Bulletin

of the Aquaculture Association of Canada

The History of Aquaculture Research and Training in St. Andrews, New Brunswick

110-1(2012)

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110-1

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ISSN 0840-5417

Imprimé par Taylor Printing Group Inc., Fredericton, N-B

Bulletin

of the Aquaculture Association of Canada

110-1

The Bulletin is available through subscription ($60 per year) or as a benefit of membership in the Aquaculture Association of Canada, a nonprofit charitable organization. For membership information contact: Aquaculture Association of Canada, 16 Lobster Lane, St. Andrews, N.B., Canada E5B 3T6 [telephone 506 529-4766; fax 506 529-4609; e-mail aac@.mpo.gc.ca; website http://www.aquacultureassociation. ca]. Annual dues are $100 for individuals ($50 for students and seniors) and $300 for companies; 25 percent of dues is designated for Bulletin subscription. The Bulletin is indexed in Aquatic Sciences and Fisheries Abstracts (ASFA), CAB International, FISHLIT, and the Zoological Record. Mailed under Canada Post Publications Mail Commercial Sales Agreement No. 40065445. Change of address notices and undelivered copies should be mailed to AAC. Return postage guaranteed.

ISSN 0840-5417

Printed by Taylor Printing Group Inc., Fredericton, NB

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Introduction from the President

It is my great pleasure to introduce this latest issue of the Aquaculture Association of Canada's Bulletin; ***The History of Aquaculture Research and Training in St. Andrews, New Brunswick***.

The articles presented provide a deep overview of the challenges and successes of aquaculture's pioneers and participants. Since the first research was conducted by Professor A.P. Knight of Queen's University, who was instrumental in the formation of the Biological Board of Canada and the establishment of a laboratory in St. Andrews, the small tourist town has become home to the recently renovated Huntsman Marine Science Centre, Canada's first Aquaculture Technician Program at the New Brunswick Community College Campus in St. Andrews and the St. Andrews Biological Station (SABS), a science research facility of DFO. As well, the Atlantic Salmon Federation has been located in the area since its inception in 1982.

St. Andrews is also near to the heart of the AAC as our home office has been located in St. Andrews since our formation in 1984.

A sincere thank you goes out to all our contributors for helping us highlight the essential role this beautiful and strategically located town has had as the centre of aquaculture development in New Brunswick. In particular, my thanks to Amber Garber of Huntsman Marine Science Centre, AAC Director Caroline Graham of the New Brunswick Community College, and AAC Director Gregor Reid of the Canadian Integrated Multi-Trophic Aquaculture Network who not only provided articles, but edited this edition of the Bulletin.

Enjoy this issue and I hope you will be moved to visit the St. Andrews area to see some of these world-class facilities for yourself.

Sincerely,

Tim Jackson

AAC President

History of Aquaculture and Training at the Huntsman Marine Science Centre

A. F. Garber, B. Glebe, and W. D. Robertson

Amber Garber

The Huntsman Marine Science Centre (Huntsman) is a registered, private, not-for-profit, research and science-based teaching institution located near the mouth of the Bay of Fundy in St Andrews, New Brunswick. The Huntsman was established in 1969 by a consortium of universities, government departments and private sector interests with the specific aim of facilitating collaboration between university, government research scientists and the industrial sector. Its research infrastructure is available to all Canadian scientists, as well as researchers outside of Canada. The property and facilities of Huntsman consist of an Upper Campus housing mostly residences and a commercial kitchen for up to 100 students, as well as a Lower Campus housing teaching laboratories, the Fundy Discovery Aquarium, and fresh and saltwater recirculating aquaculture systems in various configurations over seven buildings (Figure 1).

There are several Departments within the Huntsman including an Education Department which reaches 2,000 elementary school age to university graduate level students per annum, the Fundy Discovery Aquarium which provides outreach to the general public and receives 30,000 people per annum, the Atlantic Reference Centre (ARC) – a research museum that houses one of the most complete collections of reference specimens of the North Atlantic Ocean ecosystem (a joint venture with Fisheries and Oceans Canada, DFO), and the International Aquaculture Innovation Centre (Aquaculture Department). Huntsman has two service vessels which are used for education and research (Figure 2), laboratory and tank space for University researchers, facilities for meetings, and can cater a variety of events (e.g. scientific meetings to wedding receptions – mostly events occurring at Huntsman). The Huntsman is also home to the Lobster Academy, a unique educational experience that connects the

Figure 1: Huntsman Marine Science Centre's Lower Campus.

commercial production of *Homarus americanus* (American lobster) with buyers and the surrounding communities. It is sponsored by East Coast Seafood/Paturel and is dedicated to increasing the value of the lobster fishery worldwide.

The Huntsman's Aquaculture Department mandate is to find solutions to challenges for the sustainable development of the aquaculture sector. The local area's economy is directly linked to the opportunities provided to those generating wealth from ocean resources. As traditional fisheries have declined, development efforts have focused on finding meaningful alternate economic drivers.

Figure 2 top and bottom: The Fundy Spray and Osprey are two of Huntsman Marine Science Centre's service vessels used for education and research purposes.

Aquaculture research and training of students (technicians to graduate students) at Huntsman and/or with Huntsman staff began in 1974. At that time, the North American Salmon Research Centre (NASRC) was built by the International Atlantic Salmon Foundation (presently ASF) from private funding and was staffed and managed by the Huntsman with operating funds provided by the Department of Fisheries and Environment, Fisheries and Marine Service (presently DFO). Initially, the focus was on applied genetics and selective breeding for the enhancement of wild salmon stocks. The NASRC released Atlantic salmon smolts into nearby Chamcook Harbour, New Brunswick in May 1976 and a small portion of the population returned to the release site in July 1977 as grilse. The primary value of the returning adults was the data on survival and growth of the strains that were reared and released as smolts from NASRC.

Atlantic salmon from various rivers (strains) in New Brunswick were crossed to create pure (within river) and hybrid (between river) Atlantic salmon progeny. Return rate was highest with pure progeny to their parents' river of origin. This suggested a river-specific nature of genetics where some of the genetic instructions for migration in the high seas were river specific. The goal of the Salmon Genetics Research Program (SGRP) was to evaluate genetic selection as a tool for increasing the adult return rate in sea ranching efforts where Atlantic salmon were released, allowed to grow using natural food sources with a desire that a portion of the salmon produced would return to their point of release for harvest. SGRP directors from 1974 to 1982 were Drs John Calaprice, Richard Saunders and Brian Glebe.

In 1983, the focus of the SGRP was shifted from sea ranching to the salmon aquaculture industry in the Bay of Fundy. The theory that a healthy, growing aquaculture industry would relieve commercial fishing pressure on wild salmon stocks in Canada was proven to be true. Six New Brunswick strains were grown in sea cages and assessed for performance in what became the Atlantic Salmon Broodstock Development Program (ASBDP; see below). As a result of those trials, the Saint John River salmon stock became the preferred strain for local farming. The Saint John River stock is still being using in aquaculture today. Directors of this program were at various times Brian Glebe, John Bailey , Gerry Friars and Seumas Walker.

In January 1978, the New Brunswick Community College system and Canada Manpower cooperated with Huntsman to establish an Aquaculture Technician Training Program. This program was the first of its type in Canada (detailed elsewhere in this Bulletin). Dr. Chris Frantsi was the first course supervisor. The course was offered at the NASRC and with laboratory work at the Huntsman. It was a 48 week course, consisting of 24 weeks of lectures and laboratories and 24 weeks of on-the-job training at four of six aquaculture facilities in the Maritimes. In 1982, the Aquaculture Technician Training Program included increased use of Huntsman residence and laboratory facilities. For the 1983 course, there was a new classroom and an experimental hatchery on-site at Huntsman with some students housed in the Graduate Student Residence.

