**A review on infectious diseases in Asian seabass (*Lates calcarifer*)**

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**Abstract:**

Asian seabass (*Lates calcarifer*) or barramundi, a catadromous fish cultured in freshwater, brackish water and marine closed or open aquaculture systems. During the culture, it is affected by various diseases that cause huge loss in production. The diseases are caused by bacteria, virus, fungi and parasites. These pathogens create many changes in Asian seabass externally and internally, so they must be diagnosed and treated. There are no treatment methods identified for few diseases, so it must be prevented from entering the culture systems. “Prevention is better than cure” as the line says there should be preventive measures that are most effective against diseases. Both wild and cultured fishes are affected by numerous diseases. Health management in fishes is the most important in culture systems. Among all the pathogens, parasites cause serious effects in fish. This article provides you with basic information regarding the diseases that occurred in Asian seabass, diagnostic methods, prevention and treatment.

Keywords: Disease, *Lates calcarifer*, Asian seabass,

**Introduction:**

Aquaculture is the culture of aquatic organisms, viz., fish and aquatic plants in various production systems like tanks, ponds, lakes, swamps, floodplains, wetlands, mangroves, canals, rivers, lagoons and reservoirs which is one of the important food production sectors in the world. World fisheries and aquaculture production has attained around 177.8 million tonnes in 2020. In this, 96.4 million tonnes are contributed from inland and marine capture fisheries, and 82.1 million tonnes was produced by inland and marine aquaculture (FAO, 2022). Species diversification in aquaculture is influenced by consumer preference, technical innovations like economies of scale. Diversification in the species farmed is facilitated by the development of the farming and hatchery technologies for various fish species like tilapia, Asian seabass etc... However, the sustainability of the farming of various species is greatly determined by the species selected for farming and the intrinsic risk factors are an adaptation to the environmental characteristics, susceptibility resistance to various diseases. The first and foremost problem in the economic loss of aquaculture is the disease outbreak. Although hatchery production and commercial extension of the farming industry, there is a prevalent outbreak of various diseases caused by viruses, bacteria, fungi and parasites. As in other farmed fishes, disease outbreaks both infectious and non-infectious remain as the major challenges in Asian seabass farming. Infectious diseases caused by bacterial, viral, parasites and non-infectious diseases caused by adverse environmental parameters and nutritional deficiencies are encountered at Asian seabass farming. Good biosecurity measure is the effective method for the prevention of diseases. The following are the infections so far occurred in seabass.

* **Viral diseases:**

The important virus families inflicted in Asian seabass culture is Nodaviridae and Iridoviridae. Viral infection in fishes provokes an immune response that eliminates the infecting virus. Incorporation of the vaccine also provokes an immune response which confers an artificially acquired immunity to that viral pathogen.

1. **Nodavirus:**

Viral nervous necrosis (VNN), viral encephalopathy and retinopathy (VER) or nervous necrosis virus (NNV) is the common viral disease infected in Asian seabass. The first nodavirus in fish designated was striped jack nervous necrosis virus (SJNNV). After that, piscine nodaviruses was also designated for VER outbreaks in Asian seabass (Comps *et al.,* 1994).

**Aetiology:** This is a small (25–35 nm), non-enveloped virus belonging to the family Nodaviridae. It is a single-stranded RNA segment with two positive-sense.

