



Australian Government
Department of Agriculture,
Water and the Environment

Aquatic animal diseases significant to Australia: identification field guide 5th edition

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Foreword

The Australian Government Department of Agriculture, Water and the Environment is pleased to introduce the fifth edition of this field guide.

The field guide and its accompanying phone application aims to help people recognise diseases of significance to aquaculture and fisheries in Australia. This edition incorporates new and updated information gathered from an extensive review of the fourth edition. It now covers 53 aquatic animal diseases of significance to Australia that affect species of finfish, crustaceans, molluscs and amphibians.

Early recognition and reporting of suspected disease outbreaks is critical to protecting our unique aquatic biodiversity, and fisheries and aquaculture sectors. It can permit a rapid disease response to contain outbreaks, increasing the opportunity for disease eradication and thereby limiting potential impacts on aquatic animal industries and the environment. People who work closely with aquatic animals are usually the first to notice signs of a significant disease event. This field guide provides guidance for these people—aquaculture workers, commercial fishers, recreational fishers, quarantine staff, scientists, conservationists and students—to recognize significant aquatic animal diseases, should they occur.

Many people and institutions have contributed to the field guide, including fish health experts from industry, research organisations, state and territory governments, and government agencies of the Asia–Pacific region (including New Zealand), Canada, Denmark, Norway, the Netherlands, the United Kingdom and the United States of America.

Drawing extensively on experience and research activities in aquatic animal health management, both in Australia and abroad, the guide and its phone application complements the growing body of practical knowledge published for aquaculture and fisheries in Australia. On behalf of the Australian Government, I thank all contributors to this production for their efforts and commend this field guide to you.

Dr Mark Schipp

Australian Chief Veterinary Officer

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Introduction

This field guide provides ready access to information on the aquatic animal diseases significant to Australia. These diseases have potential to disrupt Australia's aquatic animal biodiversity, fisheries and aquaculture productivity, and international trade.

The diseases covered here are in [Australia's national list of reportable diseases of aquatic animals](#), which includes those reportable through the regional Quarterly Aquatic Animal Disease reporting program (managed by the Network of Aquaculture Centres in Asia-Pacific, the Food and Agriculture Organization of the United Nations and World Organisation for Animal Health), as well as other diseases of national significance.

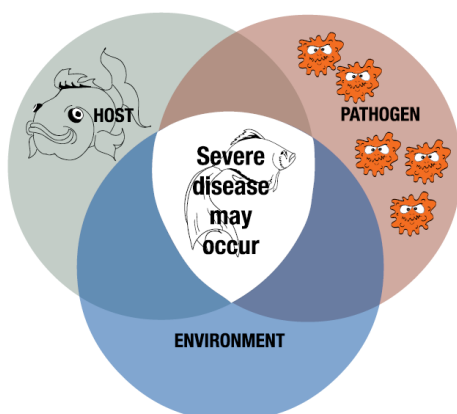
The field guide is aimed at fishery and aquaculture managers, their field staff, veterinary workers and students of aquatic animal health. The publication is also relevant to people in the seafood processing and retail industry, recreational and commercial fishers, and the general public. For people participating in national surveillance and monitoring for aquatic animal disease, the field guide is a valuable disease reference. For the casual reader, the field guide gives an informative and often graphic account of the diseases and organisms that threaten Australia's fisheries and expanding aquaculture industries.

The marine and freshwater environments in Australia are rich with many types of animals. The field guide focuses on fish, molluscs (such as oysters), crustaceans (such as prawns) and amphibians (such as frogs). It is not possible to list every disease for every species in a publication of this type. The emphasis is on infectious diseases found on Australia's National List of Reportable Diseases of Aquatic Animals, significant to our aquaculture industries, fisheries and environment.

Nature of disease

The diseases described in this field guide are caused by infectious agents—viruses, bacteria, fungi or parasites. Diseases with non-infectious causes are outside its scope. Non-infectious causes of disease in the aquatic environment are often attributable to the environment itself: morbidity and mortality can result from natural or human influenced events that lead to oxygen depletion, production of aquatic toxins, or changes in water temperature or salinity. However, disease will not occur simply because an infectious agent is present. The likelihood of disease being expressed is determined by the specific interactions between the host (the aquatic animal), the infectious agent or pathogen, and the environment (Figure 1).

Figure 1 Relationship between host, pathogen and the environment in disease outbreaks



Laboratory tests and sampling

Photographs of gross disease signs, such as those in this field guide, can help an investigator to create a preliminary list of possible disease agents (differential diagnosis list) for the case under investigation. However, although gross signs narrow the search for possible agents, they are not adequate for definitive diagnosis; representative samples from the diseased animal(s) and the environment in which they live need to be taken for analysis. Several publications offering information about sampling are available.

- The World Organisation for Animal Health (OIE) [Manual of diagnostic tests for aquatic animals](#) provides standard diagnostic methods for OIE-listed diseases.
- [Asia diagnostic guide to aquatic animal diseases](#) provides diagnostic guidelines for the pathogens and diseases listed in the Quarterly Aquatic Animal Disease Reporting System.
- The website of the Australian Government [Department of Agriculture, Water and the Environment](#) (DAWE) provides information on the management of inland water quality.

