

## Monitoring the Health of Prawns, Barramundi and Mud Crabs on Aquaculture Farms in the Northern Territory

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### INTRODUCTION

Over the past 25 years considerable investment has been made to develop marine aquaculture in the Northern Territory (NT). This has included the adaptation of farming technologies developed elsewhere for species such as barramundi and prawns, as well as the development of techniques for a species new to aquaculture, the mud crab. As expected when farming a species in a new environment, or when farming a new species, challenges have appeared from time to time in the form of previously unknown, or previously unreported, diseases and parasites.

To help manage such challenges, officers from the Darwin Aquaculture Centre and the Berrimah Veterinary Laboratories, which are both part of the Department of Primary Industry, Fisheries and Mines, have worked in close cooperation with industry. This has resulted in the development of considerable knowledge and expertise in health management of tropical marine aquaculture. The application of this knowledge and expertise has not only helped existing marine aquaculture farms to manage their fish health problems but it has also assisted to attract new investment in NT aquaculture.

An essential lesson learnt by farmers over the years has been to regularly monitor the health of their crop. Regular monitoring makes it easier for them to detect potential problems early so as to initiate timely remedial action.

This Fishnote is a guide for proactive marine aquaculture health management.

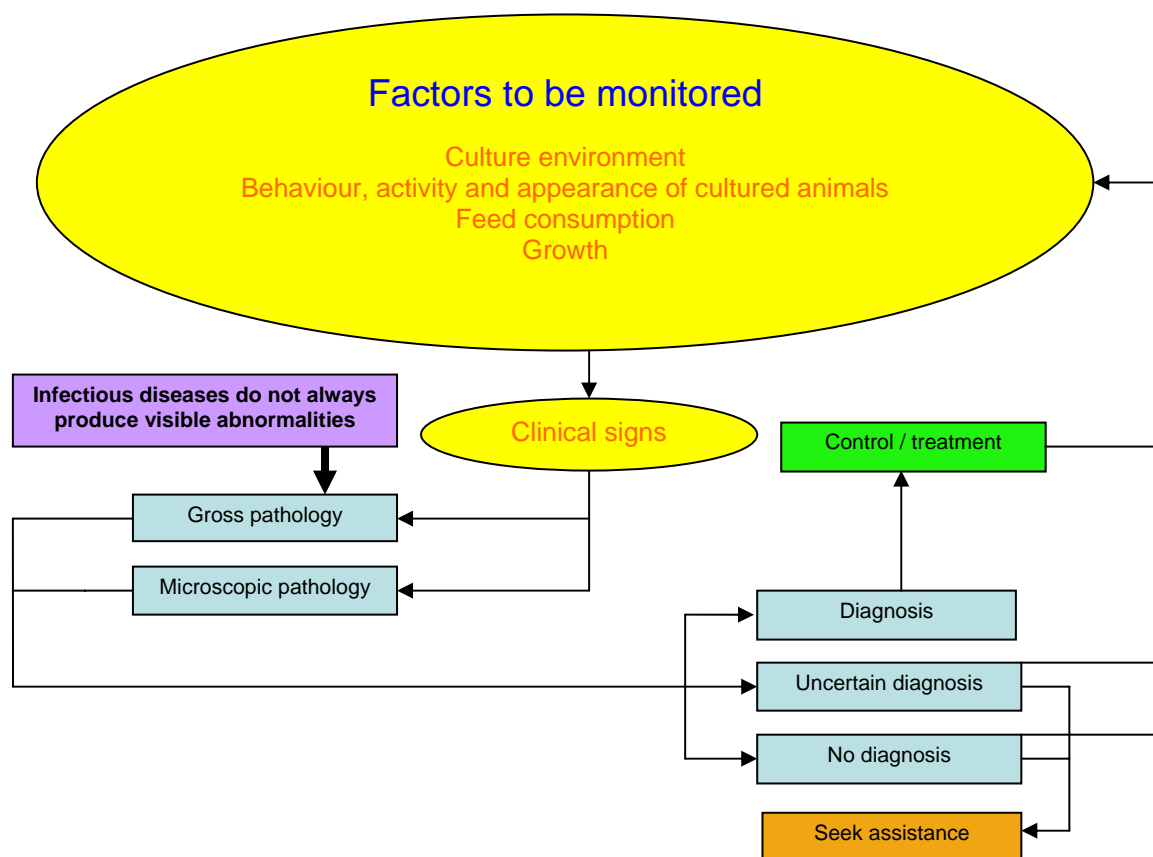
### WHAT TO MONITOR AND HOW?

