# TABLE OF CONTENTS

## Symposium 1 - Low Energy Systems

<table>
<thead>
<tr>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Head Recirculating Aquaculture Systems (LHRAS)</td>
<td>2</td>
</tr>
<tr>
<td>Mark Kidd</td>
<td></td>
</tr>
<tr>
<td>Summer Flounder (<em>Paralichthys dentatus</em>) Recirculating Mariculture Initiative</td>
<td>4</td>
</tr>
<tr>
<td>Michael H. Schwarz and Michael L. Jahncke</td>
<td></td>
</tr>
<tr>
<td>The Multipurpose, Low Head Pump by AquaManna</td>
<td>3</td>
</tr>
<tr>
<td>Jason Bradley</td>
<td></td>
</tr>
<tr>
<td>Commercial Application of a Low Head Design</td>
<td>5</td>
</tr>
<tr>
<td>William G. Blythe</td>
<td></td>
</tr>
</tbody>
</table>

## Symposium 2 - International Recirculating Aquaculture System

<table>
<thead>
<tr>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Water Quality and Performance of a Closed Recirculating Aquaculture System for Pejerrey (Atlantic Silversides)</td>
<td>10</td>
</tr>
<tr>
<td>Hiroyuki Yoshino, Daniel E. Gruenberg, Isamu Watanabe, Katsumi Miyajima, Osamu Satoh and Katsuaki Nashimoto</td>
<td></td>
</tr>
<tr>
<td>Comparisons of Four Commonly Used Aquatic Plants for Removing Nitrogen Nutrients in the Intensive Bioproduction Korean (IBK) Recirculating Aquaculture System</td>
<td>5</td>
</tr>
<tr>
<td>Jae-Yoon Jo, Jin-Seok Ma and In-Bae Kim</td>
<td></td>
</tr>
<tr>
<td>Recirculation System Design: The KISS Concept</td>
<td>2</td>
</tr>
<tr>
<td>Rene' Remmerswaal and Rolli Hadas Israel</td>
<td></td>
</tr>
<tr>
<td>The Japanese Aquaculture Market and Changes into the 21st Century</td>
<td>1</td>
</tr>
<tr>
<td>Daniel Gruenberg</td>
<td></td>
</tr>
<tr>
<td>Novel Live Seafood Shipping and Freshness Preservation Technology from Japan</td>
<td>1</td>
</tr>
<tr>
<td>Daniel Gruenberg</td>
<td></td>
</tr>
</tbody>
</table>

## Symposium 3 - Report from the Trenches

<table>
<thead>
<tr>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial and Economic Issues of Recirculating Aquaculture Ventures</td>
<td>8</td>
</tr>
<tr>
<td>Michael B. Timmons</td>
<td></td>
</tr>
<tr>
<td>Twenty-One Years of Commercial Recirculating Aquaculture with Trout and Perch</td>
<td>3</td>
</tr>
<tr>
<td>Dave Smith</td>
<td></td>
</tr>
<tr>
<td>Mike L. Jahncke and Michael H. Schwarz</td>
<td></td>
</tr>
<tr>
<td>Report from Southern States</td>
<td>1</td>
</tr>
<tr>
<td>Brian Squyars</td>
<td></td>
</tr>
<tr>
<td>Ten Year in the Trenches: Perspectives on the Operation of Large Scale Commercial RAS for the Production of Hybrid Striped Bass</td>
<td>5</td>
</tr>
<tr>
<td>Joshua N. Goldman</td>
<td></td>
</tr>
</tbody>
</table>

## Symposium 4 - EPA/DEQ Effluents

<table>
<thead>
<tr>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological and Resource Recovery Approaches to Reduce the Environmental Impact of Aquaculture Production</td>
<td>8</td>
</tr>
<tr>
<td>Paul R. Adler</td>
<td></td>
</tr>
</tbody>
</table>
Tilapia and Fish Wastewater Characterization and Regulatory Experiences in New York........................................7
Michael Timmons and Shulin Chen

Michigan’s Platte River State Fish Hatchery Case History..........................................................10
Harry Westers

Perspective on the Role of Government, Industry, and Research in Advancing the
Environmental Compatibility and Substainability of Aquaculture..................................................8
Joseph A. Hankins

Implication of Total Maximum Daily Load (TMDLs) on Aquaculture ..............................................2
Charles H. Martin

Technical Session 1 - Volunteered Papers
The NOAA/DOC Aquaculture Initiative and Policy and Its Implication for
Recirculation Systems ............................................................................................................................7
Jim McVey

