Trout farming in Denmark: recent trends and future prospects

Dalsgaard, Anne Johanne Tang; Pedersen, Per Bovbjerg

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CONTENTS:

Photo: A marine Model-Trout-Farm, located at the North Sea Research Centre. *(Courtesy: Anne Johanne Dalsgaard)*

President's Message

by Ed Aneshansley

Dear Friends and Colleagues,

Greetings and welcome back to the Aquaculture Engineering Society, 2012. We are grateful to have new and returning members and are confident that this year will bring you the exceptional content and professional resources that AES is historically known for. I would like to start by welcoming our new directors to the board. We were excited to inaugurate two new directors this year, Raul Piedrahita, and David Brune, who are both former presidents and original founding members of AES. Additionally German Merino, 2010 past President has decided to stay on the board of directors and continue his work for the organization. We are grateful to have these individuals on our team again, and believe this will prove to be a great opportunity for AES to evaluate; who we are, what we were, and where we are going. Additionally I would like to welcome Ann Johanne Dalsgaard from Denmark to the board. She is a Senior Research Scientist at the Technical University of Denmark, National Institute of Aquatic Resources. Together with Brian Vinci and Ying Liu (2012 First and Second Vice President respectively) we have solid leadership core to take us through the year. You can meet the entire group on our website where we have added photos and a short biography as part of our website enhancement program.

I would also like to thank the outgoing President, Asbjorn Bergheim for his dedication to service these past years and recognize all the outgoing directors Alexander Brinker, George Flick, and Matt Smith a for their hard work and support. We look forward to keeping all of them involved in the years to come.

2012 started with the World Aquaculture Association (WAS) Aquaculture America conference in Las Vegas. We had a strong presence at the conference with {4} half-day sessions organized, sponsored and moderated by AES. We successfully met our contractual obligation to WAS and were able to support several students and professionals locally and abroad with complimentary registrations and travel funds. All sessions were well attended and presentations were informative and professional.

We were excited to present the winners of the 2011 best paper awards during our members meeting in Las Vegas. This is the first year were we were deadlocked on the #1 paper of the year, so we decided to award it to the two top finalists. (Details of the 2011 Best Paper Awards can be found further on in this newsletter). Congratulations to all the finalists. High quality publications are the backbone of our society and we appreciate the hard work that goes into them.

We have several events this summer that I encourage all our members to participate in. We will be hosting the AES Issues Forum on August 23rd, directly preceding the International Conference on Recirculation Aquaculture (ICRA) in Roanoke Virginia. It will be a one day conference with two dedicated sessions on Advances in Biofiltration and Emerging Aquaponic Technology. If you are attending IRCA, you should not miss this opportunity to spend a day with AES members and directors for the opportunity to collaborate and discuss these topics and more. Don't miss the mixer that evening. We are also expecting a strong presence in Prague, at the WAS Global Aquaculture conference (AQUA 2012), in September where we will be co-chairing and sponsoring sessions on Recirculation Aquaculture Systems. We currently have 20 presentations submitted and 6 posters.

AES has opened a PayPal account this year to help improve the registration process both for our members and for our in-house administrative team. Direction on how to access this registration tool can be found further on in this newsletter. We hope this universal online payment option will help members maintain

» CONTINUED ON PAGE 4

Article

Trout farming in Denmark: recent trends and future prospects

Johanne Dalsgaard and Per Bovbjerg Pedersen

Technical University of Denmark, DTU Aqua, Section for Aquaculture, The North Sea Research Centre, P.O. Box 101, DK-9850 Hirtshals, Denmark. E-mail addresses: jtd@aqua.dtu.dk; pbp@aqua.dtu.dk

Photo: A freshwater Model-Trout-Farm (Lerkenfeld Fish Farm) which uses circular tanks rather than raceways. (Photo taken by Lisbeth Plesner from Dansk Akvakultur)

Rainbow trout (*Oncorhynchus mykiss*) is by far the most produced species in Denmark. The production constituted 93% of a total aquaculture production of some 36.400 metric tonnes (MT) in 2010. Of this, 73% took place in 265 freshwater farms and 27% in 18 sea farms (Danish Ministry of Food, Agriculture and Fisheries, 2012). Most of the land-based production has until recently taken place in traditional flow-through or simple partial reuse systems. A strict environmental legislation of the land-based industry was introduced in 1989 by the Danish Ministry of the Environment (Dambrugsbekendtgørelsen, 1989). Farms were allotted a fixed, maximum, yearly feed quota and had to fulfill certain requirements with respect to allowable nutrient discharge concentrations adjusted considering the recipient stream. An increase in production could therefore more or less only be achieved by improving the feed utilization (reducing FCR), whereas there were very limited incentives for development and installation of new technologies given the fixed feed quotas. The legislation thereby largely prevented the industry from increasing its production, and basically retained it from contributing to the increasing, global demands for aquaculture products (FAO, 2010). A National Aquaculture Committee was consequently appointed (Dambrugsudvalget, 2002) with the purpose of identifying aquaculture developmental potentials including technological solutions that would facilitate an increased, commercially viable production of healthy products while at the same time minimizing the environmental impact. The Model-Trout-Farm (MTF) concept was developed as part of the recommendations of this Aquaculture Committee, based on the work of a task group describing the specifications and performance expectations of such farms and associated authorization demands (Pedersen et al., 2003). Eight farmers signed up to rebuilt their traditional flow-through farms into MTF given a 30% subsidy of their investments (5% from the Danish Government and 25% from EU/FIUF), and a doubling of their feed allowance for two years. By accepting these conditions, the farmers agreed to participate in a 2-year, comprehensive monitoring program with the aim of documenting the cleaning efficiency of MTF. The MTF turned out to be much more environmentally efficient than (conservatively) assumed (table 1;