It is difficult to determine the cause of a health problem on an aquaculture farm unless the farm is well managed and accurate records are kept. Such records include stocking densities, feed consumption, feed batch identification, body weight gain and water quality.



## PROCEDURES FOR ON-FARM HEALTH MONITORING

The procedures for on-farm health monitoring are outlined in Figure 1.



**Figure 1.** On-farm health monitoring

## CULTURE ENVIRONMENT

In most cases the primary cause of health problems is environmental. This must be taken into account when considering prevention, monitoring and control. Usually the most successful method to reduce health problems is to improve the culture environment for the animals.

Degradation of water quality is detrimental to the growth and survival of cultured aquatic animals. Water quality requirements for pond-cultured *Penaeus monodon* (black tiger prawn), *Lates calcarifer* (barramundi) and *Scylla serrata* (mud crab) are shown in Appendix 1.

Many systems are available for monitoring water quality, some of which are impractical under commercial conditions. Water quality monitoring systems used by DAC and NT land-based aquaculture farms are described in Appendix 1.

The water quality parameters that should be monitored routinely are dissolved oxygen (DO), pH, water temperature (WT) and transparency. DO, pH and WT should be measured twice a day, first between 6 and 7 a.m. and again between 1 and 2 p.m. (Appendix 1). The measurements should be taken in the feeding area about 20 cm above the floor of the pond. A Secchi disc is used for transparency estimation and readings should be taken in the afternoon at the same time each day when measurements of DO, pH and WT are recorded. The area selected for measuring transparency should be representative of the pond and not in the

areas with very high or low levels of plankton due to wind action or water exchange. The back of the person taking the Secchi disk reading should be towards the sun. Sunglasses should not be worn when taking Secchi disc readings.

The other water quality parameters such as salinity, un-ionised ammonia, nitrite and hydrogen sulphide can be measured once every 3-4 days, and alkalinity once a week.

All water quality parameters should be measured prior to stocking to allow enough time for adjustments to be made if required.

There are many water quality testing instruments/kits available in the market. Separate instruments/kits can be purchased to measure individual water quality parameters, or a single logger can be purchased to test a combination of several water quality parameters. An automatic, continuous DO monitoring system has been used at two NT barramundi farms for a number of years and has been reported reliable.

Records of water quality monitoring should be maintained for subsequent examination.

Although the regime described above may be adequate for routine operations, it is recommended to measure as many parameters as possible when a problem occurs in order to obtain maximum information to assist in making a proper assessment.

## **INDICATORS/CAUSES OF POOR POND ENVIRONMENT**

- Undesirable DO, pH, WT, salinity, ammonia, nitrite, hydrogen sulphide and/or alkalinity levels (See Appendix 1).
- High daily fluctuation in pH levels (> 0.5 unit difference).
- Undesirable transparency and colour of pond water (See Appendix 1).
- Appearance of stable foam, bubbles or floating algal debris on the surface of water.
- Wide distribution of wastes on the bottom of the pond.
- A plankton bloom crash.
- A prolonged period of overcast skies, rain or hot weather with no breeze.
- Feed left over or consumed faster than expected.
- The number of prawns/fish attending the feed trays/coming to the feeding sites significantly decreases or increases.

## **BEHAVIOUR, ACTIVITY AND APPEARANCE OF CULTURED ANIMALS**

Daily observations and records of abnormal behaviour, activity and appearance of cultured animals usually provide farm managers with the first indication of potential disease and/or a deteriorating environment. Together with water quality data this information is vital for the detection of disease or poor environment during the early stages.

