Aquatic Animal Health Subprogram: Enhancement of Emergency Disease Management Capability in the Queensland Department of Primary Industries and the Redclaw Crayfish (*Cherax quadricarinatus*) industry

I.J. East and L.V. Walker

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OBJECTIVES:

1. To examine and test the skills and abilities of the participating staff in-group problem solving and decision making skills.
2. To increase the participants' knowledge of the communication routes to be used in an emergency disease response by working through a scenario which mimics a real emergency situation.
3. To improve the participants' ability to manage tasks by prioritising a number of competing demands during the operational phase of the emergency response.
4. To increase participants' understanding of the operational effects of specific requests to field staff operating at infected premises.
5. To familiarise participants with operating practices on a redclaw crayfish farm and to enhance the identification of methods of disease control applicable to this industry.
6. To identify key issues for future development of emergency management in a range of subjects including planning, communication, staffing and resourcing.

NON TECHNICAL SUMMARY:

The basis of this project was the design and conduct of four days of simulation exercises focussed on planning the response to an exotic disease incident in the redclaw crayfish industry. The exercises involved members of the Queensland Department of Primary Industries (QDPI)

and the Queensland Crayfish Farmers Association (QCFA). The aims of the exercise were:

- To practise and further develop communication networks into, within and out from the Local Disease Control Centre (LDCC),
- To practise decision-making techniques within the LDCC,
- To familiarise both government and industry staff with farm level methods of disease control.

The first component of the exercise was a daylong tabletop exercise involving participants in the operation of a Local Disease Control Centre. The second component was an on-farm day focussing on practical aspects of disease management including quarantine, emergency harvest of infected stock, transport, destruction and disposal of infected stock and disinfection of equipment and pond water. The exercises were conducted in southeast Queensland at Bribie Island and Pomona and then repeated in north Queensland at Walkamin. 48 members of QDPI, 3 members of Queensland's Environment Protection Agency, 2 members of QCFA and one observer from NSW – Fisheries participated in the tabletop exercises. A further 23 QCFA members participated in the on-farm exercises.

The project had two primary outputs. Firstly, a series of issues in the area of emergency management of disease incidents that require improvement were identified and reported to the Queensland Chief Veterinary Officer. These issues are providing a focus for QDPI to review its emergency management procedures and to establish more effective practices. Secondly, the information arising from the on-farm activities and subsequent discussions have been used to develop a farm-level health plan to advise crayfish growers on best practice to minimise the occurrence of disease related losses during the production cycle. The final plan is available to all QCFA members at no cost.

KEYWORDS: ***Cherax quadricarinatus*, emergency response, disease management**

BACKGROUND

In the past 15 years, many fisheries and aquaculture industries around the world have suffered major production losses through the impact of disease epidemics. Australia to date has avoided many of these epidemics. However, in 1995, a major disease incident resulted in the death of a substantial proportion of the Australian pilchard population. In response, the Federal Government conducted several reviews (e.g. National Taskforce on Imported Fish and Fish Products) into the management of aquatic animal health. These inquiries lead to the development of AQUAPLAN - *Australia's National Strategic Plan for Aquatic Animal Health 1998-2003*. AQUAPLAN includes eight programs that address all aspects of aquatic animal health. Program Four - Preparedness and Response focuses on the development of effective institutional arrangements to manage disease emergencies. Within this program, project 4.1.3 focuses on the conduct of simulation exercises to test the capability and capacity of Australia's State/Territory authorities to manage emergency disease incidents.

The value of simulation exercises has been further recognised by the Federal government in that, under the Federal Budget Initiative "Building a National Response to Animal and Plant Health" funds have been specifically targeted to conduct of simulation exercises?

The Office of the Chief Veterinary Officer, within the Department of Agriculture, Fisheries and Forestry – Australia, has conducted several disease simulation exercises for the aquatic sector including the following:

- October 1999 - Queensland Department of Primary Industries and the prawn farming industry
- December 1999 - Victorian Department of Natural Resources and Energy and the freshwater finfish industry
- February and April 2000 - Tasmanian Department of Primary Industry, Water and Environment and the salmonid industry
- May 2001 - South Australian Department of Primary Industries and Resources and the abalone industry

This project, conducted with the QDPI and the redclaw crayfish industry, further developed Australia's capability in management of emergency disease incidents.