Reporting disease

Fishery and aquaculture industry managers, as well as farmers and their staff, should be aware of their responsibilities to rapidly report any suspicion of diseases on [Australia's national list of reportable diseases of aquatic animals](#) to local authorities.

To prepare for possible disease incursion, fishery and aquaculture industry managers should develop an emergency management plan, in consultation with farmers and appropriate extension staff.

If you identify signs of disease in a culture system, contact your aquatic animal health officer. If your observation is of wild aquatic animals, contact a wildlife or fisheries officer.

A national emergency animal disease watch hotline number has been established to assist early reporting of suspicious disease events. Call **1800 675 888** (free call and available 24 hours).

Current contact details for state and territory governments are provided in [appendix B](#). Call to report your find or ask further questions on the observations you have made. You will be directed to an expert on diseases of aquatic animals within your state or territory.

Follow the directions and advice provided by the officer you contact. This field guide will help you find the information the officer needs.

Using the field guide

This field guide begins with coverage of the anatomy ([section 1](#)) of finfish, molluscs, crustaceans and amphibians, including images and illustrations. These are to help the reader describe lesions when reporting a suspected disease. It follows with descriptions for each infectious disease present in [Australia's national list of reportable diseases of aquatic animals](#). These are presented alphabetically, and classified into infectious diseases affecting finfish, molluscs (such as oysters), crustaceans (such as prawns) and amphibians (such as frogs).

This field guide is available both as a PDF document and as a downloadable phone app. The field guide phone app (listed as the Aquatic disease field guide) can be downloaded free for iOS and android devices at the relevant iTunes or app store outlets. For more information, see the [Aquatic animal diseases significant to Australia: Identification field guide mobile application](#) introductory video.

In both the PDF document and phone app, each disease page describes the:

- signs of disease (at the farm/tank/pond level and gross and microscopic pathological signs)
- disease agent
- host species that carry the disease agent
- presence of the disease in Australia
- epidemiology of the disease
- other diseases in the field guide that may have similar signs
- sample collection and reporting of disease outbreaks.

The disease pages also include photographs of animals with gross signs of disease and/or histological images detailing the typical tissue changes present.

Diagnosing diseases of aquatic animals is a structured process, which begins with making detailed observations, then asking the right questions. The primary aim of this process is to create a broad list of possible diseases that may account for the observed signs. This list can be further refined by targeted questioning and diagnostic tests.

Questions to ask may include:

- Which species, age class, sizes and sex of animals are involved?
- What specifically have you observed—for example, behavioural changes, changes in feed intake (reduced or increased), changes in faecal output?
- Are there obvious gross lesions (such as colour changes, ulcers or spots)?
- Does disease result in morbidity only, or are there mortalities?
- What level of mortality has been observed?
- Do animals show signs of recovery?
- At what rate did you observe disease (sudden death or chronic progression of disease)?

- Is this the first occurrence of disease with this presentation in your facility?
- Are any neighbouring properties or facilities reporting diseases?
- Have there been recent introductions to the facility or any changes in practice?

After making your initial observations, go to the 'signs of disease' section of the disease entries. Look up the diseases listed that match your observations, and you will find photographs and further information to help you narrow the search for the cause of the disease. For example, you might have observed disease in a marine fish, but then find that the listed disease with similar presenting signs affects only freshwater species—in this way, you can eliminate the unlikely, and your list of differential diagnoses will be shorter. In all cases, however, laboratory tests would be required for a definitive diagnosis. Local authorities with responsibility for aquatic animal health can advise on further courses of action should you suspect any disease listed in the field guide.

Signs of disease

Diagnostic information based on disease signs at the farm, tank or pond level, and gross pathological signs (abnormalities that can be seen with the naked eye) are important. However, in most cases, it is impossible to arrive at a definitive diagnosis on the basis of these signs alone. Although some users will not have experience in histological examination, or the equipment required for such examination in the field, the field guide also lists microscopic pathological disease signs.

Mass mortality

A fish kill involving a range of species is more likely caused by an environmental problem, such as toxicity or oxygen depletion. Deaths limited to one species (where other species are also present) are more likely a result of an infectious agent.

Behavioural changes

All species of aquatic animals have characteristic protection, food-gathering and breeding behaviours. Abnormal behaviour, such as a decrease in feeding, could indicate stress from disease. Some behavioural changes can occur across groups of species, or even across different phyla. In molluscs, few behavioural differences are observed such as gaping or delayed closing (in oysters) and decreased feeding or adhesion to vertical surfaces (in abalone). Finfish often gather at water inlets or gasp for air at the surface if the water is depleted of oxygen. If irritated by skin parasites, they may scrape themselves on hard surfaces. Whirling or 'corkscrew' swimming could indicate disease from an infectious agent or aquatic toxins. In both finfish and crustaceans, gathering at the surface or pond edges can often be a sign of disease.

