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Asia Diagnostic Guide to Aquatic Animal Diseases

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NETWORK OF
AQUACULTURE
CENTRES
IN ASIA-PACIFIC



Food
and
Agriculture
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of
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United
Nations



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PREPARATION OF THIS DOCUMENT

The **Asia Diagnostic Guide to Aquatic Animal Diseases** or '**Asia Diagnostic Guide**' is a comprehensive, up-datable diagnostic guide in support of the implementation of the **Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals** or '**Technical Guidelines**'. It was developed from technical contributions of members of the Regional Working Group (RWG) and Technical Support Services (TSS) and other aquatic animal health scientists in the Asia-Pacific region and outside who supported the Asia-Pacific Regional Aquatic Animal Health Management Programme. The *Asia Diagnostic Guide* is a third of a series of FAO Fisheries Technical Papers developed as part of an **FAO Technical Co-operation Project – Assistance for the Responsible Movement of Live Aquatic Animals** – implemented by NACA, in collaboration with OIE and several other national and regional agencies and organizations. The *Technical Guidelines* and the associated Beijing Consensus and Implementation Strategy (BCIS) was published as first (FAO Fisheries Technical Paper 402) of the series. The **Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals** or '**Manual of Procedures**', which provides background material and detailed technical procedures to assist countries and territories in the Asia-Pacific region in implementing the *Technical Guidelines* was the second of the series (FAO Fisheries Technical Paper 402, Supplement 1). The *Asia Diagnostic Guide* (FAO Fisheries Technical Paper 402, Supplement 2) is published as the third document of the series. All of the above-mentioned documents, developed in a highly consultative process over a period of three years (1998-2001) of consensus building and awareness raising, are in concordance with the **OIE International Aquatic Animal Code (Third Edition)** and the **OIE Diagnostic Manual for Aquatic Animal Diseases (Third Edition)** and the **WTO's Sanitary and Phytosanitary Agreement (SPS)** and in support of relevant provisions of **FAO's Code of Conduct for Responsible Fisheries (CCRF)**.

Distribution

Aquatic animal health personnel
FAO Fishery Regional and Sub-Regional Officers
FAO Fisheries Department
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Cover page: Representation of relationship between host, pathogen and the environment in disease development.

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Asia Diagnostic Guide to Aquatic Animal Diseases.
FAO Fisheries Technical Paper No. 402, Supplement 2. Rome, FAO. 2001. 240 p.

ABSTRACT

The Asia Diagnostic Guide to Aquatic Animal Diseases or '*Asia Diagnostic Guide*' is a comprehensive, up-datable diagnostic guide for the pathogens and diseases listed in the NACA/FAO/OIE Quarterly Aquatic Animal Disease Reporting System including a number of other diseases which are significant in the Asia region. It was developed from technical contributions of members of the Regional Working Group (RWG) and Technical Support Services (TSS) and other aquatic animal health scientists in the Asia-Pacific region who supported the Asia-Pacific Regional Aquatic Animal Health Management Programme. The objective was to produce an Asia diagnostic guide, that could be of specific use in the region, for both farm and laboratory level diagnostics, to complement the Manual of Procedures for the implementation of the "Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals". This Asia Diagnostic Guide could then be used to expand national and regional aquatic animal health diagnostic capabilities that will assist countries in upgrading technical capacities to meet the requirements in the OIE International Aquatic Animal Code (Third Edition) and the OIE Diagnostic Manual for Aquatic Animal Diseases (Third Edition) and WTO's Sanitary and Phytosanitary Agreement (SPS), and in support of relevant provisions in the FAO's Code of Conduct for Responsible Fisheries. The information in the *Asia Diagnostic Guide* is presented in a format that spans from gross observations at the pond or farm site (Level 1), to guidance for information on technologically advanced molecular or ultrastructural diagnostics and laboratory analyses (Levels II and III, and OIE aquatic animal health standards), thus, taking into account international, regional, and national variations in disease concerns, as well as varying levels of diagnostic capability between countries of the Asia-Pacific region.

(Key Words: Asia, Aquaculture, Diagnostics, Health Management, Aquatic Animal Diseases, Guidelines, Disease Reporting)

PREFACE

The Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres in Asia-Pacific (NACA) are pleased to present this document entitled *Asia Diagnostic Guide to Aquatic Animal Diseases or 'Asia Diagnostic Guide'*. The *Asia Diagnostic Guide* is the third and last of a series of FAO Fisheries Technical Papers (FAO Fish. Tech. Pap. No. 402 and 402 Supplement 1), which was developed by representatives from 21 Asian governments, scientists and experts on aquatic animal health, as well as by representatives from several national, regional and international agencies and organizations. The *Asia Diagnostic Guide* provides valuable diagnostic guidance for implementing the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* and their associated implementation plan, the *Beijing Consensus and Implementation Strategy (BCIS)* (see FAO Fish. Tech. Pap. No. 402). It also complements the *Manual of Procedures* for implementing the *Technical Guidelines* (see FAO Fish. Tech. Pap. No. 402, Supplement 1). The entire series is meant for assisting national and regional efforts in reducing the risks of diseases due to trans-boundary movement (introduction and transfer) of live aquatic animals. The implementation of the *Technical Guidelines* will contribute to securing and increasing income of aquaculturists in Asia by minimizing the disease risks associated with trans-boundary movement of aquatic animal pathogens. In many countries in Asia, aquaculture and capture fisheries provide a mainstay of rural food security and livelihoods, and effective implementation of the *Technical Guidelines* will contribute to regional efforts to improve rural livelihoods, within the broader framework of responsible management, environmental sustainability and protection of aquatic biodiversity.

An FAO Technical Co-operation Programme (TCP) Project (TCP/RAS 6714 (A) and 9065 (A) - "Assistance for the Responsible Movement of Live Aquatic Animals") was launched by NACA in 1998, with the participation of 21 countries from throughout the region. This program complemented FAO's efforts in assisting member countries to implement the relevant provisions in Article 9 - Aquaculture Development - of the *Code of Conduct for Responsible Fisheries (CCRF)*, at both the national and regional levels. A set of Guiding Principles, formulated by a group of aquatic animal health experts at the Regional Workshop held in 1996 in Bangkok, formed the basis for an extensive

consultative process, between 1998-2000, involving input from government-designated National Co-ordinators (NCs), NACA, FAO, OIE, and regional and international specialists. Based on reports from these workshops, as well as inter-sessional activities co-ordinated by FAO and NACA, the final *Technical Guidelines* were presented and discussed at the Final Project Workshop on Asia Regional Health Management for the Responsible Trans-boundary Movement of Live Aquatic Animals, held in Beijing, China, 27th-30th June 2000.

The *Technical Guidelines* were reviewed and discussed by the participants of this meeting, which included the NCs, FAO, NACA, OIE (Representatives of the Fish Disease Commission and Regional Representation in Tokyo), and many regional and international aquatic animal health management specialists. The NCs gave unanimous agreement and endorsement of the *Technical Guidelines*, in principle, as providing valuable guidance for national and regional efforts in reducing the risks of disease due to the trans-boundary movement of live aquatic animals.

Recognizing the crucial importance of implementation of the *Technical Guidelines*, the participants prepared a detailed implementation strategy, the *Beijing Consensus and Implementation Strategy (BCIS)*, focussing on National Strategies and with support through regional and international co-operation. This comprehensive implementation strategy was unanimously adopted by the workshop participants.

The countries that participated in the development of the *Technical Guidelines* and *BCIS*, and the associated *Manual of Procedures* and *Asia Diagnostic Guide* are Australia, Bangladesh, Cambodia, China P.R., Hong Kong China, India, Indonesia, Iran, Japan, Korea (D.P.R.), Korea (R.O.), Lao (P.D.R.), Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, Thailand and Vietnam.

