AES NEWS

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Photo: Circular cages at a Norwegian salmon farm

(Courtesy: Nils Hovden, OSV, Norway)

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President's Message

by German Merino

Dear all,

A year has already gone by and another one is starting. Last year began with many natural catastrophic consequences for my country, Chile, and we did well with the help of many. Today, friends and colleagues from Australia are the ones suffering inclement weather, and our thoughts and prayers are with those suffering. One more time, we expect that AES can contribute to recovery.

As a Society, we asked our members to participate in many conferences and workshops last year. And, I am glad to report that we did quite well. A quick review will enlighten us: the AES started in March with an outstanding contribution to Aquaculture America 2010, which was held in San Diego (California, USA); then we were represented at the Australasian Aquaculture Conference held in Hobart (Tasmania, Australia) and participated in the International Commission of Agricultural Engineering World Congress (CIGR) held in Quebec City (Canada); in the middle of the year, the AES Special Issues Forum and International Conference on Recirculating Aquaculture were held together in Roanoke (Virginia, USA). All these meetings and workshops were mentioned in my last letter.

After August, AES was represented at Aquaculture Europe 2010 (Porto, Portugal) in October: Dr. Oliver Schneider who chaired a session called "Land-based production: New production technologies", including large-scale RAS, production in arid regions and other land based activities. The session had 16 oral and 16 posters contributions from all over Europe and the USA. The session contributions showed the recent challenges in land based shellfish growth, new trends in Hungary for Carp productions in ponds, integrated intensive systems using RAS sludge as feed to produce worm biomass (which can be used as a potential feed ingredient), aquaculture integration through aquaponics was presented as a holistic approach to cover aspects of food safety; and a RAS that allows culturing of several cohorts of fish at a medium density and how to count flatfish in real time using a laser scanning technology. There was also a contribution on tank engineering, which described how to balance water velocities for solids removal, fish oxygen needs, and carbon dioxide removal. The bacteria community within a RAS was analyzed to determine the relationship between systems operation and impacts on nitrifier performance; interaction of nitrifying and heterotrophic bacteria; and bacteria shield effects that protect fish against pathogens. A complete report of the session can be downloaded from EAS webpage. Finally and according to Dr Schneider "it can be expected that land based system will be a true alternative to sea based production in the future"(www.easonline.org/).

Again, thanks to the AES Board of Directors for supporting sessions organized by our members worldwide . AES was involved in the 3rd Aquaculture Congress (Viña del Mar, Chile; www.southpacificconference.pucv.cl/) with a session on Recirculating Technology Applications in Chile, which was held November 26, 2010. Our 1st VP, Dr Asbjorn Bergheim, was the conference keynote speaker and gave an outstanding presentation on Atlantic salmon and aquaculture technology. Also, two Aquacultural Engineering Workshops, one in Coquimbo on November 23 and the second one in Pto Montt on November 27, were held in Chile while Dr Asbjorn was visiting. The Coquimbo´s main topic was Marine Finfish, and Dr Asbjorn presented a contribution coauthored by Dr Blancheton (IFREMER, France) and Dr Schneider (SARIA Bio-Industries). Pto Montt´workshop was based on Atlantic salmon RAS technology applications. Both Workshops did not charge any fee to attendants and our contributors were

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Article

RECENT GROWTH TRENDS AND CHALLENGES IN THE NORWEGIAN AQUACULTURE INDUSTRY

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Over the last 20 years, the Norwegian production of salmon and rainbow trout has increased by c. 10% per year and will exceed 1 million tons in 2010. All on-growing takes place in open cages in the fjords and along the coast, and the average cage volume has increased by about 300 times since the 1980's. Out of a total number of 4,000 cages more than 1,200 cages hold 20,000 – 60,000 m3. In 2005, the term 'maximum allowable biomass (MAB)' was introduced and limits the highest annual production to 65 tons per 1,000 m3 licensed volume. Generally, the increasing volume and deeper cages have made the control of the fish stock more challenging.

Sea lice attacks, especially in South Norway, have represented a major problem over the last three years. Reduced growth, increased mortality and lice treatment leads to significant losses and extra costs for the industry. Some recent reports indicate that increased use of wrasses in the cages improved the situation in the summer 2010 compared to the previous year. Extensive vaccinating and strict regulations regarding handling, etc. usually result in effective protection against diseases, but still there may occur regional outbreaks of serious diseases, such as pancreas disease (PD) and infectious salmon anaemia (ISA).

Attacks of sea lice and escaped salmon and trout from fish farms are considered to be among the main reasons for the strongly reduced wild stocks of sea trout and a reduced return of salmon spawners in the fjords and along the coast of Southwest Norway. The Directorate of Fisheries reports 511,000 escaped individuals from Norwegian fish farms last year, comprised of 187,000 salmon, 133,000 rainbow trout, 175,000 cod and 16,000 halibut.

Problems connected to open-cage production have initiated debate about other possible technical solutions. Closed floating cages supplied with pumped water and land-based farms based on recirculating of water (RAS) are such alternatives.

Production of salmon and trout for stocking of the cage farms takes place in more than 200 hatcheries along the coast. Last year, 235 million salmon and 16 million trout were produced. The majority of the Norwegian hatcheries are still flow-through systems but the number of farms introducing partial or full water reuse is rapidly growing.

Production trend

Over the last 15 years, the annual volume produced has increased about four times from 200,000 to more than 900,000 MT and is expected to pass 1 million MT this year. The salmon production constitutes about 90%, rainbow trout 7 - 8 % and cod 2% (Figure 1). Besides this, a smaller part of some 5,000 MT is represented by Artic charr, halibut and turbot. The average production per farm is c. 1000 MT/year as the total number of active licensed farms was 929 in 2007 (Statistics Norway).

