DEVELOPMENT OF BENTHIC IMTA SYSTEMS BY COUPLING POLYCHAETE PRODUCTION TO SALMON FARMING: SYSTEM DEVELOPMENT, NUTRIENT DYNAMICS AND RISK OF MEDICINE RESIDUES

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Introduction

Significant production growth is predicted for the Norwegian salmonid industry, provided that key sustainability issues can be resolved. One bottleneck for expansion of salmonid farming is the release of fish wastes into surrounding marine ecosystems. This has fuelled interest in integrated multi-trophic aquaculture (IMTA), which offers an opportunity to recycle waste streams and simultaneously provide a new source for high quality marine proteins. Polychaetes are candidate species for incorporation in IMTA systems for conversion of the organic waste streams.

Polychaetes are naturally abundant in benthic habitats under fish farms and are important in environmental recovery by consuming and transforming the organic materials deposited from the fish (Dean, 2008). Opportunistic polychaetes commonly found underneath fish farms in Norway include *Ophryotrocha spp*. at hard bottom locations (R. Bannister pers comm) and *Capitella capitata* for farms in soft sediment areas (Kutti et al. 2007).

Salmon lice are a major problem in salmon farming, and a number of compounds are available to treat salmon lice, including hydrogen peroxide (H_2O_2). H_2O_2 has long been regarded as an environmental friendly extinguishing agent because it dissociates to water and oxygen. However, it has been shown that low concentrations could affect the physiology of aquatic animals, including polychaetes (Buchner et al. 1996, Abele-Oeschger et al. 1994). Potential negative effects of H_2O_2 on polychaetes, are important considerations for design of benthic IMTA systems, from a production and food safety perspective.

A series of field and laboratory experiments were performed to study the development and efficiency of benthic trays for polychaete production, to evaluate the nutrient turnover potential, and to define potential effects of hydrogen peroxide treatment on polychaete survival.

Material and Methods

Benthic trays were designed to stimulate natural polychaete production. Trays were deployed under a commercial salmon farm and allowed us to follow succession of polychaete abundances at different sites at the farm. Succession on trays was investigated by video surveys and species identification was done after retrieval of the frames.

Polychaetes were transported to the laboratory where growth, chemical composition, respiration rates and nutrient turnover of the most dominant species (*Capitella capitata*, *Ophryotrocha spp.* and *Malacoceros fuliginosus*) were measured. The tolerance of *Capitella capitata* and *Ophryotrocha spp.* to H_2O_2 exposure was evaluated by defining the lethal concentration (LC_{50}).

Results and Discussion

The broad range of results from the field and laboratory studies will be presented, and differences between polychaete species will be discussed in terms of nutrient turnover capacity and tolerance to hydrogen peroxide. The outcomes will be placed in the framework of (benthic) IMTA development, and will address issues such as system design (methodological challenges), IMTA efficiency (nutrient removal), risks of medicine residues in integrated systems, and the potential market of polychaetes produced in IMTA systems. Differences between coupled (open water) and decoupled (semi-enclosed systems) salmon-polychaete systems will be discussed.

References

Abele-Oeschger et al. 1994. Mar Ecol Prog Ser 106: 101-110 / Buchner et al 1996. Mar Ecol Prog Ser 143:141-150 / Dean 2008. Revista De Biología Tropical 56: 11-38 / Kutti et al 2007. Aquaculture 262: 355-366 /