



Infection with white spot syndrome virus (WSSV)

Also known as white spot disease (WSD)

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

Figure 1 WSD in giant black tiger prawn (*Penaeus monodon*)



Note: White spots on carapace are typical of infection following acute phase of infection.
Source: B Diggles

Figure 2 WSD in giant black tiger prawn (*Penaeus monodon*)



Note: Carapace is loose and when removed, large smooth-edged white spots are evident. Numerous smaller white spots are also evident on the abdominal segments.
Source: B Diggles

Figure 3 Five juvenile black tiger prawns (*Penaeus monodon*) infected with WSSV lacking classical white spots



Note: Prawns exhibit few, if any, white spots. Prawns infected with WSSV can present as 'normal' prawns.

Source: B Diggles

Signs of disease

Important: Animals with this disease may show one or more of these signs, but the pathogen may still be present in the absence of any signs.

Disease signs at the farm, tank or pond level are:

- rapid onset of mass mortality (80% or more) in farmed penaeid prawns during the grow-out period
- lethargy
- cessation of feeding
- aggregations of moribund prawns near the water surface at the edge of the rearing pond or tank.

Gross pathological signs are:

- loose carapace
- high degree of colour variation, with a predominance of darkened (red, brown or pink) body surface and appendages
- heavy fouling of the surface and gills by external parasites
- white midgut line through the abdomen of severely affected larvae and postlarvae
- delayed (or completely absent) clotting reaction of the haemolymph of infected shrimp
- white calcium deposits embedded in the shell, causing white spots 0.5 to 3.0mm in diameter.

Prawns with WSD may not show distinctive clinical signs. If present, shell lesions can range from minute spots to discs several millimetres in diameter, and may coalesce into larger white plates. Spots are most easily observed by removing the cuticle over the cephalothorax, scraping away any

attached tissue with the thumbnail and holding the cuticle up to the light. However, white spots in the cuticle are unreliable for even preliminary diagnosis of WSD. Similar spots can be produced by some bacteria, high alkalinity and other infectious agents or environmental conditions.

Microscopic pathological signs are:

- hypertrophied nuclei in gills and/or cuticular epithelium
- viral aggregates (shown as small reflective spots) in unstained smear preparations of the haemolymph by dark-field microscopy
- pathognomonic inclusion bodies in histological sections in target tissues.

Disease agent

WSD is caused by infection with white spot syndrome virus (WSSV), a large DNA virus assigned as the only member of the genus *Whispovirus* (family *Nimaviridae*). The virus only infects crustaceans and appears not to be related to any other known viruses. It is not related to white spot disease of finfish, which is caused by parasitic ciliate protozoans. WSSV is known to occur in fresh, brackish and marine water.

Host range

All decapod crustaceans (order Decapoda) are considered susceptible to infection, including prawns, lobsters and crabs from marine, brackish or freshwater environments (Table 1). The disease has mainly been a problem in farmed penaeid (family *Penaeidae*) prawns.

Carriers of the virus (Table 2) include rotifers, marine molluscs, polychaete worms and non-decapod crustaceans such as *Artemia salina*, copepods, non-crustacean arthropods and aquatic insect larvae. Birds can also spread the virus.

Table 1 Species known to be susceptible to infection with WSSV

Common name	Scientific name
All decapod crustaceans	Decapoda—all species
Aloha prawn	<i>Penaeus marginatus</i>
American lobster	<i>Homarus americanus</i>
Argentine stiletto shrimp	<i>Artemesia longinaris</i>
Asian freshwater shrimp ^a	<i>Macrobrachium dayanum</i>
Barred estuarine shrimp ^a	<i>Palaemon serrifer</i>
Black tiger prawn ^a	<i>Penaeus monodon</i>
Brown tiger prawn ^a	<i>Penaeus esculentus</i>
Brush clawed shore crab	<i>Hemigrapsus penicillatus</i>
Chinese mitten crab ^a	<i>Eriocheir sinensis</i>
Chinese white shrimp ^a	<i>Penaeus (Fenneropenaeus) chinensis</i>
Crayfish (native to Europe) ^a	<i>Astacus</i> spp.
Crayfish (native to North America) ^a	<i>Orconectes</i> spp.
Cuata swimcrab	<i>Callinectes arcuatus</i>
Daggerblade grass shrimp	<i>Palaemon pugio</i>