If all is well with the culture environment, and the cultured animals are healthy, they should not be seen to exhibit abnormal behaviour, such as fish flashing on their sides.

Feeding activity can be monitored by checking feed trays, in the case of prawns, or the consumption rate and amount of feed consumed by barramundi.

The farmer should conduct routine sampling in order to measure growth and check for abnormalities in cultured animals. These observations should be recorded. Prawns can be checked daily while inspecting feed trays. Sampling frequency for barramundi and mud crabs is recommended to be at least once a week.

The checking method is visual and/or microscopic. It is preferable to randomly sample fish and prawns using a cast net, particularly at times when disease is suspected. Pots or scoop nets can be used for mud crabs.

## **ON-FARM LABORATORY EXAMINATION**

It is recommended that each farm develop basic laboratory capabilities which should include a good quality compound microscope and water quality measuring equipment.

Samples should be visually examined soon after sampling. If visual examination cannot be conducted straight away the samples of prawns and barramundi should be stored on ice ensuring the whole animal is covered by ice. Mud crabs can be held live in a ventilated moist container in the shade.

## **VISUAL EXAMINATION (GROSS PATHOLOGY)**

The morphology (colour, size and shape) of eyes, skin/shell, fins/appendages, gills, liver/hepato-pancreas, guts and spleen, together with blood/body fluid should be visually checked for abnormalities.

## **USE OF A MICROSCOPE TO AID DIAGNOSIS (MICROSCOPIC PATHOLOGY)**

Parasitic diseases and fouling problems are common in pond-reared aquatic animals. However, they are readily detected and diagnosed by regular monitoring of cultured animals through microscopic examination of gills, skin/shell and blood.

If the microscope has a power of 400X magnification it should be suitable in most situations for a basic examination of the health of farm stock. On-farm microscopic examinations are usually conducted using wet mounted (wet prep) samples.

Use a microscope to monitor for *Cryptocaryon irritans* or *Amyloodinium* sp. infestation in barramundi at least twice a week between July and October, and once a week during other times of the year. Also, whenever problems are noticed, identify what is causing fouling on prawns or mud crabs.

## **FEED CONSUMPTION**

*Is feed consumption by cultured animals at expected levels for NT conditions?*

A feed table for pond-cultured black tiger prawns during the wet season (October – April) and a guide for the use of feed trays to monitor feed consumption are shown in Appendix 2 (courtesy of Matt Seccombe, Wild River Farmed Seafood, 2007).

Currently pond-reared barramundi weighing less than 1 kg are generally fed twice daily (after dawn and before dusk) seven days a week using formulated pellets. Fish larger than 1 kg are fed once daily (before dusk) six days a week. Feeding should be stopped when a decline in feeding activity of more than 50% is detected.

Feeding tables for pond-reared barramundi during the Wet (October – April) and Dry (May – September) seasons at Wild River Farmed Seafoods farm are shown in Appendix 3 (courtesy of Matt Seccombe, Wild River Farmed Seafood, 2007).

Adam Body (ARDA-Tek), feeds pond-reared barramundi weighing 1250 – 2500 g between 11-18 g of feed pellets/fish/day during the Wet season. The feed requirement of these fish declines to approximately 80% of that amount during the Dry season.

The exact feed requirement of pond-cultured mud crabs is still uncertain as appropriate methods for monitoring feed consumption have yet to be developed. The feeding regimes commonly practised overseas (Baliao et. al., 1999) are described below.

In the Philippines mud crabs are fed fresh seafood at the rate of 10% of their body weight per day when their carapace width is less than 6 cm; and 5%, when their carapace width is 6 cm or more. The daily ration is divided into two meals. Under normal circumstances, if mud crabs are observed swimming/walking round the pond edges it may be an indication that they need more food.

Feed consumption may be affected by water quality and/or disease. For example, the feeding activity of prawns/barramundi/mud crabs decreases significantly when WT drops below 25 °C and/or the DO is below 3 ppm.