PREFACE

FAO and NACA extend special thanks to all the governments, agencies, and organizations that took part in this significant, and sometimes daunting endeavor, as well as to all the individuals who generously contributed time, effort and expertise to the compilation of this document and other information produced during the process.

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FOREWORD

Movement of live aquatic animals is a necessity for development of aquaculture on both subsistence and commercial levels. However, such movements increase the probability of introducing new pathogens, which can have dire consequences on aquaculture, capture fisheries and related resources, as well as the livelihoods which depend on them. In order to minimize or avoid the risk of pathogen transfer via aquatic animal movements, it is essential that the individuals and organizations involved in such activities appreciate, and participate in, the overall health management process.

The adverse social, economic and environmental impacts that have resulted from the irresponsible or ill-considered movement of live aquatic animals and their products have led to global recognition of the need for health management protocols to protect aquaculture, fisheries resources and the aquatic environment. In many cases, these impacts have been a direct result of the absence of effective national and regional health management strategies. However, formulation of effective quarantine measures, health certification and guidelines applicable on an international scale is complicated. A wide range of social, economic and environmental circumstances have to be considered, along with the range of aquatic animal species involved and their pathogens and diseases. In addition, differing reasons for moving live aquatic animals and products impose a further set of variables to the process. Nevertheless, the serious impacts of unrestricted regional and international movement of aquatic animals merit international recognition - a fact clearly reflected in the *International Aquatic Animal Health Code* and the *Diagnostic Manual of Aquatic Animal Diseases* of the Office International des Epizooties¹, which provide guidelines and recommendations for reducing the risk of spreading specific pathogens considered relevant to international trade of aquatic animals.

Since present international protocols are not always applicable to the disease concerns of aquatic food production and trade in the Asia Region, the need for effective health management protocols that focus on the species and disease problems of this region has been recognized for many years. A regional, as opposed to national, approach is considered appropri-

ate, since many countries in the region share social, economic, industrial, environmental, biological and geographical characteristics. Many countries also share waterbodies with neighbours and the watersheds of several major Asian rivers transcend national boundaries. A regionally adopted health management program will facilitate trade, and protect aquatic production (subsistence and commercial) and the environment upon which they depend, from preventable disease incursions.

A joint FAO/NACA Asia-Regional Programme on Aquatic Animal Health Management was undertaken to review the need for better health management to support safe movement of live aquatic animals and the applicability of existing international codes on aquatic animal health management, quarantine and health certification, including those of the OIE, the European Inland Fisheries Advisory Commission (EIFAC), and the International Council for Exploration of the Sea (ICES) to Asian circumstances. This review² highlighted the fact that the disease risks associated with pathogen transfer in the Asia Region can only be reduced through a broader approach to aquatic animal health management than currently outlined in disease-specific codes of practice (e.g., the OIE code) or in codes and protocols developed specifically for northern hemisphere countries (e.g., the ICES and EIFAC codes). In addition, it underlined the need for pre-border (exporter), border and post-border (importer) involvement in the program, to ensure co-operative health management of aquatic animal movement. With the support of an FAO Technical Co-operation Programme (TCP) implemented by NACA, the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* is a document that was compiled by a group of aquatic animal health experts within and outside the region to assist the development of effective health management procedures for safe movement of live aquatic animals within and between countries in the region. The first companion document, the *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals*, provides background material and detailed technical procedures to assist countries and territories in the

¹ see OIE. 2000a. *International Aquatic Animal Health Code*. 3rd edn. Office International des Epizooties, Paris, 153 p.; and OIE. 2000b. *Diagnostic Manual for Aquatic Animal Diseases*. 3rd edn, Office International des Epizooties, Paris, 237 p.

² see Humphrey, J.D., J.R. Arthur, R.P. Subasinghe and M.J. Phillips. 1997. *Aquatic Animal Quarantine and Health Certification in Asia. Proceedings of the Regional Workshop on Health and Quarantine Guidelines for the Responsible Movement (Introduction and Transfer of Aquatic Organisms)*, Bangkok Thailand, 28 January 1996. FAO Fish. Techn. Pap. No. 373, 153 p.

FOREWORD

Asia Region in implementing the *Technical Guidelines*. This second companion document, *Asia Diagnostic Guide*, provides valuable diagnostic guidance for implementing the *Technical Guidelines* and also complementary to the *Manual of Procedures*.

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³ The contact addresses and e-mail of persons listed are indicated elsewhere in the Asia Diagnostic Guide.

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The Editors

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GLOSSARY¹

Abscess	an aggregation of haemocytes (blood cells) associated with necrotic (decaying) host cells. Abscesses may or may not contain debris from invasive organisms which have been killed by host defences. In advanced abscesses there is a decrease in cell definition (especially the nuclei) towards the centre of the lesion, compared to cells around the periphery. Abscesses frequently involve breakdown of epithelial linings and may be surrounded by phagocytic and/or fibrocytic haemocytes.
Abiotic factors	physical factors which affect the development/survival of an organism
Acquired immunity	defence response developed following recovery from an infection (or vaccination) to a specific infectious agent (or group of agents)
Acute	infection or clinical manifestation of disease which occurs over a short period of time (cf 'Chronic')
Adhesion	(Crustacea) binding of subcuticular tissues to the cuticle due to destruction of the cuticle by chitinolytic bacteria or fungi. This may impede moulting.
Aetiologic Agent (Etiologic)	the primary organism responsible for changes in host animal, leading to disease
Aetiology (Etiology)	the study of the cause of disease, including the factors which enhance transmission and infectivity of the aetiologic agent.
Alevins	fry of certain species of fish, particularly trout and salmonids that still have the yolk-sac attached
Anaemia	(Vertebrate) a deficiency in blood or of red blood cells
Anorexia	loss of appetite
Antennal gland	(Crustacea) excretory pores at the base of the antennae (also known as kidney gland, excretory organ and green gland)
Antibody (Ab)	a protein capable of cross-reacting with an antigen. In vertebrates, antibody is produced by lymphoid cells in response to antigens. The mechanism of antibody production in shellfish is not known.
Antigen	a substance or cell that elicits an immune reaction. An antigen may have several epitopes (surface molecules) to which antibody can bind (cf Monoclonal and Polyclonal Antibodies).
Aquatic animals	live fish, molluscs and crustaceans, including their reproductive products, fertilised eggs, embryos and juvenile stages, whether from aquaculture sites or from the wild
Aquaculture	commonly termed "fish farming", it refers more broadly to the commercial hatching and rearing of marine and freshwater aquatic animals and plants
Ascites	accumulation of serous fluid in the abdominal cavity; dropsy
Aseptic	free from infection; sterile

¹ Definitions of words with * were adopted from OIE International Aquatic Animal Health Code, 3rd Edition, 2000. All other definitions were taken from the following references: FAO/NACA (2000); Dorland's Illustrated Medical Dictionary (27th Edition); "Virology Glossary" copyright 1995 by Carlton Hogan and University of Minnesota (permission to copy and distribute granted to individuals and non-profit groups <http://www.virology.net/ATVG:ossary.html>); On-line Medical Dictionary at <http://www.graylab.ac.uk/omd/index.html>.