Table 1. *Assumed and obtained average net removal efficiencies (R_N, %)a of eight Model-Trout-Farms (Svendsen et al. 2008)*

Parameter	Total Nitrogen	Total Phosphorus	BOD_5
R_N anticipated (%)	11	60	75
R_N obtained (%)	50	76	93

[a]RN (%) = ((P – U_N) / P)*100, where P = contribution of a given nutrient from fish production (Dalsgaard and Pedersen, 2011), and U_N = net discharge of a nutrient form the farm (i.e., discharge concentration minus the contribution from intake water).

Svendsen et al. 2008), with average specific discharges of TN, TP, and BOD5 of 20.0, 1.1, and 5.6 kg/MT produced, respectively. The success has subsequently leaded to a revision of the legislation, and farmers can now be regulated according to maximum nutrient emissions rather than fixed yearly feed quotas (Danish Ministry of Environment, 2012). Consequently, there are now - as opposed to previously - strong legislative incentives for farmers to continuously improve and optimize system performance and effluent treatment systems to produce more fish and improve the return of their investments.

Two types of MTF are described in the new legislation, referring to farm size (table 2). Farms applying for more than 230 MT feed/year represent the highest degree of innovation, having the lowest intake of make-up water, and the highest degree of recirculation. These farms must use ground –or drain water whereas MTF applying for between 25 and 230 MT feed/year may continue to take in (i.e., pump) water from the stream. Biofilters and constructed wetlands (or similar cleaning devises for end-of-pipe removal of nitrogen) are mandatory to both types of farms.

The new legislation requires that farmers take 26, evenly distributed, yearly samples of inlet and outlet water which must all be analyzed for TN, TAN, TP, and BOD5. The number of mandatory samples may be reduced to 12 if only ground or drain water is used. Results of the analyses are sent to the municipality, which uses the values to determine whether the outlet of nutrients complies with or exceeds permissible values.

Table 2. *Lay-out and management requirements of Danish Model Trout Farms (MTF) according to Danish Ministry of Environment (2012).*

Parameter	Requirements	
Current production (MT feed/year)	>25 – 230	>230
Raceway / pond material	Concrete or similar	Concrete or similar
Minimum degree of recirculation (%)[a]	70	95
Maximum make-up water (L/s/100 MT feed/yr)[b]	75	15
Minimum feed loading (kg feed/m^3 make-up water)	0.04	0.21
Minimum residence time in production units (h)	2	18
Minimum residence time in constructed wetland (h)	12	36
Sludge basin	Mandatory	Mandatory
Biofilter	Not required	Mandatory
Device for particle removal	Mandatory	Mandatory
Min. size of constructed wetland (m^2/MT feed/year)	40	25

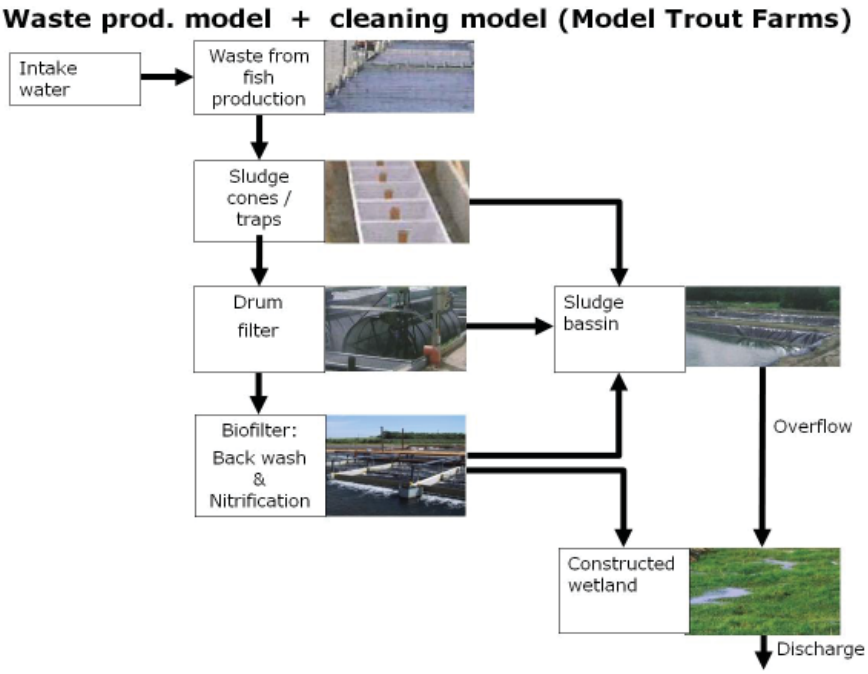
[a]Calculated as: 100% * (Fr – Fi)/Fr, where Fr is the internal recirculation flow and Fi is the amount of make-up water (L/s).