Gross signs

Gross pathological changes may indicate the presence of infectious disease. Careful observation and further laboratory investigation is required to make a definitive diagnosis because many of the signs are not singularly pathognomonic (characteristic for a specific disease) and may be common pathological changes associated with multiple infectious agents. The table below describes some of the more commonly observed visible signs and the groups of aquatic animals dealt with in this field guide for which these are most often observed.

Table 1 Potential gross signs of disease

Sign	Finfish	Molluscs	Crustaceans	Amphibians
Changes in the colour, texture and opacity of flesh	*	*	*	*
Tissue necrosis and lesions	*	*	*	*
Retraction of gill margins	na	*	na	na
Pustules	*	*	na	na
External spots	*	na	*	na
Changes in surface colour	*	na	*	*
Secondary fungal or bacterial growth	*	*	*	*
Deformities and tumours	*	na	*	*
Swollen or discoloured organs or faecal castes	*	*	*	*
White midgut line	na	na	*	na
Broken or damaged appendages	na	na	*	na
Erosion of shell	na	na	*	na
Lesions or ulcers on skin or gills	*	na	*	*
Haemorrhaging with associated anaemia	*	na	na	*
Granulomas	*	na	*	na
Exophthalmos (popeye)	*	na	na	na
Ascites (accumulation of fluid in peritoneal cavity)	*	na	na	*
Petechial haemorrhages (pinpoint bleeding in skin and mucous membranes)	*	na	na	*
Ecchymotic haemorrhages (bleeding or bruising beneath the skin or mucous membranes)	*	na	na	*
Excessive mucus on gills and skin	*	*	na	na
Dropsy (accumulation of fluid in body tissues)	*	na	na	*
Protrusion of scales	*	na	na	na

* Potential gross sign of disease. **na** Sign is not applicable to the taxonomic grouping.

Host range

A list of species known to be susceptible to the infectious agent is provided. Species are further classified as either naturally susceptible (diseased animals have been identified in the wild) or experimentally susceptible. Lists of susceptible species reflect the information available at the time of publishing. However, with further understanding and sampling, it is expected that such lists will expand and/or require refining. Both common and scientific names for hosts are provided.

Presence in Australia

Information on the national distribution of diseases listed in the field guide is based on formal reporting through the regional Quarterly Aquatic Animal Disease reporting program. This program is managed by the Network of Aquaculture Centres in Asia–Pacific (NACA), Food and Agriculture Organisations of the United Nations (FAO) and the World Organisation for Animal Health (OIE). Australia has been an active participant since 1998.

Where a listed disease has been reported under the program to have been present, a map illustrating where it occurred in Australia is included. States or territories having reported disease are listed, and shown in orange in the distribution map. It is important to note that, although a map may identify a state or territory as having reported a disease, this implies neither that it is present at the time of publication nor that it occurs across the entire state or territory.

Readers should consult the [World Animal Health Information Database \(WAHID\) interface](#) for current information on global distribution of diseases outside Australia.

Exotic diseases

Diseases in this field guide described as exotic are those that do not occur in Australian aquatic animal populations. Diseases present in Australia may still be listed as exotic if they are subject to an ongoing emergency disease response to contain and eradicate the disease.

Endemic diseases

Endemic (enzootic) diseases are those that have established in Australian aquatic animal populations. They might be native to Australia or might have been introduced in the past.

Epidemiology

The field guide describes epidemiological factors that are important to each disease. The key to describing the epidemiology of a disease involves understanding the relationship between the infectious agent, the host/s and the environment. Factors relating to the infectious agent include its life cycle (direct transmission or a requirement for intermediate host stages), survival outside the host (carriage on fomites, passage in wastewater) and sensitivity to certain temperatures or salinities.

Host factors may include the susceptible species, ages, sexes and sizes involved. Environmental factors include seasonal and non-seasonal variations in temperature, food availability, salinity, available oxygen, species movement and exposure to different environments (for example, migrations or gathering for breeding). These factors can affect disease agent survivability and host immune competence.

Differential diagnosis

The list of similar diseases at the bottom of each disease page refers only to the diseases covered by this field guide. Gross signs observed might well be representative of a wider range of diseases not included here. Therefore, these diagnostic aids should not be used as a guide to a definitive diagnosis, but rather as a tool to help identify the diseases included in this field guide that most closely account for the observed gross signs. Further diagnostic testing will be required to confirm either presence or freedom from a suspected disease.