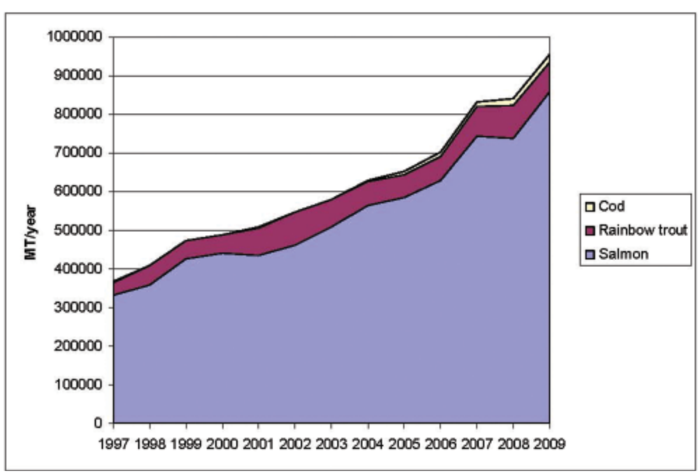

Figure 1. Annual production of salmon, trout and cod in Norway 1997 – 2009. Source: Statistics Norway.

The ownership structure of the industry has been through a revolution from a great number of companies only administering one or a few farms to a few large companies. Among these are Marine Harvest and Cermaq, controlling numerous fish farming activities in several countries.

The production of salmonid smolt for stocking in the cage farms has been through a similar development: while a typical hatchery in 1985 produced 100,000 – 300,000 smolts of 30 – 50 g, the average production in 2006 was more than 1 million smolts of 100 – 200 g per hatchery, i.e. 20 times higher annual production in terms of biomass.

Today, the total production of smolt is about 300 million and the number of licensed hatcheries was 228 in 2007 (Statistics Norway).

Technological development

Cage farms

A dramatic size increase of the cages has taken place; the shallow cages of a few 100 m3 dominating the industry back in the 1980's are now replaced by huge cage systems with 20 – 50 m net depths. The total number of cages is currently some 4,000 and out of this 1/3 have a total volume of more than 20,000 m3. During the period 2005 – 2009, the total production volume was almost doubled from 37 to 67 million m3 (Norwegian Directorate for Fisheries).

The previous cage volume and feed quantity limitations are repealed. Today, only the MAB, maximum allowable biomass, is left. MAB allows a production of 65 MT per 1,000 m3 licensed volume and a standard licence of 12,000 m3 thus permits 780 MT produced per year.

More and more cage farms are moved from protected sites to more open, deeper localities intermittently affected by strong current velocity, wind and waves. Current velocity of more than 0.5 m/s is not uncommon at such exposed cage localities. Consequently, there is a need for new and robust equipment and, not least, available technology for running control of the fish stock and the cages. Farm sites off the coast are deeper and the cage nets are 20 – 60 m deep. The visual control from the surface of a deep, large cage with a circumference of 160 m is only 0.2% of the total volume (Blaalid, 2008).

Traditionally, steel framed cages have dominated in Southern Norway, while PVC frames have been more used in the northern parts. The PVC based farms are considered to be more resistant to rough weather conditions.

Control systems

An increasing number of cages are equipped with a submerged camera for surveillance of the fish stock. A sketch of such a system with successive motion vertically-horizontally is presented in Figure 2. Vital conditions regarding the fish stock, such as appetite, possible health or lice problems, mortality rate, early warning of escape, etc. can be observed from the screen in the operation room in real-time. The behaviour of the fish will be compared to the environmental conditions, e.g. the preferred depth correlated to the temperature and oxygen profile. Current monitoring of water exchange and temperature - dissolved oxygen within the cages explains a lot of the fish stock's conduct and not least, makes it possible to put into effect countermeasures. At high temperature and low oxygen concentration feeding may fortify the situation.

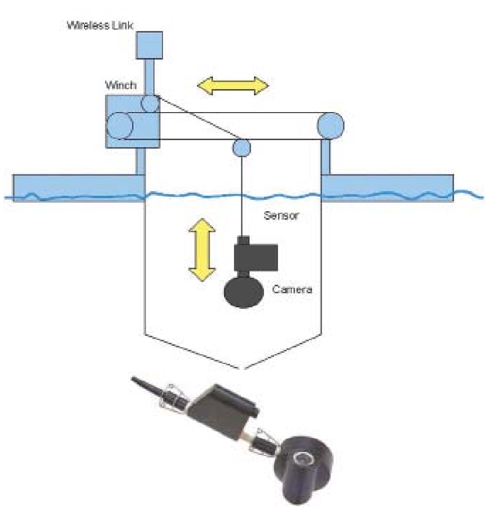

Figure 2. System for control of fish stock and environmental conditions in cages. Courtesy: Orbit AquaCam as, Norway.a) Sketch of a movable vertical – horizontal camera with sensor station, and b) Camera with Orbit-800 Sensor Station for monitoring of DO, temperature and salinity.

Use of current meters may indicate essential different conditions of the water exchange at the surface and in deeper layers at a cage site (Figure 3). A fluctuating tidal based current in a NW – SE direction was demonstrated at 5 m depth compared to current in a stable NE direction at 20 m depth. In both layers, the average velocity was c. 2 cm/s (min – max: 0 – 10 cm). Thus, the 'carrying capacity' was about the same in the water column in terms of supply of oxygen and removal of excretion products. The dissolved oxygen concentration (DO) at this farm stocked with 3 - 5 kg/m3 was reduced 10 – 15% of saturation at 8 – 9 °C in the cages due to the respiration of the cod. As much as 20 – 30% lower DO was measured a few times at 25 – 40 m depth compared to at the surface. The primary reason was lower DO saturation from outside and higher fish density below 20 m deep.