NEED

Few major disease incidents have occurred in Australian aquaculture, and as a result, State/Territory departments have relatively little experience in incident management for emergency diseases. The high level of interest that has accompanied our program of simulation exercises clearly indicates recognition of the need for this style of training. In addition to the exercises listed in the background section, interest by other jurisdictions includes:

- Attendance at the October 1999 exercise by observers from NSW fisheries and Emergency Management Australia (EMA).
- Attendance at the December 1999 exercise by observers from the Tasmanian DPIWE and EMA.
- Preliminary discussions with the Northern Territory government and the pearl industry to conduct a simulation exercise in Darwin.
- Request to hold a simulation exercise for State/Territory fisheries inspectors and police at the Compliance Committee annual conference in May 2002.

All simulation exercises are initiated by requests from clients - both industry and government. Both the Queensland DPI and the redclaw crayfish industry requested these exercises and actively supported the project.

OBJECTIVES

The objectives of the project were:

7. To examine and test the skills and abilities of the participating staff in group problem solving and decision making skills.

8. To increase the participants' knowledge of the communication routes to be used in an emergency disease response by working through a scenario which mimics a real emergency situation.
9. To improve the participants' ability to manage tasks by prioritising a number of competing demands during the operational phase of the emergency response.
10. To increase participants' understanding of the operational effects of specific requests to field staff operating at infected premises.
11. To familiarise participants with operating practices on a redclaw crayfish farm and to enhance the identification of methods of disease control applicable to this industry.
12. To identify key issues for future development of emergency management in a range of subjects including planning, communication, staffing and resourcing.

There were no changes to the objectives during the course of the project.

METHODS

The exercise was comprised of two parts. The first was a tabletop exercise that simulated the functioning of a Local Disease Control Centre. The participants operated within a single room and were required to use only the facilities and resources within the room to plan and conduct the operational phase of the response to a disease incursion. The entire exercise was pre-scripted by the controlling staff, and all contingencies were planned for using decision tree modelling. The method is an adaptation of that used by Emergency Management Australia as presented in their Course in Exercise Management. The participants were required to react to a given scenario and prepare detailed plans to control the disease outbreak. The plans were then presented and defended during a debriefing session. The success of the exercise was determined by the appropriateness of the proposed

solution to the problem as presented and also by comparison of the solutions produced during the exercise with the detailed response plans described in the AQUAVETPLAN *Control Centre Manual.*

The exercise conducted on the second day was a Tactical Exercise Without Troops. The exercise involved small teams of producers and QDPI staff situated on a working property developing solutions to a range of practical problems including water control, rapid harvesting methods, stock destruction and disinfection procedures. Differences between the plans developed by different groups were used as catalysts to promote discussion when the individual groups joined together in a forum. An optimum response plan was developed from the options presented, and this became the basis of the farm level - health plan.

The two-day exercise package was conducted once in southeast Queensland and once in north Queensland. Each exercise relied heavily on a skilled controlling staff to plan and run the exercise, conduct the debriefing and synthesize the outcomes of the exercise. The planned approach used proven techniques developed for a range of other purposes including military and civil defence. The proposed techniques have been successfully used in previous exercises and Mr Rob Lee, Assistant Director, Australian Emergency Management Institute has endorsed the performance of the Principal Investigator.

From the information gathered during the exercise, and with input from members of the Queensland Department of Primary Industries and the Queensland Crayfish Farmers Association a farm level health plan was developed.

RESULTS/DISCUSSION

Approximately 45 members of the QDPI and 15 members of the redclaw crayfish industry participated in the four days of exercises and increased their knowledge and awareness of the procedures involved in the management of an exotic disease incursion. In addition, better relationships between government and industry and between the Animal and Plant Health Service and the Queensland Fisheries Service sections of QDPI have been established. Veterinarians specialising in terrestrial animal industries have a greater awareness of the special issues involved in disease management in the aquatic environment.

Both of the tabletop exercises conducted identified areas where QDPI's ability to respond to an exotic disease incursion in the aquaculture industry could be improved. A full report detailing these areas was submitted to the Queensland Chief Veterinary Officer and to the General Manager, Fisheries and Aquaculture Development. The QDPI has already conducted several discussions to address the issues raised in the reports and in particular has sought advice from their legal department regarding the extent of search and seizure powers under the Queensland *Fisheries Act*.

As a result of the exercises, a draft health management plan for crayfish farms has been developed. This plan, in its final form, is available to all QCFA members and should result in enhanced on-farm practices that minimise the chance of disease incursion. A full copy of the plan is included at Appendix 3.