Infection with white spot syndrome virus

Common name	Scientific name
European river crab	<i>Potamon potamios</i>
European shore crab	<i>Carcinus maenas</i>
Fiddler crab	<i>Uca vocans</i>
Freshwater crayfish ^a	<i>Cherax</i> spp.
Freshwater prawn	<i>Macrobrachium lanchesteri</i>
Giant crayfish (native to Australia)	<i>Astacopsis</i> spp.
Giant freshwater prawn ^a	<i>Macrobrachium rosenbergii</i>
Giant Tasmanian crayfish	<i>Astacopsis gouldi</i>
Gippsland spiny crayfish	<i>Euastacus kershawi</i>
Green tiger prawn or grooved tiger prawn ^a	<i>Penaeus semisulcatus</i>
Greentail prawn ^a	<i>Metapenaeus bennettiae</i>
Gulf banana prawn ^a	<i>Penaeus (Fenneropenaeus) merguensis</i>
Indian banana prawn ^a	<i>Penaeus (Fenneropenaeus) indicus</i>
Japanese crayfish	<i>Cambaroides japonicus</i>
Jelly prawns ^a	<i>Acetes</i> spp.
Kuruma prawn ^a	<i>Penaeus (Marsupenaeus) japonicus</i>
Louisiana swamp crayfish ^a	<i>Procambarus clarkii</i>
Mangrove swimming crab ^a	<i>Thalamita crenata</i>
Marbled crayfish	<i>Procambarus fallax. f. virginalis</i>
Mississippi grass shrimp	<i>Palaemonetes kadiakensis</i>
Mud crab ^a	<i>Scylla serrata</i>
Mysid shrimp	<i>Palaemon styliferus</i>
Noble crayfish	<i>Astacus astacus</i>
Northern brown shrimp ^a	<i>Penaeus (Farfantepenaeus) aztecus</i>
Northern pink shrimp ^a	<i>Penaeus (Farfantepenaeus) duorarum</i>
Northern white shrimp ^a	<i>Penaeus (Litopenaeus) setiferus</i>
Oriental freshwater shrimp ^a	<i>Macrobrachium nipponense</i>
Oriental prawn	<i>Exopalaemon carinicauda</i>
Pacific blue shrimp ^a	<i>Penaeus (Litopenaeus) stylirostris</i>
Pacific white shrimp ^a	<i>Penaeus (Litopenaeus) vannamei</i>
Red claw crayfish ^a	<i>Cherax quadricarinatus</i>
Red crab	<i>Sesarma mederi</i>
Red endeavour (greasyback) prawn ^a	<i>Metapenaeus ensis</i>
Sand crab ^a	<i>Portunus pelagicus</i>
Signal crayfish	<i>Pacifastacus leniusculus</i>
Smooth crayfish	<i>Geocherax</i> spp.
Southern brown shrimp	<i>Penaeus (Farfantepenaeus) subtilis</i>
Southern white shrimp	<i>Penaeus (Litopenaeus) schmitti</i>

Common name	Scientific name
Spiny crayfish	<i>Euastacus</i> spp.
Stone crayfish	<i>Austropotamobius torrentium</i>
Sunda river prawn	<i>Macrobrachium sintangene</i>
Superb freshwater shrimp	<i>Macrobrachium superbum</i>
Three spot swimming crab ^a	<i>Portunus sanguinolentus</i>
Tropical spiny lobster	<i>Panulirus</i> spp.
Turkish crayfish	<i>Astacus leptodactylus</i>
Western white shrimp	<i>Penaeus (Litopenaeus) occidentalis</i>
White-clawed crayfish	<i>Austropotamobius pallipes</i>
Yellow-leg shrimp	<i>Penaeus (Farfantepenaeus) californiensis</i>
Yabbies (freshwater)	<i>Cherax destructor</i>

^a Naturally susceptible. Note: Other species are likely to be susceptible or shown to be experimentally susceptible.