It was in 1984 Huntsman's management of the SGRP at the NASRC was concluded. However, this did not conclude Huntsman's involvement in salmonid research or association with the SGRP. Dr. Brian Glebe moved his research program of evaluating the aquaculture potential of various salmonid species from the NASRC to Huntsman where he became the first director of the Aquaculture Department. In addition, Arctic charr also became an aquaculture species of interest. Topics of research included: physiology of seawater adaptation of Arctic charr, control of reproduction in salmonids by en-

vironmental and hormonal manipulation, application of chromosome engineering techniques to produce new hybrids, and use of sex steroids for feminization, masculinisation and sterilization of Atlantic salmon for aquaculture. These were all collaborative efforts with universities, DFO, and ASF.

In 1986, Dr. Brian Glebe (Figure 3) became the course instructor for the Aquaculture Technician Training Program. These students from the program aided in the setup of a saltwater cage site in Brandy Cove (just offshore from Huntsman's Lower Campus). In addition to rearing fish, the saltwater cage site in Brandy Cove served as an evaluation of saltwater cage types and later evaluation of salmon diets (nutrition studies). In 1987, blue mussels were also added to the course instruction with several lines of mussels added to the Brandy Cove site. It was in 1986, that Dr. Glebe and Bill Groom of the provincial Department of Fisheries organized the first instructional workshops for the fledgling New Brunswick salmon farmers. Over a period of several months, international speakers from as far as Norway provided information on the latest salmon farming technologies.

Two additional aquaculture training courses were offered at Huntsman and one university credit course in 1988. A 36 week course to train members of First Nations in effective hatchery management was offered. The course ran with the cooperation of the Department of Indian Affairs for students to apply their training to managing a hatchery that was under construction on the Tobique River, New Brunswick (Maliseet Native Aquaculture Training Program). A second course, 'Aquaculture Worker', co-sponsored by CEIC (Canada Employment Insurance Commission) was offered to instruct students on the basic principles of fish culture stressing basic hatchery and cage husbandry over a 12 week period. The growth of the aquaculture division at Huntsman kept pace with the growth of the aquaculture industry in eastern Canada growing from one staff and twelve students to seven full and part-time staff and 36 students.

In 1988, the Aquaculture Technician Training Program was instructed by Julie Delabbio (who had just received her M.Sc. working at Huntsman and the University of New Brunswick) and the program was delivered under the direction of the New Brunswick Community College. The Huntsman continued to provide instructional staff and some training facilities, but the course moved to the NBCC campus in St. Andrews. Over the years, the Aquaculture Technician Training Program has evolved to fit industry needs and now includes two practicums, each lasting two weeks. Huntsman continues to support the course by accepting students to train and work on existing research projects. The work varies depending on the season and the projects at the Huntsman, from flow

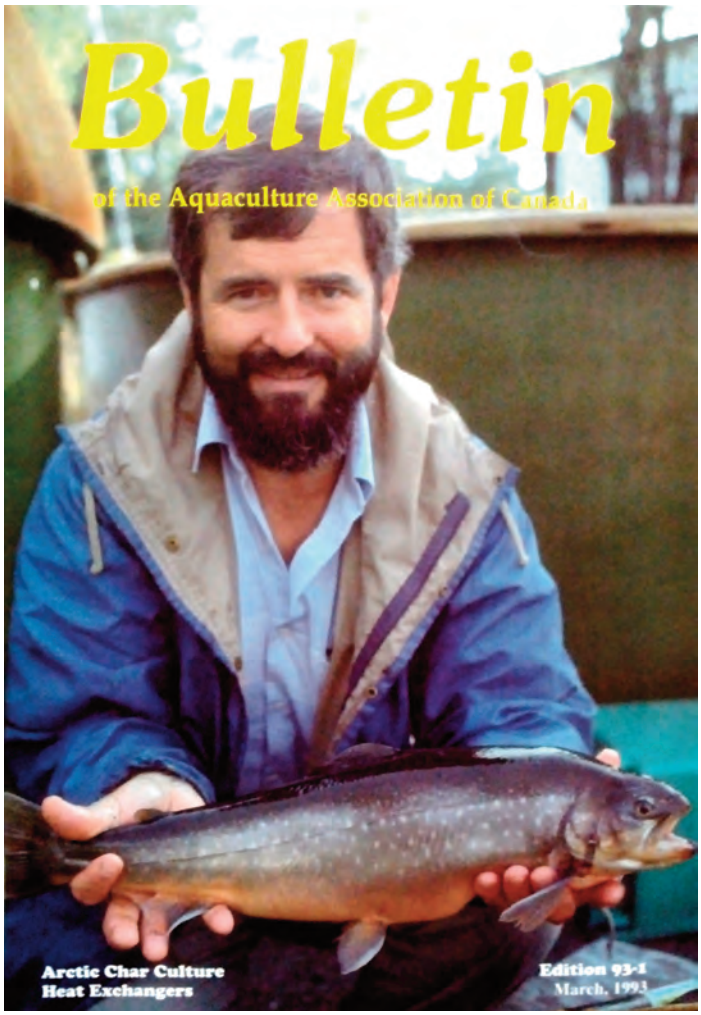


Figure 3. Dr. Brian Glebe, the first Director of the Aquaculture Department, holds a first generation farmed Arctic charr. The AAC published the proceedings of two Huntsman Marine Science Centre charr workshops in Bulletins in 1993.

through and recirculating aquaculture system maintenance, to spawning, juvenile production and maintenance or sampling (recording data on traits important for broodstock selection).

Also in 1988, the National Research Council Industrial Research Assistance Program (NRC-IRAP) signed a contribution agreement to support 'Fundy Contact', a regional aquaculture newsletter providing technical information, advice to the aquaculture industry and a communication link between government, researchers and aquaculturists. The newsletter, written by Julie Delabbio, served over 800 subscribers. In addition to the newsletter, local aquaculture companies were provided with technical advice on topics ranging from spawning of Atlantic salmon to Arctic charr culture. Huntsman was one of 70 technological institutions with NRC which formed the IRAP network. Huntsman provided technological advice to industry from 1988-2006 through the IRAP network.

Figure 4. Huntsman Marine Science Centre's Brandy Cove marine research site showing an array of different cage systems. This is the location of the first North American seawater cage introduction of Arctic charr (by Huntsman in 1986).

As a business/technology innovation centre, Huntsman saw the development of the Ocean Harvester, a hexagonal offshore sea cage prototype that was evaluated by the Aquaculture Department at the Brandy Cove experimental marine site (Figure 4). Two Kiel Cages (spherical, rotating cages) were also tested for effectiveness for grow out of Atlantic salmon. Four Hercules steel cages were erected for various studies. Research included evaluation of growth using two diets, conducted by Moore-Clark Co. (Canada), one of Canada's leading aquaculture feed companies.

In 1990, the Atlantic Reference Centre also began conducting aquaculture research by examining effects of fish farming on benthic communities. The study included: 1) establishment of a baseline for benthic communities in an area prior to emplacement of floating cages; 2) determination of change in benthic community structures of three farms already in operation; 3) determination of recolonization pattern by benthos; 4) bivalve comparative growth studies; 5) site-habitat characterization by particle size analysis; and 6) determination of microfaunal biomass by phospholipid content of the sediment.