DTU Aqua has developed a simple spreadsheet model to assist farmers, consultants, and local authorities in calculating the expected nutrient output from a given production of portion sized rainbow trout. All waste deriving from aquaculture can ultimately be traced back to the type and amount of feed applied, and the model is therefore based on: the amount of feed to be administered during a given period; the nutrient composition of the feed (protein, lipid, carbohydrates, and phosphorous); the apparent nutrient digestibility; an anticipated feed conversion ratio; and the anticipated amount of feed waste if any. Assuming a nitrogen and phosphorus content of 50-300 g rainbow trout in freshwater of 2.75% and 0.43%, respectively (Svendsen et al. 2008), and based on laboratory experiments measuring the output of solid and dissolved BOD5 and COD from commercial feed types (Dalsgaard and Pedersen, 2011), the model calculates the expected output of nitrogen, phosphorous, BOD5, and COD on total, solid, and dissolved form, respectively. The model could easily be modified to include different sized trout or even different fish species given information on common N and P concentrations and nutrient digestibility coefficients.

To further assist the industry in complying with the new legislation, the model is currently being expanded to predict the expected end, nutrient discharge from a MTF. The overall structure of the model is shown in figure 1. The model uses the information on inlet nutrient contributions (i.e., from inlet water and from a specified production of rainbow trout using a specified type of feed), and assumes that the water runs successively through a number of cleaning devises. Each cleaning

Photo: *A marine Model-Trout-Farm, located at the North Sea Research Centre. This farm is part of a developmental project partially financed by the Danish Government, and is run by the North Sea Research Centre and DTU Aqua in cooperation with the following commercial partners: BioMar A/S, AquaPri Denmark A/S, Billund Aquakultur Service ApS, and RK Plast A/S.*

Figure 1. *Overall structure of the model for estimating the expected nutrient discharge from Model-Trout-Farms*



devise removes a certain fraction of nutrients based on the results obtained during the 2-year MTF monitoring program and concomitant studies. Model predictions have been compared with actual measured emissions from a number of farms, and there is generally very good agreement between modeled and measured values. The model is therefore expected to be introduced to consultants and local authorities during late 2012.

Based on the success of MTF in freshwater, the concept is currently being developed and modified to include marine, land-based MTF potentially providing the means of commercially farming large salmonids in land-based, seawater systems with corresponding reductions in environmental impact. Commercial viability of such systems is a major issue here, since experiences from MTF have shown that an industrial "evolution" can happen rather fast given the existence of commercially viable opportunities.

References

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PM (...continued)

status and encourage membership growth abroad.

As always, we encourage your feedback on any subject that may help to improve your membership experience. Please feel free to contact me directly with comments or suggestions. I look forward to building a better Society for you and future members.

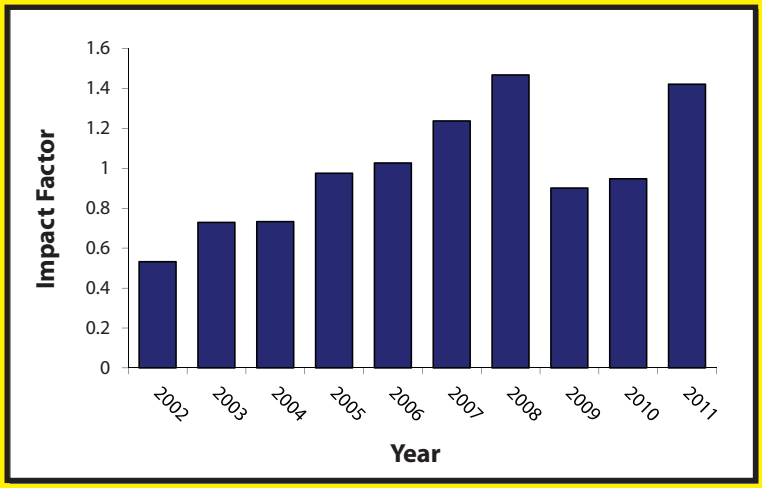
Sincerely,

Edward Aneshansley

AES President

eda@aquaticeco.com

Impact Factors for the AES Journal



Aquacultural Engineering Journal Impact Factor

The Journal has seen a significant increase back to near its peak. The value rose from 0.947 to 1.421, for 2011. It is now ranked 22nd out of 48 titles in the Fisheries category and 4th out of 12 titles in Agricultural Engineering. Impact factors in 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010 were 0.532, 0.729, 0.733, 0.975, 1.026, 1.237, 1.467, 0.901, and 0.947 respectively.

