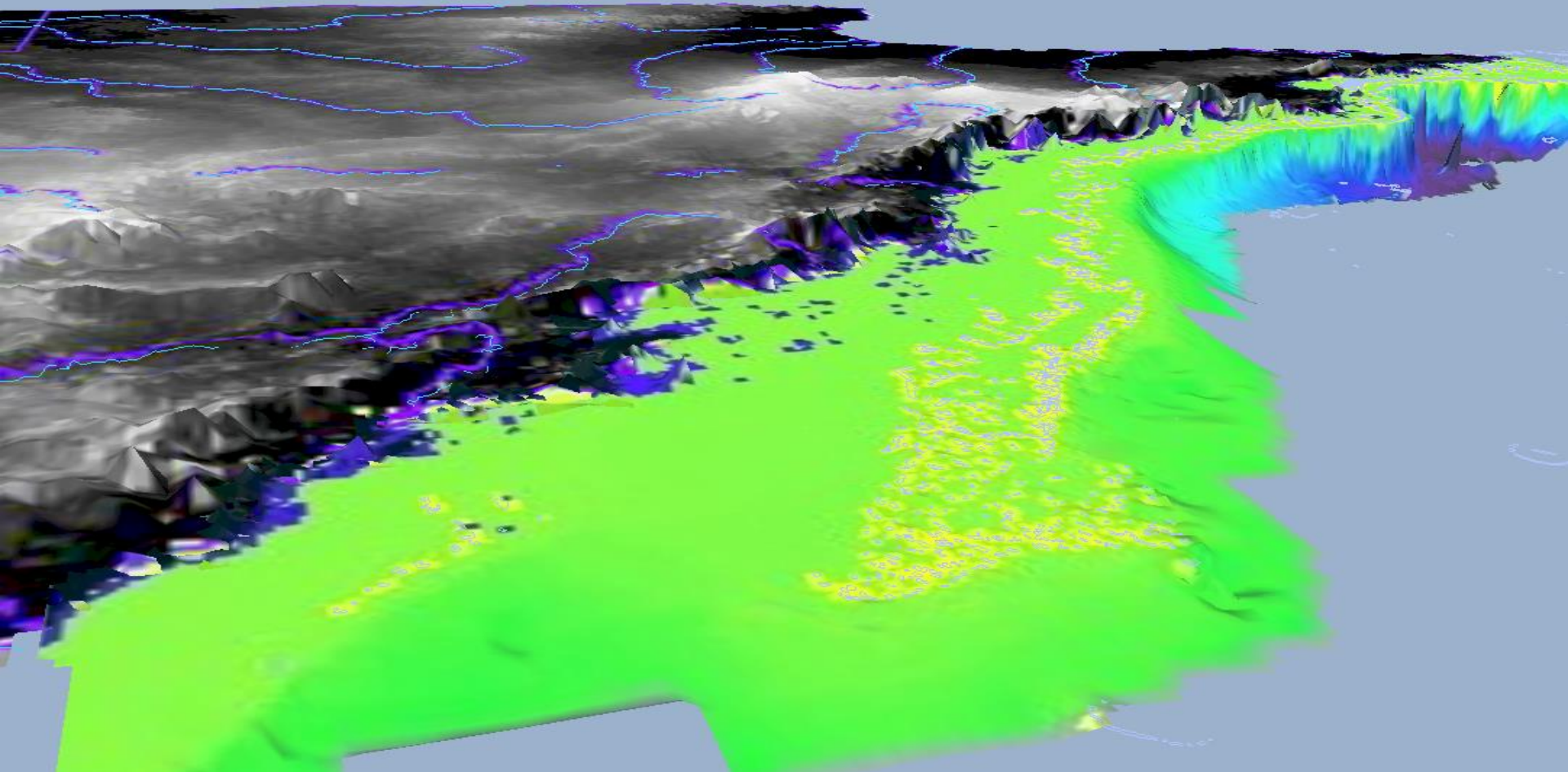
Prawn farming and the coastal environment most farms adjacent to Great Barrier Reef



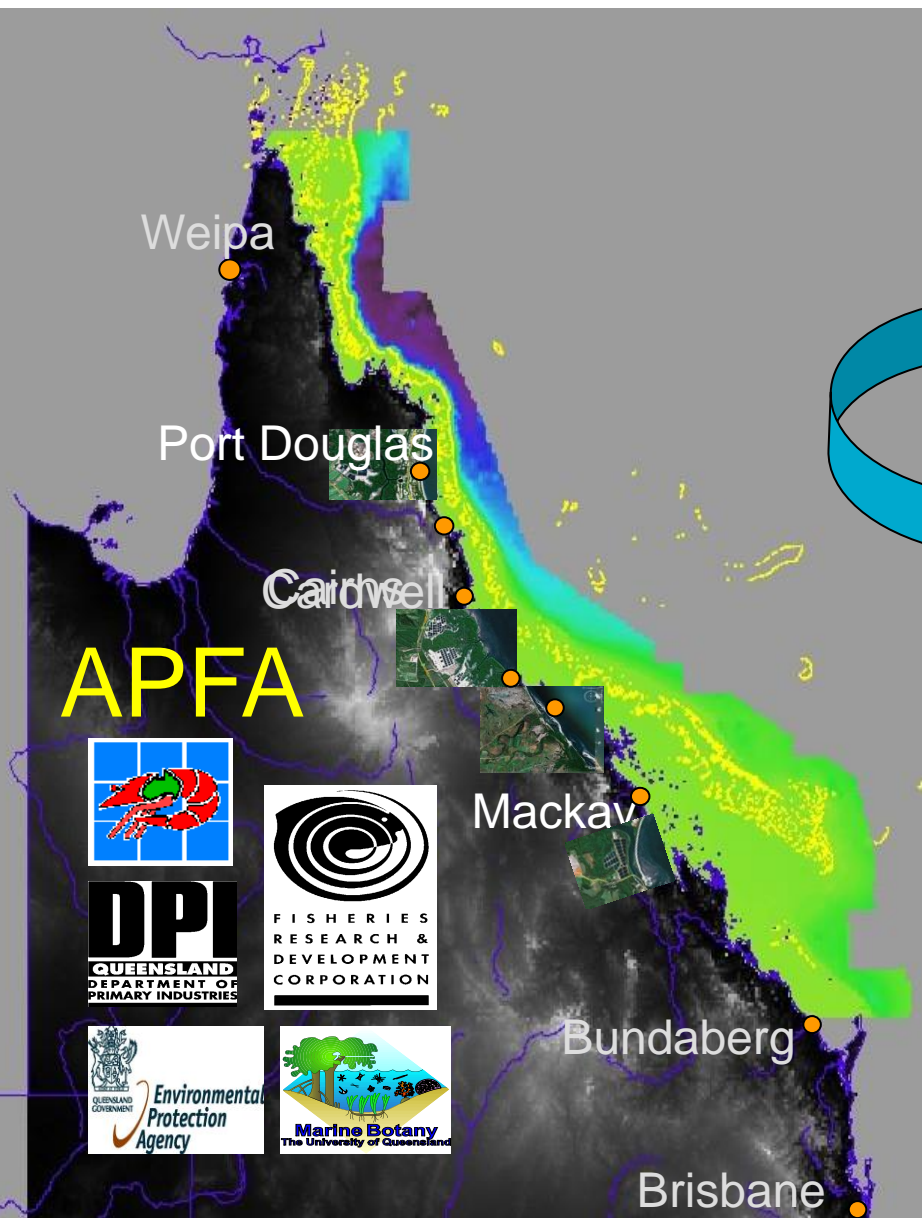
Responding to concerns about pollution

Environmental concerns

- Sediment discharge
- Nutrient discharge
- Impacts on environment



What are the impacts on the environment ?