In 1991, the number of cultured species being studied at Huntsman increased to include: brook trout, tiger trout, striped bass, and Atlantic cod. Research continued on Arctic charr and Atlantic salmon. Research projects involved studies in charr chromosome engineering and sex manipulation, salmon nutrition, marine hydrocarbon pollution, culture techniques, and engineering. The year 1992 saw another increase in the number of aquaculture species being researched adding pollock, winter flounder, and scallops. With 1993/1994 came a new Huntsman Aquaculture Departmental priority to contribute to the development of alternate marine species for culture. Two significant workshops, Arctic Charr Culture in Intensive Rearing Systems and the first national Canadian Arctic Charr Conference, were organized by Brian Glebe and Julie Delabbio of Huntsman and published in separate issues of the AAC Bulletin in 1993 (Figure 3). Additionally, a new species was added for evaluation – Yellowtail flounder – in partnership with Fisheries Products International Ltd. In 1999/2000, winter and yellowtail flounder were produced. Windowpane flounder was successfully spawned and later witch flounder (grey sole) was also produced.

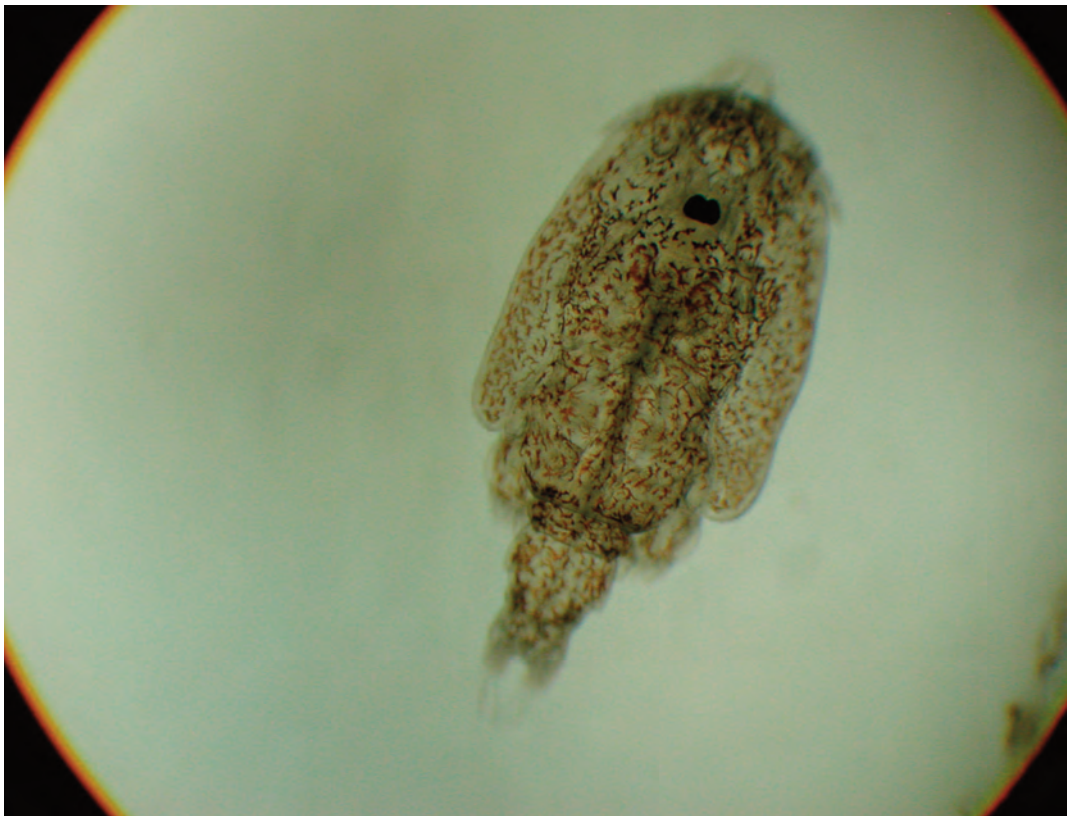


Figure 5. Picture of a chalimus IV sea louse *(Lepeophtheirus salmonis)* produced by the sea lice library at Huntsman Marine Science Centre.

Huntsman also participated in transgenic salmon research with Dr. Garth Fletcher at Memorial University of Newfoundland and the industrial partner A/F Protein Inc. The transgene implanted in the salmon produced impressive growth results, producing a 3 Kg

fish in 24 months from hatch. Huntsman production of transgenic salmon and maintenance of a number of broodlines continued to 2004. During this period, a dedicated aquaculture facility opened in PEI, Aqua Bounty Canada, and eventually all genetics were transferred to this facility. Huntsman (specifically Dr. Amber Garber) began working with Aqua Bounty and their broodstock program again in 2009.

In addition to working toward the development of new marine species for aquaculture, Huntsman also endeavoured to conduct contract research in support of companies interested in diversification. Research in production of American plaice with growth and feed evaluations of flounders conducted for Corey Feeds Mills Ltd. ensued in 1995. Additionally, Atlantic sturgeon was evaluated for Jail Island Salmon - spawning and overwintering capabilities of this species in Bay of Fundy sites. Two scientists from St. Petersburg State University in Russia arrived the following year to study osmoregulatory functions of Atlantic and short-nose sturgeons, and aided with the spawning of sturgeons. In February 1997, Huntsman began evaluating the commercial potential of haddock for Connors Bros. Ltd. One of the results of species production was the development of husbandry protocols that were either submitted to the companies that funded the research, published in graduate student theses and/or in journals for other scientists to access.

In 1988 and 1989, sea lice research began at Huntsman. W.E. (Bill) Hogans and D.J. Trudeau studied the biology of three species of sea lice – *Caligus curtus*, *Caligus elongatus*, and *Lepeophtheirus salmonis* (Figure 5) from Atlantic salmon cultured in marine waters of the lower Bay of Fundy. In 1991, sea lice research included: an Natural Sciences and Engineering Research Council International Postdoctoral Fellow, Dr. W. Piasecki investigating the life cycle of sea lice (*Caligus elongatus*); Ahmed Mustafa, a PhD student, studied the importance of host factors such as dietary modulation, stress and immunization on sea lice infections in Atlantic salmon and Arctic charr; and Bernard Wright, a PhD student, studying the ecology of the infective larval stages. By 1992, additional research ensued. This included an honours thesis by Mr. Jason Cleghorn on the immune response of charr and salmon to an injected crude sea lice vaccine. Dr. Barbara MacKinnon monitored sea lice infection levels at various farms in Passamaquoddy Bay area by studying the reproductive biology of these parasites and assessed various non-drug methods to control *C. elongatus*. Sea lice research continued at Huntsman with the testing of potential compounds to be used to control sea lice.

In 1998, Supreme Sturgeon and Caviar Ltd., a New Brunswick company, negotiated a contract with Huntsman to supply shortnose sturgeon. Success with both shortnose sturgeon production and halibut production resulted in additional Quonset buildings.

For the sturgeon, recirculation systems were installed and successfully tested with less than 10% makeup water with densities as high as 100 kg/m^3. By 2002, Supreme Sturgeon had their own staff on site and following the sturgeon were successfully moved to their own commercial facility.

During the same year there was a resurgence of Atlantic salmon business for Huntsman when the New Brunswick Salmon Growers Association asked Huntsman to submit a proposal to deliver the Atlantic Salmon Broodstock Development Program (ASBDP) on their behalf. This project initiated a lease between Huntsman and ASF for the freshwater tank field in Chamcook. Improvements were made to the ASF research hatchery in Chamcook. In addition to external funding, seven Atlantic salmon growers agreed to purchase smolts, hold pedigreed broodstock and contribute annually to research funding for five years. In the new broodstock program, Dr. Brian Glebe was once again program director. The program itself was completely transferred to industry by 2007.

Figure 6. Hatchery used for the production of Atlantic cod at Huntsman Marine Science Centre during the Atlantic Cod Genomics and Broodstock Development Project.

In 2003, Shurgain Maple Leaf AgResearch began conducting trials on new salmon diets using 24 replicate seawater tanks at Huntsman. Shurgain was ultimately purchased by Northeast Nutrition and continues to focus on the improvement of feeds for Cooke Aquaculture Inc. This research involves the investigation of new ingredients and the revision of feed formulation. An important directive of these studies is the consideration of quality, sustainability, and cost of the final fish products. Future requirements and restrictions in aquafeed ingredients are anticipated as a means to provide the most flexibility and cost effectiveness for future production rations.