AES Awards Summary - 2011

SUPERIOR PAPER AWARDS

Kevin K. Schrader, John W. Davidson, Anges M. Rimando, Steven T. Summerfelt

"Evaluation of ozonation on levels of the off-flavor compounds geosmin and 2-methylisoborneol in water and rainbow trout Oncorhynchus mykiss from recirculating aquaculture systems"

Aquacultural Engineering, Volume 43, Issue 2, 2010, pp. 46-50.

Philippe Lefrançois, Jaume Puigagut, Florent Chazarenc, Yves Comeau

"Minimizing phosphorus discharge from aquaculture earth ponds by a novel sediment retention system"

Aquacultural Engineering, Volume 43, Issue 3, 2010, pp. 94-100.

HONORABLE MENTION PAPER AWARDS:

Lars-Flemming Pedersen, Per B. Pedersen, Jeppe L. Nielsen, Per H. Nielson

"Long term/low dose formalin exposure to small-scale recirculation aquaculture systems"

Aquacultural Engineering, Volume 42, Issue 1, 2010, pp. 1-7.

I. S. Jung, R. W. Lovitt

"Integrated production of long chain polyunsaturated (PUFA)-rich Schizochytrium biomass using a nutrient supplemented marine aquaculture wastewater"

Aquacultural Engineering, Volume 43, Issue 2, 2008, pp. 51-61.

STUDENT PRESENTATION AWARDS:

1ST PLACE:

Gabriele Rodigues de Lara

"Reuse of water in the Litopenaeus vannamei culture in BFT system"

World Aquaculture 2011 - Natal, Brazil

2ND PLACE:

Kassio Rios da Silva

"Nutrient mass balance in intensive biofloc shrimp culture"

World Aquaculture 2011 - Natal, Brazil

3RD PLACE:

Mauricio Emerciano

"Recent advances in shrimp biofloc broodstock production at National Autonomous University of Mexico (UNAM)"

World Aquaculture 2011 - Natal, Brazil

Upcoming Events

9th International Conference on Recirculating Aquaculture

Aug. 24 – 26, 2012

ICRA topics may include:

- Animal Health & Biosecurity
- Aquaponics
- Cold and Cool Water Culture
- Economics and Marketing
- Ornamentals
- Quality Assurance/Off Flavor
- Shrimp Culture
- Wastewater and Solids Management
- Interaction of Water Quality and Fish Health
- Hatchery and Live Feeds
- Nutrition and Feeds
- Warm Water Culture

Contacts for ICRA:
ICRA Organizers; aquaconf@gmail.com

Aquacultural Engineering Society Issues Forum

Aug. 23, 2012

AES Issues Forum topics may include:

Advances in Biofilters

Aquaponics

Advances in Aeration/Gas Transfer

RAS Energy Efficiency

Contacts for AES:

Brian Vinci; b.vinci@freshwaterinstitute.org

Ed Aneshansley; eda@aquaticeco.com

Virginia Tech
College of Agriculture and Life Sciences

For complete details on both conferences, visit www.recircaqua.com.

AQUACULTURAL ENGINEERING SOCIETY'S

2012 ISSUES FORUM

Thursday, August 23rd, 2012

Roanoke VA, USA
Hotel Roanoke, Presidents Room

AES Issues Forum Agenda:

8:00-8:20	Welcome: President of AES Edward D. Aneshansley	
8:20-10:00	Morning Session 1A: Emerging Aquaponic Technology	Moderator: Ed Aneshansley
10:00-10:20	Break	
10:20-12:00	Morning Session 1B: Emerging Aquaponic Technology	Moderator: Daniel Taylor
12:00-1:00	Lunch	
1:00-2:40	Afternoon Session 2A: Biofiltration	Moderator: Brian Vinci
2:40-3:00	Break	
3:00-4:40	Afternoon Session 2B: Biofiltration	Moderator: Brian Vinci
4:40-5:00	Conclusion and Discussion	
5:00-6:30	Social (Drinks and Apps)	

Session #1A: Emerging Aquaponic Technology

Moderator: Edward Aneshansley

Presentations:

8:20 - 8:45 **Aquaponics: status of the industry**
Charlie Schultz

8:45 - 9:10 **Aquaponics from a horticulture perspective**
Jeremy Pickens

9:10 - 9:35 **Nutrient trough and deep water raft system design**
Rick Jones

9:35 - 10:00 **Comparison of different aquaponic designs for commercial operations.**
Carlos Leon