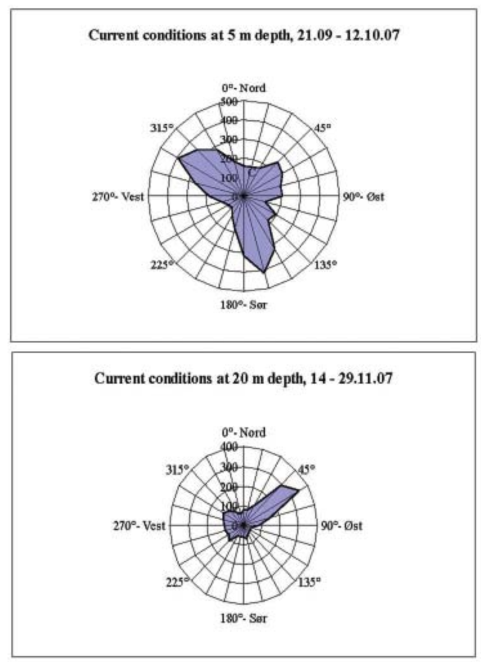

Figure 3. Monitoring of current conditions over 2 – 3 weeks at 5 and 20 m depth outside a cage farm (Bergheim et al. 2008).

On-growing in closed systems

The debate about alternative technology to open cages has reached a new era. Different problems linked to open systems described in this paper are the basis for the discussion. Such alternatives are closed floating cages supported pumped water from deeper layers and added oxygen or air (Skaar & Bodvin, 1993). Land-based recirculating systems

(RAS) are another possible trend and tests are being performed (e.g. Johnsen et al. 2003).

Intensified production of salmonids in on-shore systems (RAS) from brood stock to harvest combining freshwater and sea water is an emerging alternative (Wolters et al. 2008). An advanced research facility involving all these processes has been completed at Sunndalsora in NW Norway (Terjesen et al. 2008). Obviously, studies on non-anadromous species may also be performed in such systems.

Disease and parasite problems

Disease

Most disease problems along the Norwegian coast are caused by virus. The frequency of proved and suspected outbreaks of dominating diseases and Infectious Salmon Anaemia (ISA) is presented in Table 1. ISA has attracted special attention due to the huge damaging effects on the salmon industry in Chile and on the Faroe Islands. As a result, an international expert group has been established to enhance the knowledge base. Pancreas Disease (PD) hit 75 farm sites last year and the disease seems to move north as some incidents have been proved in Northern Norway over the last years. The actions against PD include synchronized fallowing, splitting of generations, reduced moving between sites, control of infection, and vaccination (Fiskehelserapporten, 2009). Heart and Skeleton Muscle Inflammation (HSMI) is a frequent and fatal disease first detected in one farm in 1999. This disease is associated with infection with Piscine Reovirus (PRV), first identified in 2010 (Bang Jensen, personnel communication; Palacios, 2010). Infectious Pancreas Disease (IPN) incidents were reported from altogether 53 hatcheries and 170 cage farms in 2009, the highest number ever reported. The mortality may reach high levels especially in hatcheries and survivors often demonstrate reduced growth ('IPN-losers').

Bacterial diseases, such as Vibriosis, Cold-water Vibriosis and Furunculosis, are generally effectively controlled by vaccines. PGI or Proliferative Gill

Disease	2004	2005	2006	2007	2008	2009
ISA	16	11	4	7	17	10
PD	43	45	58	98	108	75
HSMI	54	83	94	162	144	139
IPN	172	208	207	165	158	223

Table 1. Number of cage sites in Norway with outbreaks of virus diseases 2004 – 09: Infectious Salmon Anaemia (ISA), Pancreas Disease (PD), Heart and Skeleton Muscle Inflammation (HSMI) and Infectious Pancreas Necrosis (IPN). Source: Fiskehelserapporten (2009).

Inflammation has been detected in salmon farms sine the 1980's (Fiskehelserapporten, 2009).

Parasites

The predominant parasite problem in Norwegian aquaculture is caused by sea lice (Lepeophtheirus salmonis), a natural parasite of both salmon and sea trout. Whelan (2010) has reviewed the well-known effects of sea lice attacks: impacts on the host's skin include epithelium loss, bleeding, increased mucus discharge, altered mucus biochemistry, tissue necrosis and consequent loss of physical and microbial protective function. Host fish have reduced appetite, growth and food conversion efficiency, and the stress and wounds expose fish to secondary infections. Changes to the host's blood include anaemia, reduced lymphocytes, ion imbalance and elevated cortisol. These changes indicate a stressed and weakened host, with reduced osmoregulatory and respiratory ability and impaired immunocompetence.
There is also increasing evidence that the louse is vector for spreading of PD (Trond Erik Børresen, personnel communication). Over the last years, the average number of lice has increased in South Norway (Figure 4). Especially in great salmon producing regions in the mid and west part of the country the lice require extra action. Commonly used treatment chemicals administered in feed, emamectin benzoate and pyrethroids, demonstrate reduced effect (Fiskehelserapporten, 2009). A close relationship between frequent usage of these medicines and high lice numbers has been observed in several regions. In general, the lice will sooner or later develop resistance against all medicines used.

As a consequence of the situation, the fight against sea lice has been turned in two directions:

- usage of medicines in tarpaulin enclosed cages, and
- more and more stocking of wrasses in the cages

Medical treatment in enclosed large volumes is challenging, not least to get a stable effectual concentration of the drug and to avoid dissolved oxygen (DO) dropping below stressful levels. The lowest acceptable DO concentration is considered to be 6 – 7 mg/L or approx. 70% of saturation (Crampton et al., 2003).