National R & D team

Australian Institute of Marine Science

- Effluent
- fate
 - hydrodynamic models



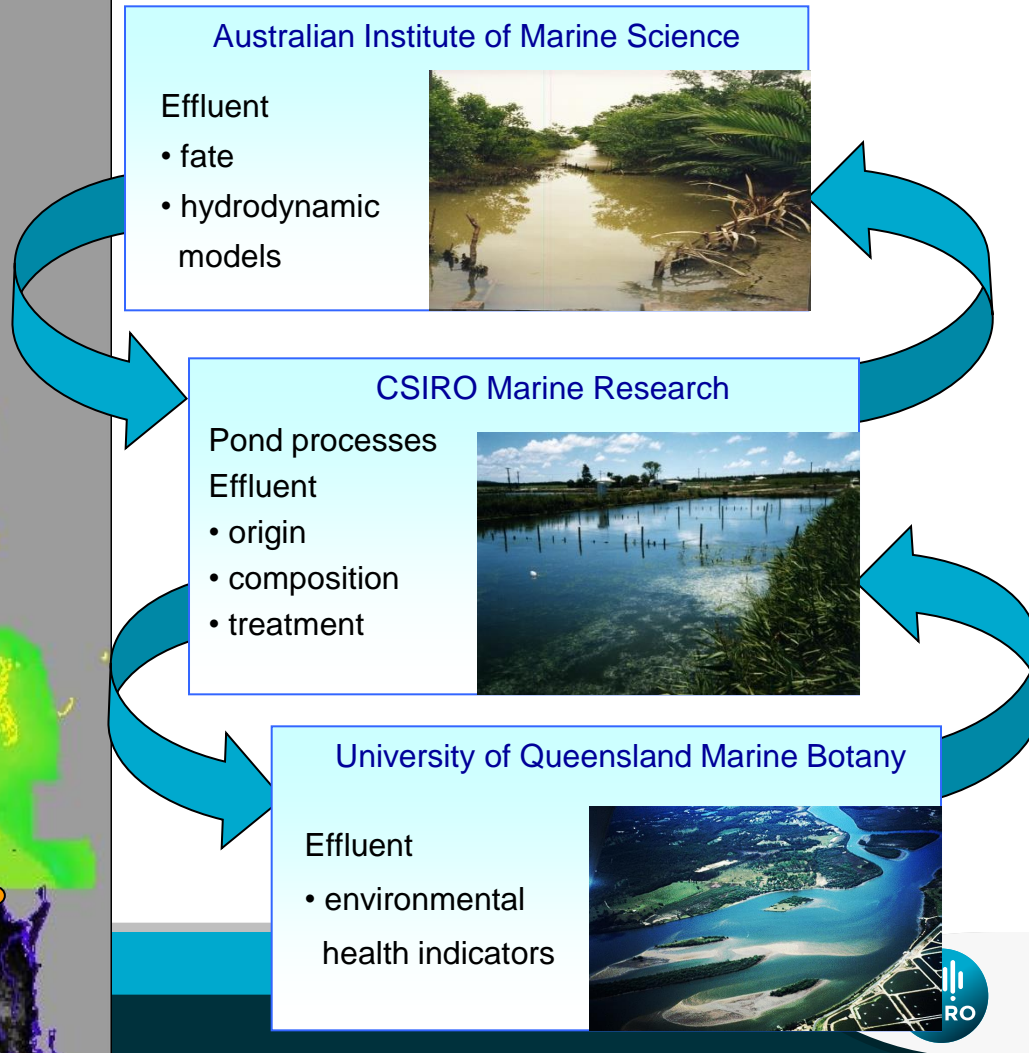
CSIRO Marine Research

- Pond processes
Effluent
- origin
 - composition
 - treatment



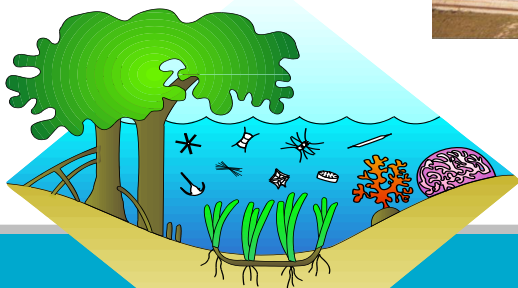
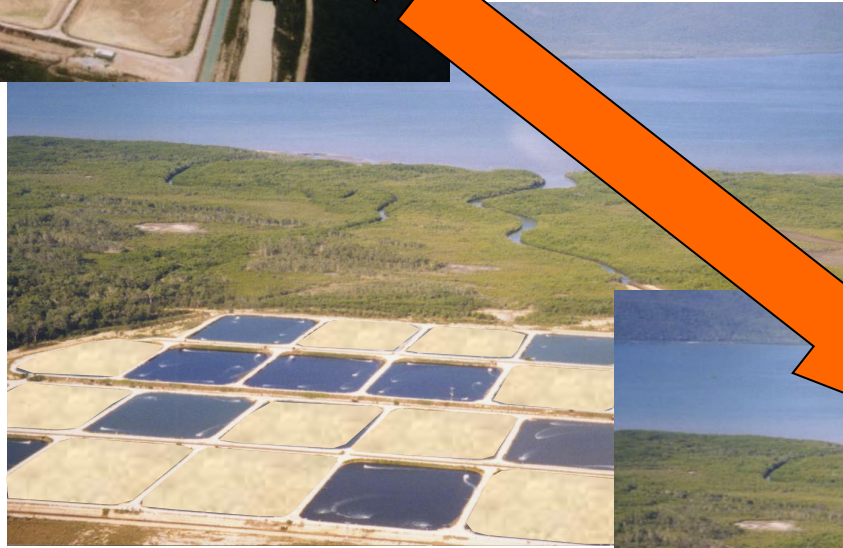
University of Queensland Marine Botany