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Atrophy	decrease in amount of tissue, or size of an organ, after normal growth has been achieved
Autolysis(-lytic)	enzyme induced rupture of cell membranes, either as a normal function of cell replacement or due to infection
Avirulent	an infection which causes negligible or no pathology (cf Virulent).
Axenic culture	culture containing cells of a single species (bacterial culture) or cell-type (tissue culture) (uncontaminated or purified)
Bacteriology	science that deals with the study of bacteria
Bacteriophage	(abbreviation - Phage) any virus that infects bacteria
Bacterium	(bacteria) unicellular prokaryotic (nuclear material not contained within a nucleus) microorganisms that multiply by cell division (fission), typically have a cell wall; may be aerobic or anaerobic, motile or non-motile, free-living, saprophytic or pathogenic
Basophilic	acidic cell and tissue components staining readily with basic dyes (<i>i.e.</i> hematoxylin); chromatin and some secretory products in stained cells appear blue to purple
Bioassay	a quantitative procedure that uses susceptible organisms to detect toxic substances or pathogens.
Broodstock*	sexually mature fish, molluscs or crustaceans
Calcareous	pertaining to or containing lime or calcium
Cannibalism	the eating of a species of animal by the same species of animal
Carrier	an individual who harbors the specific organisms of a disease without manifest symptoms and is capable of transmitting the infection; the condition of such an individual is referred to as <i>carrier state</i>
Ceroid	non-staining metabolic by-product found in many bivalves. Abnormally high concentrations indicate possible environmental or pathogen-induced physiological stress.
Chelating agent	chemical agent used to decalcify calcium carbonate in mollusc shells or pearls, <i>e.g.</i> , ethylenediaminetetracetic acid (EDTA)
Chemotherapeutant	chemical used to treat an infection or non-infectious disorder
Chitin	linear polysaccharide in the exoskeletons of arthropods, cell walls of most fungi and the cyst walls of ciliates
Chitinolytic (chitinoclastic)	(Mycology and Bacteriology) chitin degrading organisms with enzymes capable of breaking down the chitin component of arthropod exoskeletons
Chronic	long-term infection which may or may not manifest clinical signs
Clinical	pertaining to or founded on actual observation
Chromatin	nucleoprotein complex containing genomic DNA and RNA in the nucleus of most eukaryotic cells

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Chromatophores	motile, pigment-containing epidermal cells responsible for colour
Ciliostatic	exotoxin toxin secreted by some bacteria that inhibits ciliary functions
Clone	a population derived from a single organism
Coagulation	clotting (adhesion of haemocytes)
Conchiolin	nitrogenous albuminoid substance, dark brown in colour, that forms the organic base of molluscan shells
Concretions	non-staining inclusions in the tubule and kidney cells of scallops and pearl oysters, produced during the digestive cycle. Similar inclusions are also found in the gut epithelia of other bivalves.
Contagious	a disease normally transmitted only by direct contact between infected and uninfected organisms
Crustaceans*	aquatic animals belonging to the phylum Arthropoda, a large class of aquatic animals characterized by their chitinous exoskeleton and jointed appendages, e.g. crabs, lobsters, crayfish, shrimps, prawns, isopods, ostracods and amphipods
Cuticle	(Crustacea) the protein structure of arthropods consisting of an outer layer (epicuticle), an underlying exocuticle (pigmented), endocuticle (calcified) and membranous uncalcified layer. Chitin is in all layers except the epicuticle.
Cyst	(a) a resilient dormant stage of a free-living or parasitic organism, or (b) a host-response walling off a tissue irritant or infection
Cytology	the study of cells, their origin, structure, function and pathology
Cytopathic effect	pertaining to or characterized by pathological changes in cells
Decalcification	the process of removing calcareous matter
Decapitation	cutting of the head portion
Deoxyribovirus	(DNA-virus) virus with a deoxyribonucleic acid genome (cf Ribovirus)
DFAT	Direct Fluorescent Antibody Test/Technique; an immunoassay technique using antibody labelled to indicate binding to a specific antigen
Diapedesis	migration of haemocytes across any epithelium to remove metabolic by-product, dead cells and microbial infections
Disease	any deviation from or interruption of the normal structure or function of any part, organ, or system (or combination thereof) of the body that is manifested by a characteristic set of symptoms and signs and whose aetiology, pathology and prognosis may be known or unknown
Disease agent	an organism that causes or contributes to the development of a disease
Diagnosis*	determination of the nature of a disease
Disinfection*	the application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of diseases of aquatic animals; this applies to aquaculture establishments (i.e. hatcheries, fish farms,

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	objects that may have been directly or indirectly contaminated
DNA (ssDNA, dsDNA)	deoxyribonucleic acid. Nucleic acid comprised of deoxyribonucleotides containing the bases adenine, guanine, cytosine and thymine. Single strand DNA (ssDNA) occurs in some viruses (usually as a closed circle). In eukaryotes and many viruses, DNA is double-stranded (dsDNA).
DNA probes	segments of DNA labelled to indicate detection of homologous segments of DNA in samples of tissues or cultures (see RNA probes)
Dropsy	the abnormal accumulation of serous fluid in the cellular tissues or in a body cavity
Ecdysal gland	(Crustacea) see Y-organ
Ectoparasite	a parasite that lives on the outside of the body of the host
ELISA	Enzyme Linked Immunosorbent Assay, used to detect antigen (antigen capture ELISA) or antibody (antibody capture ELISA)
Emaciation	a wasted condition of the body
Endemic	present or usually prevalent in a population or geographical area at all times
Endothelial	pertaining to or made up of endothelium
Endothelium	the layer of epithelial cells that lines the cavities of the heart and of the blood and lymph vessels, and the serous cavities of the body originating from the mesoderm
Endosymbiosis	an association between two organisms (one living within the other) where both derive benefit or suffer no obvious adverse effect
Envelope	(Virology) lipoprotein membrane composed of host lipids and viral proteins (non-enveloped viruses are composed solely of the capsid and nucleoprotein core)
Enzootic	present in a population at all times but, occurring only in small numbers of cases
Eosinophilic	basic cell and tissue components staining readily with acidic dyes (<i>i.e.</i> eosin); stained cells appear pink to red
Epibiont	organisms (bacteria, fungi, algae, <i>etc.</i>) which live on the surfaces (cf fouling) of other living organisms
Epipodite	(Crustacea) cuticular extension of the base (protopodite) of the walking legs (pereopods)
Epitope	the component of an antigen which stimulates an immune response and which binds with antibody
Epizootic	affecting many animals within a given area at the same time; widely diffused and rapidly spreading (syn. Epidemic - used for human disease)
Epidemiology	science concerned with the study of the factors determining and influencing the frequency and distribution of disease or other health related events

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	and their causes in a defined population for the purpose of establishing programs to prevent and control their development and spread
Epizootiology	the study of factors influencing infection by a pathogenic agent
Epithelium	the layer of cells covering the surface of the body and all gastrointestinal linings. Epithelia are usually one cell thick and supported by a basal membrane.
Epitope	structural component of an antigen which stimulates an immune response and which binds with antibody.
Erosion	destruction of the surface of a tissue, material or structure
Eukaryotean	organism that contains the chromosomes within a membrane-bound nucleus (cf Prokaryote)
Exoenzyme	extracellular enzyme released by a cell or microorganism
Exophthalmia	abnormal protrusion of the eyeballs
Exoskeleton	(Crustacea) the chitin and calcified outer covering of crustaceans (and other arthropods) which protects the soft-inner tissues
Exudate	material, such as fluid, cells, or cellular debris, which has escaped from blood vessels and has been deposited in tissues or on tissue surfaces, usually as a result of inflammation
Euthanasia	an easy or painless death
Filtration	passage of a liquid through a filter, accomplished by gravity, pressure or vacuum (suction)
Finfish*	fresh or saltwater fish of any age
Fry	newly hatched fish larvae
Fingerling	a young or small fish
Fixation	preservation of tissues in a liquid that prevents protein and lipid breakdown and necrosis; the specimen is hardened to withstand further processing; and the cellular and sub-cellular contents are preserved in a manner close to that of the living state
Fixative	a fluid (e.g. aldehyde or ethanol-based solutions) that prevents denaturation and autolysis by cross-linking of proteins
Foreign bodies	any organism or abiotic particle not formed from host tissue
Formalin	a 37% solution of formaldehyde gas
Fouling	the mass colonisation of hard substrates by free-living organisms. Extreme fouling of living organisms, such as molluscs or shrimp, can impede their normal body-functions leading to weakening and death
Fungus	any member of the Kingdom Fungi, comprising single-celled or multinucleate organisms that live by decomposing and absorbing the organic material in which they grow oyster farms, shrimp farms, nurseries), vehicles, and different equipment/