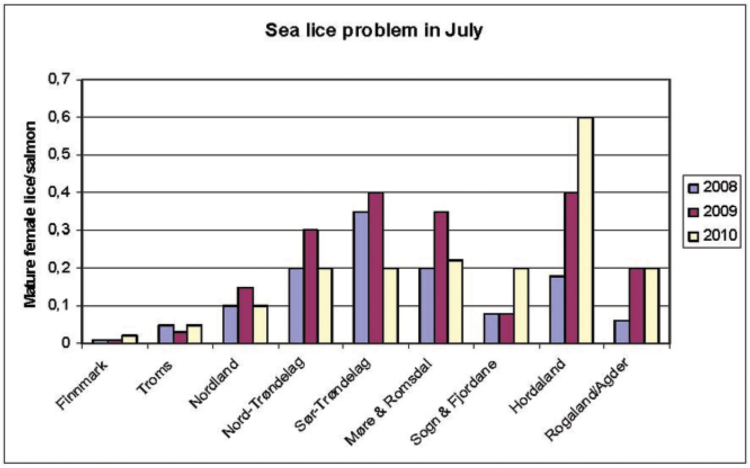

Figure 4. Sea lice problems in cage farms along the Norwegian coast in July 2008 – 2010. Unit: Mean number of sexually mature female sea lice per salmon. Source: Lusedata.no.

Stocking of cleaner-fish, goldsinny and ballan wrasse, at a ratio of about 1:100 in the cages may be an efficient attempt to control the lice population (Kvenseth et al. 2003). In order to reduce the drug usage and improve the control, more farms are substituting chemicals with stocking of cleaner-fish (Figure 5). The trend continues and according to the last reports the wrasse-stocked farms amount now to more than 60% of the total. Some recent reports indicate that increased use of wrasses in the cages improved the situation in the summer of 2010 compared to the previous year.

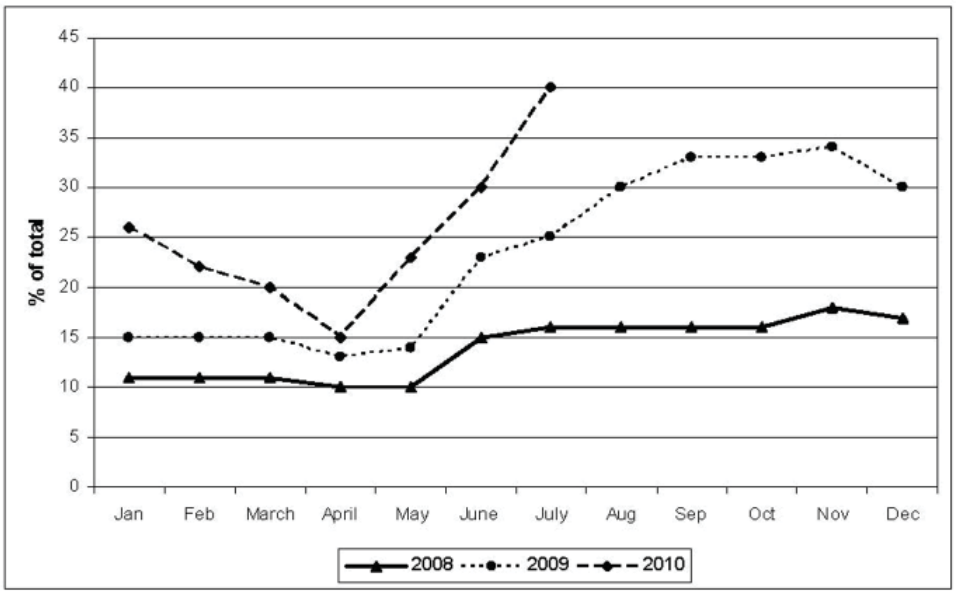

Figure 5. Usage of wrasse for sea lice control in Norwegian cage farms January 2008 – July 2010. Source: www. lusedata.no

Breeding programs for lice resistant salmon have been discussed. However, this might result in the development of sea lice which are more virulent against wild salmon. Sea lice from regions influenced by many fish farms seem to be more harmful to wild stocks compared to lice from south east Norway without aquaculture (www.kyst.no).

Alternative production systems, such as submerged cages (Dempster et al. 2009), and extended usage of artificial light (Juell & Fosseidengen, 2004), might be useful attempts to keep the fish stock away from the 'sea lice zone' towards the surface.

Conflicts aquaculture versus wild stocks

Catch and abundance of wild Atlantic salmon have declined dramatically in the North Atlantic over the last 20 - 30 years. The reported catches of salmon in 1980 of c. 10,000 tons were reduced to below 2,000 tons in 2007 (ICES, 2008). About half of the total is caught in the rivers and along the Norwegian coast (Hansen et al. 2006). In terms of estimated number of returning spawners to the rivers in Norway a total of approx. 900,000 in 1985 has been reduced to 300 – 400,000 in 2007 (Hansen et al. 2008). There are numerous causes of the reduced salmon population, such as overexploitation, river pollution and acid rain, but effects from fish farming are considered as significant in many regions. Hybridisation between wild and farmed salmon is considered a main threat to salmon in freshwater, while sea lice are a problem in many marine areas (Hansen et al. 2008).

Ford & Myers (2008) compared marine survival of wild salmonids in areas with farming to adjacent areas without farms in Scotland, Ireland and in Atlantic - Pacific Canada. Through a meta-analysis of existing data, they showed a reduction in survival of Atlantic salmon, sea trout and Pacific salmon. In many cases the reductions in survival and abundance are greater than 50%.