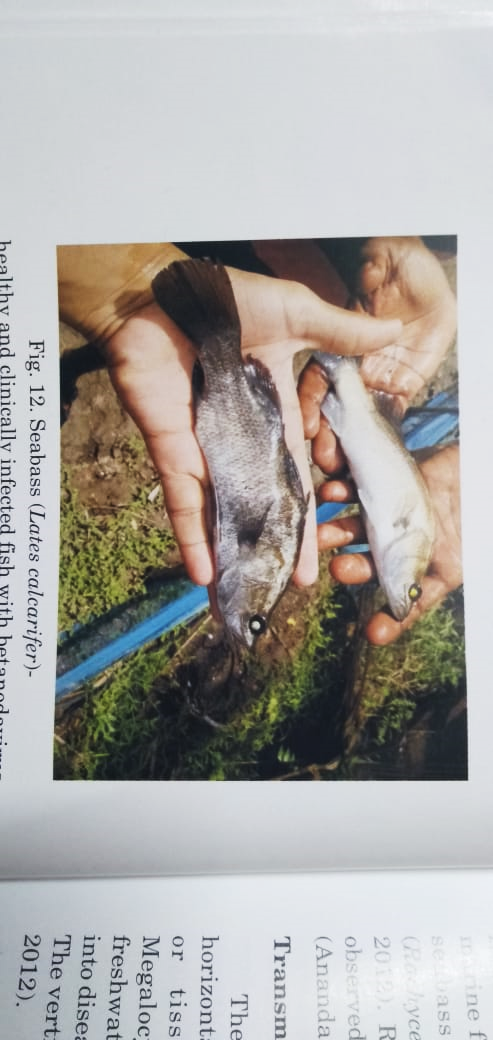
**Geographic distribution:** India, China, Israel, Indonesia, Tahiti, Malaysia, Australia, Singapore, Taiwan, Philippines and Thailand (Munday *et al.,* 2002). RGNNV genotype was reported in Asian seabass in India, Malaysia and Israel (Binesh and Greeshma, 2013).

**Symptoms:** fish becomes pale with redness around the head (Humphrey, 2006). The major infected part in fish is the nervous system resulting in cellular vacuolation and degeneration (Azad *et al.,* 2006). Mostly affected in larvae and juveniles from intensive culture systems. Photoreceptor contains clumping of melanin and degenerated cones in retina. Temporary flexion of the body results due to tonic spasms of myotomal musculature can be observed. Abnormal swimming patterns, anorexia and change in pigmentation are frequently observed.

**Transmission:** It is transmitted by both vertical and horizontal transmission. Vertical transmission is by the virus in reproductive fluids in male and female brood stock and fertilised eggs infected with virus (Johansen *et al.,* 2002) while horizontal transmission is by water supply, feeding contaminated fish and cannibalism (Hick *et al.,* 2011; Manin and Ransangan, 2011). Brood stock not infected with the virus and maintaining good water quality prevents transmission.

**Diagnosis:** The virus is diagnosed by lesions in the retina under light microscope and virions under electron microscope, serological techniques and molecular techniques like ELISA, PCR (Munday *et al.,* 2002). In substitutions to antibodies aptamers are used in enzyme-linked apta-sorbent assay (ELASA) procedure (Zhou *et al.,* 2017). Although identification of the subclinical infection is difficult due to the low quantity of viruses.

**Treatment:** There is no treatment for VNN, but now formalin deactivated betanodavirus gives protective immunity to seabass. Proadifen hydrochloride, a cytochrome P 450 inhibitor, showed strong anti-VNN activity (Bandin and Souto, 2020). Recombinant viral coat protein expression in Escherichia coli or virus-like particles expressed in a baculovirus expression system or formalin-inactivated virus may be effective in controlling the disease



1. **Iridovirus:**

Iridovirus, a member of the family Iridoviridae cause infection in freshwater and marine fishes known as Lymphocystis disease virus (LCDV). Pebble or wart-like nodules seen on the fins, skin, or gills.