Appendix A: Scientific names

Amphibians

Apistogramma spp.
Bufo marinus
Cichlidae
Cophixalus ornatus
Cyclorana alboguttata
Cyclorana brevipes
Cynops cyanurus
Cynops ensicauda
Cynops orientalis
Cynops pyrrhogaster
Euproctus platycephalus
Hydromantes strinatii
Hynobius nebulosus
Ichthyosaura alpestris
Limnodynastes ornatus
Lissotriton italicus
Lissotriton vulgaris
Litoria caerulea
Litoria inermis
Litoria rubella
Litoria splendida
Mikrogeophagus ramirezi
Mixophyes fasciolatus

Crustaceans

Acetes spp.
Artemesia longinaris
Artemia salina
Astacopsis gouldi
Astacopsis spp.
Astacus astacus
Astacus leptodactylus
Astacus spp.
Austropotamobius pallipes
Austropotamobius torrentium
Callinectes arcuatus

Amphibians

Neurergus crocatus
Notophthalmus viridescens
Onychodactylus japonicas
 Order Anura
 Order Caudata
 Order Gymnophiona
Paramesotriton deloustali
Platyplectrum ornatus
Pleurodeles waltl
Pseudophryne coriacea
Rhinella marina
Salamandra algira
Salamandra salamandra
Salamandrella keyserlingii
Salamandrina perspicillata
Siren intermedia
Speleomantes spp.
Taricha granulosa
Taudactylus acutirostris
Triturus cristatus
Tylotriton uyenoi
Tylotriton vietnamensis
Tylotriton zieglerei

Crustaceans

Cambaroides japonicus
Carcinus maenas
Cherax destructor
Cherax quadricarinatus
Cherax spp.
Eriocheir sinensis
Euastacus kershawi
Euastacus spp.
Exopalaemon carinicauda
Gammarus pulex
Geocherax spp.

Crustaceans

Hemigrapsus penicillatus
Homarus americanus
Macrobrachium dayanum
Macrobrachium lanchesteri
Macrobrachium nipponense
Macrobrachium rosenbergii
Macrobrachium sintangene
Macrobrachium superbum
Metapenaeus bennettiae
Metapenaeus ensis
Orconectes spp.
Pacifastacus leniusculus
Palaemon kadiakensis
Palaemon pugio
Palaemon serrifer
Palaemon styliferus
Palaemonetes kadiakensis
Palaemon pugio
Panulirus spp.
Penaeus (Farfantepenaeus) aztecus
Penaeus (Farfantepenaeus) californiensis
Penaeus (Farfantepenaeus) duorarum
Penaeus (Farfantepenaeus) subtilis

Finfish—Non-salmonids

Abramis brama
Acanthopagrus australis
Acanthopagrus latus
Acanthopagrus schlegelii
Acanthurus triostegus
Acipenser baerii
Acipenser gueldenstaedtii
Acipenser oxyrinchus
Acipenser transmontanus
Ambassis agassizii
Ambloplites rupestris
Ameiurus catus
Ameiurus melas
Ameiurus natalis

Crustaceans

Penaeus (Fenneropenaeus) chinensis
Penaeus (Fenneropenaeus) indicus
Penaeus (Fenneropenaeus) merguensis
Penaeus (Litopenaeus) occidentalis
Penaeus (Litopenaeus) schmitti
Penaeus (Litopenaeus) setiferus
Penaeus (Litopenaeus) stylirostris
Penaeus (Litopenaeus) vannamei
Penaeus (Marsupenaeus) japonicus
Penaeus esculentus
Penaeus marginatus
Penaeus monodon
Penaeus semisulcatus
Portunus pelagicus
Portunus sanguinolentus
Potamon potamios
Procambarus clarkii
Procambarus fallax. f. virginialis
Scylla serrata
Sesarma mederi
Thalamita crenata
Uca vocans

Finfish—Non-salmonids

Ameiurus nebulosus
Ammodytes hexapterus
Ammodytes personatus
Ammodytes spp.
Ammodytes tobianus
Amniataba percoides
Anabas testudineus
Anarhichas lupus
Anarhichas minor
Anguilla anguilla
Anguilla australis
Anguilla japonica
Anguilla rostrata
Anguillidae spp.

