Health Maintenance and Monitoring

For aquaculture species with mature technologies, the major constraints in production are usually related to health maintenance, disease occurrence, and product quality. These issues are inter-related, especially if disease prevention or control implements have long-term effects on the environment or produce residues that make products unacceptable for consumption. Although Fish Health is a relatively young discipline, numerous publications are already available for reference. One of the best references that discuss about disease, health, monitoring and surveillance is the Survey Toolbox for Aquatic Animal Diseases. Most of the information in this section is derived from various sections of that book.

Health and Disease

Disease is usually defined as any abnormality of structure or function. This means that whenever there is something abnormal about the animal, we can consider it to be a disease.

Health is simply the normal state of an animal, or the absence of disease. Determining if an animal is healthy or not does not just mean that we have to identify some physical abnormality or a disease agent. The level of production can be an indicator of whether an animal is healthy or diseased. Measures of production to indicate health status can be very useful.

Ensuring good farm production and animal health starts at the planning stage of every aquaculture venture. At each step of planning and production, questions and answers should be anticipated on how to decrease the possibility of pathogen entry and environmental contamination. These considerations include the following:

- Selection of a production site
- Selection of water source
- Water quality management and control
- Maintenance of various life stages
- Feed quality and feeding practices
- Fish health management
- Proper use of chemicals and veterinary drugs
- Proper sanitation
- Harvesting, holding and transport
- Detailed record keeping

Sources of Infection

Different measures are needed to maintain cleanliness and hygiene within culture premises. Prevention and control measures for specific diseases are discussed in the sections on Diseases in Eggs and Larvae, and in Diseases in Juveniles and Adults. The Appendices section also contains specific methods for disinfection and identification of sources of infection.

Hatchery Facilities. Maintenance of hygiene in the hatchery can be done simply by disinfecting with chlorine all facilities (reservoir, larval rearing tanks, algal tanks, rotifer tanks, *Artemia* tanks, etc.) and materials (nets, hoses, pails and other paraphernalia). A well-designed hatchery should have a disposal system for contaminated effluents to prevent contact with natural bodies of water. If a broodstock facility is incorporated in the design, this should be separated from larval rearing facilities since it is well-known that broodstock harbor and transmit various infectious diseases. Precautionary measures such as provision of footbaths at entrance and exits of production buildings are effective measures to prevent diseases.

Animals. Any stage of live animals for culture that is brought into new sites or aquaculture facilities may carry with it associated microorganisms, including those that cause diseases. Therefore, disinfection and quarantine are carried out to avoid introduction of new and exotic pathogens. Guidelines and protocols regarding introductions are discussed in various manuals and agreed-upon Codes of Practices for prevention and spread of diseases.

Natural food. Hatchery technicians should ensure that their phytoplankton and zooplankton cultures are free of contaminants such as saprophytic protozoans that may become nuisance during culture. The bacterial populations associated with *Brachionus* and *Artemia* can be checked for harmful and opportunistic pathogens through microbial culture. Microbial load of natural food can also be reduced by rinsing them in clean seawater before feeding.

Artificial feeds should be stored properly under refrigeration or in well-ventilated rooms to avoid rancidity or fungal growth resulting in toxic by-products.

Regular Record Keeping

Individual experiences in hatchery and farm operation build up information on acceptable survival and growth rates. However, careful monitoring and record keeping provide data on most profitable operational protocols that result in highest production possible. Records of water quality, stocking rate and date, daily feeding quantities, water management schemes, harvesting dates and quantities, etc. provide a picture of how each culture unit performs under a certain management regime. The accumulated information, if properly analyzed, can be the linked with production rates and become the basis for optimized and profitable operations in the hatchery and farm.

The survival and growth rate of each population depends on factors like stocking density, predation, feed, temperature and other site-specific and farmer-specific aspects. One way to increase the predictability of production outcomes is by monitoring the health status of animals. Carefully analyzed records of the presence of morphological deformities or of indicator microorganisms can generally prevent sudden mass kills. The records also enable farmers to investigate the causes of low level mortality over a period of time.

Disease Monitoring and Sampling

Data obtained from frequent and regular monitoring of farmed animals has predictive value if the examinations are based on a good number of samples. Diseases or characteristics to evaluate during a microscopic examination of larvae may include the following:

- Larval stage
- Presence and severity of microbial fouling and infection
- Presence of shell necrosis
- Presence of missing appendages or body parts, and abdominal or appendage deformities
- Gut fullness
- Discoloration of larvae

The above observations can be recorded in the sample form (Fig. 1). Diseases and abnormalities that affect cultured crabs are presented in Section III.