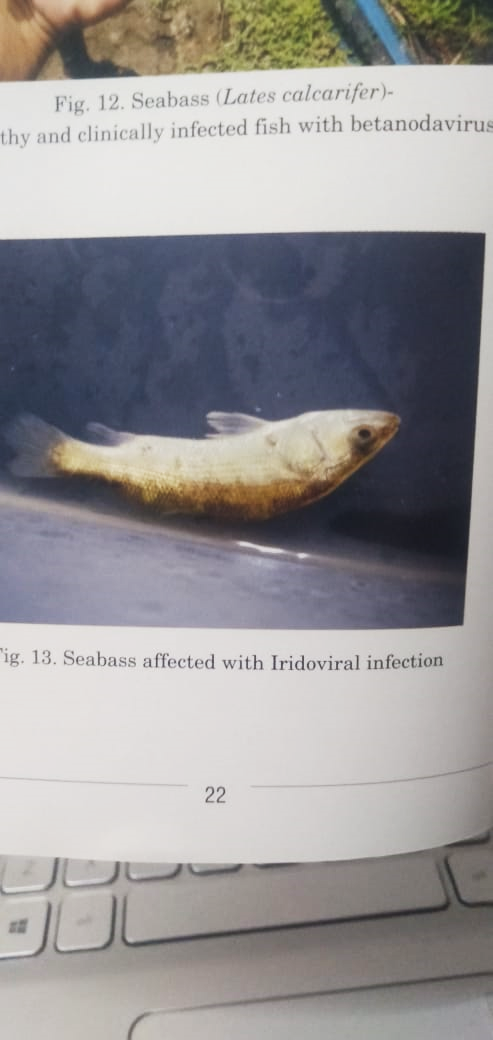
**Geographic distribution:** This infection was reported in Australia, Thailand and Singapore. 10% mortality has been reported in Thailand (Tonguthai and Chinabut, 1987) whereas 100% mortality in fry of Asian seabass in Singapore (Cheong *et al.,* 1983).

**Symptoms:** Development of single or multiple nodular lesions in the fins, skin and internal organs (Pearce *et al.,* 1990). These lesions resemble cauliflower, so it is called cauliflower disease. Lesions inhibit physiological processes and lead to secondary infection that kills the fish.

**Diagnosis:** PCR and nucleic acid hybridisation technique (Cano *et al.,* 2007). Cell lines established have a susceptibility to LCDV include SF cells from Asian seabass (Chang *et al.,* 2001). SB cell line was also derived from Asian seabass.

**Transmission:** The virus can be transmitted only through horizontal transmission.

**Treatment:** No known method of therapy or immunization.Avoidance is the universal control measures. Preventive measures are culling of infected fish and stocking of disease-free certified fishes. Stocking density should be decreased because transmission is through direct contact.

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* **Bacterial diseases:**

The common bacterial pathogen affecting Asian seabass are Streptococcus, Flexibacter, Vibrio, Aeromonas, *Cytophaga johnsonae* and Epitheliocystis. They are of wide range of shapes, ranging from rods to spheres. Most of the bacteria are harmless. Among them few are beneficial. A few harmful bacteria cause infectious diseases in fishes that may be transmitted to humans (Austin, 2010).

1. **Streptococcus:**

**Aetiology:** Streptococcosis is caused by gram-positive bacterium *Streptococcus iniae.*

**Geographic distribution:** It was once reported in Australian marine cages that caused 70% loss in production (Bromage *et al.,* 1999). In northern Australia, outbreaks of *S.iniae* are typically associated with mud and silt entering fish cages due to heavy rain (JH Creeper and NB Buller, 2006).

**Symptoms:** Sub-acute clinical signs are swelling of eyeball, darkened colouration and erratic swimming (Perera et al, 1998). Acute sign is mild corneal opacity. Infection in internal organ is haemorrhage, hyperhaemia, cellular degeneration and inflammatory cells infiltration (Kayansamruaj *et al.,* 2017). There is heavy loss in acute infection whereas in sub-acute only 1% loss (Bromage and Owens, 2002). Wild fish cultured in sea cages serves as an important reservoir of *S.iniae*. This is a zoonotic agent that affect the individuals handling infected fish which causes development of cellulitis in hands and endocarditis (Agnew and Barnes, 2007).

**Diagnosis:** Conventional and rapid identification system Polymerase chain reaction (PCR) was used to determine *S. iniae* (Suanyuk *et al.,* 2010).

**Treatment:** Vaccination in fishes showed only limited success up to six months. Infection fish can be protected by administration of oral or injection of antibiotics (Agnew and Barnes, 2007). In cages, reduction in stocking densities, removal of moribund fish and effective barrier are the measures to control the disease. In closed recirculatory systems, stocking of disease-free fish, disinfection and reduced stocking density will eliminate the disease. Immunization with oil-based formalin-killed vaccines prepared S. iniae (Lan *et al.,* 2021). A single vaccine containing combination on *Streptococcus iniae* and *Streptococcus agalactiae* showed better results (Lan *et al.,* 2021). Extracts of *Sargassum* sp. can be used as an immunostimulant against *S.iniae* (Yangthong *et al.,* 2016).