Table 2 Non-decapod crustacean carriers

Common name	Scientific name
Annelids	Various genera and species
Aquatic insects	Various genera and species
Brine shrimp	<i>Artemia salina</i>
Molluscs	Various genera and species
Parasitic copepods	<i>Ergasilus manicatus</i>
Piscivorous birds	Various genera and species
Planktonic copepods	<i>Paracartia grani</i>
Polychaetes	Various genera and species
Rotifers	Various genera and species

Presence in Australia

Exotic disease—under official control.

WSD was confirmed in South East Queensland in December 2016. An emergency response to contain and eradicate the disease is ongoing.

Map 1 Presence of WSSV, by jurisdiction



Epidemiology

- WSD is mainly a disease of farmed penaeid prawns, but many species of crustaceans are susceptible to infection with WSSV.
- Rapid mortalities of up to 80% or more within 3 to 10 days have been reported in many countries.
- Prawn farm productivity falls to about 40% of normal rate for 2 years, and then recovers to about 70% over the long term.
- Some of the species listed in the [host range](#) section (such as *Penaeus monodon*) are extremely susceptible to WSSV. Others may be infected but are more resistant to disease.
- Infection may be low level and chronic (lifelong carriers are possible) in healthy crustaceans, or acute infection with disease and mortalities.
- Viral multiplication and disease appears to be induced by environmental and handling stress. Stressors include eye-stalk ablation, spawning, moulting, high stocking densities, changes in salinity, temperature and pH, and plankton blooms. Imposing such stressors on suspect populations can be a useful diagnostic method for detecting the virus.
- All life stages are susceptible, from eggs to broodstock.
- Vertical transmission occurs from infected broodstock.
- Horizontal transmission of disease is usually via cannibalism of sick or dying prawns, or directly through contaminated water.

- Vectors of the virus include rotifers, marine molluscs, polychaete worms and non-decapod crustaceans including *Artemia salina*, copepods, non-crustacean arthropods and insect larvae.
- Birds can transmit the disease from pond to pond by releasing caught prawns over neighbouring ponds.
- White spot syndrome virus can persist and retain infectivity in seawater at 30°C for at least 30 days (under laboratory conditions) and for at least 4 days in ponds.

Differential diagnosis

The list of [similar diseases](#) in the next section refers only to the diseases covered by this field guide. Gross pathological signs may also be representative of diseases not included in this guide. Do not rely on gross signs to provide a definitive diagnosis. Use them as a tool to help identify the listed diseases that most closely account for the observed signs.

Similar diseases

Acute hepatopancreatic necrosis disease (AHPND), infection with *Hepatobacter penaei* (NHP), infection with infectious hypodermal and haematopoietic necrosis virus (IHHNV), infection with shrimp haemocyte iridescent virus (SHIV), infection with Taura syndrome virus (TSV) and infection with yellowhead virus genotype 1 (YHV1).

Sample collection

Only trained personnel should collect samples. Using only gross pathological signs to differentiate between diseases is not reliable, and some aquatic animal disease agents pose a risk to humans. If you are not appropriately trained, phone your state or territory hotline number and report your observations. If you have to collect samples, the agency taking your call will advise you on the appropriate course of action. Local or district fisheries or veterinary authorities may also advise on sampling.

