# ALMA AQUACULTURE RESEARCH STATION

## ACTIVITIES UPDATE 2004

March 3, 2004

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Since its establishment in 1991, the Alma Aquaculture Research Station (AARS) has fostered research, education, testing of products and technology transfer that is relevant to Ontario aquaculture. To date, one hundred and four research projects have been conducted at the AARS in the areas of nutrition, fish health, growth and reproductive physiology, reproduction and management, breeding and genetics, fish behaviour, culture methodology, engineering and systems design , waste management, telemetry, and product development. These projects have involved more than 321,000 eggs and 555,000 fish of three different species (rainbow trout, Arctic charr and Atlantic salmon). In addition, the AARS has provided 258,300 eggs and 31,650 fish to support 110 research and educational projects at other research and teaching facilities in North America. In 2003-04, fifteen experiments involving rainbow trout and Arctic charr were either initiated or in progress.

Dr. Laura McKay and Dr. Ian MacMillan continue their project, started in 1991, to develop and test a fast growing, late maturing, spring-spawning strain of rainbow trout. Their research involves the production, evaluation and selection of second, third and fourth generation fish using such traits as weight, length, age at sexual maturation, spawning date and egg volume, size and number. The resultant synthetic strain (SS) will combine spring spawning and fast growth. Brood stock for the 4th and 5th generations are being selected based on estimate breeding values calculated from information on each individual and its family members. The 4th generation synthetic strain is being compared with the AARS strain (a fall-spawning, commercial strain). Currently, two sets of crosses are being made: AARS females crossed with AARS and SS males in the fall of 2003; and SS females crossed with AARS and SS males in the spring of 2004. Growth, maturation, spawning and reproductive traits will be measured on the resulting fish through the life cycle. It should be noted that eggs from the 4th and 5th generation will be made available to interested farmers for incorporation into their breeding programs.

Evaluating growth of different rainbow trout strains.

Checking rainbow trout for date of maturation.

A second long term, ongoing genetics project conducted by Dr. Roy Danzmann and Dr. Moira Ferguson addresses aspects of the influence of different genes on various phenotypic traits in salmonid fishes. These traits include growth, spawn timing, maturation timing, and stress resistance. An understanding of the underlying genetic influence on these traits is of both basic and applied significance. The basic knowledge gained will increase knowledge of where the genes influencing these traits are located in the salmonid genome. The fundamental knowledge gained from this research may also enhance the aquaculture of these species via the ability to select fish with identifiable and desirable genes for the traits being studied.

Dr. John Leatherland and graduate students Jason Reid and Mao Li from the Biomedical Department of the Ontario Veterinary College have undertaken several growth and reproductive physiology studies at the AARS. Specifically, these studies involve the changes in thyroid hormone levels, thyroid hormone metabolism and thyroid hormone receptor mRNA expression in fasted rainbow trout. Thyroid hormones appear to be important regulators of growth and development in fish. Circulating levels of thyroid hormones are influenced by the nutritional status of the fish, and in turn may influence other circulating hormones, such as growth hormone and insulin-like growth factor. The object of these studies is to determine the impact of nutritional status on several parameters of thyroid physiology and growth of rainbow trout. A second objective of the study is to determine if the nutritional status of rainbow trout embryos is affected in the same way as adult fish. Another line of research investigates embryonic hormone physiology. Thyroid and growth hormones are both found in the yolk of unfertilized eggs of teleost fish. These yolk hormones are thought to be important for early development of fish prior to the production of these hormones by the embryo proper. One study determines the effect of elevated egg thyroid hormone or growth hormone content on embryo growth and thyroid and growth hormone physiology, with an emphasis on changes occurring at the molecular level.

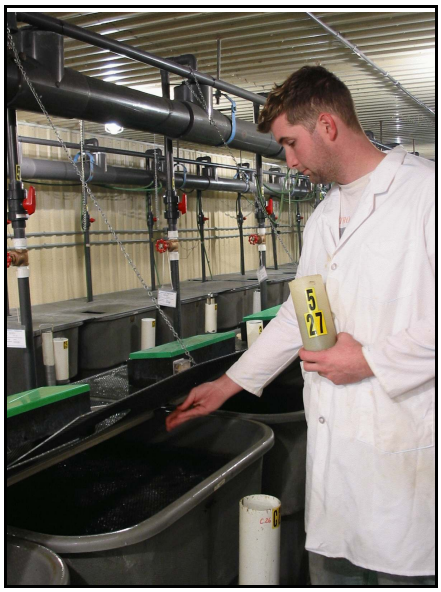
Graduate student Gregor Reid, under the supervision of Professor Richard Moccia, continues the collection of field data to identify post-prandial patterns of phosphorous excretion from rainbow trout. A post-prandial patten of excretion describes fluctuating outputs of nutrient waste relative to the time of feeding. Cage-based culture of rainbow trout in Georgian Bay account for more than 60% of Ontario's fish production. Water quality at those sites has environmental implications and can dictate the renewal of fish culture licences. Accurate assessment of the overall water quality using an appropriate sampling protocol is therefore essential. A significant post-prandial pattern of soluble phosphorous excretion could have significant implications for grab sample protocols for environmental performance-based water quality monitoring or fish farms. Experiments within a controlled laboratory setting at the AARS are ongoing and are essential as a precursor for understanding and identifying conditions in which post-prandial excretion exits 'in the field'. This line of research is meant to improve the ability to follow and possibly predict water quality parameters which may cause environmental impacts.