In our original application for funding, the production of a template for the conduct of simulation exercises was identified as an output of the project. After the commencement of the project, the investigators became aware of a publication by Emergency Management Australia entitled "Managing Exercises" which is part of the Australian Emergency Manuals Series. This manual describes in detail how to prepare and

conduct a simulation exercise, and the methods described are virtually identical to the methods that we used during this project. After discussions with the Aquatic Animal Health Subprogram leader, it was agreed that the existence of this manual made the development of an exercise template unnecessary.

BENEFITS

The benefits of this project will flow both to government and industry. The immediate beneficiary is the Queensland Department of Primary Industries with their staff gaining more experience in disease management and the areas for improvement in their emergency planning procedures identified and addressed. The benefits are a mix of those that are specific to the crayfish industry such as an awareness of industry practices and also generic benefits associated with emergency management practices. Medium term benefits will flow on to other industries based in Queensland through the enhanced performance and planning of the QDPI in the field of emergency management.

Short-term benefits will also accrue to the crayfish industry with members who participated in the exercises increasing their awareness of disease issues and management practices that can be used to minimise the possibility of disease introduction onto the farm and also control of disease if it does occur on their farm. The production of the farm level health plan will also assist producers who did not participate in the exercises. The "best practice" in farm management that was identified during the exercises and subsequently during development of the plan has been captured in the plan and this plan is available to all members of the QCFA.

Medium term benefits may also flow to the NSW Department of Fisheries. The observer from NSW-Fisheries who attended these

exercises has already contacted AFFA to negotiate the conduct of exercises in NSW.

FURTHER DEVELOPMENT

The exercises conducted during this project were part of an on-going series of simulation exercises designed to enhance the emergency response capability of States/Territories and industries. The conduct of future exercises will benefit from the lessons learned during the current exercises. The provision of funding through the Federal Government's budget initiative "*Building a National Approach to Animal and Plant Health*" will ensure that further exercises will be conducted and this training method refined through experience. Further exercises funded through this budget initiative should take account of the methods used in this exercise and adopt an approach of "continuous improvement" to ensure further development of the simulation exercise concept.

The farm level health plan should be considered as a "living document" and be revised on a regular basis in line with the latest research findings and the development of new management techniques.

This project was one component in the development of emergency management capacity in fisheries and aquaculture. Other components are detailed in AQUAPLAN – *Australia's National Strategic Plan for Aquatic Animal Health 1998-2003*. The completion of the "diagnostics" "manuals" and "training and simulations" components of the budget initiative through the FRDC Aquatic Animal Health Subprogram will ensure the further development of Australia's capability to respond effectively and efficiently to incursions of exotic disease in our aquaculture and fishing industries.

CONCLUSION

The outcomes of this project were:

- An enhanced awareness of emergency disease management techniques,
- An enhanced knowledge of the redclaw crayfish farming industry among QDPI staff,
- Improvements in the capability of the QDPI to manage disease incursions, and
- Development of a health management plan for redclaw farmers.

The objectives of the project were:

1. *To examine and test the skills and abilities of the participating staff in group problem solving and decision making skills.*

Prior to this exercise, decision making had been identified as an area that may require development in some QDPI staff. However, throughout both exercises, participants clearly demonstrated a cooperative approach to problem solving, and a practical solution or approach to a solution was identified for each problem. Those participants in a leadership role demonstrated their ability to effectively manage staff in an inclusive way. Despite the artificial time frame involved in a simulation exercise, participants were able to make decisions and plan actions within the limited time frame available during the exercise.

2. *To increase the participants' knowledge of the communication routes to be used in an emergency disease response by working through a scenario which mimics a real emergency situation.*

Approximately 50% of the participants had not previously participated in a simulation exercise or a real disease emergency incident. During the course of the exercise, the participants became familiar with the hierarchical organization of the Local Disease Control Centre, State Disease Control Centre and the Consultative Committee on Emergency Animal Disease. An understanding of this system included the need to provide regular reports to people such as the Minister, the State Chief Veterinary Officer (CVO) and the Commonwealth Chief Veterinary

Officer. Throughout the exercise, communications where managed by a special unit which included a trained media officer and an industry representative. The exercise called on this group to develop separate reports for the State CVO, the industry members and the media. This aspect of the exercise highlighted the need to provide appropriate and relevant information to different groups and was managed well by the personnel involved.