## **GROWTH**

*Are growth parameters of cultured animals within the expected ranges for NT conditions?*

The growth rate of pond-cultured black tiger prawns at an initial stocking density of 30 - 40 post-larvae /m<sup>2</sup> (PL stage 15-18) during the wet season is attached in Appendix 4 (courtesy of Matt Seccombe, Wild River Farmed Seafood, 2007).

Pond-reared barramundi weighing 1250 – 2500 g grow, on average, between 9-13 g/day during the wet season. Growth during the dry season is approximately 80% of that. It usually takes a minimum of 14 months to grow fish from 15 g to more than 2.5 kg in weight using an initial stocking density ranging from 13 000 to 25 000 fingerlings/ha (Adam Body, ARDA-Tek, 2007 pers. comm.). There has been one report of fish growing to more than 2.5 kg in just under 12 months when a stocking rate of 8-10,000 fingerlings/ ha was used (Daren Tay, Australia Aquaculture Farming (NT), 2008, pers. comm.).

The recorded growth rate of for NT pond-reared barramundi stocked at an initial density of 13 000, 100 mm long fingerlings /ha is attached in Appendix 5 (courtesy of Matt Seccombe, Wild River Farmed Seafood, 2007).

The recorded growth rate of mud crabs pond-cultured under NT conditions is attached in Appendix 6 (unpublished data, 2008).

## SIGNS OF POOR HEALTH IN PRAWNS

- Death – high mortality.
- Loss of appetite or detection of empty gut and gap between shell and muscle.
- Decreased activity, abnormal behaviour (swimming close to the water surface or round the pond edges) or reduced growth.
- Faecal strings are not long, uniform or feed-coloured.
- Body is not of normal colouration (should be yellow-green).
- Shell is not hard, firm, smooth and shiny or has necrosis.
- Appendages are damaged or have necrosis.
- Occurrence of fouling on the cuticle or appearance of red pigmentation on the dorsal exoskeleton.
- Gills are 'dirty' (with organisms or debris attached, or brown, black, green or pink in colour) or partially hanging outside carapace.
- Muscle is not full, becomes opaque or has brown/black lesions.
- Small size and abnormal colour of hepato-pancreas
- Incomplete moulting.

## SIGNS OF POOR HEALTH IN BARRAMUNDI

- Death – high mortality.
- Abnormal behaviour (reduced feeding, flashing, uncoordinated swimming, abnormal location in water column – swimming close to the water surface or round the pond edges, swimming to fresh water refuge or gills flared out).
- Haemorrhage.
- Exophthalmic eyes (bulging/ cloudy eyes).
- Ascites/abdominal distension.
- Pale/discoloured areas on skin.
- Nodules or lumps.
- Organ enlargement.
- Gill necrosis (gill-rot).
- Ulceration.
- Reduced growth.

### Infectious Diseases, NT Barramundi, Pond Culture

A more complete description of the known diseases of NT barramundi is contained in the DPIFM Publication, *The Northern Territory Barramundi Handbook, Fishery Report 89*.

At the time of writing all barramundi in the NT were raised in salt water or brackish water ponds. There was no freshwater culture conducted.

Infectious pathogens that are known to have caused mortalities in NT pond-cultured barramundi include *Vibrio harveyi* and other *Vibrio* spp., *Flexibacter* spp. and protozoan parasites such as *Cryptocaryon irritans* and *Amyloodinium* sp.

- *Flexibacter* infections often occur after fish handling during periods of low water temperature, usually during the dry season.
  - The occurrence of *Flexibacter* infection can be minimised by avoiding fish handling during periods of low water temperature.

- The outbreak of *C. irritans* or *Amyloodinium* sp. infestation mainly takes place between July and October, although outbreaks may occur at any time of the year.
  - These parasitic outbreaks tend to start around the spring tides (new or full moon) or after a sudden decrease in water temperature, as can occur in the Dry season.
  - The outbreaks of both these parasitic diseases are associated with stress. Stress factors can be poor water quality and/or poor fish health.
  - Both parasitic infestations may be curable if they are detected and treated at the early stages of disease development.

