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Finfish production in a static, inland saline water body using a Semi-Intensive Floating Tank System (SIFTS)

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Abstract

Using a newly developed culture technology known as the Semi-Intensive Floating Tank System (SIFTS), rainbow trout (*Oncorhynchus mykiss*), mulloway (*Argyrosomus japonicus*) and barramundi (*Lates calcarifer*) were produced in a 0.13 ha static, inland saline water body over a period of 292 days, yielding the equivalent of 26 tonnes/(ha year). Rainbow trout were grown with an FCR of 0.97 from 83 to 697 g over 111 days (specific growth rate (SGR), 1.91%/day) between June and September, when average daily water temperatures ranged from 12.3 to 18.2 °C. Over the same time period, mulloway grew only from 100 to 116 g, however, once temperatures increased to approximately 21 °C in October, food intake increased and mulloway grew to an average size of 384 g over 174 days with an SGR and FCR of 0.68%/day and 1.39, respectively. Barramundi stocked in November with an average weight of 40 g increased to 435 g in 138 days (SGR 1.73%/day) with an FCR of 0.90. The SIFTS significantly reduced nutrient input into the pond by removing settleable wastes as a thick sludge with a dry matter content of 5–10%. The total quantity of dry waste removed over the culture period was 527 kg (5 tonnes/(ha year)), which was calculated to contain 15 kg of nitrogen (144 kg/(ha year)) and 16 kg of phosphorus (153 kg/(ha year)). The release of soluble nutrients into the pond resulted in blooms of macro- and micro-algae which caused large and potentially lethal diurnal fluctuations in dissolved oxygen within the pond, however, comparatively stable levels of dissolved oxygen were maintained within each SIFT[1] through the use of air lift pumps.

Keywords: Saline groundwater; Barramundi; Rainbow trout; Mulloway; Pond yield; SIFTS; Waste removal

1. Introduction

Australia has a significant problem of salinisation in many of its inland farming areas, and the desire to convert this salinised groundwater from a liability into a productive resource has generated considerable interest into using this water for the culture of marine

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[1] The acronym SIFTS describes the Semi-Intensive Floating Tank System which is comprised of a number of Semi-Intensive Floating Tanks (SIFTs).

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and estuarine finfish. Such culture has the potential to offset the cost of management practices associated with dealing with rising saline groundwater (such as saltwater interception schemes), and deliver benefits to rural economies through employment and farm diversification (Doupé et al., 2003a).

Although the biological feasibility of growing certain fish species in inland saline water with suitable ionic compositions has been proven (Fielder et al., 2001; Ingram et al., 2002; Partridge, 2003), production is yet to occur on a large scale (Doupé et al., 2003b; Lever et al., 2004). A recent research and development plan for inland saline aquaculture in Australia, however suggested semi-intensive open ponds to be the best option for commercial fish production in such areas (Allan et al., 2002). These systems make excellent use of the land resources in salt affected areas, however, nutrient input from fish waste, uneaten food and microbial remineralisation of nutrients from pond sediment results in microalgal blooms (Hargreaves, 1998; Erler et al., 1999). Such blooms cause diurnal fluctuations in the concentration of dissolved oxygen and as the blooms strengthen, these fluctuations can range from supersaturated to lethally low levels. Pond systems are therefore often limited in yield by the nutrient input into the pond and the effects the subsequent microalgal blooms have on water quality (Drapcho and Brune, 2000; Avnimelech and Ritvo, 2003; Tucker and Hargreaves, 2003). Options for managing such blooms include utilising flow-through or batch water exchanges (Wang, 1990; Burford and Longmore, 2001), the cropping of microalgae within these ponds with planktivores (Shpigel et al., 1997; Drapcho and Brune, 2000; Turker et al., 2003a) and reducing the input of nutrients into the pond (Hopkins et al., 1994; Yoo et al., 1995; Burford and Longmore, 2001).

The low potassium concentration of many saline groundwater sources in Australia necessitates supplementation of this ion for many of the fish species under investigation (Fielder et al., 2001; Doroudi et al., submitted for publication; Partridge and Creeper, 2004). As such, the practice of using water exchange to manage algal blooms in such situations may not be cost effective. In addition, flow-through ponds have the potential to impact on receiving water bodies through the addition of nutrients and salt (Yoo et al., 1995; MacMillan et al., 2003; Read and Fernandes, 2003; Starcevich et al., 2003).

Tilapia (*Oreochromis* sp.) are the most common species of planktivorous fish used for cropping microalgae in aquaculture ponds (Yi and Kwei Lin, 2001; Turker et al., 2003a,b), however tilapia are classified as a noxious species by regulatory agencies in Australia, and therefore cannot be cultured. Other fish species such as mullet have been suggested as alternatives (Erler et al., 1999), but have yet to be proven suitable. The use of other organisms including bivalves (Shpigel and Neori, 1996; Masser and Lazur, 1997; Lefebvre et al., 2004; Mueller et al., 2004) and *Artemia* (Wang, 2003) can effectively crop microalgae but have yet to be investigated for static inland saline aquaculture ponds.

Up to 15% of fed nitrogen is deposited directly on the pond bottom as faeces where it undergoes microbial mineralisation to ammonia that diffuses back into the water column (Brune et al., 2003). Hopkins et al. (1994) proved that removing such sludge improves water quality and production, but Brune et al. (2003) pointed out that effective sludge removal has not been transferred to large scale systems and as such, is not widely practised in the aquaculture industry.

The Semi-Intensive Floating Tank System (SIFTS) has been designed to reduce nutrient input into ponds by the collection of settleable wastes. In addition, the SIFTS provides large volumes of well-oxygenated water to the target species, thereby ameliorating fish loss due to low dissolved oxygen concentrations. This paper describes the production of three carnivorous (i.e. non-planktivorous) fish species recently identified as having excellent potential for inland saline aquaculture in Australia (mulloway *Argyrosomus japonicus*, barramundi *Lates calcarifer* and rainbow trout *Oncorhynchus mykiss*; (Gooley, 2000; Allan et al., 2002; Doupé et al., 2003b)), in a prototype SIFTS held within a static, semi-intensive pond. The suitability of these species has been broadly based on their euryhalinity, robustness for culture, growth rate, fingerling availability and market acceptance.

2. Materials and methods

2.1. Culture pond

The trial was conducted on an inland saline aquaculture farm located at Northam in Western