Olfactory Sensitivity of the Nile Tilapia, Oreochromis Niloticus, to Amino Acids .......................8

Development of a Third Generation Acoustic Waste Feed Monitor ..............................................4
Scott Tsukuda, Roger Wallace, Steven Summerfelt, John Davidson and Joseph Hankins

Effect of Different Protein/Energy Ratios on Growth Response of Tilapia ........................................1
Fatma A. Hafez

Technical Session 2 - RAS Supplementation and Disinfection
The Effects of Ultraviolet Filtration on the Production of the Gold Fish Carassius auratus in
Recirculating Systems ..........................................................................................................................4
Donald I. Anadu

Evaluation of UV Disinfection Performance in Recirculating Systems ...........................................9
Songming Zhu, Brooks Saucier, James Durfey and Shulin Chen

Effects of Baffle Depth on Oxygenation at the Pumping Station of Intensive Bioproduction
Korean (IBK) Recirculating Aquaculture System .............................................................................5
Jae-Yoon Jo, In-Bae Kim, Jeonghwan Park, Jin Hwan Lee and Kuen-Hack Suh

Oxygen Management at a Commercial Recirculating Aquaculture Farm Producing Atlantic
Salmon (Salmo salar) Smolts ..................................................................................................................5
Edward Parker, Michel Couturier and Tillmann Benfey

Ozone Dose and Equilibrium TOC in Recirculating Systems ...............................................................4
Valdis Krumins, James Ebeling and Fred Wheaton

Technical Session 3 - Genetics for Recirculating Aquaculture System
Genetic Improvement of Fishes for Commercial Recirculating Aquaculture Systems:
A Case Study Involving Tilapia ...........................................................................................................8
Eric M. Hallerman

Strain Evaluation and Selective Breeding of Striped Bass .................................................................1
Scott Lindell

Performance Comparison of Geographically Distinct Strains of White Bass to Produce
Sunshine Bass ........................................................................................................................................1
Christopher C. Kohler, Robert J. Sheehan, Joseph J. Myers, James B. Rudacille,
M. Lizabeth Allyn and A. Victor Suresh
Production of YY Male Tilapia ............................................................................................................... 1
Robert Abernathy

Issues in the Commercialization of Transgenic Fish ................................................................................ 8
Elliot Entis

Technical Session 4 - RAS Operation

Removal of Protein and TSS From Sea Water by Foam Separator .......................................................... 4
Kuen-Hack Suh, Byong-Jin Kim, Sung-Koo Kim and Jae-Yoon Jo

Hydrodynamics in the ‘Cornell-Type’ Dual-Drain Tank ....................................................................... 7
Steven T. Summerfelt, John Davidson and Michael B. Timmons

A Partial-Reuse System for Coldwater Aquaculture .............................................................................. 9
Steve Summerfelt, John Davidson, Thomas Waldrop and Scott Tsukuda

Comparative Growth of All-Female Versus Mixed Sex Yellow Perch (*Perca Flavescens*) in Recirculating Systems ................................................................................................................ 2
Mark H. Schmitz

Effects of Temperature and Feeding Rates Upon Growth and Feed Conversion Ratios in Tilapia ........................................................................................................................................................ 18

AES Session 1 - Volunteered Papers

Predictive Computer Modeling of Growth and Feeding Rates for Pacific White Shrimp, *Penaeus vanammei*, in Hard Freshwater .................................................................................................................. 4
Anthony F. Pegel and J. Richard Booth

Development Rationale for the Use of Marine Recirculating BioFilters to Simplify Management Strategies and Reduce Costs Associated with Marine Aquaculture Systems ....................... 12
Ronald F. Malone, Douglas G. Drennan, Christopher J. Stahl and Lance E. Beecher

Enhancing Nitrification in Propeller-Washed Bioclarifiers with Modified Floating Bead Media .......... 10
Christopher J. Stahl, Douglas G. Drennan, Lance E. Beecher and Ronald F. Malone

The Cyclonic Sand Biofilter: A New Design Concept and Field Evaluation ........................................... 5
Michael B. Timmons, Neil Helwig and Steven T. Summerfelt

AES Session 2 - Volunteered Papers

U.S. EPA’s Development of Aquaculture Effluent Limitation Guideline Regulations and the Role of the Joint Subcommittee on Aquaculture and Other Stakeholders ........................................ 1
Michael L. Clipper