10:00 - 10:20 **BREAK**

Session #1B: Emerging Aquaponic Technology

Moderator: Daniel Taylor

10:20 - 10:45 **Dewatered aquaculture effluent from an intensive recirculating Nile tilapia biofloc production system as a component of horticultural container substrate: Effects on petunia growth**
Jason Danaher

10:45 - 11:10 **Factors affecting plant selections for aquaponics systems.**
Ryan Chatterson

11:10 - 11:35 **Aquaponics: green technology for mitigating the effects of climate change.**
Chito Sace

11:35 - 12:00 **Saltwater aquaponics and sustainable mariculture.**
Amir Neori

Session #2A: Advances in Biofiltration

Moderator: Brian Vinci

Presentations:

1:00 - 1:25 **Move or rest: nitrification performance of Fixed bed and moving bed biofilters.**
Lars-Flemming Pedersen

1:25 - 1:50 **Effects of alkalinity on ammonia removal and nitrite accumulation within moving bed biofilters and on carbon dioxide stripping during cascade aeration.**
Steven T. Summerfelt

1:50 - 2:15 **Practical impacts of biofilm diffusion boundary layers on TAN removal and nitrite accumulation in RAS biofilters.**
Erik Arvin

2:15 - 2:40 **Denitrification in fluidized sand beds.**
Scott Tsukuda

2:40 - 3:00 **BREAK**

Session #2B: Advances in Biofiltration

Moderator: Brian Vinci

3:00 - 3:25 *TO BE ANNOUNCED*

3:25 - 3:50 *TO BE ANNOUNCED*

3:50 - 3:15 *TO BE ANNOUNCED*

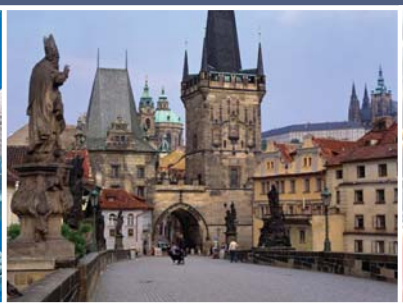
4:15 - 4:40 *TO BE ANNOUNCED*

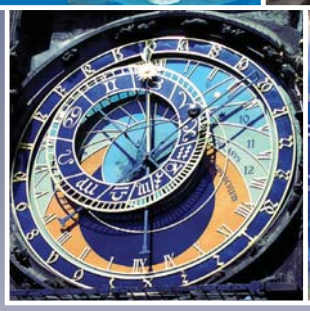
AQUA 2012

Global Aquaculture
SECURING OUR FUTURE

Prague, Czech Republic Sep 1-5, 2012





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UNIVERSITY OF SOUTH BOHEMIA IN ČESKÉ BUDĚJOVICE

AES'S Aqua 2012 Sponsered Sesssions

RAS Technologies — Monday, September 3, 2012 (3:50 - 5:10pm)

Moderators: Asbjorn Drengstig & Tom Losordo

The self cleaning "inherent gas moving bed denitrification reactor" and its application in a recirculation aquaculture system for pike perch *(Sander lucioperca)*
Andreas Muller-Belecke

Disinfection and water treatment with hydroxyl radicals using boron doped diamond (bdd) electrodes in marine as culturing white leg shrimp *(Litopeneaus vannamei)*
Chris van Bussel

Water quality control in RAS by membrane bioreactor (MBR) filtration
Astrid B. Holan

Membrane filtration in RAS – effects on bacterial communities
Per-Arvid Wold

RAS Technologies, continued — Tuesday, September 4, 2012 (9:00 - 10:40am)

Moderators: Johan Verreth

Rotating flow cell formation in a multivortex tank
Ingrid Masalo

Mass transfer and foam fractionation efficiencies of a vacuum airlift – application to water recycling in aquaculture system
Bertrand Barrut

The impact of ozone-produced oxidants on biofilter performance: a curse or a blessing?
J.P. Schroeder

Application of membrane contactors for oxygenation of process water in aquaculture
Anja Gerberth

Aquamonitor project: new fiber optic sensors for multipoint, on-line, dissolved CO2 monitoring in aquaculture
Maria-Teresa Borges

Bio-floc Systems — Wednesday, September 5, 2012 (9:00 am - 7:20 pm)

Moderators: Yoram Avnimelech

Biofloc-based super-intensive shrimp production in commercial scale with an emphasis of biofloc effects on shrimp
In Kwon Jang

Improving the spawning performance of pink shrimp *(Farfantepenaeus duorarum)* with biofloc technology
Gerard Cuzon

Biofloc effect on immune activity between three species of farmed shrimp
Su Kyoung Kim

Identification of bacterial strains of the genus Vibrio in the pacific white *(Litopenaeus vannamei)* raised in clear water and biofloc system
Diana Aquilera

The need for dietary mineral and vitamin c supplementation for nile tilapia under biofloc system
Ashraf Suloma

Effect of 17 alpha metil testosterone in masculinization of tilapia *(Oreochromis sp.)* under biofloc conditions
Carlos I. Pérez-Rostro