1. **Vibrio:**

**Aetiology:** Vibriosis, a deadly haemorrhagic septicaemia disease is caused by vibrio. Vibrio may be *V.cholera, V.parahyemolyticus, V.anguilaarum* and *V.ordalii.* They are gram -ve, motile, curved or straight rods (0.5 × 1.5 – 2.5 μm).

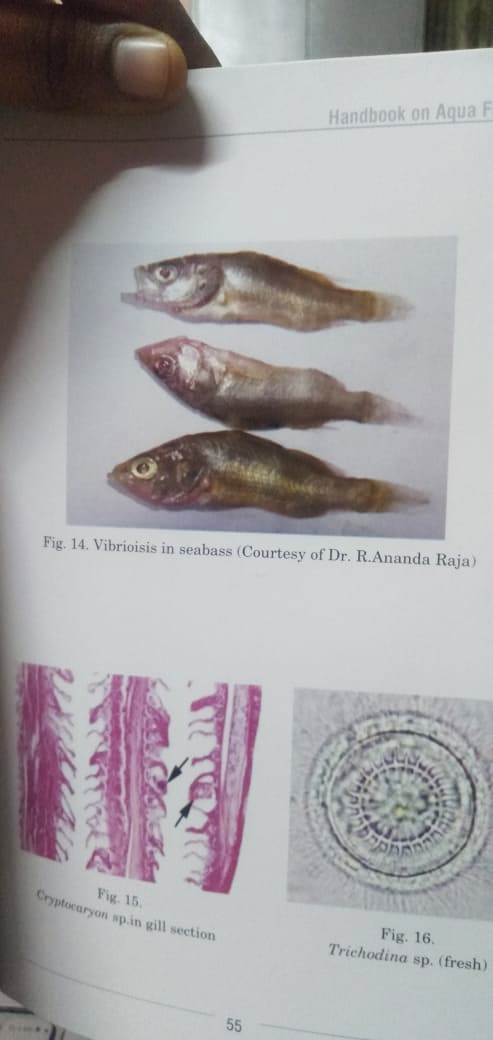
**Geographic distribution:** It was reported in phillippines with 2-3% daily mortality (Tendencia, 2002).

**Symptoms:** Infection was characterised by extensive cutaneous, systemic haemorrhage and localised cutaneous ulceration (Krupesha Sharma *et al.,* 2013). Abnormal swimming behaviour, opaque eyes, exophthalmia externally and necrosis and haemorrhage in kidney, liver and spleen internally. Due to huge mortality, research has been undertaken to elucidate virulence of the pathogen by developing detection techniques (Frans *et al.,* 2011).

**Diagnosis:** Culture on selective medium- thiosulphate citrate bile salt agar (TCBS)

**Transmission:** Transmission is horizontal through oral route.

**Treatment:** Administration of antibiotics like oxytetracycline.Vaccination with a dose of DNA plasmid encodes the major outer membrane protein (Kumar *et al.,* 2007).



1. **Aeromonas:**

**Aetiology:** Motile aeromonads of *Aeromonas hydrophila* cause haemorrhagic septicaemia in fish. It is opportunistic gram negative, motile bacterium.

**Symptoms:** External signs include dark colouration, swollen abdomen, reddened body, necrotic fins and extensive ulcers over flanks. Initially, shallow ulcers then the surface progress to brown as it necrotizes or decays. Dropsy, hyperemia and congestion of internal organs are found as internal signs.

**Diagnosis:** Agar like TSA, nutrient agar and MacConkey agar (Moyer, 1996), gel-diffusion technique, ELISA, PCR and DNA fingerprinting AFLP (Huys *et al.,* 1996).

**Transmission:** This is transmitted horizontally by discharge from intestinal tract, external lesions on the skin and water.

**Treatment:** Antibiotic like oxytetracycline, sulfamerazine. Formalin-killed vaccine of *S. agalactiae, V. harveyi* and *A. hydrophila* strains were mixed with feed pellet and an adjuvant was added to improve their antigenicity (Mohamad *et al.,* 2021).