Finfish—Non-salmonids	Finfish—Non-salmonids
<i>Anodontiglanis dahlia</i>	<i>Dorosoma cepedianum</i>
<i>Anoplopoma fimbria</i>	<i>Eigenmannia virescens</i>
<i>Aplocheilichthys normani</i>	<i>Enchelyopus cimbrius</i>
<i>Aplodinotus grunniens</i>	<i>Eopsetta grigorjewi</i>
<i>Argentina sphyraena</i>	<i>Epinephelus aeneus</i>
<i>Argyrosomus japonicus</i>	<i>Epinephelus akaara</i>
<i>Aristichthys nobilis</i>	<i>Epinephelus bruneus</i>
<i>Arius</i> spp.	<i>Epinephelus coioides</i>
<i>Astronotus ocellatus</i>	<i>Epinephelus fuscoguttatus</i>
<i>Atractoscion nobilis</i>	<i>Epinephelus fuscoguttatus</i> × <i>E. lanceolatus</i>
<i>Aulorhynchus flavidus</i>	<i>Epinephelus lanceolatus</i>
<i>Barbonymus schwanefeldii</i>	<i>Epinephelus malabaricus</i>
<i>Bidyanus bidyanus</i>	<i>Epinephelus marginatus</i>
<i>Blicca bjoerkna</i>	<i>Epinephelus melanostigma</i>
<i>Branchiostegus japonicus</i>	<i>Epinephelus sexfasciatus</i>
<i>Carassius auratus</i>	<i>Epinephelus</i> spp.
<i>Carassius carassius</i>	<i>Epinephelus tauvina</i>
<i>Carassius</i> sp.	<i>Esox lucius</i>
<i>Chanos chanos</i>	<i>Esox masquinongy</i>
<i>Chelon auratus</i>	<i>Etroplus maculatus</i>
<i>Chrysophrys auratus</i>	<i>Evynnis japonica</i>
<i>Cinetodus froggatti</i>	<i>Evynnis tumifrons</i>
<i>Clarias batrachus</i>	<i>Exocoetus volitans</i>
<i>Clupea harengus</i>	<i>Fundulus heteroclitus</i>
<i>Clupea pallasii</i>	<i>Gadus chalcogramma</i>
<i>Cnidoglanis macrocephalus</i>	<i>Gadus macrocephalus</i>
<i>Colisa labiosa</i>	<i>Gadus microgadus</i>
<i>Coptodon zilli</i>	<i>Gadus morhua</i>
<i>Cottus gobio</i>	<i>Galaxias olidus</i>
<i>Cromileptes altivelis</i>	<i>Galaxiidae all species</i>
<i>Ctenolabrus rupestris</i>	<i>Gambusia affinis</i>
<i>Ctenopharyngodon idella</i>	<i>Gasterosteus aculeatus</i>
<i>Cymatogaster aggregata</i>	<i>Girella punctata</i>
Cyprinidae	<i>Girella tricuspidata</i>
<i>Cyprinus carpio</i>	<i>Glossamia aprion</i>
<i>Danio devario</i>	<i>Glossogobius giuris</i>
<i>Danio rerio</i>	<i>Glyptocephalus stelleri</i>
<i>Dicentrarchus labrax</i>	<i>Gymnocephalus cernua</i>

Finfish—Non-salmonids	Finfish—Non-salmonids
<i>Hexagrammos otakii</i>	<i>Maccullochella peelii</i>
<i>Hippoglossoides platessoides</i>	<i>Macquaria ambigua</i>
<i>Hippoglossus hippoglossus</i>	<i>Macquaria australasica</i>
<i>Hippoglossus stenolepis</i>	<i>Macquaria novemaculeata</i>
<i>Hoplobrotula armata</i>	<i>Macropodus opercularis</i>
<i>Hucho hucho</i>	<i>Melanogrammus aeglefinus</i>
<i>Hyperoplus lanceolatus</i>	<i>Melanotaenia splendida</i>
<i>Hypomesus pretiosus</i>	<i>Merlangius merlangus</i>
<i>Hypophthalmichthys molitrix</i>	<i>Merluccius productus</i>
<i>Hypophthalmichthys nobilis</i>	<i>Microgadus proximus</i>
<i>Hyporthodus septemfasciatus</i>	<i>Micromesistius poutassou</i>
<i>Ictalurus furcatus</i>	<i>Micropterus dolomieu</i>
<i>Ictalurus punctatus</i>	<i>Micropterus salmoides</i>
<i>Inimicus japonicus</i>	<i>Morone americana</i>
<i>Kurtus gulliveri</i>	<i>Morone chrysops</i>
<i>Labridae all species</i>	<i>Morone mississippiensis</i>
<i>Labrus bergylta</i>	<i>Morone saxatilis</i>
<i>Laetacara curviceps</i>	<i>Moxostoma anisurum</i>
<i>Lampetra fluviatilis</i>	<i>Moxostoma macrolepidotum</i>
<i>Larimichthys crocea</i>	<i>Mugil cephalus</i>
<i>Lateolabrax japonicus</i>	<i>Mugilidae, all species</i>
<i>Lateolabrax spp.</i>	<i>Mullus barbatus</i>
<i>Lates calcarifer</i>	<i>Nannoperca australis</i>
<i>Latris lineata</i>	<i>Nematalosa erebi</i>
<i>Leiopotherapon unicolor</i>	<i>Neoarius berneyi</i>
<i>Lepomis gibbosus</i>	<i>Neoarius leptaspis</i>
<i>Lepomis macrochirus</i>	<i>Neogobius melanostomus</i>
<i>Lethrinus haematopterus</i>	<i>Neosilurus ater</i>
<i>Lethrinus nebulosus</i>	<i>Notropis atherinoides</i>
<i>Leuciscus cephalus</i>	<i>Notropis hudsonius</i>
<i>Leuciscus idus</i>	<i>Noturus gyrinus</i>
<i>Leuciscus leuciscus</i>	<i>Oplegnathus fasciatus</i>
<i>Limanda limanda</i>	<i>Oplegnathus punctatus</i>
<i>Lota lota</i>	<i>Oreochromis aureus</i>
<i>Lutjanus argentimaculatus</i>	<i>Oreochromis niloticus</i>
<i>Lutjanus erythropterus</i>	<i>Oreochromis niloticus</i> × <i>O. aureus</i>
<i>Luxilus cornutus</i>	<i>Oreochromis niloticus</i> × <i>O. mossambicus</i>
<i>Maccullochella ikei</i>	<i>Oxyeleotris lineolatus</i>

