Identification and control of parasites in a new species for aquaculture: A case study with striped trumpeter, *Latris lineata*

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Our studies are taking place in Tasmania, Australia's southern most island state situated directly on the 'roaring forties', which has a very changeable weather pattern throughout the year with snowfalls not uncommon in summer. This cool to mild climate is ideal for temperate agriculture and aquaculture. The Tasmanian aquaculture industry began in the mid-1940s with the cultivation of Pacific oysters. It has since expanded to include other shellfish, such as abalone, scallops and mussels. Today the largest Tasmanian aquaculture industry involves the production of over 18,000 t of Atlantic salmon per year in sea cages. Since the beginning, the salmon industry has experienced various health challenges, including amoebic gill disease (AGD). Treatment of this disease using freshwater is relatively simple but expensive and progress is being made in the development of a vaccine. Atlantic salmon are also reared at sea temperatures close to their thermal maximum in late summer and it makes sense for the industry to diversify into other marine species. The industry is particularly interested in developing an alternative native white-fleshed fish species. Striped trumpeter, *Latris lineata,* was identified in the 1980s as a possible aquaculture species because of its tolerance to handling, high stocking density as well as superior flesh quality, which is high in omega-3 fatty acids and highly regarded as sashimi (Nichols *et al.* 2005).

Striped Trumpeter: An Overview

The striped trumpeter is a very interesting species with an unusual life history that includes a protracted postlarval stage and, until very recently, little was known of its biology (Tracey and Lyle 2005). The fish used to be plentiful, however the population is currently depleted because of the combined effects of fishing and several years of poor recruitment. The wild population will not be able to support higher levels of catch, therefore, aquaculture is seen as the best option to provide striped trumpeter in greater quantity. The species is common around Tasmania, the more southern waters of mainland Australia and around New Zealand and some islands in the Indian Ocean. They are typically found in water ranging between 11 and 18°C and spawn in Tasmanian waters between July and October, depending on latitude (Tracy and Lyle 2005). Adults live in deep water and can reach 1.2 m with sexual maturity reached at 5-6 years of age (Figure 1).

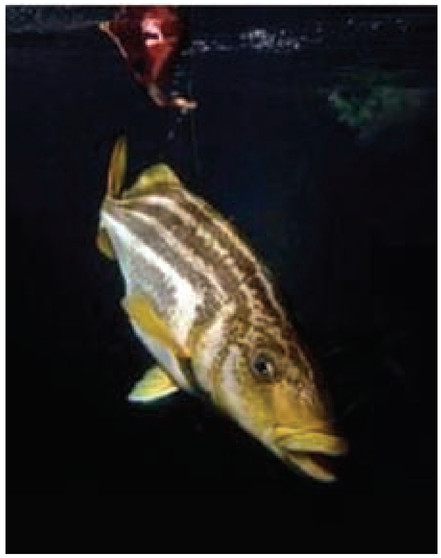

Fig. 1. Adult striped trumpeter at the Marine Research Laboratories, Tasmania

Research into the culture of striped trumpeter started in earnest in the 1990s with early emphasis being placed on the reproductive cycle, including broodstock management and egg incubation. Another very important aspect of the project was to develop techniques to improve the survival and quality of the early life stages by developing more efficient hatchery and incubation methods (Morehead and Hart 2003). Despite much research, the species has proven difficult to culture and only recently has reliable hatchery production been achieved following extensive research into nutrition and control of bacteria (Bransden *et al.* 2005, Battaglene *et al.* 2006). These studies have helped overcome many of the problems experienced in larval rearing and the first sea cage trials are planned at the time of this writing.

Aquaculture and the Problem of Diseases and Parasites

It is a widely accepted that diseases and parasites pose a major problem to aquaculture, with a variety of cultivated marine and freshwater species being affected globally. Examples of problem parasites are the copepods affecting the culture of Atlantic salmon and sea trout in the northern hemisphere, AGD in Atlantic salmon in Australia and the monogenean that affects the tiger puffer in Japan (Hirazawa *et al.* 2003). Emerging new species are particularly vulnerable as can be seen with yellowtail kingfish, *Seriola lalandi*, in Australia that are affected by the monogenean *Benedenia seriolae,* which causes reduced growth, poor carcass quality and increased mortalities (Chambers and Ernst 2005). An-

Fig. 2. Adult Chondracanthus *sp. parasitising the gills of the striped trumpeter*

other new species candidate cultured in Australia is the mulloway, *Argyrosomus japonicus,* which is parasitized by monogeneans and ciliated protozoans.