The participants also identified the need for a daily briefing or report for all staff members involved in the response so that team members were aware of the progress of the campaign and new developments. This daily briefing was included in the recommendations in the final report to the State CVO.

3. *To improve the participants' ability to manage tasks by prioritising a number of competing demands during the operational phase of the emergency response.*

The exercise was designed to include periods of time where each sub-group was given several tasks that needed to be prioritised and dealt with in order of importance. The design also included the opportunity to introduce new tasks or issues to the scenario if a particular sub-group was managing their tasks with ease. Another facet of the design was to force interactions between sub-groups with each sub-group needing to obtain information or resources from other sub-groups before they made decisions or developed plans. Throughout the exercise, the participants were, in general, able to differentiate between issues that were their responsibility and those that were not. Issues or tasks that needed to be dealt with by other groups were quickly transferred to the appropriate participants. Groups also identified issues that were the responsibility of an external group such as the State Disease Control Centre. Each group was clearly able to prioritise issues and deal with the critical issues immediately.

4. *To increase participants' understanding of the operational effects of specific requests to field staff operating at infected premises.*

One issue that came to the fore very quickly was the large number of staff needed to complete all the tasks associated with the field response to an emergency disease incursion. The participants took a realistic approach to this by determining the urgency of each task or request. The resources sub-group was also tasked with identifying sufficient staff to successfully conduct the emergency response. The inclusion of industry representatives in the Local Disease Control Centre provided the necessary expertise to determine the time, equipment and staff needed to complete particular parts of the response at the farm. The participation of producers in the second part of the exercise provided realistic input into the problem solving exercises and allowed the participants to develop some novel solutions to issues such as harvesting and destruction of infected stock.

5. *To familiarise participants with operating practices on a redclaw crayfish farm and to enhance the identification of methods of disease control applicable to this industry.*

The two days of the exercise that were conducted on operating farms were highly effective in familiarising QDPI staff with all aspects of crayfish farm operation. The need to develop practical solutions to real issues such as determining biomass in a pond, harvesting, transporting and destroying stock lead to the production of a farm level health plan that addresses many of these issues. The methods of disease control identified during the exercise have also been included in the AQUAVETPLAN Operational Procedures Manuals.

6. *To identify key issues for future development of emergency management in a range of subjects including planning, communication, staffing and resourcing.*

The exercises were highly successful in identifying areas of emergency planning that needed further development. A comprehensive list of

these issues was provided to the Queensland CVO in a confidential report. A copy of that confidential report was provided to the FRDC as an attachment to the third milestone report of this project.

APPENDIX 1 – INTELLECTUAL PROPERTY

The conduct of this project generated no intellectual property. A confidential report detailing suggested improvements to the emergency response procedures of the Queensland Department of Primary Industries was provided to the Queensland Chief Veterinary Officer, Dr Kevin Dunn.

As a result of these exercises, a farm level health plan for the Redclaw industry has been produced. The plan is a cooperative effort between AFFA, QDPI and QCFA and is freely available to all crayfish farmers. A copy of this plan is included at Appendix 3.

In the original project proposal, a template for the design and conduct of simulation exercises was identified as an output of this project. During the course of the project, the investigators became aware of a publication produced by Emergency Management Australia entitled "Managing Exercises" (Australian Emergency Manuals Series, Part V – The management of Training, Manual 2). This manual provides a detailed guide to the conduct of simulation exercises and parallels the approach used by the investigators of this project. After discussions with the FRDC Aquatic Animal Health Subprogram Leader, the requirement for the production of an exercise template was deleted from the project outputs and potential exercise planners are referred to the Emergency Management Australia manual for guidance and advice.

APPENDIX 2 - STAFF ENGAGED ON PROJECT

The Simulation exercise was designed and run by Iain East and Linda Walker of the Office of the Chief Veterinary Officer within Agriculture, Fisheries and Forestry - Australia.

The assistance of Tiina Hawkesford of the Queensland Department of Primary Industries in organising venues and participants for the simulation exercises is gratefully acknowledged.

Bill Keast and Dave Asher of the Queensland Crayfish Farmers' Association provided specialist assistance with information concerning the redclaw crayfish industry.

Rachel Bowater, Max Wingfield, Ross Lobegeiger and Millin Curtis of the Queensland Department of Primary Industries provided assistance in the drafting of the farm level health plan.