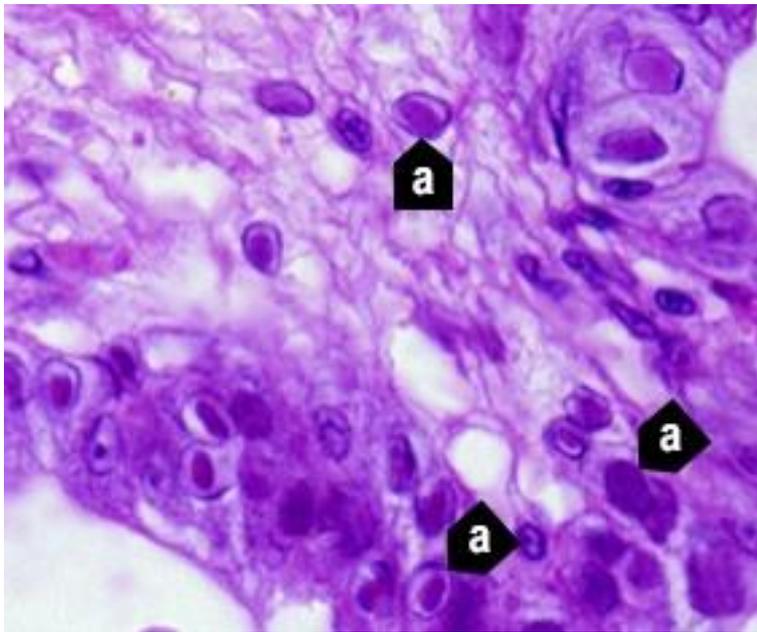
Emergency disease hotline

See something you think is this disease? Report it. Even if you're not sure.

Call the Emergency Animal Disease Watch Hotline on **1800 675 888**. They will refer you to the right state or territory agency.

Microscope images

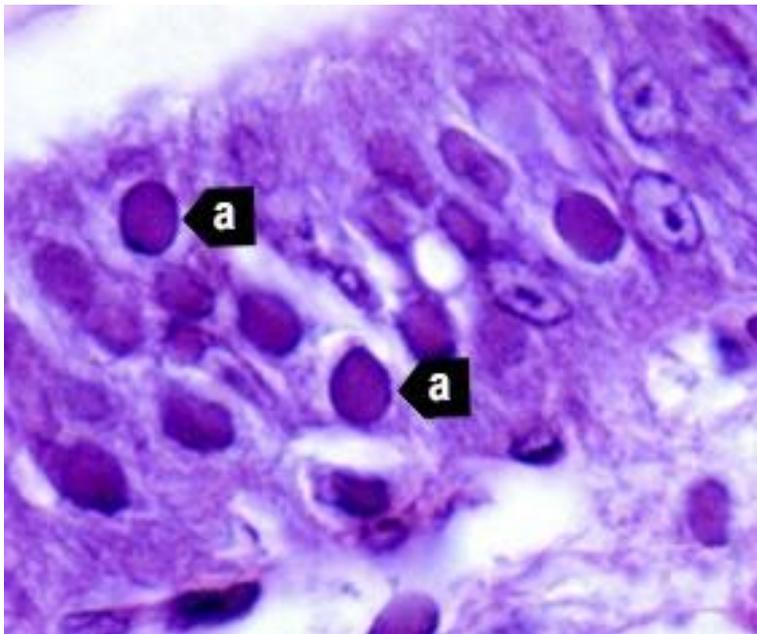
Figure 4 Photomicrograph of histological section from stomach of juvenile black tiger prawn (*Penaeus monodon*) with WSD



Note: Prominent intranuclear inclusion bodies are abundant in cuticular epithelium and subcuticular connective tissue of the organ (a). Cells in different phases of infection display intranuclear inclusion bodies. Early-phase inclusion bodies in this section are centronuclear and eosinophilic. These are separated from nuclear membrane and marginated chromatin by an artefactual halo. 900x magnification.