- Effluent
- environmental health indicators

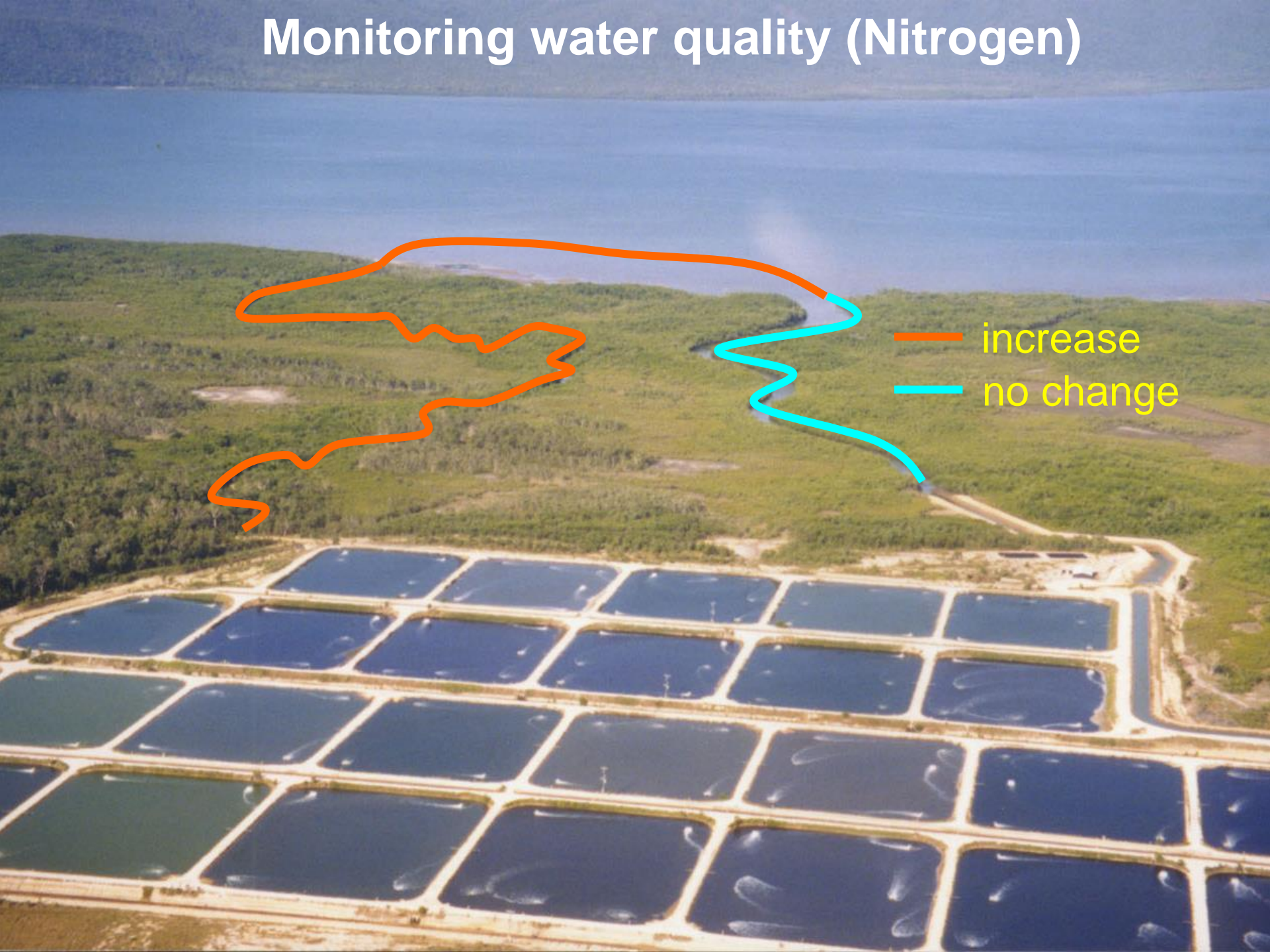




What are the impacts on the environment ?



Monitoring water quality (Nitrogen)





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

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A.D. McKinnon ^c, N.P. Preston ^a, L.A. Trott ^c

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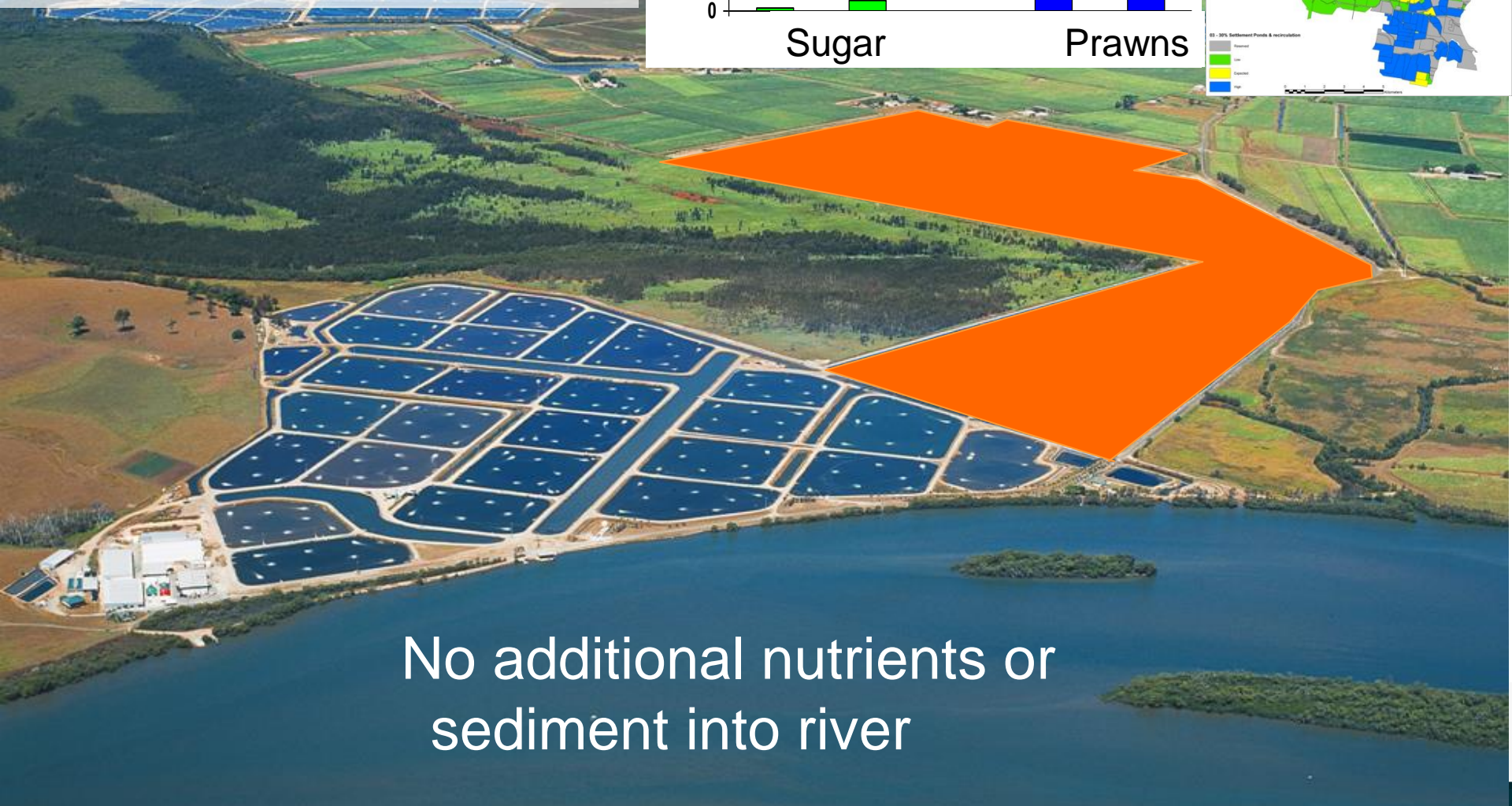
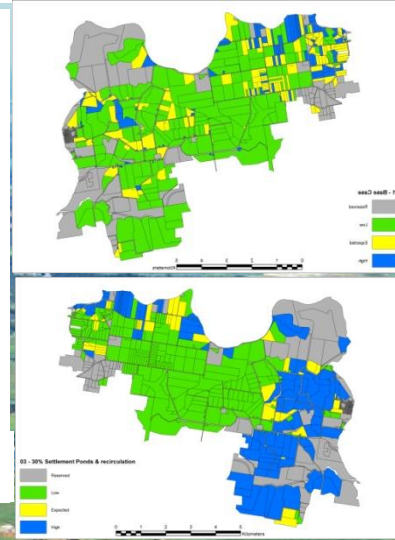
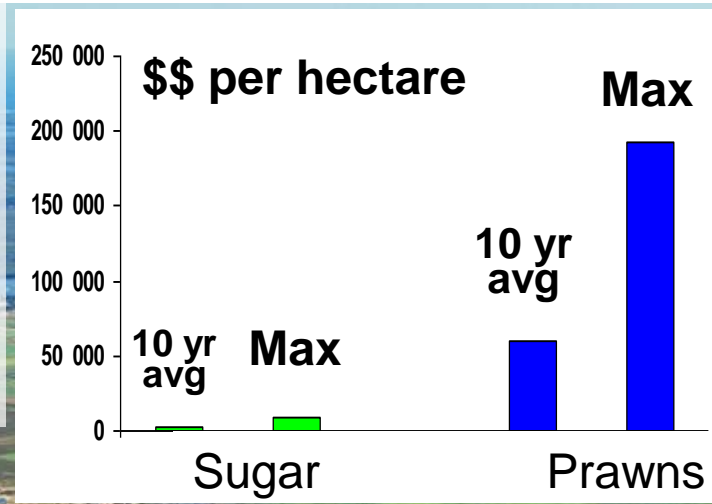
- Shrimp pond discharges unique characteristics (higher phytoplankton)
- No detectable impacts on downstream sediment processes (tidal dynamics)
- Significant potential for recirculation and nutrient recapture