Escapes

The reported number of escaped salmon from Norwegian farms since 1993 was between 187,000 and 920,000 per year, i.e. in the order of the estimated annual number of wild salmon returning to the rivers for spawning. Based on extensive data, Hansen (2006) concluded the following:

1. Wild salmon tagged as smolt show high survival to sexual maturity and high return rate to their origin rivers as spawners
2. Farmed salmon tagged as smolt show high survival to sexual maturity and return to the river where they were stocked as spawners
3. Farmed salmon stocked directly in the sea as smolt show relatively high survival and return to the area where they were stocked and then ascend the local rivers for spawning
4. Farmed salmon stocked as post-smolt in the sea show low survival to sexual maturity and ascend rivers farther away compared to salmon stocked in the sea as smolt
5. Adult farmed salmon escaping during autumn/winter seem to have lost their homing instinct and are spread with the ocean current, and may ascend rivers far away from the escape site
6. The survival rate of escaped, adult farmed salmon seems to be low until maturity
7. In summary, the survival rate and migratory pattern are dependent on the time and life stage at escape

In addition, there are incidental escapes of farmed rainbow trout and marine fish. The Directorate of Fisheries (2010) reports 133,000 rainbow trout, 175,000 cod and 16,000 halibut escaped last year.

Sea lice

Costello (2009) carried out a very detailed review of the impacts of sea lice from salmon farms on wild salmonids in Europe and North America. He concluded that there was compelling evidence that lice from farms are a significant cause of mortality in nearby wild fish populations. Sea trout dwell in the fjord systems before ascending the rivers and this cycle makes this species especially vulnerable to sea lice infestations. In June 2010, the average number of lice on returning sea trout was 60 per individual in a fjord system in SW Norway characterised by high aquaculture activity (Institute of Marine Research, 2010).

Possible ways to reduce the total biomass of sea lice in the fjords and along the coast are:

- imposed fallow periods for cage farms
- change open nets to closed enclosures
- move parts of the industry onshore (land-based farms)

The Norwegian salmon industry will spend some $200 million this year in actions against sea lice, mainly co-ordinated chemical treatment in January - April (FHL, 2010). These efforts are primarily initiated to protect the wild salmon and sea trout stocks and the final goal is to reduce the average number of lice to 0.1 per salmon in the cages. Per July 2010, the frequency of sea lice was below this level in the northern part (Nordland – Finnmark) but higher in the southern part of the country (Figure 4).

Acknowledgements

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DR. FRED WHEATON RECEIVES AES AWARD OF EXCELLENCE

Pictured from left to right: Barnaby Watten, two professors from the University of Maryland Dept. of Biosystems Engineering, Fred Wheaton, Steve Summerfelt and Brian Vinci

The AES presented Dr. Fred Wheaton with the Award of Excellence in August of 2010. This award recognizes outstanding science or technical contributions to the field of aquacultural engineering. It can sincerely be said that without Dr. Wheaton's efforts, there probably would really not be a discipline that we distinctly refer to as aquacultural engineering. Dr. Wheaton was far ahead of his time in this engineering area when he wrote, in 1977, what became known as the aquacultural engineer's Bible, the book titled "Aquacultural Engineering." This text was the foundation for many teaching programs around the world and remains popular still. Most of the technical information published in this 1977 text remains valid today 35 years later! In 2002, Dr. Wheaton co-authored the book titled "Recirculating Aquaculture Systems" by Timmons, Ebeling, Wheaton, Summerfelt and Vinci.

In addition, Dr. Wheaton developed one of the first aquacultural engineering research and extension programs in the United States. His research has included recirculating systems, seafood processing, automation of oyster shucking, and a variety of other topics related to aquaculture engineering. He has published widely producing over 100 articles and three books.

Dr. Wheaton is a founding member of the Aquacultural Engineering Society (AES) and served as our second President. Until his recent retirement, Dr. Wheaton was Professor and Chairman, Department of Biological Resources Engineering, University of Maryland, College Park, Maryland. Dr. Wheaton also retired after 5 years as the Director of the USDA Northeastern Regional Aquaculture Center.

Dr. Wheaton is one the leaders in the field of aquacultural engineering and we know of no other individual who has had such a strong impact on an emerging industry. We all owe a great deal of gratitude to him for his career efforts in this regard as a developer and supporter of the aquaculture community.

President's Message (...continued)

traveling all over the country at their own expenses. Therefore, I would like to thank Engineer Rafael Morey (OCEA Chile S.A., Chile), Engineer Jorge Contreras (OCEA Chile S.A., Chile), Marine Biologist Esteban Emparanza (Billund Aquaculture Chile S.A., Chile), Dr Rolando Vega (Universidad Catolica de Temuco, Chile), and Engineer Joel Barraza (Universidad Catolica del Norte, Chile). I am proud to tell that AES was officially recognized as sponsor for all those events.

As you were able to witness, we had a very busy 2010 and one thing that grabbed my attention was the eagerness of many young people asking for aquacultural degree programs. I would like through this letter to encourage all members to submit a short note about degree programs (MS or PhD) that are focused on either 'aquaculture' or 'aquacultural engineering'. The information submitted by you could be included in our AES Newsletter as well as the society web page. This information will provide contact information that can be used for continuing education, information exchange, and communication opportunities between students and professors at the various locations.

We will soon meet again during Aquaculture America 2011 (AA2011) between February 28 and March 3 in New Orleans (Louisiana, USA). During AA2011 AES will be sponsoring two sessions. Dr Steven Hall will chair a session titled "Aquacultural Engineering and Coastal Environment" and Dr Asbjorn Bergheim will chair a session titled "Advantages of RAS in Salmon Smolt Production". During this event, AES will be holding its Annual AES BOD and Member meeting. AES will be moving into our second year with an international President, this time with Dr Asbjorn Bergheim from Norway. As you all know, our Society has voted for international leadership. With this spirit, AES pursues the main goal of Dr. Steven Hall, AES Past President, "to continue the outreach and expansion to include representation from even more diverse countries".

And please do not forget other commitments as AES members help to grow our representation in other countries. Some of us are already working to put together AES sponsored sessions for WAS 2011, which will be held June 6-10 in Natal, Brazil. One of the sessions is focusing on Biofloc Technology, which is being organized by Dr Yoram Avnimelech. A second session will focus on Recirculating Aquacultural Systems, which I am organizing. And, we are also looking to AQUANOR 2011 to be held in Trondheim, Norway, in August 16-19. Dr Oliver Schneider is putting together a discussion panel on land-based aquaculture systems. And, AES is looking forward to Aquaculture Europe 2011 in Rhodes, Greece, October 18-21.