Source: DV Lightner

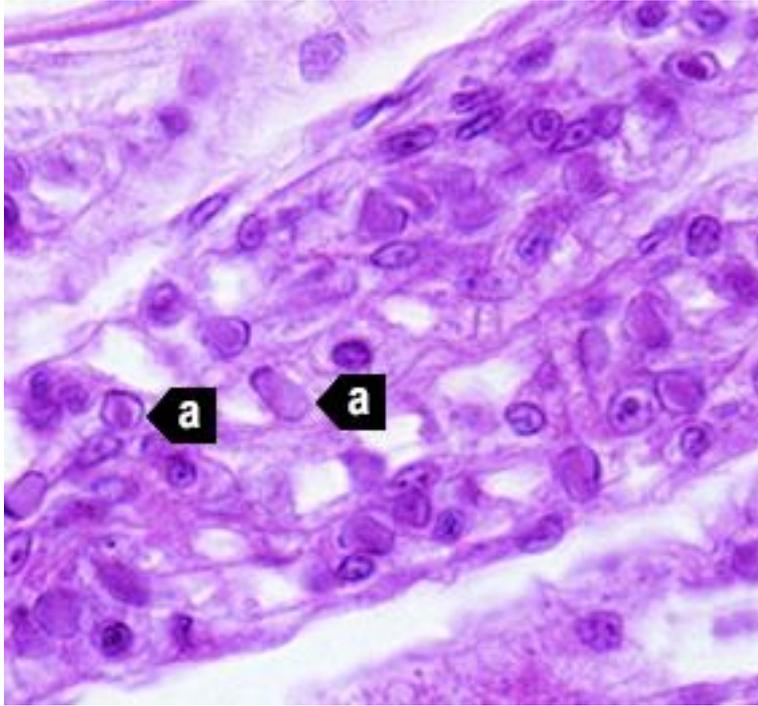
Figure 5 Histological section of stomach of juvenile Chinese white shrimp (*Penaeus (Fenneropenaeus) chinensis*) with advanced WSD



Note: Fully developed WSSV intranuclear inclusion bodies (a) are more basophilic, appear granular in texture and nearly fill affected hypertrophied nucleus. 1300x magnification.

Source: DV Lightner

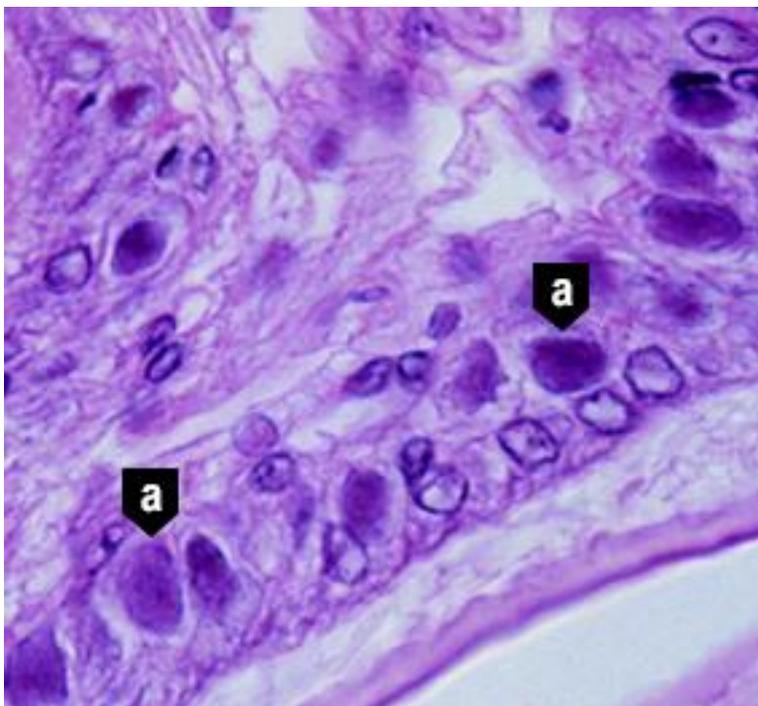
Figure 6 Histological section of gills from juvenile Chinese white shrimp (*Penaeus (Fenneropenaeus) chinensis*) with WSD



Note: Nearly one-quarter of cells are infected, as indicated by developing and fully developed intranuclear inclusion bodies (a). 900x magnification.