Comparison of tilapia *(Oreochromis niloticus)* growth, water quality and microbial community structures in indoor biofloc systems supplemented with either organic or inorganic carbon sources
Richard C. Shultz

Floc viability from biological and economical viewpoint
Arbelaez T. Alejandro

Effect of different protein levels on the performance of *(Litopenaeus vannamei)* shrimp reared in biofloc system
Eudes de Souza Correia

RAS Aquaponics — Wednesday, September 5, 2012 (2:00 - 3:40 pm)

Moderators: Geoff Allan & Ed Aneshansley

Exposure of fish to high nitrate in recirculating aquaculture systems affects growth, feed intake and physiology
Edward Schram

Aquaponics: status of the industry
Richard Shultz

Aquaponic food production using the university of the virgin islands floating raft integrated system
Richard Shultz

Yields and nutrient uptake from three aquaponic sub-systems (floating, nft and substrate) under two different protein diets
Edoardo Pantanella

Validation of an aquaponic-system for (nearly) emission free tomato and fish production in greenhouses (astaf-pro)
Werner Kloas

Recirculating Aquaculture Technology Workshop

August 31 & September 1, 2012

Presented by: Dr. Tom Losordo & Mr. Dennis DeLong

Corinthia Hotel, Kogreesova 1, Prague 4, 14069, Czech Republic

Cost:

Workshop Attendence only	US $375
Attendance at Workshop if attending AQUA 2012	US $275
Students	US $175

About the Workshop: Recirculating aquaculture technology (systems that recondition and reuse water) continue to attract attention and are the subject of considerable capital investment worldwide. This workshop is designed for a broad audience and seeks to provide participants with non-biased, research-based information about the design and management of recirculating aquaculture fish production systems. The information presented comes either from the first-hand research results, findings from the global research community, or the experiences of the presenter with commercial scale producers. Workshop registration includes a technical workbook containing the prints of the powerpoint slide presentations (the powerpoint presentations are not available for distribution), a compact disc containing useful publications and spreadsheets, and coffee, tea and lunch for both workshop days.

Reservations: Reservations are essential, and only accepted with payment to AQUA 2012. Online registration and other registration can be found at: www.was.org or by contacting John Cooksey at: Worldaqua@aol.com or Mario Stael at: mario@marevent.com.

For more detailed information about this workshop, go to: https://www.was.org/WasMeetings/Meetings/Pdf/RecircAqua.pdf

AES Board of Directors 2012

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Aquaponics Technology and Design Workshop

Fall 2012 Dates: October 2–6

Topics that will be covered during this 4½-day workshop:

UVI Aquaponic System & UVI-Based System at Aquatic Eco-Systems

- System design and management
  - Aeration
    - Blower selection and sizing
  - Plumbing
    - Pump Selection
    - Total Dynamic Head (TDH)
  - Components
  - Construction techniques
  - Operation
  - Electric Cost

Fish Production

- Stocking rates
- Feeding, growth and survival
- Harvesting and processing
- Water quality
- Brood stock management
- Breeding
- Fry sex reversal

Marketing and Economics

Plant Production

- Seedling production
- Importance of pest identification with special guest Fred Petitt of Walt Disney Parks & Resorts
- Disease and insect control
- Nutrient dynamics

Hands-On Instruction

- PVC work
- Pump setup and plumbing
- Plant grow tray construction
- Fish handling
- Water quality testing

Green Sky Growers Rooftop Greenhouse Tour

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AES President (USA)

Aneshansley, Edward D. MPS, P.E.

Ed Aneshansley is currently a Senior System Engineer for the Waterlife Design Group, a division of Aquatic Habitats Inc. Mr. Aneshansley received his Bachelor of Science from the University of Maine, Orono, with a major in Natural Resources and a concentration in Marine Resources. Aneshansley received his Masters of Professional Studies (MPS) as a Sea Grant Scholar from Cornell University in the Department of Agriculture and Biological Engineering. He has been working the in private sector since 1999 in markets that require recirculating aquatic holding systems. These markets include: commercial aquaculture, live seafood distribution, biomedical research, marine mammal rehabilitation, public aquaria and education. He is a Professional Engineer (Environmental) registered in the state of Massachusetts where he currently resides.

AES First Vice President (USA)

Vinci, Brian J. PhD., P.E.

Brian J. Vinci, Ph.D., P.E., is the Director of Engineering Services for the Freshwater Institute, a field office and program of The Conservation Fund, Arlington, VA. Dr. Vinci earned his Bachelors and Masters degree in Agricultural and Biological Engineering from Cornell University and earned his Ph.D. in Biological and Environmental Engineering from Cornell. Dr. Vinci leads engineering projects in the areas of fisheries bioengineering, environmental engineering, and facility/infrastructure planning. Dr. Vinci is a licensed professional engineer (environmental) in New York and Pennsylvania.