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Gaping	weakened molluscs that cannot close their shells when removed from water; this rapidly lead to desiccation or predation of the soft-tissues and is indicative of molluscs in poor condition (including possible infection)
Gram's Stain	stain used to differentiate bacteria with permeable cells walls (Gram-negative) and less permeable cell walls (Gram-positive)
Granulomas	any small nodular delimited aggregation of granular haemocytes, or modified macrophages resembling epithelial cells (epithelioid cells)
Granulomatosis	any condition characterized by the formation of multiple granulomas
Granulosis virus	Baculoviridae belonging to subgroup (B), characterised by a single nucleocapsid within an envelope. Granulosis viruses form intra-nuclear ellipsoid or rounded occlusion bodies (granules or capsules) containing one or two virions.
Gross signs	signs of disease visible to the naked eye
Haematopoietic	pertaining to or effecting the formation of blood cells
Haematopoietic tissue	(Decapoda) a sheet of tissue composed of small lobules surrounded by fibrous connective tissue which lies along the dorso-lateral surfaces of the posterior portion of the cardiac stomach (Brachyura) or surrounding the lateral arterial vessels, secondary maxillipeds and epigastric tissues (Penaeidae and Nephropidae); (Bivalves) unknown; (Vertebrates) spleen
Haemocytes	blood-cells
Haemolymph	cell-free fraction of the blood containing a solution of protein and non-proteinaceous defensive molecules
Haemocyte infiltration	accumulation of haemocytes around damaged or infected tissues; since the type of haemocytes most commonly responsible for phagocytosis are granulocytes, focal infiltration is often referred to as a "granuloma"
Haemocytopenia	a reduction in the number of cells in the circulatory system, usually associated with a reduction in blood-clotting capability
Haemocytosis	systemic destruction of blood cells (syn. Haemolysis)
Haemorrhage	(Vertebrate) escape of blood from the vessels; bleeding (Invertebrate) uncontrolled loss of haemocytes due to tissue trauma, epithelial rupture, chronic diapedesis
Hatcheries*	aquaculture establishments raising aquatic animals from fertilized eggs
Hepatopancreas	digestive organ composed of ciliated ducts and blind-ending tubules, which secrete digestive enzymes for uptake across the digestive tubule epithelium; also responsible for release of metabolic by-products and other molecular or microbial wastes (cf Metaplasia, Diapedesis)
Histology	the study that deals with the minute structure, composition and function of tissues
Histolysis	breakdown of tissue by disintegration of the plasma membranes
Histopathology	structural and functional changes in tissues and organs of the body which

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	cause or are caused by a disease seen in samples processed by histology
Homogenate	tissue ground into a liquid state in which all cell structure is disintegrated
Host	individual organism infected by another organism
Husbandry	management of captive animals to enhance reproduction, growth and health
Hyperplasia	abnormal increase in size of a tissue or organ due to an increase in number of cells
Hypertrophy	abnormal enlargement of cells due to irritation or infection by an intracellular organism.
Hyphae	(Mycology) tubular cells of filamentous fungi; may be divided by cross-walls (septa) into multicellular hyphae, may be branched. Interconnecting hyphae are called mycelia.
Icosahedral	shape of viruses with a 5-3-2 symmetry and 20, approximately equilateral, triangular faces
IFAT	Indirect Fluorescent Antibody Test/Technique; a technique using unlabelled antibody and a labelled anti-immunoglobulin to form a 'sandwich' with any antigen-bound antibody
Immunity	protection against infectious disease conferred either by the immune response generated by immunization or previous infection or by other non-immunologic factors
Immunization	protection against disease by deliberate exposure to pathogen antigens to induce defence system recognition and enhance subsequent responses to exposure to the same antigens (syn Vaccination)
Immunoassay	any technique using the antigen-antibody reaction to detect and quantify the antigens, antibodies or related substances (see ELISA, IFAT, DFAT)
Immunodepression	decrease in immune system response to antigens due to an infection (same or different agent) or exposure to an immunosuppressant chemical.(syn. Immunosuppression)
Immunofluorescence	any immuno-histochemical method using antibody labeled with a fluorescent dye Direct - if a specific antibody or antiserum with a fluorochrome and used as a specific fluorescent stain Indirect - if the fluorochrome is attached to an antiglobulin, and a tissue constituent is stained using an unlabeled specific antibody and the labeled antiglobulin, which binds the unlabeled antibody
Immunoglobulin (Ig)	family of proteins constructed of light and heavy molecular weight chains linked by disulphide bonds; usually produced in response to antigenic stimulation
Immunohistochemistry	application of antigen-antibody interactions to histochemical tech

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	niques, as in the use of immunofluorescence
Immunology	branch of biomedical science concerned with the response of the organisms to antigenic challenge, the recognition of self and not self, and all the biological (<i>in vivo</i>), serological (<i>in vitro</i>), and physical chemical aspects of immune phenomena
Immunostimulation	enhancement of defense responses, e.g., with vaccination
Immunization	induction of immunity
Inclusion body	non-specific discrete bodies found within the cytoplasm or nucleus of a cell. Frequently viral (cf Cowdry body, Polyhedrin Inclusion /Occlusion Bodies), or bacterial microcolonies (cf RLOs) (syn. Inclusions)
Infectious	capable of being transmitted or of causing infection
Infection	invasion and multiplication of an infectious organism within host tissues. May be clinically benign (cf sub-clinical or 'carrier') or result in cell or tissue damage. The infection may remain localized, subclinical, and temporary if the host defensive mechanisms are effective or it may spread an acute, sub-acute or chronic clinical infection (disease).
Infiltration	(Invertebrates) haemocyte migration to a site of tissue damage or infection by a foreign body/organism ('inflammation'). Infiltration may also occur for routine absorption and transport of nutrients and disposal of waste products.
Inflammation	(Vertebrate) initial response to tissue injury characterised by the release of amines which cause vasodilation, infiltration of blood cells, proteins and redness that may be associated with heat generation (Invertebrates) infiltration response to tissue damage or a foreign body. The infiltration may be focal, diffuse or systemic (syn. Infiltration).
Innate immunity	host defence mechanism that does not require prior exposure to the pathogen
Intensity of infection	the number of infectious agents in an individual organism or specimen; "mean" intensity is the average number of infectious agents present in all infected individuals in a sample
Intercellular	situated or occurring between the cells in a tissue
Interstitial tissue	tissue or cells between epithelial bound organ systems; also known as (cells) Leydig tissue (molluscs) or connective tissue
Intracellular	situated or occurring within a cell
Intrapallial	(Bivalves) space between the mantle, gills and other soft-tissues; the space between the mantle and inner shell is the extrapallial space
Karyolysis	a form of necrosis where the chromatin leaches out of the nucleus without disrupting the nuclear membrane, leaving an 'empty' appearing nucleus
Karyorrhexic	rupture of the nucleus and nuclear membrane, releasing chromatin granules into the cytoplasm
Lesion	any pathological or traumatic change in tissue form or function