Discharge treatment ponds introduced to all farms



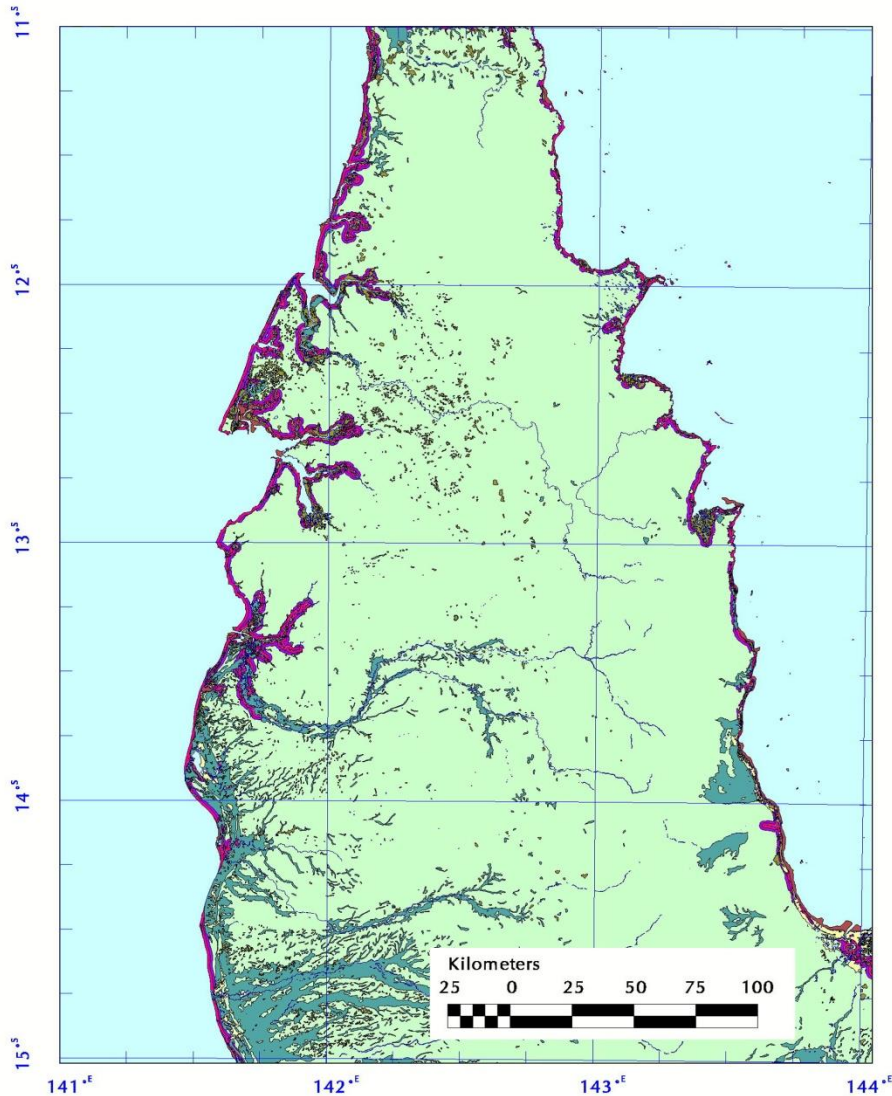
**All farms have between
10% & 35% of total pond
area as treatment ponds**