In 2004, Dr. Jane Symonds held a cod research and development workshop at the conference centre, St. Andrews Biological Station (DFO). Interested industry, government, investors and researchers were in attendance and it became clear that there was significant potential for development of cod aquaculture in Atlantic Canada and Maine/New Hampshire. The result of the workshop was the creation of the Cod Broodstock Development Focus Group chaired by Dr. Symonds. She later became one of two project leads of the Atlantic Cod Genomics and Broodstock Development project (CGP) which started in 2006. This project included two breeding programs – one in NL (Ocean Sciences Centre) and one in NB/NH housed initially at the DFO with Huntsman staff and then moved onto the Huntsman campus (Figure 6). This project ran until 2010. In 2012, the remaining elite male cod broodstock from this project in NB were cryopreserved by Canada Cryogenetics Services Inc. using their technology and commercial scale SquarePacks™. The milt is being stored in a designated biosecure area at Huntsman with plans to become the east coast laboratory for Canada Cryogenetics Services Inc.

Figure 7. Huntsman staff measure individual Atlantic salmon progeny, record data and PIT tag. Progeny from known families are evaluated in one of two breeding nuclei, BKD challenges or sea lice challenges at Huntsman Marine Science Centre.

Baltic Sea sturgeon became extinct in the 19th century. Research confirmed that it was genetically similar to Atlantic sturgeon in North America. A small fishery still exists in the Saint John River. At the request of the Society to Save the Sturgeon in Germany and later the Polish Fisheries Institute, adult fish were captured, held at Huntsman, then spawned with various life stages transported to Germany as a means to establish a breeding program for reintroduction of sturgeon into the Baltic Sea. The first transfer of broodstock occurred in 2005.

In 2008, Huntsman began work with the rainbow trout industry in Canada. The Huntsman developed a framework for a broodstock program and a workshop was held with industry. Huntsman continues research with the rainbow trout industry toward the development of a rainbow trout breeding program and has been working with a producer in Ontario (Lyndon Fish Hatcheries Inc.).

In 2009, Huntsman began working with industry on several projects to treat sea lice infestations of Atlantic salmon in the Bay of Fundy. Projects include testing of sea lice susceptibility to natural compounds and tank trial testing of the ECO-Bath (ecofriendly, safe and cost-effective ectoparasite control in finfish aquaculture). At present, the Huntsman has started a sea lice hatchery and is producing sea lice for in house projects, as well as, selling lice of various stages in hopes of making the library self sustaining.

In 2010, Huntsman began leading an Atlantic Salmon Selection and Broodstock Development Program an individual and family based selective breeding program (Figure 7) with three industry partners – Northern Harvest Sea Farms Ltd., Admiral Fish Farms Ltd., and Gray Aqua Farms Ltd. The main traits to be studied in this project are growth, fillet quality and yield, bacterial kidney disease (BKD) resistance and sea lice resistance. This program is being led by Dr. Amber Garber who started working at Huntsman in 2006 with the CGP. Additional partners in this project are the Atlantic Canada Opportunities Agency (ACOA) – Atlantic Innovation Fund (AIF), New Brunswick Innovation Foundation (NBIF), Research and Productivity Council, DFO, and the University of Guelph. Also, in 2010, Cooke Aquaculture Inc./Kelly Cove Salmon began work at Huntsman on green solutions for the removal of sea lice by researching the use of a locally avail-

able cleaner fish called cunner, *Tautogolabrus adspersus* (Walbaum) 1792.

While the focus of this article is to discuss how Huntsman has specifically contributed to the training of individuals directly in aquaculture through coursework and projects, it does not detail the myriad of graduated students who have completed parts or all of their undergraduate and graduate research at Huntsman either independently or as part of a larger project or program running at Huntsman. Graduate projects of marine organisms have included both invertebrate and vertebrate studies. These projects focused on experimental physiology, parasitology, behaviour of wild and hatchery reared Atlantic salmon, feeding studies of larval fishes, life history, distribution, zooplankton population studies, reproduction, effects of salinity, nutrition, bioenergetics, environmental and genetic sources of variation, and biofouling. Additionally, students have completed work in fields other than biology, such as chemistry - including projects such as chemical treatment of base metal mine waters, organic particles in Kennebecasis Bay, and true metals in estuarine and coastal Canadian Atlantic Regions; and environmental physiology and biochemistry – effects of toxicants, amino acid transport kinetics, control of metabolite flux through fish hepatocytes, and role of insulin in fishes (including hagfish).

Several funding agencies are mentioned directly with specific programs. However, funding has been received from these and other funding agencies, as well as industrial partners. Most notably, funds have been received from the Atlantic Canada Opportunities Agency (ACOA) and the ACOA Atlantic Innovation Fund (AIF) as well as the New Brunswick Innovation Foundation (NBIF) for improvements that have been made to Huntsman's research and training infrastructure over the years including new aquaculture facilities, saltwater upgrades, and research into the culture of alternative species.

The mission of the Huntsman Marine Science Centre is inspiring stewardship through: the engagement of the Community in the discovery of the Oceans; the design and delivery of inspirational educational experiences; and the advancement of marine sciences through collaborative research and the development of innovative technical solutions for our public and private sector partners. As we have in the past and continue in the future, the Aquaculture Department at Huntsman is interested in making progress in collaborative research areas such as broodstock development, but we are also committed to growth of new collaborative efforts that support the needs of our partners. We work to move forward today by building on past knowledge that will drive research advancements in the future. We invite you to tour our facility, stay awhile and become part of our team.

Authors:

Amber Garber is with the International Aquaculture Innovation Centre (agarber@huntsmanmarine.ca), working out of the Huntsman Marine Science Centre, St. Andrews, New Brunswick. Brian Glebe is the Salmonid Aquaculture Research Scientist at Fisheries and Oceans Canada, St. Andrews Biological Station, New Brunswick. W.D. (Bill) Robertson is the Executive Director of the Huntsman Marine Science Centre. ***Details regarding past projects were partially compiled by the authors from newsletters and annual reports. Pictures were taken by Jim Cornall (Figures 1, 2, 6, 7), Brian Glebe (Figure 4), Greig Canna (Figure 3) and the Aquaculture Department (Figure 5).***

Caroline Graham

Canada's First Aquaculture Training Program

C. Graham

The Aquaculture Technician program[a] has been offered at the New Brunswick Community College (NBCC) in St. Andrews, New Brunswick, each year since 1978. It has the distinction of being the first aquaculture training program in Canada. The program was initiated as a joint venture of the Atlantic Salmon Federation (ASF)[b] , the Huntsman Marine Science Centre (HMSC)[c] and the New Brunswick Community College (NBCC) with funding provided by Canada Manpower. The program was initially taught at the facilities of both the ASF and HMSC and in 1990 moved to the St. Andrews campus of the NBCC where the program currently resides. Throughout the years, approximately 515 students have completed the full program while additional students have taken individual courses to upgrade their skills.

An aquaculture technician is defined as someone who usually works directly with the culture of aquatic plants or animals. The duties of the technician can vary from basic rearing of the organism and maintenance of the culture facilities, to aspects like water quality analysis, disease diagnosis and treatment. Aquaculture technicians are involved in almost all aspects of the raising, harvesting, and processing of aquaculture species.

Past and Present Aquaculture Technician Program Instructors:

Dr. Chris Frantsi
Dr. Brian Glebe
Julie Delabbio
Rod Hooper
Jim Watkins
Rod Carney
Nelson Alward
Caroline Graham

a The program was initially known as the Aquaculture Technician Training program (ATTP), but is currently referred to as the Aquaculture Technician program.
b At the time of initiation, ASF was known as the International Atlantic Salmon Federation (IASF).
c At the time of initiation, HMSC was known as the Huntsman Marine Laboratory (HML).