1. **Flexibacter (Gliding bacterial disease / Tail rot disease):**

**Aetiology:** Columnaris disease is caused by gram-positive, filamentous *Flexibacter columnaris.*

**Symptoms:** They enter through damaged caudal fin, then invade the muscular region by disintegrate and causing typical tail rot. Internal organs show no pathological changes.

**Diagnosis:** Wet mount preparation of infected tissues, microscopic examination of lesions.

**Transmission:** This disease easily affects the stressed fish. It enters the fish through gills, mouth or any wound on the skin which is highly contagious as it spreads easily.

**Treatment:** Feed mixed with oxytetracycline or a bath treatment in sodium nifurstyrinatecan be used as a standard treatment. Freshwater treatment with reduction of stocking density reduces mortality (Sobhana, 2009).

1. ***Photobacterium damselae* subsp. *damselae:***

*Photobacterium damselae* subsp. *damselae* is a bacterial pathogen present in seawater.

**Symptoms:** abdominal swelling, exophthalmia, darkening of the skin and yellowish discolouration around the anus externally and cloudy yellow abdominal cavity and gelatinous fluid with liver haemorrhage.

**Diagnosis:** This disease is diagnosed by PCR.

**Treatment:** Use of antibiotics is only means to prevent the disease.

1. ***Cytophaga johnsonae:***

**Aetiology:** *Cytophagaa johnsonae* is a filamentous gram-negative, rod shaped bacterium.

**Symptoms:** Erosion of skin, lower jaw and pectoral fins are affected. At the end of lesions, scales became elevated. It was reported initially in Queensland with 2-5% mortality (Carson *et al.,* 1993).

1. **Epitheliocystis:**

Epitheliocystis or gill chlamydia is caused by chlamydia or rickettsia-like microorganism. This disease caused by epitheliocystis witnessed by formation of cyst on the gills and skin as in barramundi (Meijer *et al.,* 2006). They do not function outside the host because they are obligate intracellular bacteria. Research says that it is chronic and opportunistic pathogen in seabass (Anderson and Prior, 1992).

**Transmission:** Mode of transmission is still unknown, but horizontal transmission has occurred in some host species.

**Diagnosis:** White to yellow cyst on the gills or skin. Histology and electron microscopy is used (Nowak and LaPatra, 2006).

**Treatment:** There is no treatment for epitheliocystis.

* **Fungal diseases:**

The fungal infection caused in Asian seabass is EUS. Fungi are filamentous, microscopic organism that produce spores.

1. ***Aphanomyces invadens*:**

**Aetiology:** Epizootic Ulcerative Syndrome is caused by *Aphanomyces invadens* where motile spores invade the skin. It is reported only in freshwater and estuarine waters.

**Symptoms:** Infection begins with a small area of reddening over a single scale so called as red spot disease. In Asian seabass, development of cloudiness of cornea with or without lesions in the skin. It causes huge losses in Asian seabass juveniles (Humphrey and Pearce 2004). Since it appears on skin, marketability problems occur.

**Diagnosis:** PCR (Afzali *et al.,* 2016).

**Treatment:** Antiseptic iodophore solution or increase in salinity is the control measure (Humphrey and Pearce 2004).

* **Protozoan parasites:**

Protozoans are unicellular eukaryotic organisms. They are most important parasites affecting fish. They cause harm to fish mainly by mechanical damage, secretion of toxic substance, occlusion of blood vessels and leaving host to secondary infection. The various protozoan parasites are flagellates like Trypanosoma, Oodium and Henneguya sp. Ciliates like Trichodina, Chilodenella, *Cryptocaryon irritans* and Epistylia.

1. **Flagellates:**
2. **Trypanosoma:**

**Transmission:** Parasite directly transfer from one fish to another (Buchmann and Bresciani, 2009). Leeches are intermediate host.

**Symptoms:** Affected seabass shows anorexia, lethargy, scale loss, splenomegaly and exophthalmia (Humphrey *et al.,* 2010). Trypanosoma infect the vascular system (blood) of fishes that cause anaemia and lethargy.

**Diagnosis:** Under light microscopy with stained blood smear. In Australian marine cages, it was diagnosed as primary cause of death.

