Common pathogens found in yellowtail kingfish *Seriola lalandi* during aquaculture in Australia

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Yellowtail kingfish aquaculture in sea-cages is an emerging industry in Australia. Monogenean, myxozoan and bacterial pathogens sometimes cause health issues that require diagnosis or monitoring.

Yellowtail kingfish *Seriola lalandi* aquaculture in Australia is in its infancy with just one commercial farm in South Australia at the present time. Currently there is also interest in sea cage aquaculture of this species in Western Australia and New South Wales. The natural range of this species is from Queensland right around the south of the mainland and as far as the mid-west of Western Australia. The fish is able to spawn and grow in captivity, is very fast growing and is a firm white fleshed fish which is especially popular for sashimi.

There have been several mortality events during aquaculture of this species. The fish are generally quite robust when held in tanks on land but once they are exposed to the extra stressors associated with sea cage culture they are more likely to have periods of reduced growth and spikes of mortality. The cause of these events can be difficult to identify and are often suspected of being multifactorial in nature with various stress factors being identified and opportunistic pathogens in some but not all of the fish. Bacteria such as *Vibrio harveyi*, *V. alginolyticus*, *Photobacterium damselae* subspecies *damselae* or a *P. damselae* subspecies *piscicida*-like bacterium are sometimes isolated from the spleen and kidney of moribund fish. At times the bacteria appear to have caused a chronic hepatitis, cholangitis and pancreatitis from an ascending infection from the intestine. At other times the pseudotubercular lesions, reported in *P. damselae* subspecies *piscicida* infections overseas[1], can be seen grossly in yellowtail kingfish in Australia. A deficiency in taurine due to feeding of incompletely formulated, manufactured fish pellets is one factor shown to predispose fish to ill thrift and subsequent infections resulting in mortalities. Other possible stress factors which may lead to immunosuppression in the fish could include low dissolved oxygen events, the presence of predators such as sharks, birds or seals around the cage and extremes of water temperatures outside the normal expected range for the species.

Monogenean parasites can have a severe detrimental impact on yellowtail kingfish in sea cages and continual monitoring of the fish to determine the intensity of infestation with these parasites is required. The main skin parasites of concern are the capsalid monopisthocotyleans *Neobenedenia* sp. (pers. comm., ID Whittington, South Australian Museum) (Figure 1) and *Benedenia seriolae*[2]. These are both tissue grazing parasites that are extremely irritating to the fish and fish become inappetant when parasite numbers are high. The blood feeding polyopisthocotylean parasite *Zeuxapta seriolae*[2] (Figure 2) occurs on gills and can cause severe anaemia and death if infestations are not managed appropriately.

Fish in sea cages become infected from wild fish in the waters around the sea cage. Most of the monogenean parasites infecting yellowtail kingfish are hermaphrodites that have a direct life-cycle and tanned eggs that are resistant to chemical treatments. The eggs may have

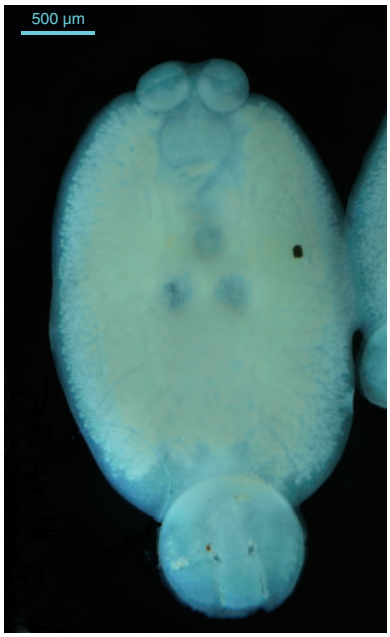

Figure 1. *Neobenedenia* sp. in a wet preparation. The parasite is very irritating to the fish and attaches to the fish by paired hooks on the haptor. Bar = 500 µm.

Figure 2. Wet preparation of *Zeuxapta seriole* demonstrating the clamps on the haptor that attach to the gill. Developing eggs can be seen in the parasite on the right. Bar = 500 µm.

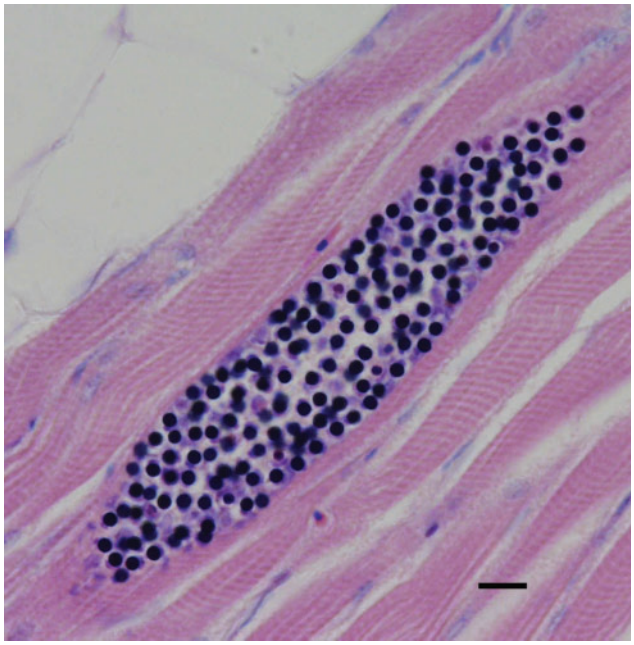

Figure 3. *Unicapsula seriolae* spores in skeletal muscle. Each spore has a single polar capsule. Giemsa. Bar = 10 µm.