The research team working on striped trumpeter is aware that when they get their prized juveniles into sea cages the next big challenge will be how to keep them healthy. To date, one myxozoan parasite, *Kudoa neurophila* (Grossel *et al.* 2003), has been identified as a problem for the culture of striped trumpeter. This parasite targets the tissues of the central nervous system, which results in behavioral changes and is a possible cause of spinal deformities (Grossel *et al.* 2003, Grossel *et al.* 2005). Many infections result in a reduction in flesh quality and, therefore, have the potential to cause major losses to the industry. Good detection methods are available, including a polymerase chain reaction (PCR), which is useful in the detection of the parasite in the early stages of the host's life cycle (Grossel 2005). *K. neurophila* appears to only be a problem with larvae and postlarvae, but it remains to be seen if fully scaled juveniles are resistant when kept in high densities. Bacteria are another common problem in most hatchery-reared marine finfish and striped trumpeter are no exception. Both problems have been effectively resolved by treating the hatchery water supply with ozone. This has decreased the bacterial problem and the incidence and severity of infection by the parasite (Smith *et al*. 2006).

Striped Trumpeter and Its Uninvited Guests

Very little work has been conducted on the metazoan parasites of wild striped trumpeter outside two surveys off the New Zealand coast (Hewitt and Hine 1972, Hine *et al*. 2000). During those surveys four species of parasites were collected, including two nematode gut parasites and two monogenean gill parasites. So the discovery of two copepod parasite species on cultured striped trumpeter at the Marine Research Laboratories was of considerable interest. The first copepod (Figure 2) is a previously undescribed *Chondracanthus* species. No species belonging to the genus has ever previously been recorded from any cultured fish species. The parasite attaches to the hosts gills, operculum and nasal cavities (Figure 3), where their movement and feeding activity irritate the host tissue, which then becomes swollen and inflamed.

Fig. 3. Gills and operculum of a striped trumpeter parasitised by the Chondracanthus *sp.*

The second species (Figure 4) belongs to the genus *Caligus,* which is one of the most common groups causing problems in aquaculture. This group includes *Lepeophtheirus salmonis* Krøyer 1838 and *Caligus elongatus* Nordmann 1832, both of which cause major problems in the culture of Atlantic salmon in the northern hemisphere (Costello *et al.* 2004). The new species occurs on the skin where its movement and feeding activity cause discomfort to the fish host, especially when the parasites are found in high numbers. The host tries to relieve its discomfort by rubbing and this causes the formation of lesions, which are then susceptible to secondary infections. Although the species found on striped trumpeter belong to the genus *Caligus*, 20 years of farming salmonids in Tasmania suggests it does not parasitize Atlantic salmon.

Who are the Guests and How Do They Develop?

The discovery of new parasites on striped trumpeter has prompted a variety of descriptive studies. These include detailed descriptions of the male and female for both copepod species. This is a vital step that will aid in future identification if they are ever found parasitizing other fish species. We have also begun to describe their various life stages. Many descriptive studies have been conducted on the developmental stages of various *Caligus* species (MacKinnon and Piasecki1992, Piasecki and MacKinnon 1995), whereas only one study has been performed on those of the *Chondracanthus* species (Izawa 1986). During our studies we collect eggs from gravid females, hatch them using water baths and describe each developmental stage as it occurs (Figure 5). This allows us to predict the length of the developmental stages, which will assist us in developing effective treatments and preventing or controlling future outbreaks.