**Treatment:** There is no treatment but eradication of leeches helps in protection from trypanosomes.

1. **Oodinium sp:**

**Aetiology:** Velvet disease is caused by Oodinium species. They are dinoflagellates. In marine, *Amyloodinium ocellatum* and in freshwater, *Piscinoodinium pillulare*. It has two flagella for attachment and locomotion which infects skin, fins and gills.

**Symptoms:** Pyriform trophonts (<160 µm) attach to the epidermis with rod like rhizocysts which penetrates epithelial cells and finally destroy by causing hyperplasia, fusion of lamellae and petechial haemorrhage (Humphrey *et al.,* 2006). External velvet-like layer occurs on surface.

**Diagnosis:** Infection diagnosed by microscope.

**Treatment:** Bath treatment with copper sulphate (<2ppm) or benzalkonium chloride (0.5ppm).

1. ***Henneguya sp*:**

**Aetiology:** *Henneguya setiuensis*, *Henneguya voronini* and *Henneguya calcarifer* were reported in Lates calcarifer in Malaysia (Borkhanuddin *et al.,* 2019).

**Symptoms:** *Henneguya sp* infects the gills and when heavy infection found on skin. Gross signs are hyperplasia, bronchitis and necrosis. Two flagella are used for attachment in host and transforms to sac-like trophont which encyst and produce dinospores.

**Diagnosis:** Diagnosed based on clinical signs, gross lesions and microscopic examination of wet mounts from gill biopsy.

**Treatment:** Bath treatment with copper sulphate (<2 ppm) or benzalkonium chloride (up to 0.5 ppm) for up to 3 days may be effective (Buchmann and Bresciani, 2009).

1. **Ciliates:**
2. **Tricodina:**

Trichodina is a genus of ciliate protists which provide support for the cell that have a ring of interlocking cytoskeletal denticles which allows for adhesion to surfaces of Asian seabass. They affect the gills and inner operculum of barramundi (Rückert *et al.,* 2008). They reproduce by binary fission and feed on organic matter by filtration. Dense populations inhibit normal physiological function like osmoregulation.

**Symptoms:** Clinical signs are excessive mucous production, anorexia, hyperventilation and lethargy.

**Diagnosis:** Microscopic detection in gill or skin scrapings.

**Treatment:** Bath Treatment of copper sulphate, formalin, sodium chloride and sodium percarbonate (Buchmann and Bresciani, 2009).

1. **Chilodenella:**

Chilodonella are freshwater single cell organisms that have been linked to huge Asian seabass in freshwater pond systems in northern Queensland. They harm the skin and gills.

Symptoms: Osmoregulation, gas exchange, excretion morbidity, mortality, lethargy, and anorexia are only a few of the physiological processes that are inhibited by dense populations on the host epithelium.

Diagnosis: Diagnosed by microscopic detection in gill or skin scrapings.

Treatment: Bath treatment containing malachite green, methylene blue, formalin, copper sulphate, and other chemicals (Buchmann and Bresciani, 2009).

1. ***Cryptocaryon irritans*:**

**Aetiology:** A ciliated protozoan parasite that occurs in marine (*Cryptocaryon irritans*; saltwater ‘Ich’) or freshwater (*Ichthyophthirius multifiliis*; freshwater ‘Ich’) environments causes white spot disease.

**Symptoms:** White spots (0.4–0.8 mm) on external fish surfaces are encysted trophonts, which feed on host epidermis. Tomonts encyst to form tomocyst that undergoes numerous cell divisions. One tomocyst produce 1000 free-swimming theronts that escape to attach a host. Increase in temperature may cause infection (Karvonen *et al.,* 2010). *r*Once the organism establishes in a large fish culture facility, it is difficult to manage due to its rapid life cycle with 100% mortality if left untreated.

**Diagnosis:** Diagnosis is by making skin scrapings and examining for trophonts under microscope.

**Treatment:** A bath treatment that works well is malachite green (0.2 ppm). Infectious theronts and trophonts can be eliminated with the use of formalin, copper sulphate, sodium percarbonate, sodium chloride, hydrogen peroxide, or other disinfectants.