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

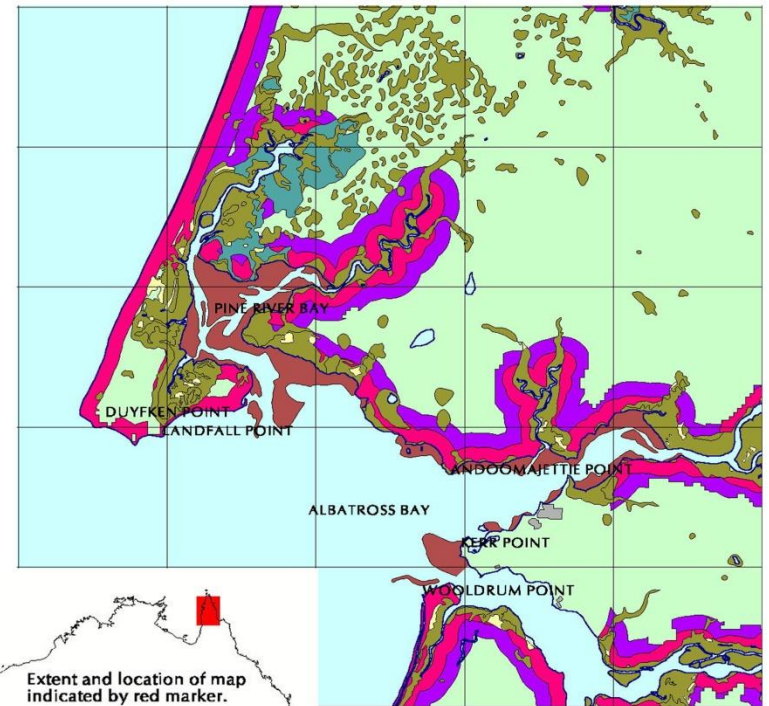


No additional nutrients or sediment into river

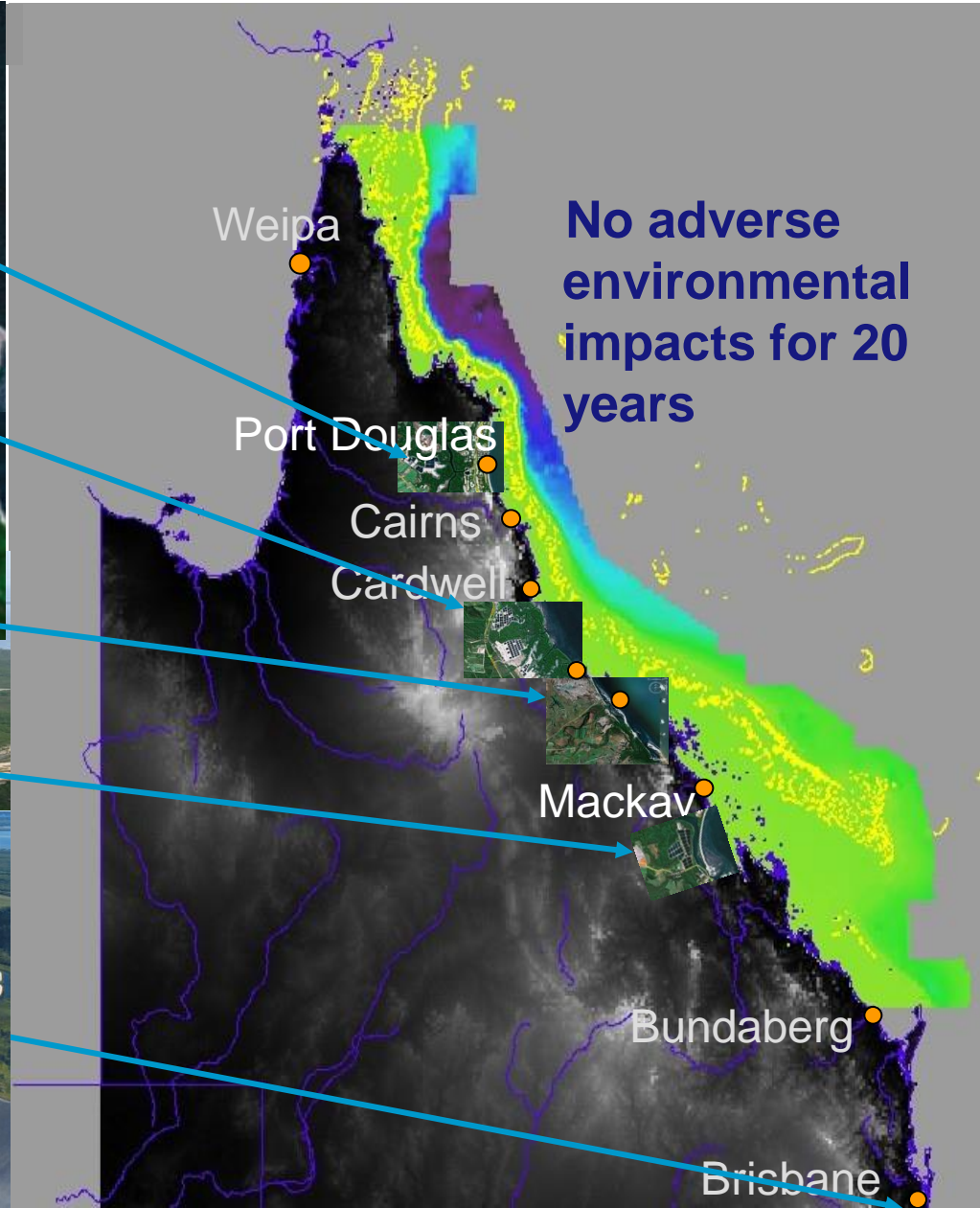
Broad scale (whole coastline) spatial analysis



Areas potentially suitable for prawn farms



Australian prawn farms total ~ 1,000 ha

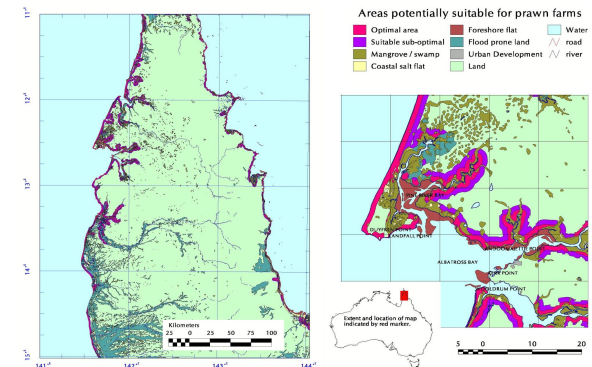


No adverse environmental impacts for 20 years

Grand challenges for coastal aquaculture

1. Site selection

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

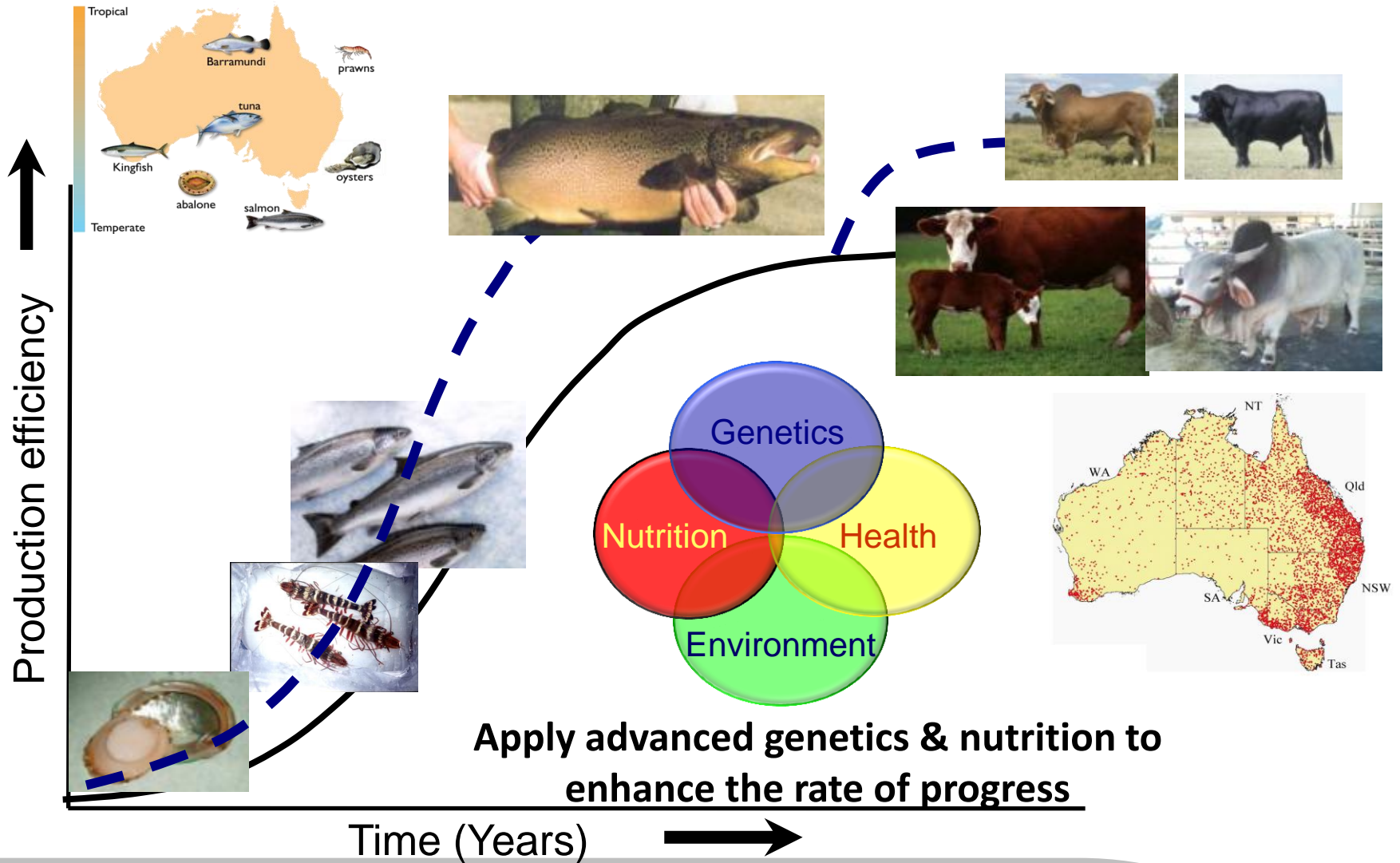


3 weeks



5 months

Challenge 3. Domestication



Short term (1-4 yr)

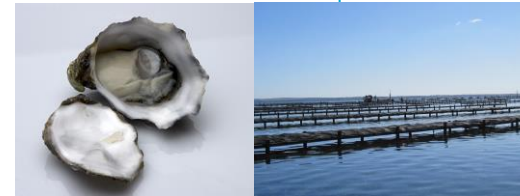
Domestication & founder stock selection

- Molecular markers
- Genetic diversity
- Disease diagnostics
- Health status
- Database



