Parallel Sessions

DEVELOPMENTS IN ENVIRONMENTALLY-FRIENDLY SYSTEMS

Chairs: Maeve Kelly (UK) and Ep Eding (The Netherlands)

Keynote presentations:
"Can we integrate to accumulate? Utilizing 'waste' in open aquaculture".
Kelly M.S., K.D. Black, J.C. Sanderson and E.J. Cook (UK)

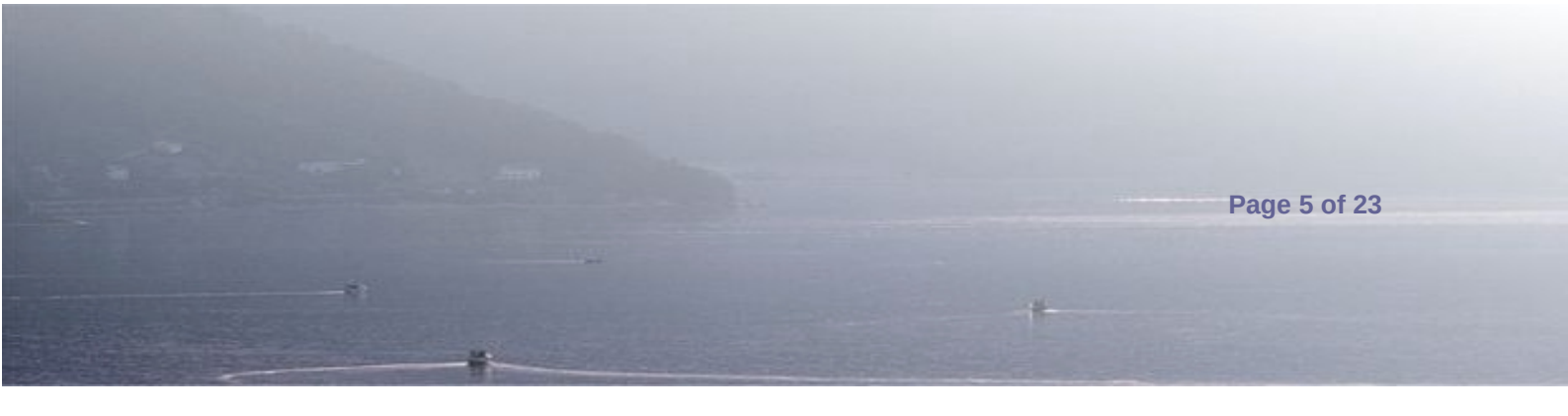
"Biofouling in European aquaculture: is there an easy solution?"
Willemsen P.R. (The Netherlands)

The fast growth of Aquaculture during the last decades resulted in an increasing demand for production technologies which improve the environmental friendliness of the sector and the public acceptability on which the future of the industry depends. Public acceptability can be maintained when innovations in the field of environmental, social and animal welfare issues are continuously stimulated.

This session was developed to discuss developments in environmentally friendliness of (existing) production technologies. Two types of production systems were discussed: open systems (cages) and recirculation systems. In terms of waste discharge and water consumption per kg fish produced recirculation systems are already environmentally friendly systems. However further improvements are ongoing.
Unfortunately there were no contributions discussing the improvements currently going on in pond culture. Assessment of the environmental impact of different production systems (flow through, cage culture and recirculation systems) was discussed in the presentation scheduled at the end of this session.

Open systems The presentations on open (sea cage) systems focused on developments in integrated aquaculture and on developments in photoperiod manipulation and telemetry in a variety of fish species. Integrated or multi-trophic level aquaculture involves combining species from different trophic levels on the same site, to maximise the economic potential and minimise environmental impact. Data on the growth of seaweeds adjacent to salmon cages was presented and concluded that seaweeds can benefit from farm-origin nitrogen up to 200m from the farm.

Although the onset of early maturation can be controlled through the manipulation of photoperiod in many species of fish farmed in Europe, it is less effective in sea cages or outdoor tanks than it fully-controllable systems and there are welfare and husbandry issues associated with its use. Further research into the physiological responses of fish to light manipulation could lead to improvements in feeding regimes and fish welfare. Similarly biotelemetric study of caged fish behaviour, as illustrated by a study on cod, could lead to further improvement in cage design and feed management. The development of techniques to produce 100% sterile fish that are acceptable in terms of



fish welfare and consumer acceptance was recommended to overcome the problem of escaped farm fish interbreeding with local wild populations.
The presentations emphasised that there can be economic advantages to improving aquaculture practice; re-circulating nutrients can allow the production of a second crop from the same site and improving fish welfare leads to better food utilisation.

Recirculation systems The developments in recirculation systems focused on relatively 'new' water treatment technologies. These water treatments were: bioreactors for the treatment of dissolved waste (micro and macro algae), for dissolved and solid waste (periphyton and single cell protein) and for solid waste (polychaetes). As in conventional recirculation systems most of these reactors are able to control the water quality. However, in contrast to the conventional systems, these bioreactors have also the potential to reduce the nutrient discharge to the environment (e.g. carbon nitrogen and phosphorus). Economic evaluation of these systems for their application in commercial recirculation systems has still to be done.
To better understand the interaction between the different water treatment units modelling work was started for closed Mariculture recirculation systems.
Recirculation systems are also continuously adapted for 'new' species not yet cultured commercially in recirculation systems. The presented development of a commercial recirculation system for the production of abalone seed was a good example of this. Improved growth of abalone seed was mainly due to control of temperature.
A relatively new technique for application in aquaculture, Geotube, was presented and can be used to concentrate the waste in aquaculture effluents.

Conclusions:
1) Stimulate commercial application of technology innovations with the aim to improve the environmental friendliness of the sector. Successful projects can serve as an example for others. Currently many innovations are research driven while the market driven approach should be stimulated.
2) Most of the technologies presented (photoperiod manipulation, anti biofouling products, selection of netting material, biotelemetry, integration of additional culture/water treatment processes etc.) can be translated in the impact they have on C, N, and P utilization by the cultured species and discharge of particulate and dissolved waste.
3). Assessment of the environmental performance of different production systems should be based on life cycle analysis (LCA) outcomes.
4) Stimulate workshops or training sessions or other activities which disseminate the current state of art in water treatment and production technologies applicable in the field of aquaculture.