a filament that becomes entangled on structures around the cage such as the net and moorings. Individual parasites can produce large numbers of eggs daily when water temperatures are suitable. *Zeuxapta seriolae* is particularly fecund[2]. One management strategy is for nets to be regularly cleaned or changed to reduce the number of monogenean eggs present in the sea cage environment. This also removes fouling organisms that reduce water flow through the cage. Parasite infection intensity is monitored by sampling live fish from the sea cage and placing the fish in a diluted praziquantal treatment bath. The parasites detach from the fish and can be counted before the fish is returned to the cage. Chemotherapy using hydrogen peroxide or paraziquantal baths is labour intensive as the sea cage must first be surrounded by an impervious tarpaulin. Then the oxygen in the bath water must be monitored and the static water aerated to ensure the fish have access to sufficient oxygen. The treatment dose must be calculated accurately and then well dispersed through the bath water. Timing is critical in these bathing processes and must be aligned with the lifecycle of the monogenean being treated.

A number of tissue dwelling myxozoan parasites have been observed infecting yellowtail kingfish that are confined in sea cages. Of these, *Unicapsula seriolae* (Figure 3) has the greatest potential to impact the industry due to the parasites' ability to cause unacceptably soft or liquefied flesh when high numbers of spores are present in the skeletal muscle[3]. It was first identified in wild fish in Queensland and also occurs in Western Australia[4]. It can infect yellowtail kingfish in sea cages that are in relatively shallow water close to the probable habitat of its intermediate host[5]. At the present time it does not appear to be a major impediment to the aquaculture of yellowtail kingfish. *Unicapsula seriolae* has not been identified as a problem in South Australia[6].

Several other myxozoan parasites have been seen in aquaculture operations but their presence has not been definitively linked with major morbidity or production loss in Australia. In one locality in Western Australia *Kudoa neurophila* was highly prevalent in the brains of yellowtail kingfish[5,7]. These fish had been spawned and reared in a nearby hatchery that used water pumped from the adjacent harbour where their likely invertebrate intermediate hosts (e.g. polychaete worms) were abundant. It is suspected that the fish became infected in the hatchery but the presence of infection did not present with pseudocysts in the brain until after the fish were stocked into sea cages. This parasite has not been seen in other hatcheries or yellowtail kingfish in aquaculture in Western Australia but did occur in striped trumpeter in a hatchery in Tasmania. The incoming water at that hatchery was infected with the infective stage of the parasite[8].

Other potential pathogens include myxozoans in the epicardium and in the lumen of kidney tubules in some fish. The *Kudoa* species in the heart is similar to *K. pericardialis* that occurs in Japan[9]. Uncharacterised Apicomplexan parasites have also been seen in the intestines of fish with ill thrift. Blood flukes of the Aporocotylidae were identified as a potential risk factor for yellowtail kingfish aquaculture in Australia[6] and have occurred in sea cage aquaculture in South Australia.

In summary the Monogenea have been the most troublesome pathogens of yellowtail kingfish culture in Australia. Their

management requires regular monitoring of the intensity of infestation together with time consuming and logistically demanding therapeutic bathing at strategic times. Other pathogens cause sporadic problems that require management on a case by case basis.

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Biography

Fran Stephens is a Fish Pathologist at the Fish Health Unit of the Department of Fisheries in Western Australia. She has an interest in diseases of aquatic animals and the management of aquaculture production units.

A simple summary of ASM Finances

The audited financial statements are available on the website, but, as required, they amalgamate all the financial activities of the society. This brief summary is provided to give members more insight into the individual areas that make up ASM finances.

1. The annual scientific meeting
The meeting held in Canberra in 2015 was a scientific, social and financial success, resulting in a final profit of $50 000, 10% of which is retained by the NSW branch.

2. State branches
Most states have financial holdings representing five years of capitation payments, therefore enabling them to organise most events without needing to charge members or obtain outside sponsorship. In total the branches hold a total of $250 000.

3. ASM
(i) Day-to-day operations:
99% of our income of $262 000 is derived from membership fees.
Capitation payments to the states of $52 000 represent 20% of this amount.
Expenditure of $190 000 is due mainly to payment for membership services provided by ASN ($96 000) and the production of *Microbiology Australia* ($45 000). Sponsorship of other meetings and membership of STA account for $9000 and $14 000 respectively.

(ii) Share portfolio:
The society has a share portfolio with a value of approximately $500 000, comprising seven holdings of comparatively equal value in the following companies: AGL, ANZ, BHP, CBA, CSL NAB and Westpac. The annual yield of approximately $24 000 is reinvested to maintain the value of the portfolio.

4. Research trust
The Research trust holds funds to the value of $1 028 000. These are held in capital notes and preference shares in CBA (50% of holding), ANZ, Macquarie, NAB (10% each) and the residual 20% in Bendigo Bank, BOQ and Westpac. These holdings yield an annual income of $47 500, which is used to pay all the society's awards. Any residual funds are reinvested.

The society's finances are responsibly and competently managed by Bree Knights and Kerrie Harris-Spencer at ASN, Tammy Currie at FAME, Rollo Morgan at Morgan's financial services and Eric Townsend (Auditor).

If you have any queries, please email Cheryl Power, VP Corporate Affairs, at cheryljp@unimelb.edu.au.