Other known protozoan parasites include *Trichodina* sp., monogenic parasites (flukes), *Diplectanum* sp., and the copepod parasite, *Lernanthropus latis*. These parasites have not yet been associated with significant fish mortality events even though their presence is usually associated with poor fish health.

### **Infectious Diseases, NT Barramundi, Sea Cage Culture**

Infectious pathogens known to have caused mortalities in NT barramundi sea cage culture include *Vibrio harveyi* and other *Vibrio* spp., *Streptococcus iniae* and the blood protozoan parasite, *Trypanosoma* sp.

*S. iniae* infection is a notifiable disease. This means that if the disease is detected, the farm is obligated to report the incident to Fisheries and quarantine may be activated. The outbreak of this disease may result in mass mortalities in fish. Barramundi to be farmed in the immediate Darwin area can be effectively vaccinated against *S. iniae* using a vaccine developed from strains of the bacteria found in the Darwin region.

### **SIGNS OF POOR HEALTH IN MUD CRABS**

- Death – high mortality.
- Loss of appetite.
- Decreased activity or abnormal behaviour (swimming close to the water surface or round the pond edges or crawling out of the water).
- Faecal strings are not long, uniform or feed-coloured.
- Mouth parts are moving fast or have foam attached.
- Body is not of normal colouration (should be green-brown).
- Shell is not hard, firm, smooth and shiny or has discoloured patches or necrosis (shell disease).
- Appendages are damaged, lost or have necrosis.
- Occurrence of fouling on the exoskeleton.
- Gills are not clean (covered with algae, commensals, parasites or debris attached, or brown, black or green in colour).
- Incomplete moulting.
- Failure to thrive:
  - Small size and abnormal colour of hepato-pancreas.
  - Crabs appear stunted (can have ventral side of carapace depressed at distal end of tail, tail segments near distal end curved or bent, gills partially hanging outside carapace).
  - Reduced growth.

Lavilla-Pitogo and de la Pena (2004) have provided further information on the diagnosis, prevention and control of diseases in farmed mud crabs, *Scylla* spp.

**Appendix 1.** Water quality for optimal survival and growth of pond-reared *Penaeus monodon*, *Lates calcarifer* and *Scylla serrata* under NT conditions and methods for practical measurement

Water quality parameter	Optimum level	Comments	Measurement method
pH	7.5 - 8.5	Daily fluctuation < 0.5.	Portable pH meter; twice a day at 6 - 7 a.m. and 1 - 2 p.m.
Dissolved oxygen	5 - 7 ppm	Not less than 4 ppm.	Portable DO meter; twice a day at the same time when pH measurement is done.
Temperature	27 – 31 °C for <i>P. monodon</i>  28 - 32 °C for <i>L. calcarifer</i> (Schipp et. al., 2007)  27 - 32 °C for <i>S. serrata</i>	Daily fluctuation < 5 °C.	Thermometer; twice a day at the same time when pH measurement is done.
Transparency	30 - 40 cm	It is preferable to maintain water transparency within the ranges of 25 - 35 cm if bloom colour is green, and 35 - 45 cm if brown.	Secchi disc reading ; once a day at 1 - 2 p.m.
Salinity	10 - 30 ppt for <i>P. monodon</i>  0 - 36 ppt for <i>L. calcarifer</i> (Schipp et. al., 2007)  15 - 25 ppt for <i>S. serrata</i> (Mann, 2005)	Daily fluctuation < 5 ppt.	Refractometer; normally measured once every three days but every time after heavy rainfall.
Un-ionised ammonia	< 0.1 ppm	More toxic at high pH level and water temperature.	Ammonia test kit; once every three days.
Nitrite	< 0.1 ppm		Nitrate test kit; once every three days.
Hydrogen sulphide	< 0.03 ppm	More toxic at low pH.	Hydrogen sulphide test kit; once every three days.
Alkalinity	> 70 - 80 ppm	Preferably > 100 ppm	Alkalinity test kit; once a week

ppm = parts per million; ppt = parts per thousand.