Finfish—Non-salmonids	Finfish—Non-salmonids
<i>Oxyeleotris marmorata</i>	<i>Pseudocaranx dentex</i>
<i>Oxyeleotris selheimi</i>	<i>Pseudochondrostoma polylepis</i>
<i>Pagrus auratus</i>	<i>Pseudopleuronectes americanus</i>
<i>Pagrus major</i>	<i>Pterapogon kauderni</i>
<i>Pampus argenteus</i>	<i>Pterophyllum scalare</i>
<i>Pangasianodon hypophthalmus</i>	<i>Puntius conchoniuis</i>
<i>Pangasius hypophthalmus</i>	<i>Rachycentron canadum</i>
<i>Paralichthyidae, all species</i>	<i>Reinhardtius hippoglossoides</i>
<i>Paralichthys olivaceus</i>	<i>Rhacochilus vacca</i>
<i>Parambassis gulliveri</i>	<i>Rhombosolea tapirina</i>
<i>Parapristipoma trilineatum</i>	<i>Rutilus rutilus</i>
<i>Parophrys vetulus</i>	<i>Sander lucioperca</i>
<i>Pelteobagrus fulvidraco</i>	<i>Sardinops sagax</i>
<i>Pelvicachromis pulcher</i>	<i>Sarotherodon galilaeus</i>
<i>Perca flavescens</i>	<i>Scardinius erythrophthalmus</i>
<i>Perca fluviatilis</i>	<i>Scatophagus argus</i>
<i>Percopsis omiscomaycus</i>	<i>Sciaenops ocellatus</i>
<i>Petromyzon marinus</i>	<i>Scleropages jardini</i>
<i>Phoxinus phoxinus</i>	<i>Scomber japonicus</i>
<i>Pimephales notatus</i>	<i>Scomberomorus niphonius</i>
<i>Pimephales promelas</i>	<i>Scophthalmus maximus</i>
<i>Platax orbicularis</i>	<i>Scortum barcoo</i>
<i>Platichthys flesus</i>	<i>Sebastes schlegelii</i>
<i>Platycephalus fuscus</i>	<i>Sebastes spp.</i>
<i>Platycephalus indicus</i>	<i>Seriola dumerili</i>
<i>Plecoglossus altivelis</i>	<i>Seriola hippos</i>
<i>Plectorhinchus cinctus</i>	<i>Seriola lalandi</i>
<i>Plectranthias yamakawai</i>	<i>Seriola quinqueradiata</i>
<i>Plectropomus leopardus</i>	<i>Sillago ciliata</i>
<i>Plectropomus maculatus</i>	<i>Sillago maculata</i>
<i>Pleuronectes platessa</i>	<i>Silurus asotus</i>
<i>Poecilia latipinna</i>	<i>Silurus glanis</i>
<i>Poecilia reticulata</i>	<i>Siniperca chuatsi</i>
<i>Poecilia sphenops</i>	<i>Solea senegalensis</i>
<i>Pollachius virens</i>	<i>Solea solea</i>
<i>Pomatoschistus minutus</i>	<i>Sparus aurata</i>
<i>Pomoxis nigromaculatus</i>	<i>Sprattus sprattus</i>
<i>Pristiapogon exostigma</i>	<i>Stephanolepis cirrhifer</i>

Finfish—Non-salmonids

Strongylura krefftii
Takifugu rubripes
Tandanus tropicanus
Thaleichthys pacificus
Thunnus thynnus
Tilapia zilli
Tinca tinca
Toxotes chatareus
Toxotes jaculatrix
Toxotes lorentzi
Trachinotus blochii
Trachinotus falcatus
Trachurus japonicus
Trichiurus lepturus

Finfish—Salmonids

Coregonus artedi
Coregonus clupeaformis
Coregonus muksun
Coregonus peled
Coregonus spp.
Oncorhynchus aguabonita
Oncorhynchus clarkii
Oncorhynchus gilae
Oncorhynchus gorbuscha
Oncorhynchus keta
Oncorhynchus kisutch
Oncorhynchus masou
Oncorhynchus mykiss
Oncorhynchus mykiss × *O. kisutch*
Oncorhynchus nerka

Molluscs

Anadara trapezia
Anodonta cygnea
Argopecten gibbus
Austrovenus stutchburyi
Balanus spp.
Barbatia novaezelandiae

Finfish—Non-salmonids

Trichogaster lalius
Trichogaster leerii
Trichogaster microlepis
Trichogaster trichopterus
Trisopterus esmarkii
Trisopterus minutus
Tristramella simonis
Umbrina cirrosa
Verasper moseri
Verasper variegatus
Xiphophorus helleri
Xiphophorus maculatus
Zoarces viviparous

Finfish—Salmonids

Oncorhynchus rhodurus
Oncorhynchus spp.
Oncorhynchus tshawytscha
Prosopium williamsoni
Salmo labrax
Salmo salar
Salmo trutta
Salmonidae all species
Salvelinus alpinus
Salvelinus confluentus
Salvelinus fontinalis
Salvelinus leucomaenis
Salvelinus namaycush
Salvelinus namaycush × *S. fontinalis*
Thymallus thymallus