APPENDIX 3 – HEALTH PLAN FOR CRAYFISH FARMS

Health Plan for Crayfish Farms

February 25th 2002

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1. INTRODUCTION

This health management plan (HMP) is designed as a guide to crayfish farmers for on-farm management, with the aim of providing optimal health of their stock. The health of stock is critical because it affects growth and therefore, profitability. This is intended as a generic guide only, and producers will need to modify or adapt the plan according to their own particular property and set of circumstances.

This HMP is not intended to cover optimal design or construction of a crayfish farm. However, it should be realised that aspects of design and construction may well have an impact on the productivity, stress and susceptibility to disease on any given farm.

The development of a HMP for each individual farm is an important component of the normal day-to-day operation of an aquaculture farm. As such, development of a HMP tailored to your own farm is strongly recommended.

At all times, a farm must operate within the conditions associated with its aquaculture licence and other conditions set by the Local Authority, Environmental Protection Agency and any other relevant authorities.

2. NORMAL FARM OPERATIONS

A property should be well maintained and animals well cared for. Stress increases the susceptibility of all animals to disease, and therefore stress should be minimised at all times. This can be achieved by using appropriate stocking rates, the ready availability of appropriate habitat, and a high quality diet fed at correct rates, minimal handling and optimum water conditions.

Entry of predators to the farm should be prevented through the appropriate use of bird netting, solid perimeter fences and electric fencing. These devices not only prevent predation but also greatly reduce the chance of a predator introducing disease to the farm.

Health management involves many factors and is much easier on a well-designed and well-constructed farm. Sections 2.1 to 2.4 discuss ways to optimise farm siting, design and construction to minimise stress to the animals and the likelihood of disease.

2.1 Site Selection

When selecting a site to build or extend an aquaculture facility, the following conditions should be thoroughly investigated:

- Ensure the site has a suitable temperature range for culture of redclaw

- Ensure the soil, water & air are free of noxious agents
- Ensure the aquaculture facility is an adequate distance from any neighbouring aquaculture facilities
- Consider that local weather patterns may seriously influence day-to-day management and operational procedures (eg. cyclones, year round rainfall etc.)

2.2 Water Source

A constant supply of water of good quality is the single most important factor in the operation of an aquaculture facility. In assessing the potential of the water supply, the following factors must be addressed:

- Ensure the water source is clean and good quality
- Ensure you have a guaranteed year-round supply of high quality water, and you have back-up storage for times of adverse weather
- Ensure water is free of predators, parasites and noxious agents (or is appropriately screened or treated)
- Ensure water is not drawn from outlet water from a neighbouring aquaculture facility

2.2.1 Water type

Different sites will have access to different sources of water. In general, bore, well or spring water supplies are well regarded because they are usually disease and parasite free. However, bore water can sometimes be high in hydrogen sulphide (H_2S), which is toxic to crayfish. It is advisable to aerate bore water for at least 48 hours in a reservoir tank, prior to use, then test the water for H_2S levels, before use.

River, creek, dam water or water from a reservoir, should be tested for suitability, and filtered at the intake to prevent native crustaceans and other animals from entering the ponds via the water.

2.3 Farm / Hatchery Structures

In the design and construction of farm facilities, several points that will aid in disease prevention and/or management should be considered. These points should also be considered when purchasing replacement equipment:

- Design the farm as several physically separate subunits (ponds, tanks etc.) to reduce cross contamination
- Ensure the design of tanks and ponds allows complete drainage. Ensure that the aquaculture facilities (tanks, pond liners etc.) are non-toxic to crayfish and are suitable for aquaculture purposes
- Ensure the aquaculture facilities (tanks, pond liners etc.) are able to withstand cleaning processes and disinfectant chemicals
- Ensure pumps, aerators have back-up system generators for times of power failure, to prevent deterioration of water quality

2.4 Farm Records

All farms should keep farm records. It is important to record daily mortalities of crayfish in ponds, since patterns of mortalities can give clues as to the type of disease. It is also important to keep records on water quality and weather patterns, since changes in certain environmental parameters (eg temperature, dissolved oxygen etc.) can cause stress, and may trigger a disease outbreak.

Crayfish often show altered behaviour when sick or diseased. Such changes include lethargy, anorexia and aggregating at the pond edge.