Quite soon members and Board Directors will be receiving a ballot with candidates for 2nd VP and BOD members prepared by Dr. Hall. Please return your ballot promtly. I will be announcing the new AES Officers and give a farewell to the departing officers during our annual meeting.

Again, I would like to remind you that the working committees are: Past President, Dr. Steven Hall (SGHall@agcenter.lsu.edu), Chair of the Nominating Committee, which proposes new candidates for 2nd VP and new BOD members. Our 1st VP, Dr. Asbjorn Bergheim (Asbjorn.Bergheim@iris.no) is Chair of the Program Committee, who is responsible for organizing AES sponsored sessions at conferences and coordinates with AES members working in the Program Committee. Our 2nd VP, Ed Aneshansley (eda@aquaticeco.com), Chairs the Membership and Publication Committee. Finally, Dr Barnaby Watten (bwatten@usgs.gov), Chairs the AES Award Committee. Please forward nominations for future officers, programs, publications and awardees to them or to Terry Rakestraw rakestra@vt.edu .

I cannot finish this letter without letting you know to send Dr. Steve Summerfelt some of your own engineering work for inclusion in the AES newsletter at s.summerfelt@freshwaterinstitute.org. Again, thank you all for contributing to our Aquacultural Engineering Journal, and congratulations to our organizers and officers. I am looking forward to seeing you soon at Aquaculture America 2011 at New Orleans (Louisiana, USA).

Sincerely,

German

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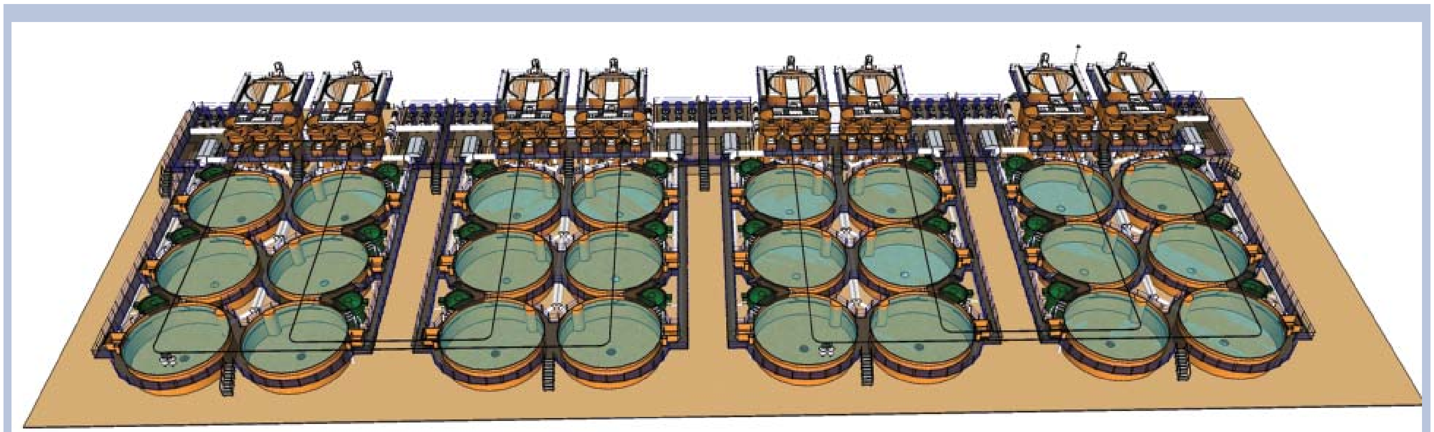

A model 1,000 ton/year closed containment system (courtesy of Freshwater Institute)

Upcoming Events

AES Session at
Aquaculture America 2011

March 1-3, New Orleans, LA

ADVANTAGES OF RAS IN SALMON SMOLT PRODUCTION

Moderator:
Tuesday, March 1, 2:00 pm- 5:30pm, Mardi Gras D

UNOFFICIAL PROGRAM - PLEASE CHECK PRESENTATION SCHEDULE IN THE SHOW DIRECTORY THAT IS DISTRIBUTED AT THE CONFERENCE.

Presentor*/Author(s)	Title

Asbjorn Drengstig*, Yngve Ulgenes, Helge Liltved and Asbjorn Bergheim
RECENT RAS TRENDS OF COMMERCIAL SALMON SMOLT FARMING IN NORWAY

G. Merino*, E. Emparanza & R. Morey
TRENDS FOR SALMON LAND BASE PRODUCTION IN CHILE TOWARDS RECIRCULATION SYSTEMS

Thue Holm, Bjarne Hald Olsen, Marcelo Varela, and **Esteban J.M. Emparanza***
DESIGN AND PERFORMANCE OF WATER RECIRCULATING SYSTEMS FOR COMMERCIAL SALMON SMOLT PRODUCTION IN CHILE

Christopher Good*, Brian Vinci, Steven Summerfelt, Kevin Snekvik, Ian Adams, and Samuel Dilly
STUDIES ON THE COMPARATIVE HEALTH, WELFARE, AND POST-STOCKING PERFORMANCE OF JUVENILE ANADROMOUS CHINOOK SALMON (*Oncorhynchus tshawytscha*) AND STEELHEAD (*Oncorhynchus mykiss*) RAISED IN EITHER PARTIAL WATER REUSE SYSTEMS OR FLOW-THROUGH RACEWAYS

John Davidson*, Christopher Good, Carla Welsh, and Steven Summerfelt
THE EFFECTS OF LONG-TERM HIGH VERSUS LOW DISSOLVED CARBON DIOXIDE EXPOSURE ON THE PERFORMANCE, HEALTH, AND WELFARE OF ATLANTIC SALMON (*Salmo salar*) IN FRESHWATER RECIRCULATION AQUACULTURE SYSTEMS.