Molluscs

Cerastoderma edule
Chamelea gallina
Chelonibia spp.
Octolasmis spp.
Crassostrea angulata
Crassostrea ariakensis

Molluscs	Molluscs
<i>Crassostrea corteziensis</i>	<i>Ostrea denselammellosa</i>
<i>Crassostrea gigas</i>	<i>Ostrea edulis</i>
<i>Crassostrea nippona</i>	<i>Ostrea equestris</i>
<i>Crassostrea rhizophorae</i>	<i>Ostrea lurida</i>
<i>Crassostrea sikamea</i>	<i>Ostrea puelchana</i>
<i>Crassostrea virginica</i>	<i>Ostrea stentina</i>
<i>Dendostrea sandvicensis</i>	<i>Paphies australis</i>
<i>Haliotis conicopora</i>	<i>Patinopecten yessoensis</i>
<i>Haliotis corrugata</i>	<i>Pecten maximus</i>
<i>Haliotis cracherodii</i>	<i>Pecten novaezelandiae</i>
<i>Haliotis cyclobates</i>	<i>Perna canaliculus</i>
<i>Haliotis discus hannai</i>	<i>Pinctada fucata</i>
<i>Haliotis diversicolor</i>	<i>Pinctada margaritifera</i>
<i>Haliotis diversicolor supertexta</i>	<i>Pinctada martensii</i>
<i>Haliotis fulgens</i>	<i>Pinctada maxima</i>
<i>Haliotis iris</i>	<i>Pinctada sugillata</i>
<i>Haliotis laevigata</i>	<i>Pitar prostrata</i>
<i>Haliotis rubra</i>	<i>Protothaca jedoensis</i>
<i>Haliotis rubra x laevigata</i>	<i>Pyrazus spp.</i>
<i>Haliotis rufescens</i>	<i>Batillaria spp.</i>
<i>Haliotis scalaris</i>	<i>Ruditapes (Venerupis) philippinarum</i>
<i>Haliotis sorenseni</i>	<i>Ruditapes decussatus</i>
<i>Haliotis tuberculata</i>	<i>Saccostrea cucullata</i>
<i>Haliotis wallalensis</i>	<i>Saccostrea glomerata</i>
<i>Katelysia rhytiphora</i>	<i>Solen marginatus</i>
<i>Macoma balthica</i>	<i>Trichomya hirsuta</i>
<i>Macomona liliana</i>	<i>Tridacna crocea</i>
<i>Mya arenaria</i>	<i>Tridacna gigas</i>
<i>Mytilus edulis</i>	<i>Tridacna maxima</i>
<i>Mytilus galloprovincialis</i>	<i>Venerupis aurea</i>
<i>Ostrea angasi</i>	<i>Venerupis corrugata</i>
<i>Ostrea chilensis</i>	<i>Venerupis philippinarum</i>
<i>Ostrea conchaphila</i>	<i>Xenostrobus securis</i>
Other	Other
<i>Ardea cinerea</i>	<i>Caligus elongatus</i>
<i>Argulus foliaceus</i>	<i>Callibaetis spp.</i>
<i>Caligus coryphaenae</i>	<i>Lepeophtheirus salmonis</i>

Other

Nephtys australiensis

Nereis spp.

Paracartia grani

Other

Piscicola spp.

Salmincola spp.

Tubifex tubifex

Appendix B: Reporting suspected disease

If you see any unusual symptoms in wild or farmed aquatic animals, play it safe and **report it immediately**. Don't worry about how insignificant it may be—small signs may be an early indication of a serious disease problem.

**National 24 hour emergency animal disease watch
hotline: 1800 675 888 (freecall)**

Each state or territory can also be contacted if you suspect a disease. Table 2 shows the state and territory government agencies responsible for aquatic health, and provides points of contact.

Table 2 State and territory government contact details for reporting aquatic animal disease

State or territory	Government agency	Internet site	State telephone
Australian Capital Territory	Environment Planning and Sustainable Development Directorate	www.environment.act.gov.au	132 281
New South Wales	Department of Primary Industries	www.dpi.nsw.gov.au	1800 043 536 (fishwatch)
Northern Territory	Department of Environment and Natural Resources	nt.gov.au	1800 891 136 (fishwatch) 0413 381 094
Queensland	Department of Agriculture and Fisheries	www.daf.qld.gov.au	13 25 23 or 07 3404 6999
South Australia	Department of Primary Industries and Regions SA	www.pir.sa.gov.au	1800 065 522 (fishwatch 24 hours)
Tasmania	Department of Primary Industries, Parks, Water and Environment	www.dpipwe.tas.gov.au	1300 368 550
Victoria	Department of Jobs, Precincts and Regions	agriculture.vic.gov.au	136 186
Western Australia	Department of Primary Industries and Regional Development	www.fish.wa.gov.au	1800 815 507 (fishwatch)

Appendix C: Further reading

These hyperlinks were correct at the time of publication.