Recirculating aquaculture system at the Alma Aquaculture Research Station.

With limited water resources and growing environmental concerns, water recirculating aquaculture systems (RAS) have been increasingly attractive to the aquaculture industry. Effective water treatment is required to maintain high water quality for fish production and to meet the requirements of environmental protection. While various water treatment processes have been proposed for recirculating systems, their applications in practice are often limited due to either their less than satisfactory removal efficiencies, lack of process reliability or high costs. Membrane technologies have been successfully used in municipal water treatment for a variety of purposes. They have been proven to be the most effective process for removing suspended solids, colloidal matter and microorganisms altogether within a single step. Recently, membrane bioreactor processes have been developed that increase biodegradation rate and improve process reliability. Furthermore, compared to conventional RAS technologies, membrane technologies offer compact installation, no chemical addition and less operating and maintenance requirements. However, little information is available for the applications of membrane filtration for aquaculture wastewater treatment, let alone for the integrated membrane process to simultaneously remove nitrogen and phosphorous. As the chemical composition and treatment requirement for aquaculture wastewater are greatly different from those of municipal wastewater, it is expected that the membrane filtration will behave differently. Dr. Hongde Zhou (School of Engineering) and graduate students Amanda Portelance and Yang Ling, in collaboration with Professor Richard Moccia, have recently launched an investigation of the use of hybrid membrane technologies for treating wastewater from recirculating aquaculture systems. Using waste waters generated from an intensive, warm-water recirculating facility at the AARS, this study will investigate the feasibility of different membrane technologies for selected water recirculating aquaculture systems in terms of organic content, total suspended solids, nitrogen and phosphorous removal efficiencies. It will examine the effects of various factors including different water characteristics, membrane configurations and operating conditions. It will assess membrane fouling potential and develop new control strategies as well as compare the applicability of new membrane technologies with other treatment processes currently being used.

Recording oxygen injection levels.

In order to encourage 'applied' research and development studies, the Alma Aquaculture Research Station has developed various industrial partnerships and has participated in proprietary research for several feed companies involved in the aquaculture industry. Professor Richard Moccia and the Alma Station staff undertook two projects on behalf of Shur-Gain (Maple Leaf Foods Inc., Guelph, ON). One study investigated the dietary efficacy, digestibility and pigment retention of two new pigment sources incorporated into rainbow trout diets, A second study looked at selenomethionine supplementation in rainbow trout feeds to improve pigment retention Both these studies used growth performance, feed efficiencies, pigment measurements and analysis, fillet drip loss and flesh texture to assess the performances of the test diets. An investigation currently ongoing on behalf of Martin Feed Mills Ltd. (Elmira, ON) is meant to evaluate alternative fish, blood and fat sources in high-energy rainbow trout feeds. Growth performance, feed efficiency, morbidity, mortality, and feeding behaviour are being used to assess the performance of each diet.



Hand-feeding rainbow trout in 1m tanks.

The recent addition of three independent recirculation units in the station's Quarantine building has given the station even greater flexibility in both the diversity of fish species it can maintain and the types of research it can support. Each room contains twelve circular fibreglass rearing tanks with a rearing volume of 340 litres per tank allowing for a maximum biomass of 360 kgs. Water temperatures can be controlled between 10°C and 30°C. Unit processes include rotating drum filtration, foam fractionation, micro-bead biofiltration, carbon dioxide stripping, oxygenation and ozonation, ultraviolet treatment and water heating. A YSI monitoring system, installed in each of the units, allows for the continuous monitoring of dissolved oxygen, temperature, pH, and oxidation-reduction potential. With the extensive unit processes and monitoring systems, each unit is capable of rearing fish at recirculation rates of 99.5%. Potential projects for the future include the nutritional requirements of such warm-water fishes as tilapia and yellow perch, effluent management of recirculation systems, endocrinology and reproduction, and disease management in recirculation systems.

The Research Station staff always welcomes visitors but please phone or email ahead of time so that we can co-ordinate your visit.

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