Medium (Years 5-10)

Selected genotypes stocked on farm



Long term (10-20)

Cumulative genetic gains to increase value of Australian industry by \$400 M by 2020

Founder stocks

Pilot breeding

Commercial breeding

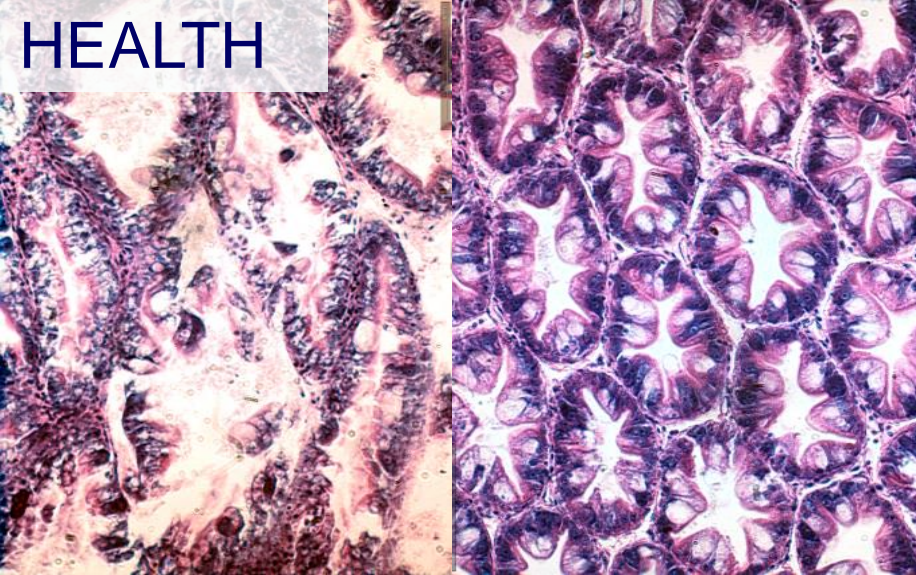
Scale up breeding

Selective breeding of *Penaeus monodon*

GROWTH



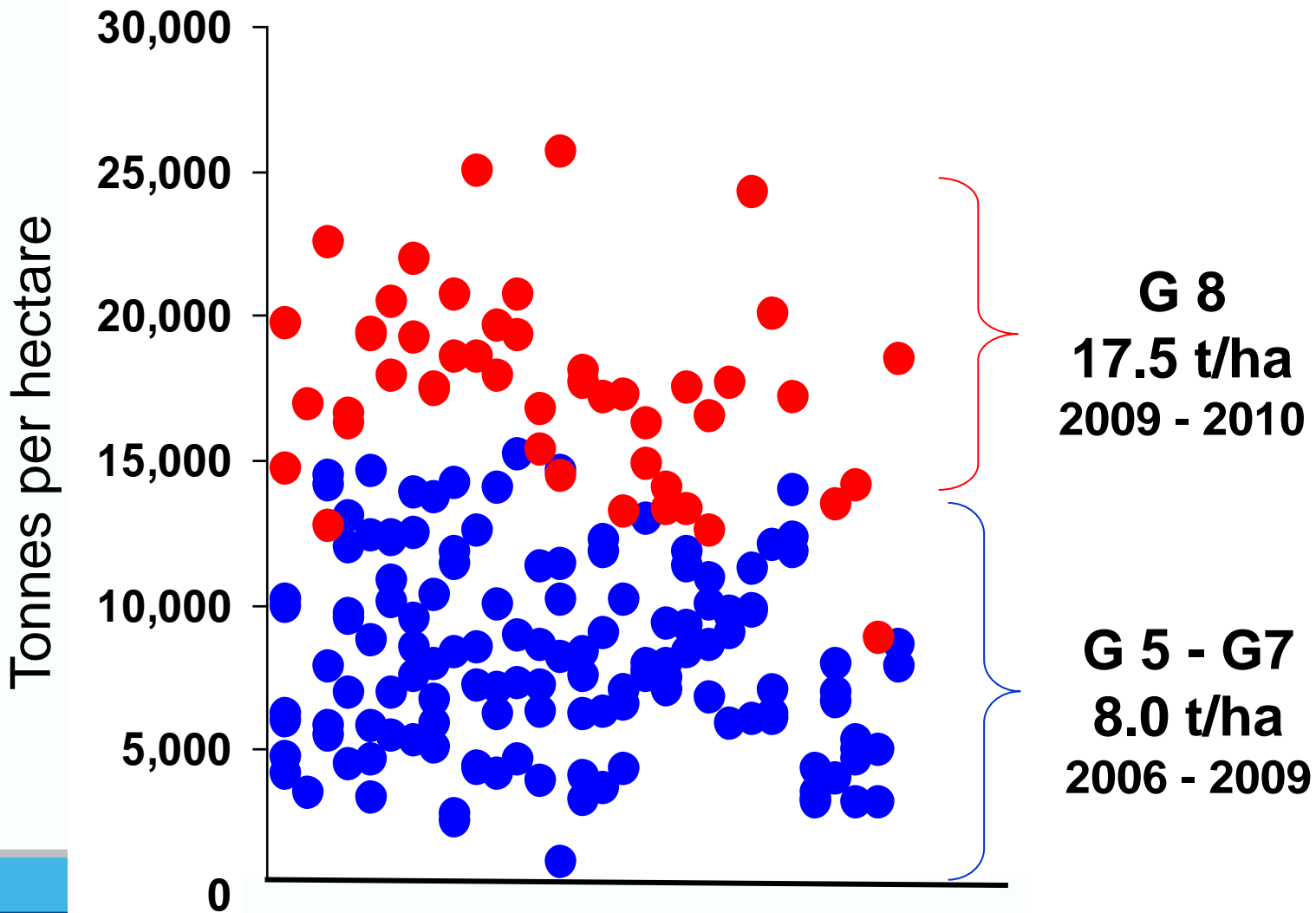
HEALTH



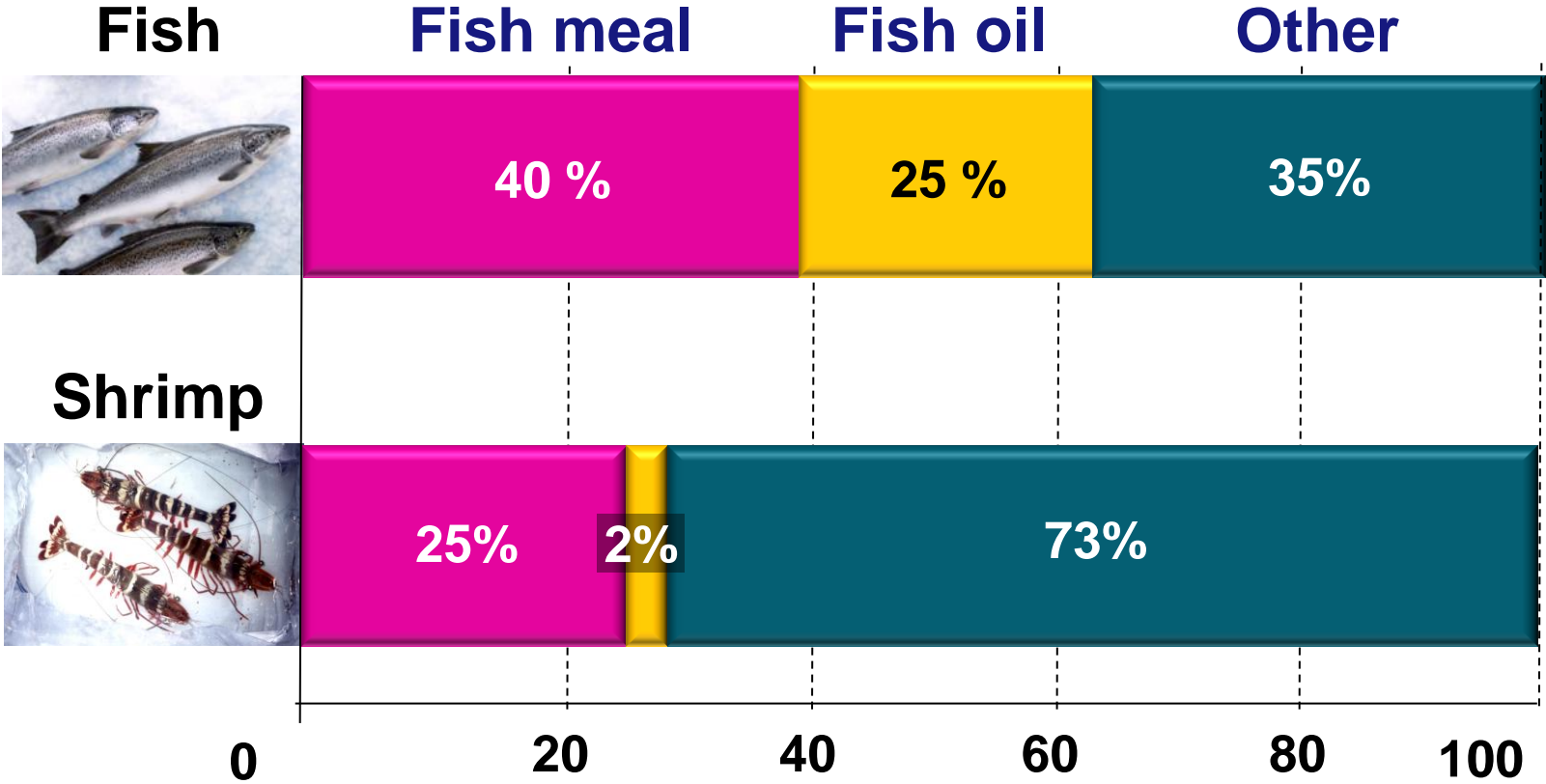