A simple way of recording this information is by using a "farm diary". Alternatively, a special form or table can be drawn up for each pond/tank on the farm, where daily entries can be recorded. Records should include information on:

- water quality (dissolved oxygen, pH, ammonia, nitrite)
- weather patterns
- water exchanges
- daily feed intake
- stocking densities
- biomass
- movement of stock on the farm
- movement of stock from the farm
- disease events
- daily mortalities
- unusual behaviour
- treatments given

2.5 Introduction of Stock onto the Farm

Introduction of live crayfish onto your farm is a risk, since introduced stock may carry disease. Introduction of stock is one way in which disease can move to your farm, from another farm. If purchasing stock from a different farm, consider the following issues:

- Deal only with a reputable supplier of stock,
- Do not introduce suspect stock onto your farm,
- Ensure that the supplier has not had a history of disease on their farm,
- Inspect stock for visible signs of disease prior to purchase,
- Request a health examination of crayfish by a reputable veterinary laboratory prior to purchase,
- Introduce stock into a quarantine area of your farm and monitor daily for signs of disease or ill health. Keep the new stock separate for a minimum of two weeks,
- If a quarantine area is not available, stock a pond that is separated or furthest away from other stocked ponds on the farm. Do not

exchange water from that pond until you are satisfied with the health of the stock.

2.6 Water Quality Monitoring

Inadequate water quality can quickly lead to stress in crayfish, and this in turn can make the animals more susceptible to disease. The water quality should be monitored at least weekly to ensure all parameters (dissolved oxygen, ammonia, nitrite, pH and temperature) are within normal tolerable ranges for redclaw. It is very important that pH is checked after liming ponds, since lime can drastically alter the pH of the water.
In particular, it is important to regularly monitor the dissolved oxygen content to ensure aeration is adequate in each pond/tank to provide sufficient dissolved oxygen. The dissolved oxygen content of the pond varies naturally throughout the day and night so the dissolved oxygen content should be checked at a consistent time of day. In general, the dissolved oxygen content is lowest in the early morning, increases throughout the day and decreases throughout the night.

2.7 Nutrition

Ensure the feed is purchased from a reputable supplier, is of high quality and is fresh. Store the feed correctly, in airtight bags in a cool room at 5^{0}C or freezer, to prevent degradation. Feed stored in sheds at ambient air temperature and/or exposed to high humidity and sunlight in the tropics will rapidly degrade in quality. Important points to note when feeding are to:

- Ensure adequate supplies at all times,
- Record and monitor feeding rates daily (use feed trays, and check them after each feed),
- Do not overfeed, as this causes accumulation of waste/organic loads in ponds
- Feed rations that are appropriate for the age and reproductive state of the crayfish.

2.8 Staff Movements

Disease organisms can be easily transported around a farm on equipment or clothing. The possibility of this occurring can be minimised by ensuring that:

- Staff work from youngest animals to the oldest animals each day, or have separate work teams for the different age classes on the farm (if possible),
- Farm workers disinfect footwear and hands when moving from one area of the farm to another, and also at the end of each day. This

should always be done before moving from ponds where newly purchased stock are quarantined to other areas of the farm
- Clothing, particularly footwear should be left at the farm and not taken from home to work.
- Vehicles, equipment and clothing should not be taken from one farm to another.

2.9 Animal Handling

Animal welfare is not only a "social issue". Inappropriate handling or treatment can increase stress levels in the animals that in turn can have adverse impacts on resistance to disease, growth and breeding success. To minimise stress in animals, the following guidelines should be observed:

- Minimise the frequency of handling,
- Minimise the time animals are out of the water,
- Minimise the number of procedures done at any one time,
- Use low-stress, non-traumatic handling procedures,
- Avoid or minimize pain, distress and suffering of the animals.

2.10 Health Monitoring

Health monitoring is a vital component of the farm records (see section 2.4). It is much easier to detect sick animals if the producer is familiar with the appearance and behaviour of healthy stock. Regular inspection of stock will allow early detection of any changes in appearance, growth or behaviour. Health monitoring should include:

- Monitoring of the health of stock at regular intervals (at least once a week). Trapped stock should be visibly inspected for size, colour, growths on shell and any other visible abnormalities.
- Recording of all introductions and disposal of aquatic animals,
- Recording of all mortalities and/or disease outbreaks,
- Regular measurement and recording of growth rates,
- Recording of any unusual behaviour (crayfish at the pond edge, anorexia, lethargy).