AES Second Vice President (China)

Liu, Ying

Dr. Ying Liu, is currently the Professor of the Institute of Oceanology, Chinese Academy of Sciences (IOCAS) and the vice director of R&D Center of Marine Environmental Engineering & Technology. He has also served as the Director of Branch Society of Aquacultural Engineering, Chinese Society of Agricultural Engineering (CSAE). Dr. Liu has been involved in aquacultural engineering research and education since 1994. Dr. Liu received a B.S. in Agricultural Architecture from North-west A&F University (China), a M.S. and Ph.D. in Biosystem Engineering from Zhejiang University (ZJU). Being the Professor of IOCAS, his research focuses on recirculating aquaculture system design. In this post, he is responsible for design and use of recirculating aquaculture systems in China and the basic theory research of industrial farming.

AES Treasurer (USA)

Pfeiffer, Timothy

Tim Pfeiffer received his PhD in Engineering Science from the Department of Biological and Agricultural Engineering of Louisiana State University. A major focus of his research has been directed at improving the energy and water usage of recirculating aquaculture systems for the production of algae, clams, marine and freshwater finfish. Prior to a career with USDA he did seed clam and algal research at the University of Georgia Marine Extension Laboratory in Savannah, GA and at Marinetics, a private seed clam operation in Cambridge, MD. Tim spent four years as an Agricultural Engineer with the USDA Agricultural Research Service in Pine Bluff, AR working on improving pond harvest techniques and freshwater recirculating systems. From AR he moved to FL with the USDA ARS and continued RAS research activities with marine finfish at the FAU / Harbor Branch Oceanographic Institute campus in Fort Pierce, FL. Following termination of the USDA project in 2011 and a brief consulting period, Tim took a position with the USDA Foreign Agricultural Service as an Agricultural Advisor for Provencial Reconstruction efforts in Afghanistan. Tim will be deployed to Afghanistan in June 2012.

AES Past President (Norway)

Bergheim, Asbjørn

Dr. A. Bergheim is a senior researcher in the Dept. of Marine Environment at IRIS – International Research Institute of Stavanger (www.irisresearch.no). Prior to the present position, he worked at NINA – Norwegian Institute for Nature Research for ten years and he has also been at a private Norwegian consulting company for two years. Dr. Bergheim holds a PhD from The University of Life Science in Norway. In 1993, he was a visiting researcher at Inst. of Aquaculture, Univ. of Stirling, Scotland. He has been a member of the editorial board of Aquacultural Engineering since 1996. Over the last five years he has been a member of AES Board and is current Past president (2012). Dr. Bergheim's fields of interest within aquaculture are primarily water quality vs. technology and management in tanks, cages and ponds, effluent loading and treatment, recirculation systems, and intensification of farming systems. He has been involved in many research and consulting projects in Norway (land and cage based systems for salmonids), Scotland, Asia (mainly brackish water shrimp culture in Bangladesh, India, Sri Lanka), and in some other parts of the world. Some of the achieved results are published in Aquaculture and Aquacultural Engineering, and Dr. Bergheim has also been a former columnist in the UK based magazine, Fish Farmer (2000 – 2003).

AES Director (Chile)

Merino, German

He has a professional title as Aquacultural Engineer from Universidad Catolica del Norte (1994, Chile) and a PhD in Biological and Agricultural Engineering from University of California Davis (2004, USA). Dr Merino work as a professor of the Aquacultural Department at the Universidad Catolica del Norte, Chile. Dr Merino became involved in aquacultural activities back in 1992, accumulating experience in aquaculture facility operations, design and construction management with an emphasis on marine animals. Dr. Merino has worked with shellfish, flatfish, finfish, seaweeds, algae, rotifers under intensive culture systems, from which 15 papers have been published during the last 5 years. His recent projects include direction and participation as an aquaculture expert in the design of recirculation seawater aquaculture systems for mollusks such as abalone and scallops and marine finfish. He has been an AES member since 1996 and participated with oral presentations, session chair and workshop speaker at several Aquacultural Conferences counting more than 40 presentations in the last 5 years. Dr Merino has served the Aquacultural Engineering Society as BOD member for first time in 1998 and again in 2004 as well as Officer between 2008 and 2011 and therefore performed as AES President during year 2010. Recently took responsibilities as AES Chairman Award Committee and was elected to serve AES again as BOD member.

AES Director (Denmark)

Dalsgaard, Anne Johanne

Dr. Anne Johanne Dalsgaard is a Senior Research Scientist at the Technical University of Denmark, National Institute of Aquatic Resources (DTU Aqua), Section for Aquaculture. She received a B.Sc. and Ph.D. from the Faculty of Science at the University of Copenhagen (Denmark), and a M.Sc. in Resource Management and Environmental Studies from the University of British Columbia (Canada). Dr. Dalsgaard is organizer of the Nordic Network on Recirculating Aquaculture Systems (www.NordicRAS.net). Her research focuses on water quality and the coupling between fish feed utilization and waste nutrient composition and form.

