Part 1 – The parasites

Important parasitic diseases in cultured marine fish in the Asia-Pacific region

by Leong Tak Seng, Zilong Tan and William J. Enright

Parasitic infections and associated diseases are becoming more frequent with the intensification of mariculture systems in many parts of the Asia Pacific region. In this two- part article, the authors provide information on the various pathogenic parasites and their control measures.

Traditional marine fish farming in South-East Asia. Different species of fish with overlapping generations are cultured at one farm site. The lack of good health management practice, such as high stocking density, feeding trash fish and poor sanitation, has led to a high incidence of diseases.

Mariculture is a form of rearing aquatic organisms for commercial purposes, either in an open coastal ecosystem or in a controlled marine ecosystem. It is an important aquaculture activity in the Asia-Pacific region. There are over 40 marine fish species commonly cultured, such as groupers (*Epinephelus* spp.), snappers (*Lutjanus* spp.), Asian seabass (*Lates calcarifer*) and golden pompano (*Trachinotus blochii*). They are typically cultured in open floating net-cages along the Asia-Pacific coastal areas, with an annual production of approximately one million tonnes.

The increasing intensification of production and lack of health management measures have lead to many disease problems of bacterial, viral, fungal and parasitic origin. In recent years, the improper use of chemicals and antibiotics has raised concerns regarding both human and environmental safety.

Under natural environmental conditions, coastal waterways are free of obstructions. However, the placement of floating net-cages along these waterways has created 'artificial islands', resulting in the congregation of a diverse biological community comprising both vertebrate and invertebrate organisms. Therefore, one would expect to find a similar congregation of bacteria, viruses, fungi, parasites and other pathogens within this newly- created ecosystem, as well as the natural occurrence of other wild aquatic organisms.

Mortality of a large number of fish is seldom observed in the wild and, when it does occur, it is most likely to be due to sudden environmental deterioration. However, in the confined net-cage environment, mortality is often seen. Signs include abnormalities in behaviour, darkened body, exophthalmia (pop eye) and ulcerations on the fish body. There are many causes of fish mortality in the confined net-cage environment but possible causes for these disease outbreaks are pathogenic parasites.

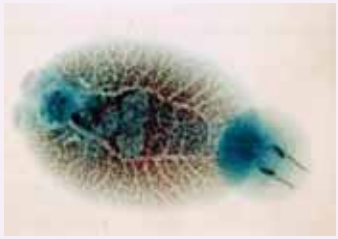
What are parasites, how do they enter the net-cages and how are they maintained there?

Parasites are invertebrate organisms; some are free-living and can become opportunistic parasites; others require hosts for their survival and reproduction, and these are referred to as obligate parasites. Both opportunistic and obligate parasites are found in fish hosts but most parasitic diseases in fish are generally caused by obligate parasites.

Types of parasitic diseases

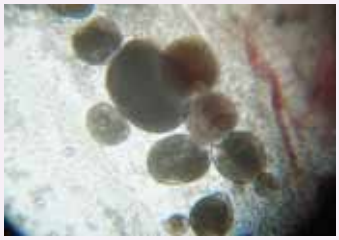
Most apparently healthy fish usually harbour various parasites but at low numbers, either on or in their bodies. The low number of these parasites generally causes little or no harm to the fish. However, when the number of parasites per fish increases significantly (the natural parasite-host balance becomes broken) due to overstocking, changes in water temperature or salinity that are favourable to the reproduction and growth of parasites, or that cause a reduction in fish immunity

Examples of some of the parasites that cause diseases in marine fish in the Asia-Pacific region.



Neobenedenia sp. (skin fluke)

Haliotrema spp. on gills (gill fluke)



Cryptocaryon irritans (white spot)

Caligus sp. (sea lice)

Table 1. Fish diseases caused by protozoan parasites at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)

Parasite	Site of infection	Hatchery	Nursery	Grow- out		Major signs
				Newly stocked	Grow-out	
Ciliates						
Cryptocaryon irritans (white spot)	Gills & body surface	++	+++	+++	+++	Whitish spot on body surface, darkened body, lethargy, exophthalmia, increased mucus production, rub body surface against net.
Trichodina spp.	Gills & body surface	++	++	+	+	Lethargy, non-feeding, pale gills with increased mucus production, rub body surface against net, hyperplasia and necrosis of epidermis.
Brooklynella spp.	Gills & body surface	+++	+++	++	+	Lethargy, non-feeding, rub body surface against net, subcutaneous haemorrhage.
Henneguya spp.	Gills & body surface	+++	+++	++	+	Pale gills and hyperplasia.
Dinoflagellate						
Amyloodinium ocellatum	Gills & body surface	+++	+++	++	+	Fish gather at water surface or aeration outlet, rapid gill operculum movement, pale gills, darkened body, increased mucus production in gills.
Myxosporean						
Sphaerospora epinepheli	Kidney, liver, spleen, & intestine	–	++	++	+	Loss of equilibrium, floating upside down, some with swollen abdomen & haemorrhages on mouth and body surface.
Microsporidian						
Glugea spp.	Internal organs	–	+	++	+++	Swollen abdomen, black nodules on internal organs.
Pleistophora spp.	Internal organs	–	+	++	+++	Swollen abdomen, black nodules on internal organs.

