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Publications:

Micro particles in Danish Model Trout Farms

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Authors: de Jesus Gregersen, J. (Intern), Pedersen, P. B. (Intern), Pedersen, L. (Intern), Møller, B. (Intern), Dalsgaard, A. J. T. (Intern)
Number of pages: 56
Pages: 43
Publication date: 2017

Host publication information
Title of host publication: 4th NordicRAS Workshop on Recirculating Aquaculture Systems. Aalborg, Denmark, 12-13 October 2017 : Book of Abstracts
Publisher: National Institute of Aquatic Resources, Technical University of Denmark
Editor: Dalsgaard, A. J. T.
ISBN (Print): 978-87-7481-241-8
ISBN (Electronic): 978-87-7481-240-1

Series: DTU Aqua Report
Number: 321-17
ISSN: 1395-8216
Main Research Area: Technical/natural sciences
Conference: NordicRAS Workshop on Recirculating Aquaculture Systems, Aalborg, Denmark, 12/10/2017 - 12/10/2017
Electronic versions:
Publishers version
Publication: Research › Conference abstract in proceedings – Annual report year: 2017

Projects:

Efficient and innovative fish production via best available technology (RAS2020) (39328)
This project includes a full scale test and development of a conceptual recirculating aquaculture system (RAS) for king fish production. The innovative aspect of this modular RAS2020 concept regards the design—a one unit circular module designed to have a 1200 MT/Y capacity.

The aim of this project is to build and develop a RAS unit with small footprint, low cost and reduced construction time. The RAS2020 unit includes state of the art treatment units (Hydrotech drumfilters, Krüeger biofilters—nitrification and denitrification) and is built with flexible interconnected rearing sections. When the RAS2020 is built and stocked with kingfish, an extended sampling and monitoring program will be performed in order to assess system performance in particular N, P and organic matter removal.

This project is coordinated by Sashimi Royal.

The project is funded by the Danish Environmental Protection Agency.

National Institute of Aquatic Resources
Environmental neutral aquaculture water treatment (MIVANAK) (39295)

Despite a transition from flow-through systems to more advanced open water reuse aquaculture systems (e.g. model trout farms), the need for water treatment still exists. In brackish and saltwater reuse systems, blooms of toxic microalgae in an example of a recently new challenge.

The purpose of this project is to further develop current aquaculture water treatment practice and reduce the total amount of disinfectants used.

The project includes 3 different work packages, investigating
- ecological consequences of continuous application of peroxyacetid acid.
- toxicological effects of easy degradable disinfectants.
- alternative biological methods to control / avoid blooms of toxic heterotrophic dinoflagellates.

Trials will include mesocomosos experiments where disinfectants are added continuously or by daily pulses over a prolonged period of time where phyto- and zoo-plankton abundance and compositions will be investigated. Other trials will be made in batch experiments with pure algae cultures, as will prolonged continuous peroxyacid application experiments be made.

This project is coordinated by DTU Aqua.

The project is funded by the Environmental Protection Agency's Programme for Pesticide Research.
**Water treatment technology for microbial stabilization in landbased aquaculture systems (MicStaTech) (39277)**

MicStaTech is a transnational research project (COFASP) between Norwegian, German and Danish research groups. The paradigm of this project is that a stable, elevated microbial abundance in the water phase of land based aquaculture systems can be beneficial for fish health and economically profitable. A common challenge in land based systems, and shown across species, is the loss of fish due to unfavourable conditions and disease outbreaks that may be linked to opportunistic bacteria. A popular approach to prevent this is to attempt to reduce the load of bacteria in the systems by the use of UV, ozone or chemical disinfection. This is however not possible or sufficient in the majority of systems, because disinfection has a non-lasting effect on the numbers and a destabilising effect on the composition of bacteria. In most systems, the water exchange rates and organic loading applied for biological reasons allow for microbial regrowth in the rearing tanks. Hence, alternative approaches to reduce the chances of disease outbreaks are needed. This project pursues the concept of establishing and maintaining stable microbial systems.

Water treatment technology for promoting K-selection, which is a selective pressure disfavouring the r-selected opportunists, has shown very promising results for several marine species in small scale experiments, but the up-scaling and optimization for flow through systems (FTS) and recirculating aquaculture systems (RAS) remains. The paradigm favouring a stable and elevated bacterial abundance is foreseen to reduce fish mortality and also reduce water treatment costs. This project will investigate fish health and microbial carrying capacity in experiments performed at three locations – NTNU, DTU Aqua and University of Applied Sciences, Saarlandes, Germany.

This project is coordinated by Norwegian University of Science and Technology, Norway.

The project is funded by EU, COFASP, ERA-NET.

National Institute of Aquatic Resources
Section for Aquaculture
Norwegian University of Science and Technology
Hochschule für Technik und Wirtschaft des Saarlandes University of Applied Sciences
Period: 01/03/2015 → 31/12/2017
Number of participants: 7
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**Proteins of the future in feed for recirculating aquaculture systems (ProffAqua) (39274)**

There is an increasing shortage of available high quality proteins for feed. More than half of all aquatic species is now produced by aquaculture. Aquaculture production will double in the next 15 years and so will the need for protein into aquafeed. As substantial amount of worldwide wild fish catch is processed into fishmeal and fish oil for feed production, raising concerns regarding the sustainability of this arrangement. The industry’s growing need for feed therefore requires new approaches. This project focuses on turning waste streams into valuable products. Organic chemicals found in pulp mills steams for cellulose fibre production can be used to grow fungi and turned into Single Cell Proteins (SCP), suitable as protein-rich components in fish feed. Due to the low protein content of waste materials from agriculture and fish processing, this raw material is not suitable for direct use in fish feed. The black soldier fly larvae (BSF) are very efficient in transforming such waste streams into high quality protein and oil ingredients. Based on the available waste streams, several thousand tonnes of both SCP and BSF can be produced at a very favourable price compared to the current price and quality of fish meal.