AES Director (USA)

Brune, David

David Brune received his B.S. and M.S. in Agricultural Engineering and PhD in Sanitary Engineering from the University of Missouri-Columbia. A major focus of his research has been directed at quantifying, modeling, and optimizing the role of photosynthesis in existing and emerging aquacultural practices. His R&D activities at Clemson University in South Carolina resulted in the U.S. patented, "Partitioned Aquaculture System" and "Controlled Eutrophication Process." Currently, at the University of Missouri, he leads research and extension efforts targeting deployment of integrated aquaculture / algal culture systems supporting co-production of bioenergy with environmental protection and remediation. He is a founding member and past president of the Aquacultural Engineering Society.

AES Director (USA)

Piedrahita, Raul H.

Dr. Raul H. Piedrahita is professor and department chair in the department of Biological and Agricultural Engineering at the University of California, Davis, where he has been on the faculty since 1984. Dr. Piedrahita's research interests are in the area of water quality and treatment in aquaculture: theory and practice of CO2 measurement and control, suspended solids characterization and control, biofiltration, and computer modeling of unit operations and systems. He is a founding member and past president of the Aquacultural Engineering Society.

AES Director (USA)

Boardman, Greg

Dr. Gregory Boardman is a Professor of Civil and Environmental Engineering and Director of the Annual Short Courses for Treatment Plant Operators at Virginia Tech. Dr. Boardman is a Fellow of the American Society of Civil Engineers (F.ASCE), licensed as a professional engineer (P.E.) in Virginia, and registered as a Diplomate of Environmental Engineering (DEE) with expertise in the areas of water and wastewater engineering. He performs research and teaches courses in the areas of environmental engineering principles, industrial and hazardous waste management, environmental toxicology, and water and wastewater treatment processes. Since joining the Virginia Tech faculty in 1976, Dr. Boardman has served as an engineering consultant to more than 30 agencies and companies, been the principal or co-principal investigator for more than 135 funded research projects, and published more than 160 papers and reports in the environmental area. He has served on the Board of Directors twice and as an officer of the Aquacultural Engineering Society (1st and 2nd VP, and President).

AES Director (USA)

Kuhn, David

Dr. David D. Kuhn, Assistant Professor, joined the Department of Food Science and Technology faculty at Virginia Tech after receiving his doctorate, Ph.D., in Civil and Environmental Engineering at Virginia Tech in 2008. He also holds a B.S. degree in Mathematics (Saint Lawrence University), B.S. degree in Civil Engineering (Clarkson University), and a M.S. in Civil and Environmental Engineering (Clarkson University). In his short time as a faculty member he has helped bring in extramural funds to the University to work on various aquaculture projects that serve the needs of the aquaculture industry. To date, he has over 30 publications (18 peer-reviewed scientific manuscripts in press/published and 2 book chapters) and has presented more than 40 papers at various national/international meetings. His research interests include animal husbandry, alternative ingredients for aquaculture feeds, new species culture in recirculating aquaculture systems, seafood quality, systems engineering, toxicology, and waste handling/reuse. Overall, he enjoys working with industry to help them become more economically and environmentally sustainable.

AES Director (The Netherlands)

Verdegem, Mark

Dr. M.C.J. Verdegem is lecturer at the Fish Culture and Fisheries Group within the Department of Animal Sciences of Wageningen University, the Netherlands. He holds a PhD degree in Marine Sciences, specialization Aquaculture of the University of Puerto Rico, USA. He joined Wageningen University in 1987 as project coordinator of international Aquaculture Projects, working all over the globe. Early 2000 he became lecturer responsible for teaching and research in the field of Aquaculture Production Systems, optimizing the functioning of aquaculture systems through steering of microbial mediated processes. In the past his main research focus has been on tropical pond management, but he presently also works on recirculating aquaculture systems. To date, he contributed to 235 scientific reports, presentations and manuscripts of which 82 peer-reviewed manuscripts and 5 chapters in books. Nine PhD students graduated under his supervision. Since 2009 he is Editor of Aquaculture Research.

AES Director (Chile)

Morey, Rafael

Rafael I. Morey is an Engineer from the Universidad Catolica del Norte - Chile, graduated in 1998 with high distinction. He began working for PRAqua Technologies in Canada in 1999, where he was part of the engineering team that developed several advance water treatment projects for fish farming in Canada and North America. He moved back to Chile in 2004 where he was the Project and Business Manager at Hydrogest. He developed several recirculation and water reuse projects, together with waste water treatment plants and water disinfection projects applying UV and ozone. Currently he is the Manager of the Water Engineering Division of OCEA Chile S.A. He is in charge of a group of engineers with valuable experience where he coordinates and manages large engineering and implementation projects. He has participated in several AES conferences as speaker. Also, he is studying a "Diploma" at the PUC Engineering of Advance Project Management.

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