Fig. 4. Adult Caligus *sp. parasitising the skin of the striped trumpeter*

Fig. 5. Nauplii larval stage of the Chondracanthus *sp. parasitising the striped trumpeter*

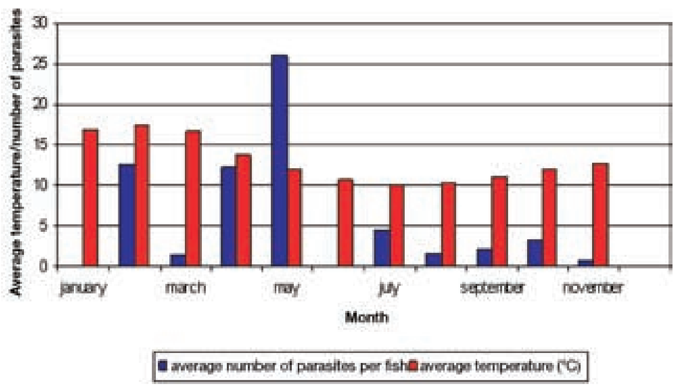

Fig. 6. Average number of chondracanthid parasites per fish compared to the average ambient temperatures

How Will We Control Them?

Many studies have been conducted on the development of treatment and control methods to reduce the impact that parasites have on aquaculture globally (Raynard *et al.* 2002, Treasurer 2002, Pietrak and Opitz 2004). Thankfully, neither parasite affecting the striped trumpeter is a major problem when present in low numbers. They only become a nuisance when their numbers increase rapidly (Figure 3). We will monitor parasite numbers to determine if they are affected by water temperature. Even though the project is in its first year we can see that there is a correlation between the chondracanthid parasite numbers and water temperature (Figure 6). In the case of the striped trumpeter, the lack of knowledge of the parasites affecting the species means that there are no treatments in place if the parasite loads increase. This is why it is vital that we use the knowledge gained from studying the developmental stages to identify those most susceptible to treatment. With the planned start of sea cage trials, there is a need for treatments that are easy, cost-efficient and effective as well as being environmentally sustainable and having minimal detrimental effects on the host. During this study we will examine the effects of freshwater, hydrogen peroxide and Neguvon® treatments on both copepod parasites at a number of concentrations and treatment times. We will conduct *in vitro* trials on the developmental stages for both parasites and determine the effect treatments have on parasite viability.

In vitro treatment trials for the adult *Caligus* sp. will be conducted, with the most effective treatment then being used to treat parasitized fish. Because the method of attachment used by the *Chondracanthus* sp., *in vitro* trials aren't possible, therefore, all treatment trials for the adult parasites will be conducted on parasitized fish. Many of the potential treatments to control parasite infections in aquaculture can be quite harmful to the environment. This is why we hope to develop one that will have minimal impact and could possibly replace other, more harmful, treatment methods.

Conclusion

Many parasites pose a considerable threat to aquaculture. The discovery of two previously undescribed copepod species on striped trumpeter is a potential challenge to the successful sea cage culture trials. With both parasites now fully described and their developmental stages being properly identified, we can concentrate on the development of control and treatment methods. We hope to eventually demystify general opinions regarding parasites by increasing our knowledge of their biology and effective control methods.

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Notes

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Ethics in Aquaculture

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we identify and recognize feelings of friendship and even love. Although the customer seems not to care about the welfare of cultured animals, universities and funding agencies do, especially with those used for scientific research. Curiously, the ethical principles of the Brazilian "ethic commissions for research animals" seem to apply only to vertebrates, fish inclusive, but leave those without a spinal column out; like shrimp and mollusks.

Going further into the social field, a development plan without ethics could also result in impacts to society. For example, agriculture in the context of the "Green Revolution" – a model that favored and still favors the cultivation of a single genetically enhanced crop – promoted mechanization and caused a major social impact, such as unemployment and migration of rural workers to the big cities. Furthermore, it is hard to understand why, particularly in Brazil, a country that produces more than 100 million tons of cereal grains and seeds annually, hunger still persists. In fisheries, the social consequences of exclusively profit-driven developmental policies are similar. For example, in Peru, a country with a population of almost 30 million people and with eight million tons per year of fisheries production, enough to feed every inhabitant with 250 g of protein daily, 40 percent of the population is malnourished. It is even worse because 90 percent of the fisheries are transformed into fishmeal or exported to other countries to be used as an animal feedstuff, instead of reducing hunger (Vinatea and Muedas 1998).

Ethics needs to be addressed. We must anticipate the revolutionaries and the critics from the establishment by pondering current ethics as a whole, not only the environmental implications. At the present time, when thoughts change radically, when humanity asks more and more about its ? role in the world, ethics should become the main item when preparing developmental policies, scientific research and technological studies for aquaculture. If we do not do it now, nature and society can condemn us sooner than we expect.

Notes

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