1. **Eimeria:**

Eimeria is a significant pathogen of Asian seabass that affects the intestine in Vietnam nurseries (Gibson-Kueh *et al.,* 2011). Genetic sequences for piscine-derived eimeria are not yet found.

1. **Epistylis:**

Epistylis is a freshwater protozoan parasite belonging to the sub-class Peritrichia occasionally turns pathogenic. It attaches to the fish by using stalks. When they are large in number enough to cause a grey mat on the epithelial surface at different temperature.

* **Metazoan parasites:**

Metazoan parasites are multi-celled organisms that live on and within the body of their host. Common metazoan parasites are monogeneans, digeneans, cestodes, nematodes, acanthocephalans, leeches and crustaceans.

1. **Helminthes:**
2. **Monogenean trematodes (haptor worms):**

Monogeneans are one of the most serious parasitic diseases in Asian seabass when left untreated, fish develop secondary infections (Leong, 1997; Anonymous, 2011). The reported monogeneans to infect Asian seabass are *Neobenedenia melleni* and *Benedenia epinepheli* which are prevalent in tropical and subtropical fishes worldwide that lay eggs into the water which hatch into ciliated larvae and directly infect fish.

**Symptoms:** Clinical indicators include anorexia, lethargy, pale gills, a darker body, and increased mucus production. Fish with high levels of infection become emaciated and die as a result of subsequent bacterial infections. In Indonesia and Australia, fatality rates of 30–40% are frequently observed (Deveney et al., 2001; Ruckert et al., 2008). They irritate the eyes, resulting in opacity, exophthalmia, and fraying of the caudal and pectoral fins. They erode on mucous and epidermis.

**Treatment:** Acute bathing of infected fishes with formalin or freshwater solutions is effective method (Thoney and Hargis, 1991; Fajer-Avila *et al.,* 2008). Natural treatment methods are used instead of chemicals (Hutson *et al.,* 2012, Militz *et al.,* 2013).

1. **Digenean trematodes (flukes):**

Digenean occurs in wild and captive Asian seabass. They are usually found as **immature metacercariae in fishes**. The blood flukes (Family Aporocotylidae) are serious pathogens of hosts in mariculture. Although these species have no known pathology, other fish blood fluke are considered a major threat to fish production.Thin shelled eggs can be diagnosed in microscopy or histology.

**Geographic distribution:** *Cruoricola lates* was reported in Malaysia, Thailand and Australia in cultured Asian seabass (Herbert *et al.,* 1994). *Parasanguinicola vastispina* infects cultured fish in Malaysia (Herbert and Harrison, 1995).

**Symptoms:** Eggs from adult parasites are released into the circulatory system. They impair the physiological function of these organs by causing inflammation in the gills, heart, spleen, pancreas, kidney, liver, or other organs. They cause problem in open or semi-closed aquaculture systems because their intermediate invertebrate host may inhabit areas close to farmed fish, such as on cage structures or in sediment (Cribb et al., 2011). Flukes discovered as adults in blood arteries. The intestine of sea bass is affected by *Lecithochirium* sp., particularly in wild fish. 86% of people were infected, and 5.5% of people had an average parasite burden. *Pseudometadena* *celebesensis* is another digenetic trematode frequently discovered in the intestine of wild seabass. It had a 100% infection rate and a 9.3% parasite burden, respectively.

**Treatment:** Oral administration of praziquantel against blood fluke infections (Hardy-Smith *et al.,* 2012, Shirakashi *et al.,* 2012).

1. **Nematodes (roundworms):**

Nematodes are long, slender and cylindrical un-segmented worm that tapers at each end. In wild and farmed Asian seabass, several larval nematodes have been documented. Larval nematodes may be able to survive in a large variety of intermediate hosts. Members of Anisakidae have been reported from farmed Asian seabass, if raw or undercooked seafood is consumed it may cause health issues in humans (Sabater, 2000).

**Treatment: P**reventive measure is use of extruded pellet feed..

1. **Cestodes (tapeworms):**

**Aetiology:** In farmed Asian seabass, two species of cestodes were found namely, *Scolex pleuronectis* and *Nybelinia indica* (Ruckert *et al.,* 2008) while other species are found in wild fishes.