**Appendix 2.** Feed requirement of pond-reared *Penaeus monodon* during the wet season (October – April)<sup>1</sup>

DOC*	ABW* (grams)	Feed/day/ 100 000 PLs*	Feed type	Feed tray times(hrs)	Grams of feed placed on tray for each kg of feed fed to pond
1	0.01	1kg/day/100 000 PLs	PL 0	N/A	N/A
2 - 10	0.01 - 0.8	300 g/day/100 000 PLs increase	PL 0	N/A	N/A
11 - 20	1.0 - 1.5	400 g/day/100 000 PLs increase	PL 1	N/A	N/A
21 - 30	1.5 - 3.0	500 g/day/100 000 PLs increase	PL 1	N/A	N/A

DOC	ABW (grams)	Feed ( % of ABW/day)	Feed type	Feed tray times(hrs)	Grams of feed placed on tray for each kg of feed fed to pond
31	3 - 5	7.5 - 6.0	PL 2C	2.5	1.5
40	5	6	PL 2C (up to DOC 46)	2	3
50	6	5.5	PL 2	2	3
55	7	5.3	PL 2	2	3
60	8	5.1	PL 2	2	3
65	9	4.9	PL 2	2	3
70	10	4.5	PL 2	2	3
74	11	4.4	Starter 3	2	3
77	12	4.35	Starter 3	2	3
80	13	4.3	Starter 3	2	3
83	14	4.25	Starter 3	2	3
86	15	4.1	Starter 4	2	3
89	16	4	Starter 4	2	5
92	17	3.8	Starter 4	2	5
95	18	3.6	Starter 4	2	5
98	19	3.5	Starter 4	2	5
101	20	3.3	Starter 4	2	5
103	21	3.1	Starter 4	2	5
105	22	3	Starter 4	2	5
107	23	2.9	Starter 4	2	5
109	24	2.85	Starter 4	2	5
111	25	2.8	Grower 5	2	5
113	26	2.65	Grower 5	2	5
115	27	2.5	Grower 5	2	5
117	28	2.35	Grower 5	2	5
119	29	2.2	Grower 5	2	5
121	30	2.1	Grower 5	2	5
123	31	2	Grower 5	2	5
125	32	2	Grower 5	2	5
127	33	2	Grower 5	2	5
130 - 150	34 - 38	1.8	Finisher 6	2	5

\*DOC: Days of culture; ABW: Average body weigh; PL: Post larvae

<sup>1</sup> Data sourced from Mr Matt Secombe of Wild River Farmed Seafood, 2007.

**Appendix 3.** Feed requirement of pond-reared *Lates calcarifer* during the wet (October – April) and dry (May – September) seasons<sup>2</sup>

**Feeding table for the wet season**

<b>ABW (grams)</b>	<b>Feed (% of ABW/day)</b>
14	4.4
38	3.1
75	2.43
125	2.02
187	1.75
263	1.55
350	1.4
450	1.3
562	1.2
680	1.12
817	1.05
962	1
1119	0.96
1285	0.9
1463	0.86
1653	0.83
1852	0.8
2060	0.77
2280	0.75
2510	0.72
2745	0.7
2996	0.68