QUALITY



Exceptional yields from G8 stocks



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

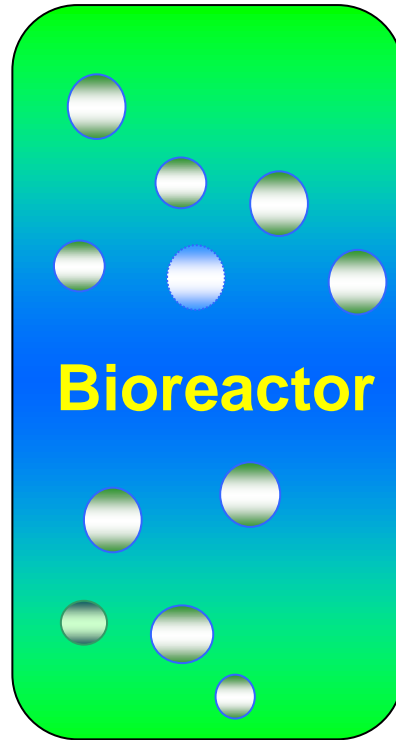


Novacq™ Production

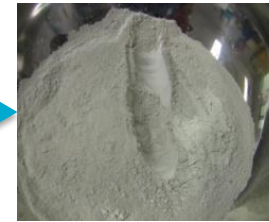
Raw materials



Solid or liquid wastes



Bioconversion to Novacq



Novacq



Prawn feed



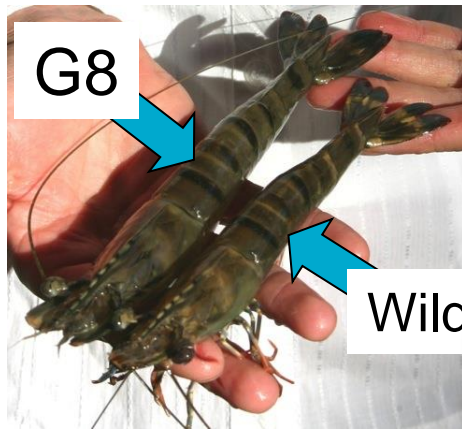
Prawn feed + Novacq

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.