**Symptoms:** Cestodes infect intestine, stomach, mesenteries and pyloric caeca of Asian seabass. Larvae of cestode (plerocercoids) are found in Asian seabass.

**Treatment:** Feeding of extruded pellets reduce the infection (Ogawa, 1996)

1. **Leeches:**

Leeches are segmented predatory worms and belong to subclass Hirudinea that occur in freshwater, brackish and marine environments. They get attach to their host using suckers which feed on the blood of the fishes (host) and leave the host. Until the last meal is digested it does not gets attached to another host (Kearn, 2004). It inhibits the host’s clotting enzyme, thrombin by injecting saliva while feeding to prevent clotting in fishes.

**Symptoms:** Anaemia, body discolouration, scaleless body, frayed fins and restless swimming. To lay cocoons on a chosen substrate, including aquaculture structures such as moorings and nets, they detach from host. The cocoons have ring-shaped compartments that protect the developing embryo from the environment. In severe infestations, the fish are unable to be sold because of frayed fin, bleeding and swelling at the attachment site and feeding site (cruz-lacierda e al., 2000).

**Treatment:** 50ppm formalin bath treatment found effective for managing leeches (Cruz-Lacierda *et al.,* 2000)

1. **Acanthocephalans (spiny-headed worms):**

Acanthocephalid wormshave not been observed as serious pathogens of fish. The great majority of acanthocephalans in seabass are found as adults in the gut with its row of hooks.

1. **Crustacean parasites:**
2. **Copepods:**

Caligus adults are capable of swimming but other copepods cannot swim and can leave one host to become attached to another. Due to their broad distribution, direct life cycle and low host specificity, they are threat to aquaculture. This species was found in sea caged Asian seabass in Malaysia (Venmathi Maran *et al.,* 2009, Muhd-Faizul *et al.,* 2012).

**Aetiology:** Several harmful copepod species (sea-lice) are known from wild and farmed Asian seabass including *Caligus epidemicus, C.chiastos, C.orientalis, C.pagrosomi, C.rotundigenitalis* and *C.punctatus*.

**Symptoms:** The haematophagous copepod, *Lernanthropus latis* is found in brackish pond culture and sea cage culture of Asian seabass in Australia and its presence is associated with poor fish health (Kuo and Humphrey 2008). Adult females attach to the primary gill filaments whereas smaller males attach to females in gills (Brazenor and Hutson 2013). Parasites cause irreparable damage to the gills by way of their mode of attachment and feeding activity (Small et al. 2002) by causing haemorrhages, hyperplasia and necrosis along the secondary lamellae of gill filaments (Kua et al. 2012).

**Treatment:** Emamectin benzoate (EMB) is found to be an effective oral treatment for controlling caligus (Raja et al, 2020).

1. **Isopods:**

Isopods that resemble *Aega* sp. have been found abundant in cage-cultured seabass.

**Symptoms:** Clinical signs are fish lose appetite, become anaemic, and grow very slowly. In heavily infected young fish, death occurs in 2-3 days. In wild fish, *Nerocila barramundaei* and *Rocinela latis* are only known but pathology is not known. Parasitic isopods feeds blood of the host fish. Infections of farmed hatchery seabass in the branchial and antero-dorsal regions by *Cymothoa indica* resulted in skin lesions caused low growth rates and mortality (Rajkumar *et al.,* 2005). The parasite always attaches to the gills.

**Treatment:** Preventive measure is to filter wild zooplankton.

**Conclusion:**

The range of diseases and parasites that could infect Asian seabass, and even the best ways to cure infections, are still being studied. Stress reduction, parasite and pathogen mitigation, and the use of potent medications and immunisations are the main management objectives. The most effective method for disease control is good health management. It is possible for pathogens to spread both vertically and horizontally if wild conspecifics are still used for stocking. We comprehend more about the biology of the pathogens as our understanding of Asian seabass disease grows. To assist prevent diseases and boost productivity, enhanced management techniques and ideal rearing environments will be developed. Overall, prevention must take precedence over therapy.

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