Steven Summerfelt*, John Davidson, P. Brett Kenney, and Christopher Good
EFFECTS OF STRAIN AND PHOTOPERIOD MANIPULATION (TO PRODUCE S0 SMOLTIFICATION) IN A 2 X 2 FACTORIAL STUDY ON ATLANTIC SALMON GROWTH, PROCESSING ATTRIBUTES, AND SEXUAL MATURITY TO 24 MONTHS POST-HATCH IN FRESHWATER RAS

Thomas Waldrop*, Christopher Good, Grete Baeverfjord, Kirsti Hjelde, P. Brett Kenney, Kevin Snekvik, and S. Summerfelt
A FACTORIAL STUDY TO INVESTIGATE THE EFFECTS OF SWIMMING SPEED AND DISSOLVED OXYGEN CONCENTRATION ON ATLANTIC SALMON AND RAINBOW TROUT PERFORMANCE, HEALTH AND WELFARE

Dan Dycha*
SUCCESSFUL UV DISINFECTION FOR RECIRCULATING AQUACULTURE SYSTEMS

Alexander Brinker*
FUNCTIONAL FEED FOR FECAL SOLID CONTROL IN AQUACULTURAL OPERATIONS

Per Bovbjerg Pedersen*
CONTROLLING EFFLUENTS FROM RAS – WASTE MANAGEMENT STRATEGIES IMPORTANT FOR COMMERCIAL RAS SUSTAINABILITY

AQUACULTURE ENGINEERING AND THE COASTAL ENVIRONMENT

UNOFFICIAL PROGRAM - PLEASE CHECK PRESENTATION SCHEDULE IN THE SHOW DIRECTORY THAT IS DISTRIBUTED AT THE CONFERENCE.

Moderators: Steven Hall and Milton Saidu

Presentor	Title
11:00	**S. Hall** OVERVIEW OF AQUACULTURAL ENGINEERING AND THE COASTAL ENVIRONMENT.
11:15	**Gutierrez-Wing, Maria Teresa** MICROALGAL CO-CULTURE AS A MANAGEMENT STRATEGY TO INCREASE PRODUCTIVITY AND STABILITY (#373)
11:30	**Athens G. Silaban, Maria Teresa Gutierrez-Wing, Ioan Negulescu and Kelly A. Rusch** EFFECT OF LIGHT AND NUTRIENTS ON BIOMASS AND LIPID PRODUCTION OF A LOUISIANA NATIVE ALGAL CO-CULTURE SELECTED FOR BIOFUEL PRODUCTION. (#107)
11:45	Rong Bai, Maria Teresa Gutierrez-Wing, Michael Benton and Kelly A. Rusch EFFECTS ON LIPID YIELD, COMPOSITION AND FATTY ACID PROFILE OF A LOUISIANA NATIVE ALGAL CO-CULTURE FOR BIOFUEL PRODUCTION. (#106)
12:00	**Nick Lemoine, Chandra Theegala.** GROWTH KINETICS OF VARIOUS MICROALGAL SPECIES SUITABLE FOR AQUACULTURE AND BIOFUEL APPLICATIONS (#167)
12:15	**A. Dassey, C. Theegala.** LOW-COST AND PRACTICAL HARVESTING TECHNIQUES FOR MICROALGAE. (#66)
	LUNCH
2:00	**E. Ancelet, B. Benson, B. Meyer, R. Bajpai.** STUDIES ON THE PHYTOPLANKTON COLLECTED IN THE HYPOXIC ZONE OF THE NORTHERN GULF OF MEXICO AND THEIR POTENTIAL FOR BIOFUEL PRODUCTION (#177)
2:15	D. Dehon, S. Hall, J. Supan, J. Day. BIOENGINEERED OYSTER REEFS FOR MULTIPLE COASTAL FUNCTIONS: FOOD, PROTECTION, HABITAT, CARBON SEQUESTRATION (#13)
2:30	**C. Malveaux, S. Hall, R. Laine.** COASTAL PLANTS FOR WAVE REDUCTION AND BIOENERGY
2:45	**A. Bergheim, B. Braaten & J. Gunnarsson.** SLUDGE COLLECTION SYSTEMS FOR CAGE FARMS. (#407)
3:00	**S. Gilliam, M. Clark, R. Kirk, S. Hall.** DESIGN AND DEVELOPMENT OF AN AUTONOMOUS BOAT TO MEASURE SEDIMENTATION AND EROSION IN THE COASTAL ENVIRONMENT. (#126)
3:15	**D. Hsu, D. Smith, B. Thompson, S. Gilliam, S. Hall** DESIGN AND DEVELOPMENT OF A FLEET OF AUTONOMOUS VEHICLES FOR AQUACULTURAL AND COASTAL APPLICATIONS. (#197)
4:00	**Moderated by Hall** **CONCLUSION/DISCUSSION, All Speakers**

Sectretary/Treasury Report

AES Member Registration:

Please note the location of membership registration and payment. Ms. Terry Rakestraw is the Society's office administrator. If there are any questions regarding membership and journal subscriptions please contact Terry. Below is Terry's contact information.

Ms. Terry T. Rakestraw
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E-mail: rakestra@vt.edu or
aquaculturaleng@swva.net
Office Hours: 8 a.m. to 4 p.m. EST

Please do not hesitate to email (AquaEngrSociety@comcast.net) either Terry or myself if there are any questions or concerns regarding membership or journal subscription.