Award winning students from 2011 Class, pictured with instructor and industry representatives

Since its first offering in 1978, the program has evolved in a number of ways to result in its present form. The program began as a 48 week program with 25 weeks of industry practical training designed to provide students with skills and knowledge necessary for employment in the aquaculture industry. The program now spans 40 weeks and includes 6 weeks of practical training tailored to each student's particular interests in the aquaculture industry. Over the years, additional programming has been offered, such as Aquaculture Worker and Aquaculture for Other Species.

Program Courses

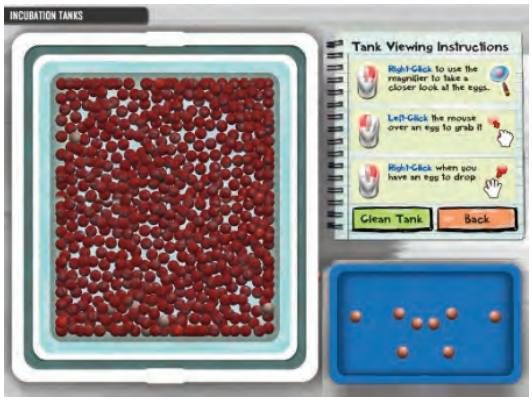
- **Introduction to Aquaculture**
- **Biology of Fish**
- **Handling Fish**
- **Water Treatment for Aquaculture**
- **Hatchery Culture**
- **Sea Cage Culture**
- **Fish Health**
- **Alternate Species**
- **Aquaculture Equipment**
- **Feeding and Nutrition**
- **Aquaculture Research Project**
- **Reading and Writing Applications in the Workplace**
- **Interaction in the Workplace**
- **Workplace Safety Practices (including Marine Basic First Aid and WHMIS)**
- **Marine Emergency Duties (A3)**

Students with instructor in NBCC Training Hatchery (1990)

The course has always been closely aligned to New Brunswick's salmon industry so special attention is placed upon techniques required in the operation of salmon hatcheries and marine farms. Throughout the years, NBCC has welcomed recommendations on the program curriculum from industrial partners through working groups and one-on-one meetings. For example, the Sea Cage Culture course has shifted to include a greater focus on environmental management, and now includes a clean-up of local beaches.

Regardless of the changes to the curriculum, the training has consistently been provided through a combination of classroom lecture, laboratory sessions, and on the job practical training. Facilities at NBCC include fully equipped classrooms, laboratory, and a fully functional freshwater teaching hatchery utilizing recirculation technology.

As one example of innovative training, NBCC has recently completed a simulation game called "Sim Fish Farmer", which is a realistic computer graphics program that requires students to apply their knowledge from egg to harvest in a salmon farm setting. The simulation is very challenging, and requires that the user apply critical thinking and their newly acquired aquaculture skills to bring their Atlantic salmon to market.



Screen shot showing a tray of eggs that the student must pick as part of their experience in Sim Fish Farmer

Aquaculture student taking part in the annual beach clean up

The New Brunswick aquaculture industry has always supported the program in a variety of ways, including hosting students during practical training, opening doors to show their operations to students, being guest speakers, providing input on curriculum. Industry has also been very supportive in providing awards to students at graduation. The most important role industry plays is in hiring graduates.

2011/12 NBCC Aquaculture Technician program on a field trip to a Cooke Aquaculture marine site (Photo credit – Chuck Brown)

Students of the NBCC program are also eligible for the AquaFair Award, which was established during the 2000 Atlantic Aquaculture Exposition, Conference, and Fair. The award was established in honor of Dr. Chris Frantsi who was the original instructor of the program at NBCC from 1978-84 and who was also named Aquaculturist of the Millennium at the 2000 Aquaculture Fair. The $1000 award is given each year to the student(s) who best demonstrates academic achievement, commitment to the aquaculture industry, and financial need.

Today, the Aquaculture Technician Program continues to appeal to those interested in a production based career in aquaculture, freshwater and marine sciences, or research. Students learn the structural and operational principles of aquaculture that guide this global industry. Graduates apply operating principles to a variety of species, locations, and

AquaFair (Dr. Chris Frantsi) Award Recipients

2000/01 – Tanya Patterson (first year the award was given)
2001/02 – Lisa Muise
2002/03 - Stephen Flynn
2003/04 – Roberto Pegoraro
2004/05 – Thomas McComb
2005/06 – Joey Pratt
2006/07 – David Wong
2007/08 – Jeff Gibbons; Jeffrey Lazore
2008/09 – Stevie-Lynn Hurley; Faith Caskenette
2009/10 - Kelli Mitchell; Randi Briggs
2010/11 – Angelina Fader-Day; Nancy Linehan
2011/12 – Katelyn McLaughlin

techniques. NBCC Aquaculture graduates are working locally, in the NB industry, as well as in other parts of Atlantic Canada. Furthermore, the opportunity exists for graduates to work in other parts of Canada, or in other parts of the world. Over the years, NBCC has welcomed international students to its campuses, including those interested in aquaculture training.

Graduates who wish to further their career in aquaculture will have acquired the essential skills necessary to continue in a program of higher learning. Should NBCC graduates wish to pursue their studies further, they have the potential to apply their certificate towards a Bachelor of Science degree at University of New Brunswick, Saint John.

As the Aquaculture Technician program reaches the milestone of the 35th graduating class, current instructors Rod Carney and Caroline Graham look forward to the continuation of this unique program. They acknowledge that one of the challenges facing enrollment is the general lack of awareness about aquaculture, particularly away from areas where the industry is located. High school students inland know very little about this industry, and are often surprised at the opportunities for careers in this field. Instructors and NBCC students frequently visit with high school students to teach them about aquaculture, and always welcome tours of the St. Andrews facility.

Author

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Thanks

The author would like to thank Dr. Chris Frantsi, Nelson Alward and Rod Carney for their suggestions and edits.

A Brief History of Aquaculture Research and Development at the St. Andrews Biological Station

G.K. Reid

Gregor Reid

Introduction

St. Andrews Biological Station (SABS) is a science research facility of Fisheries and Oceans Canada (DFO). It has been part of the St. Andrews, New Brunswick (NB) landscape for over 100 years. It is often referred to locally as the "Biological Station", "The Bi-log" or simply "The Station". While it is known for its research on fisheries, physiology, ecology, lifecycles and oceanography; it has also played a pivotal role in aquaculture research, development and training in the St. Andrews area (Charlotte County) and beyond. There is a recently written book chapter by former Station Director Dr. Robert Cook (1977-1992), called "Aquaculture Research and Development at SABS: 1908-2008". The soon to be published book (title forthcoming) is to commemorate 100 years of science at SABS, and will be available from the University of Toronto Press. Portions of this article highlight a number of the chapter's key writings, with permission by Dr. Cook.