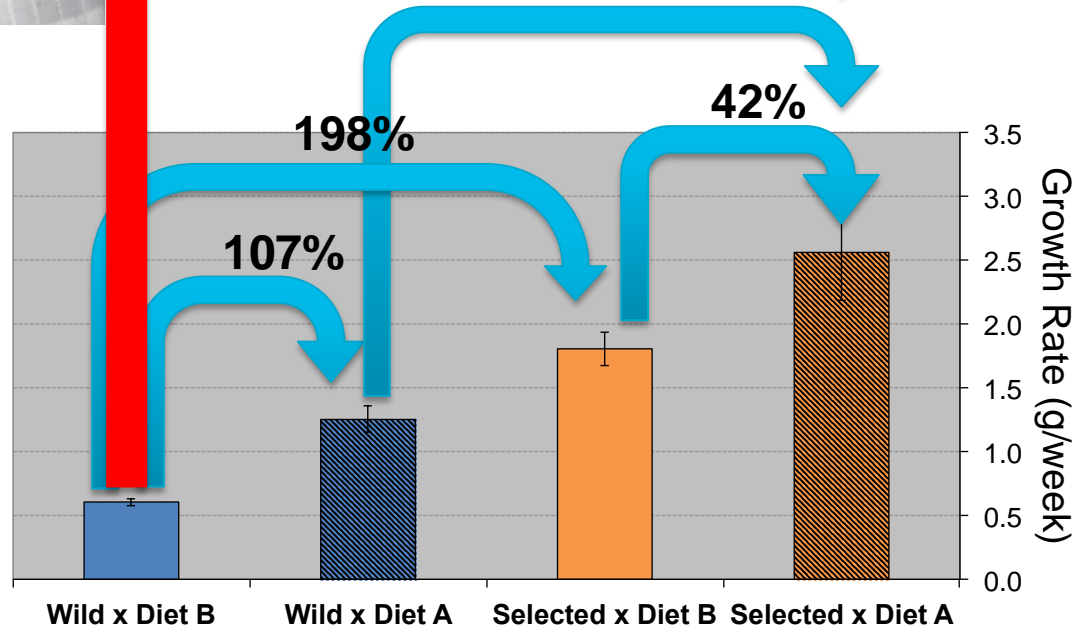
Combining Genetics and Diet



DIET A
High specification
322%



DIET B
Low specification
104%







Global market for Novacq technology



National and global focus

Norway and Scotland



Feeds



Canada



USA



Middle East



Asia



S. Korea



Prawns



Chile



Salmon



Abalone



Oysters



Feeds



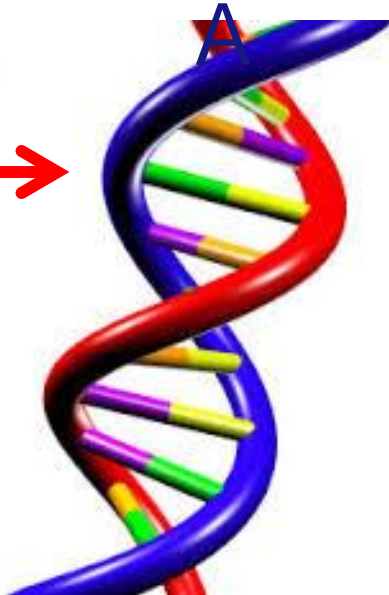
Challenge 5. Disease control via RNAi

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

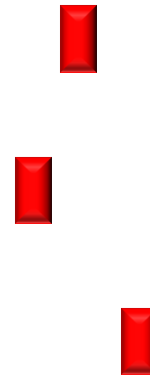
Virus



DN



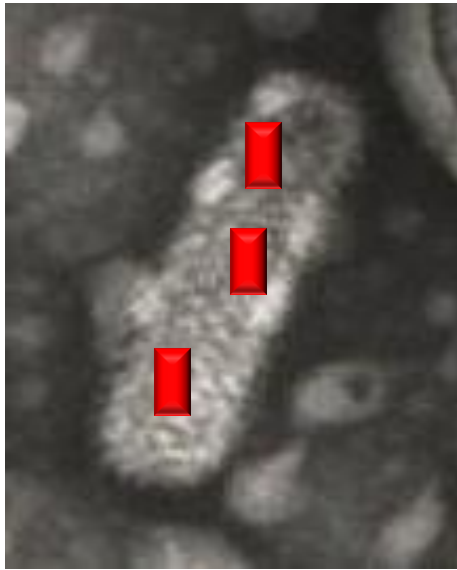
RNA



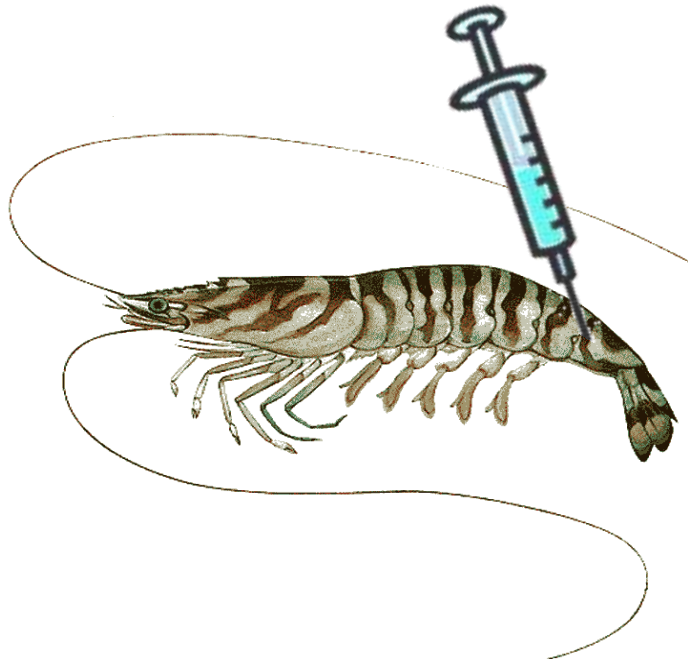
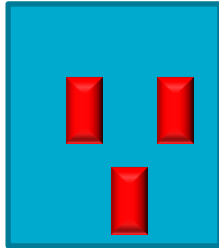
How do the anti-virals work?

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

Virus

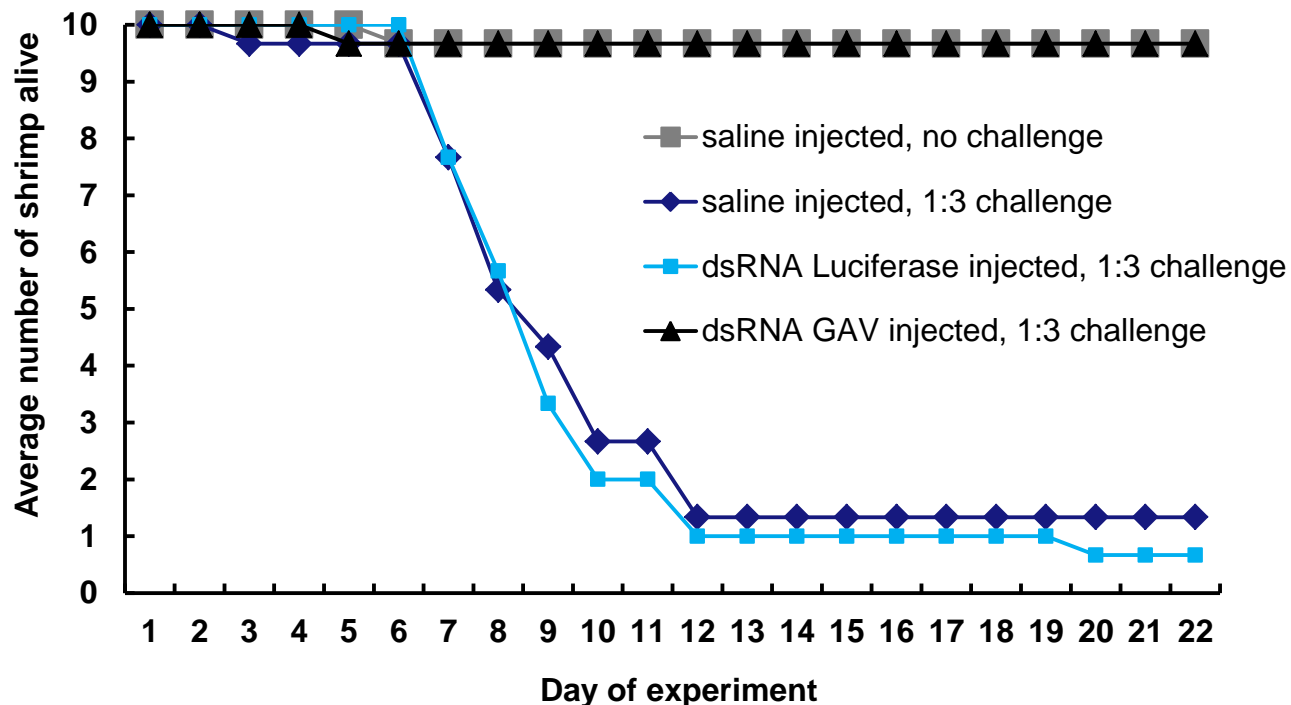


How do we administer the anti-virals?



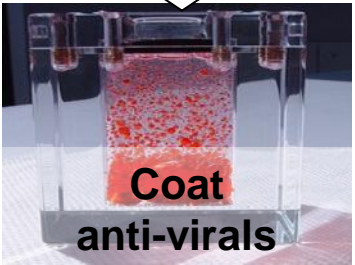
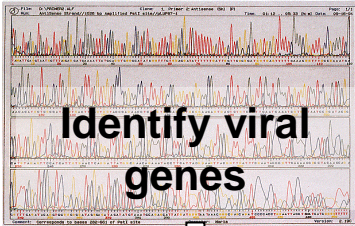
Recent advances in shrimp anti-virals

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

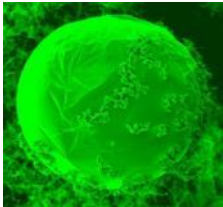


Sellars, M.J., Rao, M., Arnold, S.J., Wade N., Cowley, J. 2011. *Penaeus monodon* is protected against gill-associated virus by muscle injection but not oral delivery of bacterially expressed dsRNAs. *Diseases of Aquatic Organisms* 95(1): 19-30.

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



Coated anti-virals



Shrimp feeds



Viral Immunity



Fish feeds



Grand challenges for coastal aquaculture

1. Site selection

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Thank you