EGG/LARVAL MONITORING FORM

Tank No.:_____ **Sampling Time:**_____ **Date:** _____
Source: _____ **Larval Stage:**_____ **Species:** _____

Findings	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Filamentous bacteria																				
Fungi																				
Protozoa: Vorticella																				
Zoothamnium																				
Others																				
Nematodes																				
Necrotic tissues																				
Shell disease																				
Incomplete molting																				
Empty gut																				
Weak																				
Dead																				
Others																				

Comments: _____

Fig. 1. Sample form to record observations during daily monitoring of eggs and larvae of crabs

In aquatic culture systems, it is difficult to determined the exact number of animals in the population because of their small size at the larval stages and because they are swimming in the water column. Obtaining the representative number and kind of samples for monitoring purposes is difficult. Sampling is the process of selecting this group from the population. Each member of the sample will be examined and the results are used to generate a picture of the status of the entire population from which the sample was drawn.

For routine examination to determine the condition of hatchery-reared crab larvae, the recommended sample size for daily monitoring follows:

Larval Population	Sample Size (Number of Larvae)
1,000 to 199,000	20
200,000 to 399,000	40
400,000 to 599,000	60
600,000 to 799,000	80
800,000 up	100

However, when disease is suspected in the population, a different sampling guideline and sample number should be used. Below are the sample sizes based on assumed pathogen prevalence in the population.

Population size	Sample Size		
	at 2% prevalence	at 5% prevalence	at 10% prevalence
50	50	35	20
100	75	45	23
250	110	50	25
500	130	55	26
1,000	140	55	27
1,500	140	55	27
2,000	145	60	27
4,000	145	60	27
10,000	145	60	27
10,000 or more	150	60	30

Therefore, in a population of 10,000 crab larvae in one rearing tank where a serious disease caused by an infectious organism is assumed to occur at 5% prevalence, the sample to be obtained should be 60 larvae. In cases where the assumed disease prevalence is unknown, it is best to obtain and examine the maximum number of sample recommended.

Levels of Diagnosis

The Asia Diagnostic Guide provides guide for the pathogens and diseases listed in the NACA/FAO/OIE Quarterly Aquatic Animal Disease Reporting System. It was developed from a large amount of technical contribution from aquatic animal health scientists in the Asia-Pacific region who supported the regional programme. The Asia Diagnostic Guide could be effectively used for both farm and laboratory level diagnosis in the region. It complements the Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals. It also assists countries in expanding national and regional aquatic animal health diagnostic capabilities to meet the requirements in the International Aquatic Animal Code and the Diagnostic Manual for Aquatic Animal Diseases of the Office International des Epizooties (OIE).

Definition of levels of diagnosis

Level I : Diagnostic activity includes observation of animal and the environment and clinical examination (Diagnosis site: Field);

Level II: Diagnostic activity includes parasitology, bacteriology, mycology, and histopathology (Diagnosis site: Laboratory);

Level III: Diagnostic activity includes virology, electron microscopy, molecular biology and immunology (Diagnosis site: Laboratory).

Sending Samples for Diagnosis

Farm site diagnosis is very important in order to gather information about diseases, especially for emerging problems caused by infectious microorganisms. Strong disease recognition capability at Level I, coupled with more understanding about the course of disease after Level II and III diagnoses, will fast-track our understanding of disease problems affecting aquatic animals. Recognizing the limited facilities for laboratory diagnosis, it is very important for farmers and technicians to know where samples can be sent. Based on the recommended number of representative samples, good quality specimens can be submitted. Farmers and technicians should know where to contact fishery officers and laboratories near their culture sites so that disease outbreaks can readily be reported and investigated.

Sample preparation, fixation, packing and submission are in Appendix 1. Formulae of fixatives and fixation procedures are in Appendix 2.

References

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Web-based Resources

http://aquanic.org/publicat/state/il-in/as-503.htm = Fish Farmer's Guide to Understanding Water Quality can be downloaded from this site

http://aquanic.org/publicat/usda_rac/tr/ctsa/mangro95.pdf = This site contains a document by the Center for Tropical and Subtropical Aquaculture (CTSA) entitled "Mangrove Crab as a Model for Development of a Quarantine System to Screen Species for Aquaculture in Guam"

www.oie.int, specifically at http://www.oie.int/eng/normes/fmanual/A_00046.htm

www.fao.org/docrep/003/w7499e/w7499e23.htm = link to a document on developments and issues in fish health, application of chemicals in aquaculture and quarantine

http://www.fao.org/DOCREP/005/X8485E/x8485e06.htm = this site provides a link to the "Beijing Consensus and Implementation Strategy"

http://www.seafdec.org.ph/information/publication.html = link to the website of SEAFDEC Aquaculture Department that provides free downloads of information materials and proceedings of meetings

http://www.dpi.qld.gov.au/thematiclists/14515.html and http://www.dpi.qld.gov.au/thematiclists/14527.html = these links to the Department of Primary Industries and Fisheries of the Queensland Government, Australia with information about submitting samples for laboratory examination and crab culture

http://www.enaca.org/modules/mydownloads/singlefile.php?cid=23&lid=52 = This is the download site of the Asia Diagnostic Guide to Aquatic Animal Diseases or 'Asia Diagnostic Guide'