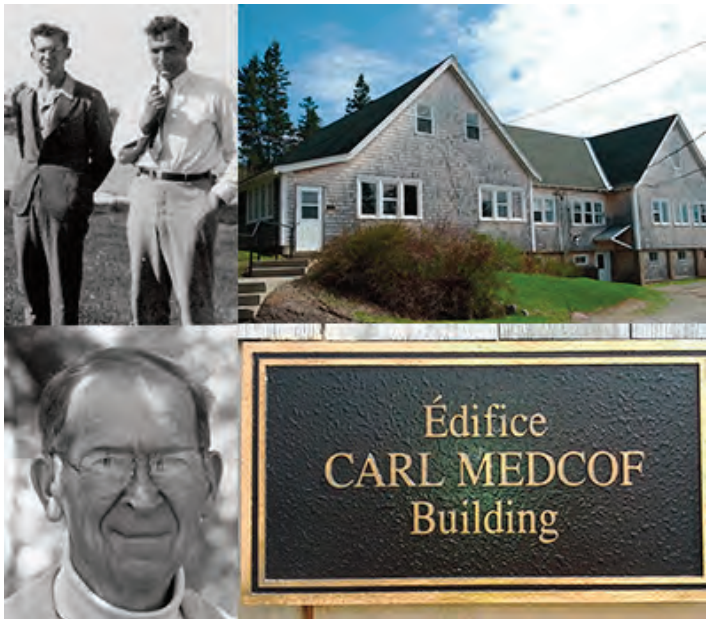
Other sources include "The Salmon Connection" (Glen Margaret Publishing) by former Station Director Dr. John Anderson (1967-1972), input by retired and current Station staff (see Acknowledgements), and the author's own familiarity with ongoing aquaculture projects.

Dr. Alfred Needler in 1925 (top left), 1959 (bottom left), and the ship that bears his name (right)

The early years

One of the first aquaculture research endeavours at SABS was that of Professor A.P. Knight of Queens University. Dr. Knight was instrumental in the formation of the Biological Board of Canada and the establishment of a laboratory at St. Andrews. Lobster culture was one of the three priorities in 1908, due to concern about the dismal future of the fishery at the time. Dr. Knight worked extensively on a method of rearing lobster larvae and demonstrated the ineffectiveness of lobster culture systems employed elsewhere.

Other early aquaculture efforts involved the culture of the American oyster. Early oyster studies began in Prince Edward



Dr. Carl Medcof at the SABS field substation, Ellerslie (PEI) 1936 (top left on the left, beside Dr. Alfred Needler), in 1985 (bottom left) and the Medcof Building at St. Andrews Biological Station (right)

Island (PEI) around 1903, but oyster research became a priority once the first significant disease issues arose (an "oyster blight") in Malpeque PEI in 1917. After the Federal Government assumed jurisdiction of oyster growing areas in 1928, an oyster hatchery was constructed in the early 30s at the SABS field substation, Ellerslie (situated by Malpeque Bay), as a means to provide sound scientific advice. Former Station

Director Alfred Needler (1941-1954) started his career with oyster culture research and was the first scientist responsible for the Ellerslie operation. Dr. Needler held many senior positions with the Fisheries Research Board of Canada (one of DFO's predecessor organizations), ultimately becoming the Deputy Minister of Fisheries. Today's Station researchers who study the pelagic environment and its residents, are very familiar with the 50 metre research vessel named in his honour, the CCGS Alfred Needler. Soon afterwards Dr. J.C. Medcof joined the oyster project. A building at the Station is currently named after him and the Medcof Building presently hosts the Aquaculture Association of Canada (AAC) office. The Ellerslie substation continued until the 1960s.

Early researchers such as Dr. Medcof also pursued initial work on toxic algal blooms; specifically paralytic shellfish poisoning and related research, which continue to the present day. In 1985, Dr. Alan White organized the third annual conference on toxic dinoflagellates, which was hosted at SABS. Today, Jennifer Martin and her team continue related work on the development of early warning mechanisms for toxic algal blooms and training of aquaculture farm staff to identify key phytoplankton species.

Invertebrate culture progresses

Pioneering work in scallops, soft shelled clams and urchins has also been undertaken at SABS. Early efforts in clam culture were pursued by Dr. J.C. Medcof. Dr. Michael Dadswell began to take an interest in scallop culture in the mid 1980s. SABS was an ideal location for this given its proximity to Tongue Shoal, an area abundant in scallops (too rocky to be dragged by commercial fishermen) and an excellent location for spat collection. Dadswell (who eventually took a posting at Acadia University) was joined by Drs. David Wildish and Shawn Robinson (former AAC President) along with then graduate students (and future AAC Presidents), Jay Parsons and Cyr Couturier; making significant advancements in scallop hatchery and seed collection, juvenile grow-out and rearing systems. Later, Dr. Robinson continued efforts with soft shelled clam culture, investigating the use of cultured juvenile clams for planting strategies and enhancement. Robinson further went on to explore facets of sea-urchin culture in collaboration with fish and shellfish nutritionist, Dr. John Castell.

Left to right, the Governor General of Canada, Edward Schreyer, Susan Waddy and Dr. Robert Cook touring the lobster culture facility (SABS), 1980s

Through selective breeding, staff at the St. Andrews Lobster Culture Laboratory were able to produce strains of distinct colours, including the red and blue juveniles shown here. Unique colour strains would be valuable for marketing (branding and product identification) and could be useful for population studies with wild stocks. The red one in this photo was raised to maturity, and produced a third generation of red progeny.

From the 1930s to the 1960s, Drs. A.F. Chiasson, D.G Wilder, and D.W. McLeese worked on lobster storage and shipment, a necessary precursor to full-fledged culture and grow out. Research by Dr. D.E. Aiken in 1970 demonstrated that lobsters held at temperatures of < 5°C for several months do not molt. That information, and a collaboration with Jack Van Olst of the University of Southern California in San Diego, led to a revolution in the lobster storage industry. The development of land-based low temperature holding systems enabled the quality of lobsters to be maintained for long periods with little or no feeding and greatly reduced the risk of disease and of lobsters molting or spawning and becoming unmarketable. In 1974, Aiken designed and built the first and only lobster grow-out facility to operate as a fully-integrated lobster culture system with year-round production. Other culture facilities existed but they relied on egg-bearing females from the fishery and none combined all stages from broodstock to marketable product in a year-round production system. The St. Andrews facility was independent of the fishery—eggs were obtained from broodstock raised in captivity. It was also fully-integrated, incorporating broodstock, egg, larval, juvenile, adult, and growout to market size. Strategies developed by Aiken and Susan Waddy enabled the production of eggs and larvae in every month of the year on a predictable schedule. Their work generated knowledge on the effects of the environment, especially changes in temperature, on reproduction, development, and growth. Today, that information has important implications for climate change research. The Lobster Culture Facility was shut down in 1983


Dr. Richard L. Saunders, 1975

due to reduced funding and realignment of regional priorities. A contributing factor was the continuing strength of the lobster fishery, which, unlike many other marine fisheries, had remained productive. This latter fact eliminated the economic incentive for development of commercial lobster farming. Lobster research as it relates to aquaculture today continues at SABS primarily by Susan Waddy, and Dr. Les Burridge, in the context of how lobster fisheries may be affected by fish farming activities.

Salmon culture

Then there is also, of course, Atlantic salmon culture, now a major economic contributor for the region. Research on the physiology and culture of the Atlantic salmon began in earnest in the 1960s. Initial work led by Dr. Richard Saunders, pursued aspects of physiology in fresh and salt water with parr from DFO hatcheries, to support basic scientific research. However, it was soon discovered that this research would also be important for culture. Saunders and his team would ultimately develop an experimental hatchery and perform research into the smoltification process which would prove vital to farmers. While the development of salmon aquaculture was progressing in Scotland and Norway around the same time, there was some scepticism as to whether salmon could be successfully overwintered in Canada's colder waters. Surprisingly, there were few detailed temperature measures of Maritime winter coastal waters at the time. Nevertheless, the first step was to find the lower lethal temperature of Atlantic salmon. In 1972, Saunders determined that the lower lethal limit for Atlantic salmon was -0.7 ºC. Despite a lack of detailed temperature data there was a theory, that the high hydraulic exchanges of the Bay of Fundy would reduce the potential for lower lethal temperatures. This was soon to be tested.