Tim Pfeiffer,

Acting Secretary/Treasurer

AES Account Summary:

Description	Ending Balance 6/30/10	Current Balance 12/31/10
BB&T- Checking	$1,770.22	$5,203.87
BB&T - Savings	$52,765.11	$42,827.56

July - December 2010 Account Transaction summary:

BB&T Checking	Amount
Deposits:	
AES Issues Forum/ICRA	$3,380.00
Membership & Journal Subscriptions	$2,830.00
Transfer from Savings	$10,000.00
Total Deposits	$16,210.00
Expenses:	
NC Agricultural Foundation	$500.00
Newsletter Printing	$750.75
Postage	$9.78
Travel Support	$500.00
Website Services	$970.00
Elsevier Journal	$8,139.60
Admin Services	$1,750.00
Total Expenses	$12,776.35

BB&T Savings	
Deposits:	
Interest (2%)	$62.45
Expenses:	
Transfer to Checking	$10,000.00

REQUEST FOR INFORMATION

We invite our members to submit a short note about degree programs (MS or PhD) that are focused on either 'aquaculture' or 'aquacultural engineering'. This information will provide contact information that can be used for continuing education, information exchange, and communication opportunities between students and professors at the various locations."

AES Board of Directors 2010

Name	City, State, Country	Position	Term	Engineering Status	E-mail Address
Steve Hall	Baton Rouge, LA	Past President	2007-2010	ENGR	shall5@lsu.edu sghall@agcenter.lsu.edu
German Merino	Coquimbo, Chile	President	2008-2011	INT-ENG	gmerino@unc.cl
Asbjorn Bergheim	Stavanger, Norway	Vice-President	2009-2012	INT-ENG	asbjorn.bergheim@iris.no
Ed Aneshanesley	Beverly, MA	2nd Vice-President	2010-2013	ENGR	eda@aquaticeco.com
Tim Pfeiffer	Fort Pierce, FL	Secretary/ Treasurer	2006-	ENGR	Timothy.Pfeiffer@ars.usda.gov tjpfeif@comcast.net
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Odd-Ivar Lekang	Aas, Norway	Director	2009-2011	INT-ENGR	odd-ivar.lekang@umb.no oddle@umbno
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Steven Summerfelt	Shepherdstown, WV	Director	2009-2011	ENGR	s.summerfelt@freshwaterinstitute.org
Alexander Brinker	Stuttgart, Germany	Director	2010-2012	INT-ENGR	Alexander.Brinker@mlr.bwl.de
George Flick	Blacksburg, VA	Director	2010-2012	NON-ENGR	flickg@vt.edu
Matt Smith	Fort Myers, FL	Director	2010-2012	ENGR	mattsmith@biofilters.com

MASTER PROGRAM IN AQUACULTURE WITH POSSIBLE SPECIALIZATION IN ENGINEERING

The Norwegian University of Life Sciences offers a 2 year Master of Science program in aquaculture. Lectures are given in English. During the first year, the students take courses in fish physiology and anatomy, and aquaculture fields, such as nutrition, breeding, production and engineering. The students may specialize in the second year taking more advanced courses within the mentioned aquaculture disciplines and also prepare master thesis within a chosen special approach.

Within aquaculture engineering, the students are offered special lectures. These students will perform a case study including development of a production plan for a new land based fish farm and based on this, select and propose necessary technical equipment, and prepare process diagrams and technical drawings of the farm concept. The project is normally performed in cooperation with the fish farming industry. The master thesis in the last half year of the program is either performed at the experimental fish farm at the university or out in the industry. Typical subjects for master thesis are connected to developing and evaluation of technical solutions. Examples of such thesis subjects in the last year are development of cage mooring systems, new biofilter technology, evaluation of membrane filters and protein skimmers. Yearly, 15 – 20 students are fulfilling the program, and the students come from all around the word. The prerequisite to attend the program is a bachelor degree or equal qualifications, and there are currently no school fees for foreigners.

For more information go to http://www.umb.no/study-options/article/master-of-science-in-aquaculture

or

Contact:

odd-ivar.lekang@umb.no

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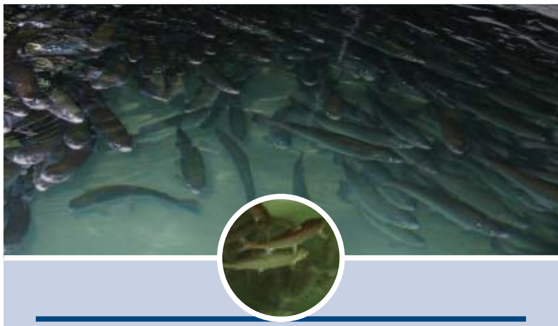

A.E.S. Information

The AES News is printed quarterly by the Aquacultural Engineering Society. You can receive the AES News by joining the Aquacultural Engineering Society. If you would like to discuss the contents of the AES News, or if you would like to contribute information to the AES News, please contact the editor.

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AES Member Registration

Name ______________________________ Company ______________________________

Street Address ____

City ________________________ State _______ Postal Code _________ Country ______________

Phone ______________________________ Fax ______________________________

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❑ **2011 Annual Membership.** Includes: $30

- ➢ One year subscription to the AES quarterly newsletter AES News (Volume 13)
- ➢ AES Member Directory for 2011

* NOTE: Student membership is free with a letter from advisor

Options (additional cost to the $30 annual membership dues):

❑ Print subscription to Elsevier's journal Aquacultural Engineering (Volumes 40 & 41). $80

- ➢ Standard one year subscription of the print journal

❑ Online subscription to Elsevier's journal Aquacultural Engineering (Volumes 40 & 41). $60

- ➢ Web-based access through ScienceDirect (www.sciencedirect.com)

Total _________

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❑ Check enclosed (Made payable to Aquacultural Engineering Society in US Funds)

❑ Charge: o Visa o MasterCard o American Express o Discover

Credit Card #______________________ Expiration Date:______________ Security # (3-4digits):______________

Name on Card: ______________________________ Signature: ______________ ______________

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