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Lethargy	abnormal drowsiness or stupor (response only to vigorous stimulation); a condition of indifference
Liquefaction	conversion of a tissue into a semi-solid or fluid mass due to necrosis
Luminescent	marine or euryhaline bacteria which contain luciferase (a fluorescent, bacteriaenzyme) <i>e.g.</i> , <i>Vibrio harveyi</i> and <i>V. splendidus</i>
Lymphoid organ	(Crustacea) an organ situated between the anterior and posterior stomach chambers which connects the sub-gastric artery to the anterior aorta, via a mass of interconnected tubules
Lymphoid organ	spherical cellular masses composed of presumed phagocytic haemocytes, spheres which sequester Taura Syndrome Virus (TSV) and aggregate within intertubular spaces of the lymphoid organs
Macrophages	(Vertebrates) large (10-20 μ m) amoeboid blood cells, responsible for phagocytosis, inflammation, antibody and cytotoxin production.
Mandibular organ	(Crustacea) large glandular organ close to the ventral epidermis between the mandibles; believed to be related to the moulting cycle, although it does not produce a known moult-inducing hormone
Mantle retraction/recession	during periods of no growth in molluscs, the mantle retracts away from the edge of the shell. Prolonged mantle retraction leaves the inner shell edge open to erosion and fouling.
Melanin	dark brown-black polymer (pigment) of indole quinone which has enzyme inhibiting properties. It forms part of the primary defence mechanism against cuticle and epidermal damage in many crustaceans
Melanisation	abnormal deposits of dark pigment in various organs or tissues
Melanophores	(Crustacea) dermal cells containing melanin (syn. melanocytes)
Metaplasia	the change in shape of any epithelial cell, <i>e.g.</i> , from columnar to cuboidal or squamous (flattened)
Microcolonies	membrane-bound populations of Chlamydia bacteria or non-membrane bound Rickettsial colonies (cf Inclusion bodies)
Microorganism	principally, viruses, bacteria and fungi (microscopic species, and taxonomically-related macroscopic species). Microscopic protists (Protozoa) and algae may also be referred to as microorganisms.
Molecular probes	see DNA probes
Molluscs*	aquatic organism belonging to the Phylum Mollusca in the Kingdom Metazoa characterized by soft unsegmented bodies. Most forms are enclosed in a calcareous shell. The different developmental stages of molluscs are termed larvae, postlarvae, spat, juvenile and adult.
Monoclonal antibody (MaB)	identical antibody molecules produced by clonage of the antibody producing cell and responsive to a single antigen epitope (cf Epitope)
Moribund	diseased; near death
Mortality	death

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Moulting	(Crustacea) the shedding of the exoskeleton to permit growth (increase in size) of internal soft-tissues (syn. Ecdysis)
Mucous	pertaining or relating to, or resembling mucus
Mucus	the free slime of the mucous membrane, composed of secretion of the glands, along with various inorganic salts, desquamated cells and leukocytes
Multiple aetiology	disease associated with more than one infectious agent; may be directly attributed to one or more infectious organism (cf Syndrome)
Mycelial colonies	(Bacteriology) colony growth of Gram-positive Actinomycete bacteria with branched mycelia which may fragment into rods or coccoid forms
Mycelium	(Mycology) network formed by interconnecting hyphae (syn. Mycelial network)
Mycology	the study of fungi (Mycota)
Mycosis	any disease resulting from infection by a fungus
Myodegeneration	breakdown of muscle fibres
Mysis larvae	(Crustacea) pelagic larval stage between protozoa (zoeal) and post larva
Nacre	inner layer of molluscan shells; may have an iridescent crystal matrix (mother-of-pearl)
Nauplius(-plii)	(Crustacea) earliest larval stage; with three pairs of appendages, uniramous first antennae, biramous second antennae and mandibles
Necrosis	sum of the morphological changes indicative of cell death and caused by the progressive and irreversible degradative action of enzymes; it may affect groups of cells or part of a structure or an organ; necrosis may take different forms and be associated with saprobionts (bacterial, fungal or protistan) proliferation.
Notifiable Diseases*	'diseases notifiable to the OIE' means the list of transmissible diseases that are considered to be of socio-economic and/or public health importance within countries and that are significant in the international trade in aquatic animals and aquatic animal products (see also OIE 1997, OIE 2000a, b)
Nuclear Polyhedrosis Virus (NPV)	Baculoviruses (Type A) which produce intranuclear polyhedral protein matrices (see Polyhedral Occlusion/Inclusion Bodies)
Nucleocapsid	protein-nucleic acid complex which may form the core, capsid and/or helical nucleoprotein of the virion
Occlusion	(vascular) filling or blocking of vascular sinuses by haemocytes; (perivascular) infiltration of haemocytes, several cells deep into the tissues surrounding vascular sinuses; (luminal) filling or blocking of gonoducts, renal ducts, digestive tubules or ducts by haemocytes or other cell debris
Occlusion body	(see Polyhedrin Inclusion/Occlusion Body)

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Oedema (edema)	presence of abnormally large amounts of fluid in the intercellular spaces of the body
Opportunistic	organism capable of causing disease only when a host's resistance is pathogen lowered by other factors (another disease, adverse growing conditions, drugs, <i>etc.</i>)
Osmoregulation	maintenance of osmolarity by a simple organism or body cell with respect to the surrounding medium
Other Significant Diseases*	diseases that are of current or potential international significance in aquaculture, but that have not been included in the list of diseases notifiable to the OIE because they are less important than the 'notifiable diseases', or because their geographical distribution is limited, or is too wide for notification to be meaningful, or it is not yet sufficiently defined, or because the aetiology of the disease is not well enough understood, or approved diagnostic methods are not available (see also OIE 1997, OIE 2000a, b)
Outbreak	the sudden onset of disease in epizootic proportions
Overt	open to view; not concealed
Parasite	an organism which lives upon or within another living organism (host) at whose expense it obtains some advantage, generally nourishment
Parasitology	science that deals with the study of parasites
Passage	(Virology) the successive transfer of a virus or other infectious agent through a series of experimental animals, tissue culture, or synthetic media with growth occurring in each medium
Patent infection	period when clinical signs and/or the infectious organism can be detected (cf Prepatent)
Pathogen	an infectious agent capable of causing disease
Pathogenicity	the ability to produce pathologic changes or disease
Pathognomonic	sign or symptom that is distinctive for a specific disease or pathologic condition
Pathology	deals with the essential nature of disease, especially of the structural and functional changes in tissues and organs of the body which cause or are caused by a disease
PCR	Polymerase Chain Reaction, a process by which nucleic acid sequences can be replicated ('nucleic acid amplification')
Pereiopods	(Crustacea) thoracic appendages ('walking legs') (cf Pleopods and Uropods)
Periostracum	(Molluscs) calcareous layers of shell which may contain quinine-tanned protein
Phages	(see Bacteriophage)
Phagocytosis	uptake by a cell of material from the environment by invagination of its plasma membrane