**Feeding table for the dry season**

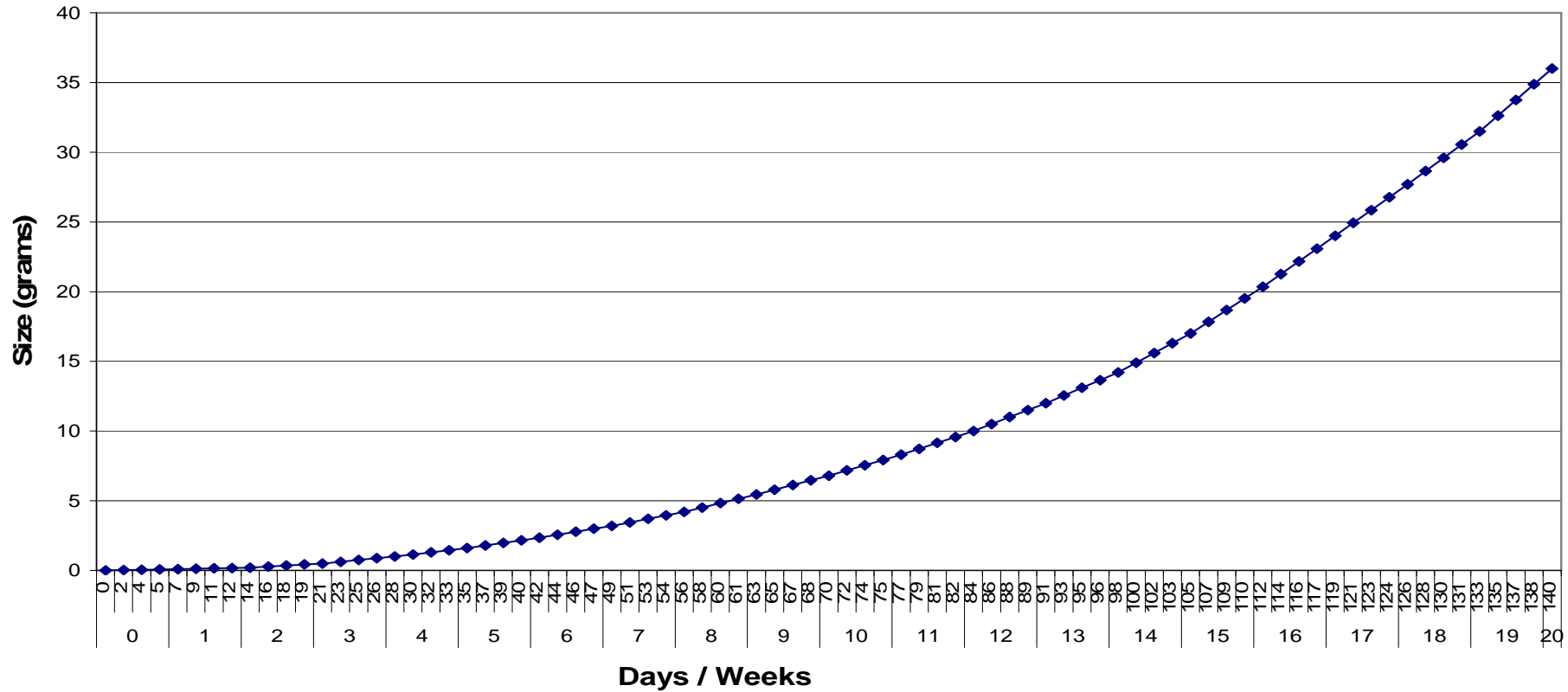
<b>ABW (grams)</b>	<b>Feed (% of ABW*/day)</b>
14.6	3.52
33	2.48
62	1.944
100	1.616
146	1.4
203	1.24
266	1.12
340	1.04
420	0.96
509	0.896
606	0.84
710	0.8
822	0.768
943	0.72
1070	0.688
1204	0.664
1347	0.64
1498	0.616
1647	0.6
1820	0.576
1989	0.56
2160	0.544
2348	0.536
2502	0.52

\*ABW: Average body weight

<sup>2</sup> Data sourced from Mr Matt Seccombe of Wild River Farmed Seafood, 2007.

