Available online at www.sciencedirect.com
ScienceDirect
Aquaculture
Aquaculture 268 (2007) 195–208
www.elsevier.com/locate/aqua-online

Advances in the culture of striped trumpeter larvae: A review

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Abstract

Striped trumpeter, *Latris lineata*, was chosen as the best new candidate for sea cage culture in Tasmania in the late 1980s. It has a complex and extended post-larval or 'paperfish' stage lasting up to 9 months and has historically proven difficult to culture. Excellent progress has been made in understanding and controlling reproduction and broodstock are spawned year-round through photothermal control. Problems with early larval rearing have been overcome and egg incubation and early larval rearing protocols have been established. A mortality peak associated with first feeding has been reduced using better live feed production techniques and improved water quality. Using antibiotics showed that high bacterial loads were an important factor in larval mortality. A new water filtration and ozonation system has removed the need for antibiotics. Larval nutrition research focused on the link between potential deficiencies or imbalances in the three essential PUFA in live feeds: docosahexaenoic acid, eicosapentaenoic acid and arachidonic acid. Novel experimental emulsions were applied with dose response experimental designs to identify the dietary requirement for selected PUFA and vitamins. Despite the advances in live feed enrichments, the live feeds, particularly *Artemia*, were found to have sub-optimal lipid profiles. Copepods were cultured, as a supplement to traditional live feeds, and improved larval rearing success. Costs to scale-up production and to control extensive cultures presently restrict the usefulness of copepods. Important breakthroughs have occurred in health with the detection and control of nodavirus, myxozoan and bacterial disease. Ozone disinfection of eggs and sterilisation of hatchery seawater have been important control measures. Another bottleneck to production has been mortality of larvae from notochord flexion to metamorphosis. System changes to reduce nocturnal movements and a better understanding of optimal live feed densities, and weaning onto formulated diets, have improved survival and growth. High rates of jaw malformation remain a challenge and no definitive cause has been established. Reduced rates of malformations have been associated with one or a combination of high feed rates, lower larval densities and temperatures, and reductions in 'walling' behaviour. Future research is aimed at finding ways to reduce malformations, develop probiotics and early weaning strategies, control parasites and scale-up production to assess performance of juveniles in sea cages.

Keywords: *Latris lineata*; Marine fish larvae; Development; PUFA; Jaw malformations; Wall-nosing; Bacteria; Ozone; Betanodavirus; Myxozoan

1. Introduction

A major bottleneck in the development of many new marine fish species for aquaculture in Australia has been the production of high quality juveniles (Battaglene and Fielder, 1997). There are currently only two species cultivated from eggs and reared in sea cages in large numbers in Australia. The largest production is for Atlantic salmon at 14,828 m t per annum in Tasmania with much smaller but growing production of barramundi at 1567 m t in Queensland, Northern Territory, South Australia, and New South Wales (ABARE, 2004).

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doi:10.1016/j.aquaculture.2007.04.048

In line with world trends there has been some diversification into new species, including yellowtail kingfish and mulloway in South Australia and snapper in NSW. There is currently no aquaculture species suited to colder water to help diversify the Atlantic salmon industry, whose rapid growth has recently slowed and is under threat from global competition, rising seawater temperatures and the high cost of managing diseases (Battaglene and Cobcroft, 2003).

Striped trumpeter, *Latris lineata* (Bloch and Schneider, 1801), was chosen as the best candidate for diversifying salmonid sea cage culture in Tasmania in the late 1980s following a review of aquaculture research in Tasmania (Searle and Zacharin, 1994). The species is widely distributed in the temperate latitudes of southern Australia, around Tasmania and New Zealand, and isolated island groups in the Indian and Atlantic Oceans (Last et al., 1983; Tracey and Lyle, 2005). Once plentiful in Tasmania, the fishery for striped trumpeter has declined to typically less than 100 m t per annum. The limited information on wild fish indicates that they are long-lived (>45 years), rapidly growing in the first 5 years of their life, and are opportunistic carnivores found over rocky reefs at depths from 5 to 300 m (Tracey and Lyle, 2005). Described as the “most excellent of all Tasmanian fishes” in 1882 they have long been prized as one of the best eating fishes in Australia and have firm white flesh, which is both tasty and fatty (Morehead, 1997; Nichols et al., 2005). This contention is backed by recent studies into the flesh qualities of ‘farmed striped trumpeter’ (wild-caught juveniles reared in captivity to adulthood), which ranked them alongside Australia’s best white-fleshed fish in controlled taste tests (Pakes Research, 2000). They have also been recorded as having the highest omega-3 polyunsaturated fatty acids (PUFA) concentrations in the flesh of any fish in Australia (Nichols et al., 2005). In addition, striped trumpeter were selected for their docile nature, lack of cannibalism, ability to take formulated feeds and tolerance to being held in captivity at high densities.

Research on striped trumpeter culture started in the late 1980s with a production approach based on the successful development of Atlantic salmon farming in Tasmania. At the same time other Australian states were developing new species like barramundi, snapper, and mulloway (Battaglene and Talbot, 1992, 1994; Rimmer et al., 1994). It quickly became apparent that striped trumpeter, a deeper water more oceanic species, were not easy to culture and had a complex life cycle with an extended larval phase, including a 9-month neustonic ‘paperfish’ stage (Furlani and Ruwald, 1999). Early research examined morphological development of striped trumpeter larvae including the use of histology and histochemical techniques (Ruwald et al., 1991; Goodsell et al., 1996). Rearing of striped trumpeter larvae was characterised by low and highly variable survival from first feeding through to metamorphosis and a high incidence of jaw and spinal malformations in post-larvae (Ruwald et al., 1991; Pankhurst and Hilder, 1998; Trotter et al., 2001; Cobcroft et al., 2001a). These problems compromised the early research and proved difficult to solve, shaping the research agenda for the next 10 years.

Despite a paucity of information on their biology in the wild, striped trumpeter are one of the most highly studied of the new aquaculture candidate species in Australia with over 30 scientific publications over the last 10 years and five doctoral theses (Morehead, 1997; Cobcroft, 2002; Trotter, 2003; Grossel, 2005; Shaw, 2006). Research has been based at the Tasmanian Aquaculture and Fisheries Institute, Marine Research Laboratories, Hobart and has been focused in four key areas starting with the control of reproduction, then early larval development and more recently larval nutrition and health. In this paper we synthesise the outcomes within the four key areas with some final comments on the direction for future research.

2. Control of reproduction

Control of reproduction in striped trumpeter is among the best for any species being developed for aquaculture in Australia (Morehead, 1997). Striped trumpeter are multiple spawners with group synchronous oocyte development, producing eggs on a four-day cycle over 3 months (Hutchinson, 1994; Morehead et al., 1998). Mature fish caught during the spawning season, that typically extends from August to November, were implanted with LHRHa pellets and provided hormone-induced ovulations for early larval rearing trials (Morehead, 1997). Striped trumpeter are easily acclimated and held in captivity in 25,000 l tanks under artificial light. Broodstock of 3 to 6 kg have been held since 1997 under controlled photoperiod and temperature and entrained to spawn out of season (Morehead et al., 2000). Spawning usually occurs within 6 months of capture at ambient temperatures of 12 to 16 °C. Compression of the spawning cycle can be achieved within 6 months and three different broodstock groups are now maintained to provide a steady supply of eggs at regular intervals during the year. The stress and ovarian response of captive striped trumpeter is unlike that of most other marine species under investigation in Australia, such as snapper or barramundi (Morehead, 1997; Pankhurst, 1997; Cleary et al., 2000). Striped trumpeter