The role of DTU Aqua in the project is to evaluate BSF and SCP as protein sources in fish feeds by performing digestibility and growth trials using the two types of protein sources at several inclusion level in the diets. DTU Aqua participates in the project by performing feeding trials using contaminated feed for Atlantic salmon and seabass respectively. Furthermore, the project also investigates potential effects of microplastic incorporated into feed pellets, on accumulation and elimination of the selected priority contaminants. The feeding trials consist of a 12 week to 15 week accumulation period for seabass and salmon respectively and a 8 week depuration period where all groups are fed control feed. The results obtained from the trail will be the used to develop mathematical models estimating accumulation and elimination of priority contaminants in filet.
Towards stable water quality in RAS by use of a new rapid microbial test (Biostable water) (39154)

Water quality control is central for successful management of recirculating aquaculture systems. Most common and important chemical parameters (i.e. pH, TAN, nitrite, alkalinity) are measurable, whereas microbial water quality (abundance and activity) is more complicated to measure. Microbial water quality measurements are important for several reasons: it can be used to ensure safe and stable conditions (baseline), to identify sudden changes (deviations from baseline) and potentially contribute to improve system performance by identifying suboptimal treatment component or practices.

The aim of this project is to test a rapid microbial methods developed by Mycometer; a test that quantifies the microbial activity in different types of water samples within 30 minutes from sampling to measurement. The Bactiquant® method is expected to provide new insight of microbial succession within RAS and will be used to monitor microbial water quality in commercial recirculating aquaculture systems.

The project includes controlled batch experiments where disinfection efficiency and regrowth potentials can be estimated. The new knowledge can be applied in RAS management, and the project also includes method verification under commercial RAS conditions. The equipment has been introduced and implemented on a large model trout 3 farm with mixed effect and valuable experiences. The method is also being introduced to a huge smolt RAS facility build by Billund Aqua; here daily monitoring as well as intensive campaigns including diurnal measurements will be performed.

The project is coordinated by DTU Aqua.

The project is funded by the Danish Ministry of Food, Agriculture and Fisheries through the Green Development and Demonstration Program (GUDP).
Network towards phasing out formalin in aquaculture (39140)

Formalin is still used in large quantities in aquaculture systems despite unwanted side-effects and efforts to reduce the amount used. Apparently the need for water treatment increases with shift from flow-through to RAS. This project established a network of fish farmers (8 persons representing different systems), three national fish-vets covering >95% of Danish fish farms, DTU Aqua researchers and Danish Aquaculture organization. The common goal was to identify methods to cease the aquaculture related use of formalin. Recent knowledge, new techniques and practical experience with alternative disinfectants (e.g. hydrogen peroxide or peracetic acid) were applied and tested. In particular, distribution, degradation and automatic dosage of Peracetic acid by digital pumps was analytically verified. The project tested and developed better water treatment protocols for different types of rearing systems (hatcheries and grow out production systems, flow-through, model trout farms to fully recirculated systems) in close collaboration between fish-vets, fish farmers and DTU Aqua. Results from monitoring on a number of fish farms and experience over 2 seasons were obtained and the new practically applied knowledge/information was presented at workshops/seminars with the aquaculture industry as well as reported in a Danish report (Danish Aquaculture 2015-10). A number of veterinarians and fish farms were partners in the project. The project was coordinated by Danish Aquaculture Association. The project was funded by the Danish Ministry og Food, Agriculuture and Fisheries and the European Fisheries Fund (EFF).

Sustainable technologies to control microalgae in land based saltwater recirculating systems (39032)

Land based salt water recirculating systems is a potential alternative to fish farming in net pens. This purpose of this project was to test different solutions on how to control unwanted microalgae growth thereby addressing a potential challenges associated with land based farming.

A high degree of water reuse and the associated nutrient accumulation may favour growth of microorganisms and thereby deteriorate the biological water quality.

The project included:
- Test of improved mechanical filtration (application of pilot scale protein skimmers on small to medium sized RAS, and application of full scale 4 meter vacuum airlift; an innovative treatment technique tested in full scale RAS)
- Test of chemical water treatment routines using easy degradable disinfectants (Peracetic acid, chloramine-T, hydrogen peroxide) to control and inhibit toxic microalgae,
- Test of electrochemical oxidation disinfection technology to assess the efficacy (radical formation and algicidal effects) of boron doped diamond electrodes.

Numerous batch and pilot scale experiments were made at the section for Aquaculture, Hirtshals. In addition, intensive,
diurnal sampling/monitoring and analysis on location was performed on a commercial pike perch RAS facilities facing toxic algae problems.

The project is coordinated by DTU Aqua.

The project was funded by the National Environmental Protection Agency through Programme for Development and Demonstration of Bio-technologies (MUDP).

National Institute of Aquatic Resources
Section for Aquaculture
University of Copenhagen
AquaPri Innovation
Billund Aquaculture Service Aps
Electrocell

Environmental Protection Agency
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