Left to right, Drs. Dave Aiken and Arne Sutterlin, 1970's

The image of aquaculture changed dramatically as a result of the salmon aquaculture team at SABS in the 1970s. As early as 1968, there were a number of visiting Norwegian scientists with special interests in salmon physiology for application to a developing aquaculture industry. Reciprocally, Saunders visited some aquaculture sites in Norway in 1972, which further intensified interest on the potential for salmon culture in Canada. A few years later in 1976, Dr. Arnold Sutterlin a fish physiologist at the Station followed, going to the University of Tromsø (the world's northernmost university) for sabbatical to learn about their burgeoning Atlantic salmon culture industry. Upon his return, Sutterlin and his team were sufficiently inspired to pursue grow-out trials on Canada's east coast. In the early to mid-seventies the biggest limiting factor for salmon culture was an absence of commercial hatcheries and consequently, a supply of smolts. Sutterlin spearheaded a request, backed by then Station Director Dr. Bob Cook, to acquire government hatchery smolts (sourced from the DFO Mactaquac hatchery) for informal experimentation by the industry and its research partners. Sutterlin and his team raided the Station's 'Moose Pasture', where old equipment is placed with the hope of future usefulness. They built small square experimental cages the size of card tables to assist one of the regional aquaculture pioneers, private sector biologist, Arthur MacKay. While an initial attempt to overwinter salmon in Brandy Cove (where SABS is located) failed, they ultimately proved that speculation on the overwinter potential in the Bay of Fundy was correct. Salmon were successfully held in cages during the winter months (1978-79) at Lord's Cove, Deer Island, NB. These trials and those performed by others in locations ranging from Cape Breton, Nova Scotia (NS), down to Grand Manan, NB, indicated that most areas along the coast, southwest of Saint John (and eventually areas on the NS side of the Bay) could successfully overwinter salmon.


Gene Henderson netting trout at the former Tide Pool facility (SABS). Photograph undated.

Left to right, Dr. John Anderson, Tom Siddon (Minster of Fisheries and Oceans), Gene Henderson, and Dr. Robert Cook during the opening of the Salmonid Demonstration and Development Farm at Lime Kiln Bay, St. George, NB, 1986

In 1977, Dr. Brian Glebe joined the Saunders DFO team as a postdoctoral fellow and was charged with identifying the best wild salmon stock for performance under farm conditions. Two years later, Brian replaced Saunders as Director of the Salmon Genetics Research Program, a farmed salmon genetic improvement strategy implemented by the Huntsman Marine Science Centre (HMSC). Glebe would collaborate with numerous researchers through the HMSC for many years, before returning to the Station. As the smolt supply began to be addressed (initially supplied by SABS followed by the Atlantic Salmon Federation, in collaboration with the HMSC and DFO), and additional research (nutrition, fish health, genetic selection) was initiated, a regional salmon aquaculture industry began to look promising.

Drs. Wendy Watson-Wright and Dr. Dick Peterson, 1990s

Important research, development, technology transfer and collaboration on salmon culture continued in the 1980s. At least one Canada – Norway finfish (salmon and halibut) workshop was held at the station. A series of international smolt workshops were held every four years, beginning in 1980 (with SABS hosting the 4th workshop in 1992). The development of private hatcheries lessened the dependence on government and association supply of smolts. However, in order to translate research into development, questions of practicality and implementation needed to be addressed. To answer questions on the best construction materials for cages, best diet, and best age for smolt stocking, the Salmonid Demonstration and Development Farm (SDDF) was initiated in Lime Kiln Bay, NB in 1986. This project was spearheaded by SABS researchers under the management of Dr. Robert Cook, and modelled after the Department of Agriculture's network of experimental farms. The 12 cage farm and adjacent facilities under the direction of manager Gene Henderson, became an important hub for farmers to liaise on technical aspects and for researchers to conduct experimentation. Upon retirement from SABS, Gene Henderson became the first manager of the newly formed New Brunswick Salmon Growers Association in 1989, which assumed responsibility for the SDDF.

By the 1990s, the salmon culture industry in the region was well underway, but it was not without its hardships. Disease management figured prominently and there was an increasing awareness that in some cases, salmon culture had the potential to impact the environment. Bay Management Areas (BMAs) were introduced by the Province of New Brunswick in the early 1990s to help partition aquaculture leases into discrete areas based on minimal water exchange overlap, as a means to reduce disease transfer potential between farms. In 1996 Infectious Salmon Anemia (ISA) appeared in New Brunswick and made history by being the first disease in the aquaculture sea-cage industry in Canada where a mandatory eradication order was issued. Such events prompted further refinement of BMAs. Over the next decade, Dr. Fred Page's team of oceanographers at SABS used circulation models validated with field data to help predict the potential spread of ISA, and this work was largely responsible for defining the latest reorganization of BMAs in 2006. These revised BMAs in combination with a mandatory one year fallowing period and only single year class stocking, have largely thwarted the potential for ISA epidemics in the region. Additional work by Dr. David Wildish and his group (in conjunction with Dr. Barry Hargrave of the Bedford Institute of Oceanography) on benthic hydrogen sulphide monitoring developed pivotal monitoring techniques for sulphides under cages (beginning in 1985 on until the early 2000s) which were ultimately adopted by the Province of New Brunswick as part of their regulatory monitoring protocols for fish farms. Since the retirements of Drs. Wildish and Hargrave, environmental monitoring has been continued by Page's team.

New finfish aquaculture species development program

Another prominent aquaculture initiative during the 1990s was the, Canada-New Brunswick-Nova Scotia, New Finfish Aquaculture Species Development Program (funded primarily by the Cooperation Agreement on Economic Diversification between Canada, New Brunswick and Nova Scotia), which occurred from 1995-2000. This initiative was a large collaborative venture to promote aquaculture of new finfish species in the Maritimes. Several relatively new culture

species were pursued and SABS researchers partnered in various projects with HMSC, Nova Scotia Agriculture College (NSAC), the New Brunswick Department of Fisheries and Aquaculture (NBDFA) Aquarium and Marine Centre, the Nova Scotia Department of Fisheries and Aquaculture, National Research Council's (NRC) Institute for Marine Biosciences, researchers from Dalhousie University and the University of New Brunswick (UNB), as well as several industry partners. Station Director Wendy Watson-Wright (1992-1997) was co-chair of the initial Steering Committee.

One project built on halibut culture research started by Dr. Ken Waiwood in the late 1980s (eventually taken over by Debbie Martin-Robichaud in 1995). Wild broodstock were collected, maintained and spawned, and SABS' halibut hatchery became a major supplier to other hatcheries and research projects supported by the program. The halibut research team at SABS was the first in North America to successfully raise all life cycle stages under laboratory conditions and those fish ultimately became the first F1 (first filial generation of offspring from an arranged cross) cultured broodstock in North America and these are currently being used by industry. Additional research included: techniques for collection of wild halibut for broodstock, determining the timing, quality and quantity of wild zooplankton production for larval nutrition, and developing strategies for maintaining halibut yolk-sac larvae in low ambient salinities. Martin-Robichaud and collaborators also developed techniques to produce all-female halibut to improve the growth potential for culture. Again, these broodstock are currently used by the industry for commercial production.

Former St. Andrews Biological Station researchers and graduate students who have served on the Aquaculture Association of Canada's Board of Directors:

Dave Aiken
John Anderson
Neil Bourne
Ian Butts
Cyr Couturier
Chris Hendry
Terralynn Lander
Matthew Liutkus
Debbie Martin-Robichaud
Brian Muise
Sharon McGladdery
Jason Mullen
Jay Parsons
Chris Pearce
Gregor Reid
Shawn Robinson
Richard Saunders
Arnold Sutterlin
Joy Wade
Susan Waddy

Waiwood also began to expand on his initial haddock research from the early 90s. The first haddock production in the program occurred at SABS in 1993, with haddock ultimately held and studied by partners at the NBDFA Marine Centre (recirculation), NRC (flow-through tanks) and, Harbour Deloutre Products Ltd. (sea cages, Campobello Island, NB). Dr. John Castell (and partners) worked on larval nutrition for haddock and winter flounder which prompted a workshop held in St. Andrews, on the use of live feeds in larval fish culture. Research on halibut and haddock involved graduate students from Memorial University of Newfoundland, UNB and the University of Maine.
In another project Dr. Dick Peterson tested culture requirements of striped bass, continuing this work with partners (NSAC, HMSC, NBDFA) in the 90s and ultimately producing a culture manual in 1996. Peterson also pursued first feeding of American eel elvers with Debbie Martin-Robichaud, through this program. Additional details of the Canada-New Brunswick-Nova Scotia, New Finfish Aquaculture Species Development Program can be found in Chang[1].