**Appendix 4.** The growth of pond-reared *Penaeus monodon* during the wet season (October – April)<sup>3</sup>

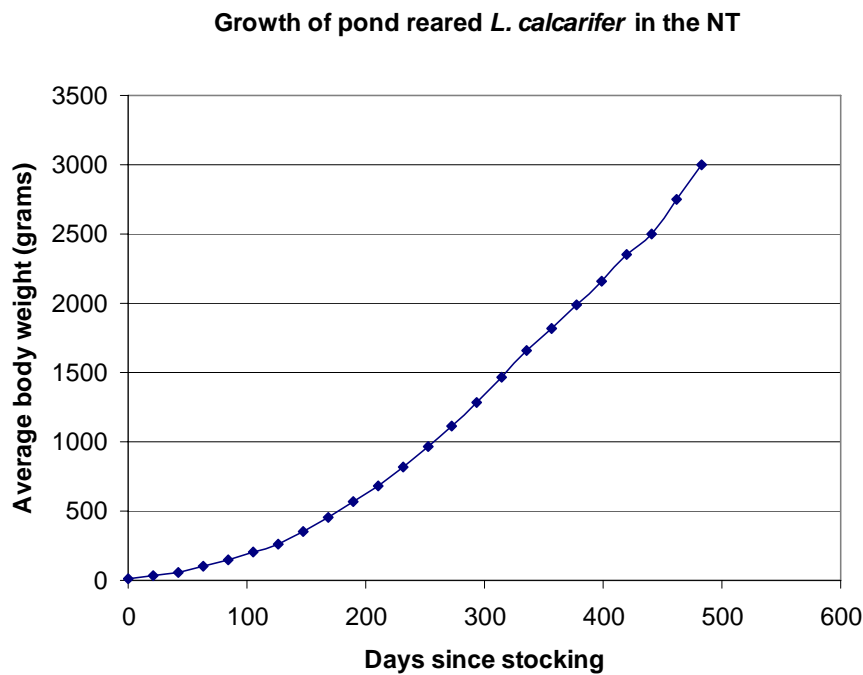
**Growth of pond reared *P. monodon* in the NT**



The ponds were initially stocked at a density of 30 - 40 post-larvae 15 – 18/m<sup>2</sup>.

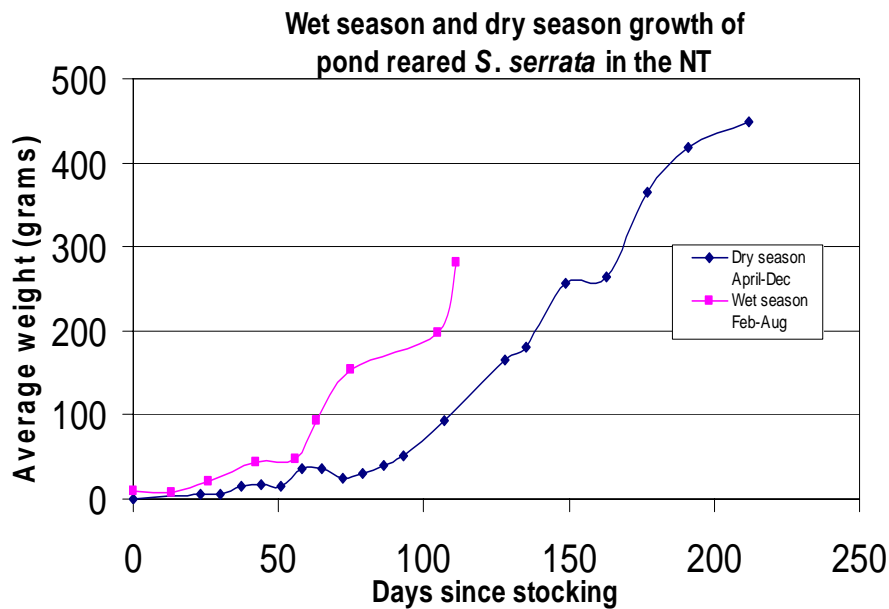
<sup>3</sup> Data sourced from Mr Matt Seccombe of Wild River Farmed Seafood, 2007.

**Appendix 5.** The growth of pond-reared *Lates calcarifer* in the NT<sup>4</sup>



Fish of 100 mm in total length were stocked into the ponds at a density of 13 000 fingerlings/ha in May 2006.

**Appendix 6.** Growth of pond-reared *Scylla serrata* in the NT<sup>5</sup>



The ponds were initially stocked at a density of 20 000 crablets of 10 mm in carapace width/ha in the dry season trial. The wet season trial used an initial stocking density of 20 000 crablets of 35 mm in carapace width/ha.

<sup>4</sup> Data sourced from Mr Matt Seccombe of Wild River Farmed Seafood, 2007.

<sup>5</sup> Data sourced from DAC, 2008.

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