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Plasma membrane	trilaminar membrane enclosing the cytoplasm and organelles of a cell
Pleiopod	small legs of some crustaceans
Pleomorphic	organism demonstrating more than one body form within a life-cycle
Polyadenalated RNA	messenger RNA (mRNA) which has a polyadenylate sequence bound to the 3' end of the molecule. This is common in most eukaryote mRNA and is present in some riboviruses. The function of this addition is unknown.
Polyclonal antibodies (PAb)	(more correctly, but rarely, termed 'Polyclonal antiserum') an antiserum prepared from an organism exposed to an antigen. The PAb contains several different antibodies, each specific to a different epitope of the same antigen. (see Monoclonal antibody).
Polyhedral Inclusion/Occlusion Body (POB, PIB)	protein-based crystalline matrix made up of Polyhedrin (Baculovirus group A - Nuclear Polyhedrosis Viruses (NPV)) or Granulin (Baculovirus group B - Granulosis Viruses (GV)). Baculovirus group C do not form occlusion bodies.
Polymorphic	(a) capability of molecules, such as enzymes, to exist in several forms; (b) ability of nuclei of certain cells (e.g., haemocytes) to change shape; and (c) ability of microorganisms to change shape (e.g., in different host species or tissues)
Pop-eye	abnormal protrusion of the eyes from the eye sockets
Postlarvae (PL)	the stage following metamorphosis from larvae to juvenile in the life cycle of Crustacea. In penaeid shrimp, this is commonly counted in days after appearance of postlarval features, e.g., PL12 indicates a post-larvae that has lived 12 days since its metamorphosis from the zoea stage of development.
Predator	an organism that derives elements essential for its existence from organisms of other species, which it consumes and destroys
Predispose	to make susceptible to a disease which may be activated by certain conditions, as by stress
Preening	(Crustacea) cleaning surface tissues or eggs exposed to fouling (cf Epibionts and Fouling); some crustaceans have modified appendages to enhance preening (e.g., the gill-rakers of <i>Brachyura</i>)
Prepatent period	period between infection and the manifestation of clinical or detectable signs of disease
Prevalence	percentage of individuals in a sample infected by a specific disease, parasite or other organism
Prokaryote	(syn. Bacteria) cellular micro-organisms in which the chromsomes are not enclosed within a nucleus
Prophylactic (-axis):	action or chemotherapeutant administered to healthy animals in order to prevent infection (see Treatment)
Pustule	a sub-epidermal swelling containing necrotic cell debris as a result of inflammation (haemocyte infiltration) in response to a focal infection

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Putative	signifies that which is commonly thought, reputed or believed
Pyknosis/Pyknotic	contraction of nuclear contents to a deep staining (basophilic) irregular mass, sign of death cell (cf Karyorhexis and Karyolysis)
Quarantine	holding or rearing of aquatic animals under conditions which prevent their escape, and the escape of any pathogens they may be carrying, into the surrounding environment. This usually involves sterilisation/disinfection of all effluent and quarantine materials. Quarantine measures are measures developed as a result of risk analysis to prevent the transfer of disease agents with live aquatic animal movements, with pre-border, border and post-border health management processes, however, such activities are equally applicable to intra-national movements of live aquatic animal.
Repair	process to re-establish anatomical and functional integrity of tissues after an injury or infection
Reservoir	(host or infection) an alternate or passive host or carrier that harbors pathogenic organisms, without injury to itself, and serves as a source from which other individuals can be infected
Resistance	(to Disease) (cf Acquired immunity and Innate immunity) the capacity of an organism to control the pathogenic effects of an infection. Resistance does not necessarily negate infection ('Refraction') and varying degrees of tolerance to the infection may be manifest. Heavy sub-clinical infections are indicative of resistance (syn. Tolerance; opp. Susceptible)
Resistance	(Antibiotic or 'drug' resistance) the capability of a microbe to evade destruction by an antibiotic. This may arise from changes in the antigenic properties of the microbe. Survival and multiplication leads to development of drug resistant strains of the pathogen. This may confer resistance to related (heteroresistance) or non-related antibiotics (multiple drug resistance).
Ribosomes	intracytoplasmic granules which are rich in RNA and function in protein synthesis
Ribovirus (RNA-virus)	virus with a ribonucleic acid (see RNA) genome (see Deoxyribovirus)
Risk	the probability of negative impact(s) on aquatic animal health, environmental biodiversity and habitat and/or socio-economic investment(s)
RNA	ribonucleic acid consisting of ribonucleotides made up of the bases (ssRNA, dsRNA) adenine, guanine, cytosine and uracil
RNA probes	segments of RNA which are labelled to detect homologous segments of RNA or DNA in tissue or culture samples (cf DNA probes)
rRNA	(Ribosomal RNA) RNA component of the ribonucleoprotein organelle responsible for protein synthesis within a cell
Saprobionts	(syn. Saprotroph) organisms which obtain nutrition from dead organic matter
Schizonts	the multinucleated stage or form of development during schizogony

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Secondary	infection infection resulting from a reduction in the host's resistance as a consequence of an earlier infection
Septicaemia	systemic disease associated with the presence and persistence of pathogenic microorganisms or their toxins in the blood; blood poisoning
Serology	term now used to refer to the use of such reactions to measure serum antibody titers in infectious disease (serologic tests), to the clinical correlations of the antibody titer (the 'serology' of a disease) and the use of serologic reactions to detect antigens
Serum	fluid component of coagulated haemolymph
Shipment*	a group of aquatic animals or products thereof destined for transportation
Sporangium	(Mycology) hyphal swelling which contains motile or non-motile zoospores; release is via a pore or breakdown of the sporangial wall. (syn. Zoosporangium)
Sporangium	(Bacteriology) the cell, or part of a cell, which subsequently develops into an endospore (intracellularly formed spore)
Spore	infective stage of an organism that is usually protected from the environment by one or more protective membranes (syn. Zoospores)
Sporogenesis	formation of or reproduction by spores; sporulation
Sterilization	any process (physical or chemical) which kills or destroys all contaminating organisms, irrespective of type; a sterile environment (aquatic or solid) is free of any living organism
Stress	the sum of biological reactions to any adverse stimuli (physical, internal or external) that disturb the organism's optimum operating status
Sub-clinical	(asymptomatic) an infection with no evident symptoms or clinical signs of disease, or a period of infection preceding the onset of clinical signs (cf Prepatent)
Surveillance*	a systematic series of investigations of a given population of aquatic animals to detect the occurrence of disease for control purposes, and which may involve testing of samples of a population
Susceptible	an organism which has no immunity or resistance to infection by a another organism
Syndrome	an assembly of clinical signs which when manifest together are indicative of a distinct disease or abnormality (syn. Pathognomic/ Pathognomonic)
Synergistic	(infection) pathology increased by two or more infections by different agents, compared with the effect from individual effects (opp. to 'antagonistic' or 'suppressive', where one infection counteracts the other)
Systemic	pertaining to or affecting the body as a whole
Systemic infection	an infection involving the whole body
Tail rot	disintegration of tail and fin tissue
Telson	(Crustacea) terminal segment of the abdomen which overlies the uropods

GLOSSARY

Tomont	the non-feeding, dividing stage or form in the life cycle of certain protozoa that typically encysts and produces tomites by fission
Transmission	transfer of an infectious agent from one organism to another Horizontal - direct from environment (<i>e.g.</i> , via ingestion, skin and gills) Vertical - prenatal transmission (<i>i.e.</i> , passed from parent to egg); may be either inside the egg (intra-ovum) or through external exposure to pathogens from the parent generation
Transport	movement of stocks between locations by human influence
Trauma	an effect of physical shock or injury
Treatmentaction	taken to eradicate an infection (cf Prophylaxis)
Trophozoites	the active, motile, feeding stage of a protozoan organism, as contrasted with the non-motile encysted stage
Tumour	abnormal growth as a result of uncontrolled cell division of a localised group of cells
Ubiquitous	existing or being everywhere
Ulcer	excavation of the surface of an organ or tissue, involving sloughing of necrotic inflammatory tissue.
Uropods	(Crustacea) the terminal appendages underlying the telson that form the 'tail fan' (see Pereiopods and Pleopods)
Vaccine	an antigen preparation from whole or extracted parts of an infectious organism, which is used to enhance the specific immune response of a susceptible host
Vacuolated	containing spaces or cavities within the cytoplasm of a cell
Veliger	(Mollusc) ciliated planktonic larval stage
Velum (Velar)	(Mollusc) ciliated feeding surface of veliger larvae
Viable	capable of living or causing a disease
Virion	individual viral particle containing nucleic acid (the nucleoid), DNA or RNA (but not both) and a protein shell, or capsid
Virogenic stroma(e)	site of viral replication or assembly (syn. Viroplasm)
Virogenesis	production of virions
Virology	branch of microbiology which is concerned with the study of viruses and viral diseases
Virulence	the degree of pathogenicity caused by an infectious organism, as indicated by the severity of the disease produced and its ability to invade the tissues of the host; the competence of any infectious agent to produce pathologic effects; virulence is measured experimentally by the median lethal dose (LD ₅₀) or median infective dose (ID ₅₀)