Source: DV Lightner

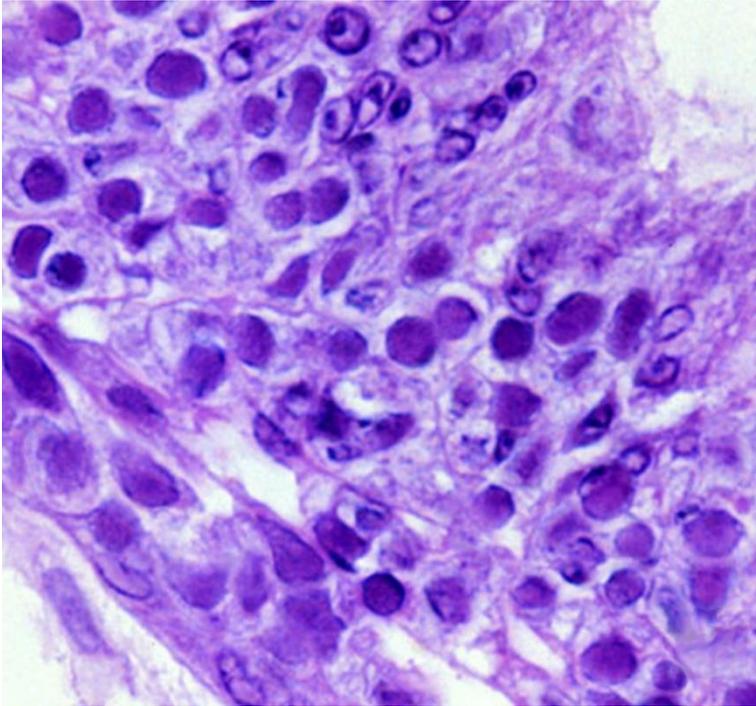
Figure 7 Histological section of stomach of Pacific blue shrimp (*Penaeus (Litopenaeus) stylirostris*) experimentally infected with WSSV



Note: Severe grade 4 infection evidenced by classic WSD intranuclear inclusion bodies (a). 900x magnification.

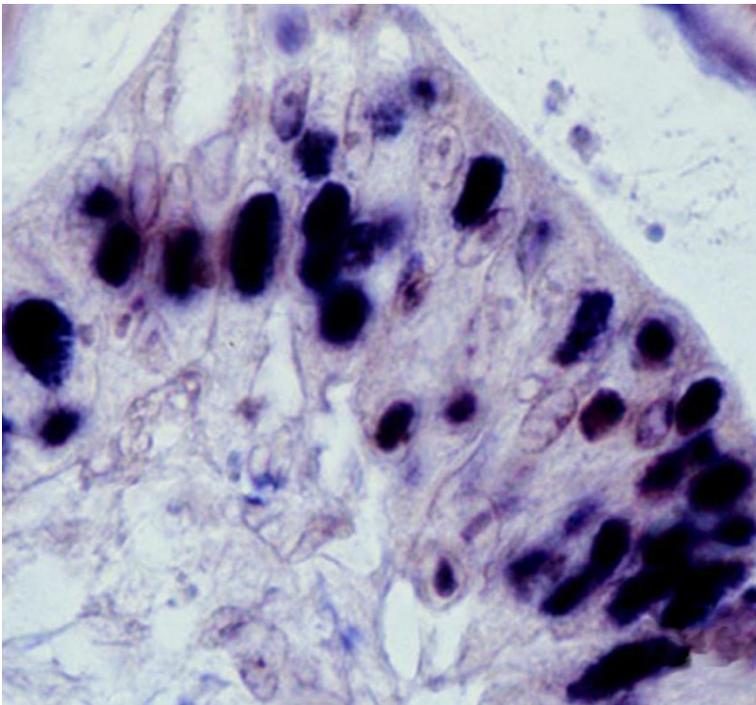
Source: DV Lightner

Figure 8 Histological section of stomach of Pacific white shrimp (*Penaeus (Litopenaeus) vannamei*) experimentally infected with WSSV



Note: Severe grade 4 infection with many classic WSD intranuclear inclusion bodies. 900x magnification.
Source: DV Lightner

Figure 9 In situ hybridisation of histological section of stomach of juvenile Pacific white shrimp (*Penaeus (Litopenaeus) stylirostris*) with WSD



Note: Intranuclear inclusion bodies in the cuticular epithelium of stomach reacting to digoxigenin-labelled DNA probe. 900x magnification.
Source: DV Lightner

Further reading

CABI Invasive Species Compendium [White spot disease](#)

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

Department of Agriculture, Water and the Environment [AQUAVETPLAN disease strategy manual: White spot disease of prawns](#)

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

These hyperlinks were correct at the time of publication.

Contact details

Emergency Animal Disease Watch Hotline 1800 675 888

Email AAH@agriculture.gov.au

Website agriculture.gov.au/pests-diseases-weeds/aquatic

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