Table 2. Fish diseases caused by plathyhelminthes at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)*

Parasite	Site of infection	Nursery	Grow-out		Major signs
			Newly stocked	Grow-out	
Capsalid Monogenean (skin flukes)					
Benedenia spp. *Neobenedenia* spp.	gills & body surface	+++ +++	+++ +++	+++ +++	Darkened body, erratic swimming behaviour, rub against net, pale gills, lethargy and loss of appetite, opaque eyes, patches of "dryness" on scales or loss of scales at forehead (above the eyes), haemorrhage & necrosis on body surface.
Diplectanid mongenean (gill flukes)					
Pseudorhahdosynochus spp. *Diplectenum* spp	Gills	++ +	++ +	+ +	Darkened body, rub against net, pale gills, lethargy, loss of appetite, excess mucus production.
Dactylogyrid monogenean (gill flukes)					
Haliotrema spp. *Dactylogyrus* spp.	Gills	+++ +	+++ +	+ +	Rub against net, devoid of scales at forehead (above eyes), pale gills, lethargy, loss of appetite, excess mucus production.
Microcotylid monogenean (gill flukes)					
Heterobothrium spp. *Heteraxine heterocerca* *Microcotyle* spp. *Bivagina* sp. *Choricotyle* sp.	Gills	+++ +++ ++ ++ ++	+++ +++ ++ ++ ++	+ + + + +	Show no clinical signs except lethargy, loss of appetite, pale gills and anaemia.
Sanguinicolid digenean (blood flukes)					
Cruoricola lates *Pearsonellum corventum* *Cardicola* sp. *Paradeontacylix* spp.	Circulatory system	++ ++ ++ ++	++ ++ ++ ++	+ + + +	No obvious signs, affected fish gasp for air at the water surface, gill lamellae fusion & hyperplasia.

** These parasites are seldom observed in hatcheries*

(due to these stressful conditions), parasitic disease outbreaks often occur. Parasitic disease and other pathogens are interrelated. For example, bacterial and viral diseases can weaken fish and make them more susceptible to parasitic infestation and *vice versa*. In an aquatic ecosystem, where the health conditions of cultured fish are not easily observed, proper care of the fish and their environment are of the utmost importance. This is to help the natural immune system of the fish react and keep the pathogens in check.

A large variety of parasites have been reported in cultured marine fish. Some of these parasites have caused serious disease outbreaks in farmed fish resulting in significant financial losses to fish farmers. Parasites either cause major disease outbreaks in cultured fish or rather contribute to a chronic sub-clinical effect. In general, the fish are most susceptible at the early stages, particularly at the hatchery and nursery stages of the culture cycle when fish are small.

Parasitic organisms affecting cultured fish can be grouped into

Table 3. Fish diseases caused by crustacean parasites and leeches at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)*

Parasite	Site of infection	Nursery	Grow-out		Major signs
			Newly stocked	Grow-out	
Copepods					
Caligus spp. (sea lice)	Gills	+	+	+	Lethargy at the water surface, haemorrhages, erosion of scales and skin at affected body surface, loss of appetite, pale gills and excess mucus production, haemolysis, hyperanaemia and hyperplasia.
Pseudocaligus spp.		+	+	+	
Lernanthropus latis		+	+	+	
Isopods					
Rhexanella sp.	Body surface	++	++	+	Loss of appetite, rub body against object on side of net, sluggish swimming, rapid gill operculum movement with isopods in buccal cavity, necrosis of skin and gill filaments.
Nerocila sp.		++	++	+	
Hirudina (leech)					
Zeylanicobdella arugamensis	Body surface	+	+	+	Frayed fins, haemorrhagic and swollen at site of attachment loss of appetite, sluggish swimming.

** These parasites are seldom observed in hatcheries*

three main groups, namely, protozoa (Table 1), plathyhelminthes (e.g., flatworms & roundworms; Table 2) and crustaceans (Table 3). At each stage of the culture cycle, the pathogenicity of a particular pathogen on a fish host may differ. For example, the protozoa *Amyloodinium ocellatum* is very pathogenic to fry and fingerlings at the hatchery and nursery stages. At the initial stage of the grow-out phase of net-cage culture, the newly stocked fish become increasingly susceptible to parasitic diseases caused by capsalid monogeneans.

Many of these parasites can cause disease outbreaks and significant financial losses. Severity of parasites at various stages of the grow-out period and the disease signs are presented in Tables 1–3.

Entry of parasites to the culture system

Many species of marine fish are now produced in the hatchery for culture in ponds or net-cages, but some are still wild-caught. At the nursery stage, these fish are placed in cement tanks, ponds or net-cages for some time, before being transferred to grow-out cages.

It is very unlikely that fish nursed in cement tanks would have monogenean infections but they could be infected with protozoa. If the fry are nursed in ponds or nursery cages, they could acquire protozoa and monogeneans, as well as other pathogens. The wild-caught fingerlings could have been infected with pathogens before stocking.

Fingerling suppliers may also combine various batches of fish from different sources so as to have sufficient numbers of fish for distribution. However, an infected batch will spread disease to the others. Furthermore, net-cage farming is an open system whereby fish reared in the cages are in close proximity with wild fish which may transfer pathogens to those inside the cages. Also, in this region, trash fish are commonly used as feed which can act as a source of parasites.

One of the major problems in implementing control measures to prevent parasitic infection in net-cage fish farming in Asia is the overlapping generations (and species) of fish. There are no breaks in the production cycle or fallowing before the next batch of fish is stocked. As a consequence, naïve fish introduced into the farm would likely be infected with one or more species of parasite which already exist on the farm. Therefore, the fish farm itself is a reservoir for parasites.

Given the above scenario, how would one then be able to control parasitic infections in a farm? It is not possible to have a parasite-free environment; however, one can implement preventative and control measures to limit the populations of parasites in fish and to minimize the associated diseases. Fish infected with few parasites show no ill effects. Usually, parasitic diseases are caused by a high density of parasites. Very often, concurrent secondary bacterial infections occur, imposing an additive or synergistic effect on fish mortality.

Suggested Reading

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Part 2 of this article will appear in the next issue and will address the principles of control measures for parasitic diseases.

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