GLOSSARY

- Virus one of a group of minute infectious agents, characterized by a lack of independent metabolism and by the ability to replicate only within living host cells
- Y-organ (Crustacea) (syn. Ecdysal gland) gland responsible for production of the moulting hormone ecdysone. Production of the moulting hormone is controlled by a moulting inhibiting hormone synthesised in the eye-stalk
- Zoea larvae (Crustacea) stage following metamorphosis from the nauplius larva, characterised by four pairs of thoracic appendages; may be referred to as protozoa where differentiation between the nauplius and mysis or postlarva stage of development is difficult
- Zoospores motile, flagellated and asexual spores

ABBREVIATIONS

BF-2	Bluegill-Fin 2
BKD	Bacterial kidney disease
BMN	Baculoviral Midgut Gland Necrosis
BMNV	Baculoviral Midgut Gland Necrosis Virus
BP	<i>Baculovirus penaei</i>
BWSS	Bacterial white spot syndrome
CAIs	Cowdry type A inclusion bodies
CHSE-214	Chinook salmon embryo-214
CPE	Cytopathic effect
CSHV	Coho Salmon Herpesvirus
CSTV	Coho Salmon Tumour Virus
CTAB	cetyltrimethylammonium bromide
DFAT	Direct fluorescent antibody test
DNA	Deoxyribonucleic acid
dd	double distilled
dsDNA	double stranded DNA
DTAB	dodecyltrimethylammonium bromide
EHN	Epizootic Haematopoietic Necrosis
EHNV	Epizootic Haematopoietic Necrosis Virus
ELISA	Enzyme-linked Immunosorbent Assay
EPC	<i>Epithelioma papulosum cyprinae</i>
ERA	EUS-related <i>Aphanomyces</i>
EUS	Epizootic Ulcerative Syndrome
FBS	fetal bovine serum
FEV	Fish Encephalitis Virus
FHM	Fathead Minnow
GAV	Gill Associated Virus
GP	glucose peptone
GPY	glucose peptone yeast
H&E	Haematoxylin & Eosin
HHNBV	Baculoviral Hypodermal and Haematopoietic Necrosis
1G4F	1% Glutaraldehyde : 4% Formaldehyde
ICTV	International Committee on Taxonomy of Viruses
IFAT	Indirect Fluorescent Antibody Test
IgG	primary antibody (IgG)
IHHN	Infectious Hypodermal and Hematopoietic Necrosis
IHHNV	Infectious Hypodermal and Hematopoietic Necrosis Virus
IHN	Infectious Haematopoietic Necrosis
IHNV	Infectious Haematopoietic Necrosis Virus
IPN	Infectious Pancreatic Necrosis
IPNV	Infectious Pancreatic Necrosis Virus
ISH	<i>in situ</i> hybridization
kDa	kilodalton
KDM2	Kidney Disease Medium
KDMC	Kidney Disease Medium Charcoal
LDV	Lymphocystis Disease Virus
LOS	'lymphoid organ spheroids'
LOV	Lymphoid Organ Virus
LOVV	Lymphoid Organ Vacuolisation Virus
LPV	Lymphoidal Parvo-like Virus
Mab	Monoclonal antibody
MCMS	Mid-crop Mortality Syndrome
MEM	Minimal Essential Medium
MG	Mycotic Granuloma-fungus
"MSX"	multinucleate sphere X
NeVTA	Nerka virus Towada Lake, Akita and Amori prefecture
NHP	Necrotising Hepatopancreatitis
NPB	Nuclear Polyhedrosis Baculovirus
OKV	<i>Oncorhynchus kisutch</i> virus

ABBREVIATIONS

OTC	oxytetracycline
OMV	<i>Oncorhynchus masou</i> virus
OVVD	Oyster Velar Virus Disease
PCR	Polymerase Chain Reaction
PBS	Phosphate Buffered Saline
PKD	Proliferative Kidney Disease
PL	Postlarvae
PNHP	Peru Necrotizing Hepatopancreatitis
RDS	“runt deformity syndrome”
RHV	Rainbow Trout Herpesvirus
RKV	Rainbow Trout Kidney Virus
RNA	Ribonucleic Acid
RSD	Red spot disease
RTG-2	Rainbow Trout Gonad-2
RT-PCR	Reverse Transcriptase-Polymerase Chain Reaction
RV-PJ	Rod-shaped Nuclear Virus of <i>Penaeus japonicus</i>
RVC	<i>Rhabdovirus carpio</i>
SDS-PAGE	Sodium dodecyl sulfate polyacrylamide gel electrophoresis
SEED	Shrimp Explosive Epidemic Disease
SEMBV	Systemic Ectodermal and Mesodermal Baculovirus
SJNNV	Striped Jack Nervous Necrosis Virus
SKDM	Selective Kidney Disease Medium
SMV	Spawner-isolated Mortality Virus
SMVD	Spawner-isolated Mortality Virus Disease
SPF	Specific Pathogen Free
ssDNA	single stranded DNA
ssRNA	single stranded RNA
“SSO”	seaside organism
SSN-1	Striped Snakehead (<i>Channa striatus</i>) cell-line
SVC	Spring Viraemia of Carp
SVCV	Spring Viraemia of Carp Virus
TEM	Transmission Electron Microscopy
TNHP	Texas Necrotizing Hepatopancreatitis
TPMS	Texas Pond Mortality Syndrome
TS	Taura Syndrome
TSV	Taura Syndrome Virus
UV	ultraviolet
VER	Viral Encephalopathy and Retinopathy
VHS	Viral Haemorrhagic Septicaemia
VHSV	Viral Haemorrhagic Septicaemia Virus
VIMS	Virginia Institute of Marine Science
VNN	Viral Nervous Necrosis)
YBV	Yellowhead Baculovirus
YHD	Yellowhead disease
YHV	Yellowhead Virus
YHDBV	Yellowhead Disease Baculovirus
YHDLV	Yellow-Head-Disease-Like virus
YTV	Yamame tumour virus
WSBV	White Spot Baculovirus
WSD	White Spot Disease
WSS	White Spot Syndrome
WSSV	White Spot Syndrome Virus