Each farm should keep specimen transport boxes, dissection equipment, and preservative on hand for collection, preservation and transport of crayfish to the Veterinary Laboratory for disease diagnosis. Advice should be sought from the laboratory before any samples are collected and dispatched. Sampling kits are available from QDPI laboratories (contact: Rachel Bowater 07-4722 2692).

2.11 Hygiene

Establishment of standard hygiene practices will assist greatly in the prevention of disease on the farm. Standard practices should include:

- Holding tanks should be disinfected with chlorine between batches,
- Ponds should be disinfected after each harvest, crack-dried and limed before refilling (see Section 2.11.2 Preparing the Pond),
- Equipment should be allocated to each area of the farm. It must be cleaned and disinfected before it is used in another area of the farm (to prevent transfer of infection) (see Section 3.4 Disinfection),
- Any sick crayfish that come to the surface or edges of the pond must be collected daily from ponds, recorded, and then disposed of appropriately (see Section 3.3 Disposal),
- Visitors to the farm should disinfect footwear and hands before entering the farm. Keeping several pairs of boots for the use of visitors will help prevent the introduction of disease.

2.11.1 Habitat and equipment

Habitat and equipment have the potential to move disease between ponds. Habitat that holds sediment and/or water is a particular threat. To avoid transfer of disease, adopt the following practices:

- Ensure all habitat (tyres, pipes) to be used in ponds and all equipment (aerators, nets, buckets, bait traps) is free of sediment and soil. Clean with a high pressure hose or by thoroughly scrubbing and then disinfect before and after use in a pond (see Section 3.4 Disinfection),
- Ensure that all equipment used is in good working order (check regularly),
- Do not move equipment (buckets, nets, aerators, bait traps etc.) or habitat from one farm area to another before disinfecting it,
- Do not move equipment or habitat from one farm to another before it is scrubbed clean and then disinfected.

2.11.2 Preparing the pond

If a pond contains a disease organism when stocked, there is little that can be done to prevent infection of the stock. Therefore, if a pond is known to be infected, or to minimise the risk of disease organisms being present in a pond prior to stocking, the following procedure should be adopted:

- The pond should first be drained. Prior to drainage, water should have been disinfected with chlorine (at 10 ppm for 24 to 48 hours), then dechlorinated (see section 3.4.1 Treatment of water prior to discharge),
- The pond should be free of any crayfish, crustaceans or other dead animals. Any dead crayfish remaining from a previous harvest should be removed and disposed of appropriately (see Section 3.3 Destruction of Stock),
- Organic material that has accumulated on the pond bottom should be removed. If there is an excessive amount, it can be removed by a long reach excavator or other suitable method,

- The pond should be sun dried, until the clay pans and cracks (cracks approximately 20 mm deep develop on the pond bottom),
- Apply slaked lime (calcium hydroxide) evenly across the pond bottom and walls at a rate of 150g/ m^2 (equivalent to 1.5 tonnes/ha),
- Clean water should be pumped into the pond to cover the pond bottom to a depth of at least 30cm. This water should sit for 24 hrs in the pond and then drained. Pond walls should be sprayed with clean water to moisten the walls.
- The pond should then be dried out for at least 2 weeks,
- After filling, allow the ponds to sit for several days before stocking.

Lime will minimise the survival of any microorganisms in the soil. Lime will also have an impact on the pH of the soil, and the water once the pond is filled. Lime is harmful to human skin, eyes, nose and lungs, Protective clothing, boots, glasses and a facemask should be worn to prevent contact of this chemical with the skin and mucous membranes, when applying lime to ponds.

3. DISEASE OUTBREAK PROCEDURES

The response to a disease outbreak is your responsibility. The first action recommended in the event of a suspected disease outbreak is to contact a Veterinary Officer of the Queensland Department of Primary Industries (QDPI) for advice. The conditions of your aquaculture licence also require that the fisheries group of QDPI be notified in the event of a disease outbreak. The QDPI will advise you of actions to be taken.

3.1 Procedures to be Followed

At the first sign of disease, ensure the following steps are taken. These will include:

- Alert the farm manager of a disease problem,
- Confirm the presence of disease by obtaining a diagnosis from a reputable Veterinary Laboratory,
- Implement quarantine procedures for the affected pond(s) (see Section 3.1.2),
- Implement staff movement protocols (see Section 3.1.1),
- Implement water quality treatment and disinfection protocols as necessary (see Section 3.5),
- Implement plans to isolate the disease, so as to stop the spread of disease both within the farm, to the environment, and to other farms (see 3.1.2 below),
- Ensure equipment is available for use only in the diseased pond(s), and confine this equipment to the infected area only.