Nitrification Potential and Oxygen Limitation in Biofilters ................................................................... 9
Brooks Saucier, Songming Zhu and Shulin Chen

Nitrification Performance of Nitrifiers Immobilized in PVA (Polyvinyl alcohol) for Marine Recirculating Aquarium System .............................................................................................................. 4
Sung-Koo Kim, Jae-Koan Seo, Eun-Ju Park and Kuen-Hack Suh

Recirculating Systems for Maintenance and Propagation of Freshwater Mussels (Unionidae) .................................................................................................................. 1

Antifouling Sensors and Systems for Continuous Dissolved Oxygen, Ph, and Temperature Measurements ................................................................................................................................. 1
Sean M. Christian, Paul Grems Duncan and John A. Schroeder
AES Session 3 - Volunteered Papers

Intensive Recirculation Aquaculture Facility at the Hackettstown State Fish Hatchery
Warren County, New Jersey

Thomas L. Johnson

The Vic Thomas Striped Bass Hatchery at Brookneal, Virginia

Thomas L. Johnson

Use of a Recirculating Aquaculture System to Hold Sacramento Splittail and Native Fish Species

Louis A. Helfrich, Brent Bridges, Lloyd Hess, Don Ferris, Diana L. Weigmann and Charles Liston


Brendan Larkin

Program to Facilitate the Preliminary Design of Land-Based Recirculating Aquaculture Facilities

T. McCallum, M. Rifai, M. Couturier and T. Pugsley

AES Session 4 - Volunteered Papers

The Effect of Fish Biomass and Denitrification on the Energy Balance in African Catfish Farms


Marine Denitrification of Denitrifier Consortium Immobilized in Polyvinyl Alcohol

Sung-Koo Kim, Eun-Ju Park, Jae-Koan Seo and Kuen-Hack Suh

Basic Design Considerations for Small Fish Holding Facilities: For the Biologist/Aquarist

Todd S. Harmon

Heat Budget Model for Predicting Water Temperature in Outdoor Intensive Fish Tanks Under Greenhouse Cover

Arik Ashkenazil, Noam Mozes and Ido Seginer

Recirculation Systems for Farming Eel in Western Europe; Towards a Certified Environmental Performance

Andries Kamstra, Peter Rand, Kees Kloet and Andre Aarnink

Special Session 1 - Economics/Computers

Business Planning for Urban Aquaculture

Lawrence D. Tagrin

Designing A Research Protocol for Economic and Financial Analysis Phase 1

Alice T. Spradlin, Ryan Athearn, Charlie Coale, Mark Kidd, George Libey, Greg Boardman, George Flick, Stephen Smith, Eric Herbst and Simonel Sandu

Economic Viability of an Aquaculture Producer/Processor COOP (APPC) in a North Central Location

Patrick D. O’Rourke, Kerry Tudor and Patrick Foley

Economics of Shrimp Culture in a Freshwater Recirculating Aquaculture System

Peter Van Wyk
Special Session 2 - Volunteered Papers

Role of Biological Filters in the Maintenance of Water Quality in the Recirculation System

   JaiGopal Sharma, Sunil Kumar and Rina Chakrabarti

Propagation and Culture of Endangered Freshwater Juvenile Mussels in a Recirculating Aquaculture System

   Jess W. Jones and Richard J. Neves

Use of Recirculating Aquaculture Systems (RAS) for Eel (Anguilla rostrata) Production in Virginia

   Scott Smith

Use of Bead Filter Backwash to Enhance Shrimp Growth

   Shaun M. Moss, Clete A. Otoshi and Anthony D. Montgomery

Modification of D-Ended Tanks for Flat Fish Culture

   Greg Beckman

---

Special Session 3 - Fish Health Issues

Effects of Chloramine-T and Hydrogen Peroxide on Nitrification in Fluidized-Sand Biofilters for Cold Water Fish Production

   Michael F. Schwartz, Graham L. Bullock, Joseph A. Hankins, Steven T. Summerfelt and Jay A. Mathias

The Potential for the Presence of Bacterial Pathogens in Biofilms of Recirculating Aquaculture Systems

   Robin K. King and George J. Flick

Transmission of Furunculosis and Enteric Redmouth by Means of Fluidized Sand Biofilters

   G.L. Bullock, W.B. Schill and E.Burchard

Fish Health Monitoring and Maintenance of Small Scale Recirculating Systems in Virginia

   David Crosby

The Role of Fish Density in Infectious Disease Outbreaks

   Julie Bebak, Phil McAllister, Ray Boston and Gary Smith