SCIENTIFIC AND COMMON NAMES

A. FINFISH (Hosts)

<u>Scientific Name</u>	<u>Common Name</u>
<i>Argentina sphyraena</i>	lesser argentine
<i>Aristichthys nobilis</i>	bighead carp
<i>Bidyanus bidyanus</i>	silver perch
<i>Carassius auratus</i>	goldfish
<i>Carassius carassius</i>	crucian carp
<i>Channa striatus</i>	striped snakehead
<i>Chanos chanos</i>	milkfish
<i>Clupea harengus</i>	herring
<i>Clupea pallasii</i>	Pacific herring
<i>Coregonus</i> spp.	white fish
<i>Ctenopharyngodon idellus</i>	grass carp
<i>Cyprinus carpio</i>	common carp
<i>Dicentrarchus labrax</i>	European sea bass
<i>Epinephelus akaara</i>	red-spotted grouper
<i>Epinephelus malabaricus</i>	brown spotted grouper
<i>Epinephelus moara</i>	kelp grouper
<i>Esox lucius</i>	pike
<i>Gadus macrocephalus</i>	Pacific cod
<i>Gadus morhua</i>	Atlantic cod
<i>Galaxias olidus</i>	mountain galaxias
<i>Gambusia affinis</i>	mosquito fish
<i>Hippoglossus hippoglossus</i>	halibut
<i>Hypophthalmichthys molitrix</i>	silver carp
<i>Ictalurus melas</i>	catfish
<i>Labroides dimidatus</i>	doctor fish
<i>Lates calcarifer</i>	sea bass, Australian barramundi
<i>Macquaria australasica</i>	Macquarie perch
<i>Melanogrammus aeglefinus</i>	haddock
<i>Merlangius merlangius</i>	whiting
<i>Micromesistius poutassou</i>	blue whiting
<i>Mugil cephalus</i>	grey mullet
<i>Oncorhynchus keta</i>	chum salmon
<i>Oncorhynchus kisutch</i>	coho salmon
<i>Oncorhynchus masou</i>	sockeye salmon/Yamame salmon/masou salmon
<i>Oncorhynchus mykiss</i>	rainbow or steelhead trout
<i>Oncorhynchus nerka</i>	Kokanee (non-anadromous sockeye) salmon
<i>Oncorhynchus rhodurus</i>	amago salmon
<i>Oncorhynchus tshawytscha</i>	chinook salmon
<i>Oplegnathus fasciatus</i>	Japanese parrotfish
<i>Oplegnathus punctatus</i>	rock porgy
<i>Oreochromis</i> spp.	Tilapia
<i>Paralichthys olivaceus</i>	Japanese flounder
<i>Perca fluviatilis</i>	redfin perch
<i>Plecoglossus altivelis</i>	ayu
<i>Poecilia reticulata</i>	guppy
<i>Pseudocaranx dentex</i>	striped jack
<i>Rhinonemus cimbrius</i>	rockling
<i>Salmo salar</i>	Atlantic salmon
<i>Salmo trutta</i>	brown trout
<i>Salvelinus fontinalis</i>	brook trout
<i>Scophthalmus maximus</i>	turbot
<i>Seriola quinqueradiata</i>	Japanese yellowtail flounder
<i>Silurus glanis</i>	sheatfish
<i>Sparus aurata</i>	gilt-head sea bream

SCIENTIFIC AND COMMON NAMES

Sprattus sprattus
Takifugu rubripes
Tinca tinca
Thymallus thymallus
Trisopterus esmarkii
Umbrina cirrosa

sprat
tiger puffer
tench
grayling
Norway pout
shi drum

B. MOLLUSCS (Hosts)

Scientific Name

Acanthogobius flavimanus
Arca sp.
Argopecten gibbus
Austrovenus stutchburyi
Barbatia novae-zelandiae (Family Arcidae)
Cerastoderma (= *Cardium*) *edule*
Crassostrea angulata
Crassostrea ariakensis
Crassostrea commercialis
Crassostrea gigas
Crassostrea virginica
Crassostrea angulata
Haliotis cyclobates
Haliotis laevigata
Haliotis roei
Haliotis rubra
Haliotis scalaris
Macomona liliana (Family Tellinidae)
Mercenaria mercenaria
Mytilus edulis
Mytilus galloprovincialis
Ostrea angasi
Ostrea conchaphila (*O. lurida*)
Ostrea edulis
Ostrea lutaria (*Tiostrea lutaria*)
Ostrea puelchana
Patinopecten yessoensis
Pinctada albicans
Pinctada maxima
Pteria penguin
Ruditapes decussatus
Ruditapes philippinarum
Saccostrea commercialis
Saccostrea (*Crassostrea*) *cucullata*
Saccostrea echinata
Saccostrea glomerata
Scrobicularia plana
Tiostrea chilensis (*Ostrea chilensis*)
Tiostrea lutaria
Tridacna maxima

Common Name

Japanese yellow goby
clams
Calico scallop
New Zealand cockles
(not available)
Common European cockle
Portuguese oysters
Ariake cupped oyster
Sydney rock oyster
Pacific oyster
American oysters
Portugese oysters
abalone
greenlip abalone
abalone
blacklip abalone
abalone
(bivalve, not available)
hard shell clam
edible mussel
edible mussel
flat oyster (southern mud oyster)
Olympia oyster
European oyster
New Zealand oyster
(not available)
Japanese (Yesso) scallops
pearl oyster
Mother of pearl
winged pearl oyster
European clam
Manila clam
Sydney rock oyster
Mangrove oyster
Northern black lip oyster
Sydney rock oysters
Peppery furrow shell
South American oyster
(not available)
giant clam

C. CRUSTACEANS (Hosts)

Scientific Name

Acetes spp. (Crustacea:Sergestidae)
Cherax quadricarinatus
Euphausia spp.

Common Name

krill, small shrimp
freshwater crayfish, red claw
krill

SCIENTIFIC AND COMMON NAMES

<i>Marsupenaeus (Penaeus) japonicus</i>	Kuruma prawn
<i>Metapenaeus ensis</i>	red endeavour or greasy back shrimp/prawn
<i>Palaemon styliferus</i>	(not available)
<i>Penaeus aztecus</i>	Northern brown shrimp
<i>Penaeus californiensis</i>	yellowleg shrimp
<i>Penaeus chinensis</i>	Chinese white shrimp
<i>Penaeus duodarum</i>	caged pink shrimp
<i>Penaeus esculentus</i>	brown tiger shrimp/prawn
<i>Penaeus indicus</i>	Indian or red legged banana shrimp/prawn
<i>Penaeus japonicus</i>	Japanese king or Kuruma shrimp/prawn
<i>Penaeus marginatus</i>	Aloha prawn
<i>Penaeus merguensis</i>	common or Gulf banana shrimp/prawn
<i>Penaeus monodon</i>	giant black tiger shrimp/prawn
<i>Penaeus occidentalis</i>	Western white shrimp
<i>Penaeus paulensis</i>	pink shrimp
<i>Penaeus penicillatus</i>	redtail prawn, beige colored shrimp
<i>Penaeus plebejus</i>	Eastern king shrimp/prawn
<i>Penaeus schmitti</i>	white shrimp
<i>Penaeus semisulcatus</i>	grooved tiger or green tiger shrimp/prawn
<i>Penaeus setiferus</i>	Native white shrimp
<i>Penaeus stylirostris</i>	blue shrimp
<i>Penaeus subtilis</i>	Southern brown shrimp
<i>Penaeus vannamei</i>	white shrimp

D. Pathogens/Disease Agents

Aeromonas hydrophila
Argulus foliaceus
Argulus spp
Aphanomyces astaci
Aphanomyces invadans
Aphanomyces invaderis
Aphanomyces piscicida
Baculovirus penaei
Bonamia ostreae
Bonamia sp
Dermocystidium marinum
Haplosporidium costale
Haplosporidium. Nelsoni
Herpervirus
Hexamita inflata
Hexamita salmonis
Mytilicola sp.
Labyrinthomyxa marinus
Lerneae cyprinacea
Marteilia maurini
Marteilia refringens
Marteilia sydneyi
Marteilioides branchialis
Marteilioides christenseni
Marteilioides chungmuensis
Marteilioides lengehi
Mikrocytos mackini
Mikrocytos roughleyi
Minchinia costale
Minchinia nelsoni
Myxobolus artus
Ligula sp.
Perkinsus atlanticus

SCIENTIFIC AND COMMON NAMES

Perkinsus marinus
Perkinsus olseni
Perkinsus qugwadi
Piscicola geometra
Polydora sp.
Posthodiplostomum cuticola
Ranavirus
Renibacterium salmoninarum
Rhabdovirus carpio
Salmincola salmoneus
Staphylococcus aureus
Vibrio harveyi
Vibrio splendidus
Vibrio spp