3.1.1 Staff movement protocols

In the event of a disease incident, routine farm work will still need to be completed. To prevent the spread of disease to uninfected areas of the farm, the following practices should be adopted:

- Complete work on clean ponds first and work on diseased ponds last, so as to minimise spread of disease,
- Farm workers should disinfect boots and hands when moving from the infected pond to any other part of the farm

3.1.2 General quarantine measures

Please note that these are general principles only. Many will only apply if an infectious disease has been diagnosed on your farm. A QDPI Veterinary Officer will advise you of steps that need to be taken. The steps to be taken will depend upon the disease that is present. Some actions will be necessary to prevent the spread of disease to other farms. These include:

- Do not visit other farms unless absolutely necessary. Warn other farmers of the disease on your property before visiting,
- Do not take a vehicle from an infected farm onto another farm (park at the gate if necessary),
- Change clothes and ensure footwear and hands are disinfected before visiting another farm,
- Do not move infected stock off the farm,
- Do not sell infected/diseased crayfish to another farmer,
- Do not sell apparently healthy crayfish to other farmers if you suspect a disease until cleared by a QDPI officer,
- Do not move equipment from an infected pond off the farm.

Within the infected farm, additional action will be required. This includes:

- Remove dead animals that have come to the surface or edges of the infected pond(s) daily and dispose of appropriately (see Section 3.3 Destruction of Stock),
- ensure footbaths are set up next to pond,
- In a closed recirculation system, do not recirculate water from an infected pond to unaffected ponds,
- Do not discharge water from an infected pond(s) into a local waterway without prior disinfection (see section 3.4.1),
- Ensure predator exclusion devices are intact (electric fence, bird nets, perimeter fences etc) to reduce risk of infection spreading the disease from pond to pond.
- Exclude farm animals such as pets and sheep from the pond area.

3.2 Harvest

During a disease outbreak, harvesting of diseased stock may become necessary. It is best, where possible to use standard harvesting

practices because the equipment will be available and farm staff will be familiar with procedures. During a disease outbreak, several additional requirements will also be necessary. These are:

- If the level of a pond needs to be lowered prior to using a flow trap, ensure that the drained water is moved to an empty pond,
- If a pump or siphon is used to drain water, ensure that the pump and any pipes are disinfected after use,
- Use the flow trap in the usual fashion and allow enough time to remove all the crayfish. The crayfish should be packed into waterproof boxes with lids prior to removal from the pond side.

3.3 Destruction of Stock

During some disease outbreaks, it may be necessary to destroy stock to control the disease. In all disease outbreaks, clinically infected and moribund stock will need to be destroyed. It is important to ensure the welfare of the animals at all times and to avoid or minimize pain, distress or suffering.

Crayfish can be humanely euthanased by placing in a -20° C freezer for 24 hours. After this, the crayfish can then be disposed of by incineration or burial (seek Veterinary advice).

3.4 Disinfection

3.4.1Treatment of water prior to discharge

Water from an infected pond should be pumped into a settlement/discharge pond to allow any suspended material in the pond to settle for 2-3 days. Water can then be treated with chlorine to a final concentration of 30-ppm active chlorine. Ponds with a higher level of turbidity or organic matter may need additional chlorine. The chlorine content of the discharge pond can be checked with a chlorine monitor or a chlorine test kit (available at most swimming pool suppliers) and should stay above 30 ppm for a minimum of 24 hr. Once the chlorine level has fallen below detectable limits, the water may be safely discharged or moved to a non-secure location. Aeration of the pond will assist with chlorine removal, if necessary.

3.4.2 Disinfection of habitat and farm equipment

The type of disinfection and degree to which disinfection should be carried out will depend upon the type of disease, and Veterinary advice should be sought.

All farm equipment (buckets, nets, aerators, bait traps) that has been in contact with infectious organisms should be disinfected by firstly scrubbing the equipment to remove organic debris, then immersion in a 50-ppm chlorine solution for 60 minutes.

Habitat should be removed from the pond and placed in a location near the pond where draining water will not threaten unaffected stock. The habitat should be first cleaned with a high-powered hose and scrubbed down so it is free of organic debris. It should then be disinfected by immersion in a 50-ppm chlorine solution for 60minutes. Exposure to sunlight whilst the pond is dry will also assist destruction of pathogenic organisms.