General

CABI [Invasive Species Compendium](#) (search by disease)

CEFAS [International Database on Aquatic Animal Diseases](#)

Department of Agriculture, Water and the Environment [AQUAVETPLAN disease strategy manuals](#)

World Organisation for Animal Health [Manual of diagnostic tests for aquatic animals](#)

Finfish

Biosecurity Australia 2014, *Importation of freshwater ornamental fish: review of biosecurity risks associated with gourami iridovirus and related viruses—provisional final import risk analysis report*

Camus, AC 2004, *Channel catfish virus disease*, Southern Regional Aquaculture Centre

Elwell LC, Stromberg KE, Ryce EK, Bartholomew JL 2009, 'Whirling disease in the United States: a summary of progress and research and management 2009', *Trout Unlimited*

Fu X, Li N, Liu L, Lin Q, Wang F, Lai Y, Jiang H, Pan H, Shi C, Wu S 2011, 'Genotype and host range analysis of infectious spleen and kidney necrosis virus (ISKNV)', *Virus Gene*

Glenn RA, Taylor PW, Pelton EH, Gutenberger SK, Ahrens MA, Marchant LM, Hanson KC 2015, [Genetic evidence of vertical transmission and cycling of 'Yersinia ruckeri' in hatchery-origin fall chinook salmon 'Oncorhynchus tshawytscha'](#), *Journal of Fish and Wildlife Management*.

Hazeri M, Hassan MD, Abba Y, Omar AR, Allaudin ZN, Soltani M, Hamdan RH, Mohamad NF 2017, [Molecular characterisation of grouper iridovirus isolates from Peninsular Malaysia](#), *Journal Veterinar Malaysia*

Jansen MD and Mohan CV 2017, *Tilapia lake virus (TiLV): Literature review*, Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems

Kumar G, Menanteau-Ledouble S, Saleh M, El-Matbouli M 2015, ['Yersinia ruckeri', the causative agent of enteric red mouth disease in fish](#), *Veterinary Research*.

Ma H, Peng C, Su Y, Feng J, Guo Z 2016, 'Isolation of a Ranavirus-type grouper iridovirus in mainland China and comparison of its pathogenicity with that of a Megalocytivirus-type grouper iridovirus', *Aquaculture*

Menanteau-Ledouble S, Kumar G, Saleh M, El-Matbouli M 2016, ['Aeromonas salmonicida': updates on an old acquaintance](#), *Diseases of Aquatic Organisms*

Network of Aquaculture Centres in Asia–Pacific [Epizootic ulcerative syndrome: disease card](#)

Network of Aquaculture Centres in Asia–Pacific [Grouper iridoviral disease: disease card](#)

Network of Aquaculture Centres in Asia–Pacific [Tilapia Lake Virus \(TiLV\)—A novel orthomyxo-like virus: disease card](#)

Whittington RJ, Djordjevic SP, Carson J, Callinan RB 1995, [Restriction endonuclease analysis of atypical 'Aeromonas salmonicida' isolates from goldfish 'Carassius auratus', silver perch 'Bidyanus bidyanus', and greenback flounder 'Rhombosolea tapirina' in Australia](#), *Diseases of Aquatic Organisms*

Molluscs

Australia and New Zealand standard diagnostic procedure [Bonamiosis in Australian 'Ostrea angasi'](#)

European Union Reference Laboratory for Molluscs Diseases ['Martellioides chungmuensis'](#)

European Union Reference Laboratory for Molluscs Diseases ['Mikrocytos mackini'](#)

Fisheries and Oceans Canada ['Martellioides chungmuensis' of oysters](#)

Fisheries and Oceans Canada [Gill disease of Portuguese oyster](#)

Fisheries and Oceans Canada [Oyster velar virus disease](#)

Crustaceans

Network of Aquaculture Centres in Asia-Pacific ['Monodon' slow growth syndrome and Laem-Singh virus retinopathy: disease card](#)

Network of Aquaculture Centres in Asia-Pacific [Acute hepatopancreatic necrosis: disease card](#)

Network of Aquaculture Centres in Asia-Pacific [Hepatopancreatic microsporidiosis caused by infection with 'Enterocytooon hepatopenaei': disease card](#)

Poornima, M, Seetang-Nun, Y, Alavandi, SV & Dayal, J 2012, [Laem-Singh virus: A probable etiological agent associated with Monodon slow growth syndrome in farmed black tiger shrimp \('Penaeus monodon'\)](#), *Indian Journal of Virology*, vol. 23.

Amphibians

Department of the Environment and Energy [Infection of amphibians with chytrid fungus resulting in chytridiomycosis \(2016\)](#)

European Food Safety Authority [Scientific and technical assistance concerning the survival, establishment and spread of 'Batrachochytrium salamandrivorans' \(Bsal\) in the EU](#)

Imperial College London [Global Bd mapping project](#)

Wildlife Health Australia [Ranaviral disease in wild Australian amphibians](#)

World Organisation for Animal Health, ['Batrachochytrium salamandrivorans' disease card](#)