Other aquaculture projects and developments

There are a number of other aquaculture related research programs of note. Martin-Robichaud and Peterson pursued aspects of lumpfish culture in the early 90s. Around the same time, Dr. Peter Lawton studied the potential impact of salmon aquaculture on lobster populations, and followed up with related studies in the early 2000s on possible effects to lobster juveniles and abundance. The interaction of aquaculture with the herring weir fishery has been the subject of numerous studies, mainly by former Station Director, Dr. Robert Stephenson (2005-2010). In 2000, the Aquaculture Collaborative Research and Development Program (ACRDP), was initiated by DFO and continues today. This collaborative DFO-Industry research initiative is modeled on the Matching Investment Initiative approach of Agriculture and Agri-Food Canada. Numerous ACRDP projects have been led or have involved SABS staff, and details of these projects can be

Dr. Brian Glebe and Nellie Gagne (DFO, Gulf Region) in the SABS Containment Laboratory, used for fish disease studies, 2011

found at the following DFO website: *http://www.dfo-po.gc.ca/science/enviro/aquaculture/acrdp-pcrda/projects/projects-eng.asp* (see Maritimes/Gulf Region). In 2001, Dr. Brian Glebe returned to SABS to fill the position vacated by Dr. Saunders when he retired. At this time, as a variety of pathogens plagued the salmon industry, fish health in aquaculture became a research priority. A level 2 containment laboratory was built at the Station and has been continuously operated since to study novel fish vaccines and the genetic basis to disease resistance. Aspects of invertebrate related Integrated Multi-Trophic Aquaculture (IMTA) have been investigated by Dr. Shawn Robinson and his team since 2002. Over the last several years, Dr. Ed Trippel and his lab have been key researchers in the Atlantic Cod Genomics Broodstock Development Project of Genome Canada. In 2007, the Centre for Integrated Aquaculture Science, a virtual network of DFO aquaculture expertise from around the country, was headquartered at SABS, headed by Dr. Fred Page. Finally, a number of SABS researchers are presently involved with the Canadian Multi-Trophic Aquaculture Network (CIMTAN), a Natural Sciences and Engineering Research Council of Canada Strategic Network, which is partially funded by DFO. The Station hosts a number of CIMTAN students and personnel on projects ranging from co-cultured species nutrition to temporal and spatial patterns of nutrient dispersion from fish cages.

Present day

Previously, data from small scale pilot projects run by scientists were extrapolated to an industry culture scale, several orders of magnitude greater, while accounting for commercial deliverables to help build an industry. Today the salmon aquaculture industry is now of sufficient size and scale that they have their own resources and research capacity. As a result, DFO has now moved away from production based research. However, recent events in the region have demonstrated that information exchange between researchers, industry, academia and other stakeholders continues to be just as imperative now as ever. While BMAs were designed for and have been effective with ISA, they have not been as effective with sea lice. Since 2009, SABS researchers have once again been at the forefront of unprecedented time-sensitive sea lice research involving aquaculture companies, industry associations, provincial ministries, and other federal departments. Fred Page's group, embarked on an intensive series of dye dispersal experiments to track sea lice therapeutants released from tarped salmon cages and salmon in "well boats" undergoing treatment. Dr. Les Burridge's and Susan Waddy's groups investigated the potential of therapeutant toxicity to lobsters. Dr. Shawn Robinson's group is investigating the consumption of free living larval stages of sea lice, by blue mussels. The combined research output from all of the participants in such a short time was impressive and detailed online in sea lice workshop reports (2010, 2011) by the Atlantic Canada Fish Famers Association.

SABS aquaculture legacy

This brief history of aquaculture at SABS has focused mainly on personnel at the project leader level for the sake of brevity. Attempting to ensure all participants from the last century were appropriately noted would be a daunting task and beyond the scope of this article. Nevertheless, it is important to acknowledge the contribution of various support staff at all levels, as they were and are, crucial to the success of so many aquaculture projects. One of the greatest contributions the Station has made to aquaculture-related research, is the training and education of students. Many a research or academic leader involved in aquaculture have passed through the Station doors as a student and gone on to industry, the provincial government, academia or remained with DFO.

Finally, the reader is encouraged to "keep an eye out" for the upcoming book commemorating 100 years of research at SABS, and Dr. Cook's chapter. Specifics of numerous SABS aquaculture research projects can also be found in back issues of the Bulletin of the AAC and Aquaculture Canada^{OM} conference proceedings *(see http://www.aquacultureassociation.ca/publications).*

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Acknowledgments

Many thanks to several former and current SABS researchers whose suggestions and edits helped improve this article immensely. Special thanks to Henrik Kreiberg, Blythe Chang, Tammy Blair, Dave Aiken, Dick Saunders, Ken Waiwood, Cyr Couturier, Pamela Parker, Dave Wildish, Robert Cooke, Robert Stephenson, Suzanne Taylor, Jay Parsons, Debbie Martin-Robichaud, John Castell, Susan Waddy, Fred Page, Shawn Robinson and Charlotte McAdam.

The Atlantic Salmon Federation and their Work with Aquaculture in the St. Andrews Area

G.K. Reid and T.J. Benfey

The Atlantic Salmon Federation (ASF) was formed in 1982, when the International Atlantic Salmon Foundation (IASF) of Chamcook merged with the Atlantic Salmon Association (ASA) of Montreal for the purpose of improving and maintaining the health and habitat of wild Atlantic salmon populations. Their headquarters and Interpretive Centre are located in Chamcook, just outside St. Andrews, NB. Many people today think of salmon aquaculture as large-scale commercial ventures in cages. However, it is important to acknowledge that salmon aquaculture techniques were initially developed to rear fish for wild stock enhancement. ASF got into smolt production as a means to augment natural populations and, along with their research partners, were among the early pioneers in developing aquaculture expertise in the region. In his book, "The Salmon Connection", published by Glen Margaret Publishing, the late Dr. John Anderson touches on the pivotal role ASF has had in the development of Atlantic salmon aquaculture. Several of the following historical details of ASF's involvement are summarized from Dr. Anderson's book and the reader is encouraged to peruse this work. Dr. John Anderson was a former ASF Vice President of Operations and Chief Scientific Advisor to the President, and was instrumental in locating the ASF headquarters in St. Andrews.

ASF is a role model for successful research collaboration. In 1973, Dr. Wilfred Carter, then Executive Director of IASF, organized construction of the research hatchery in Chamcook using private funds. Fisheries and Oceans Canada (DFO) provided operating funds, and the Huntsman Marine Science Centre managed the staff and scientific program as part of the Salmon Genetics Research Program. When this occurred, of course, the commercial cage culture industry for Atlantic salmon had not yet developed. It was not until the fall of 1979 that the first cage-cultured Atlantic salmon in the region were harvested out of Lords Cove, Deer Island. The growth of commercial production was threatened by a lack of smolt availability. ASF, the only entity besides DFO involved in smolt production at the time, supplied smolts from their Chamcook research hatchery to salmon farmers because they felt that the development of an aquaculture industry would take away the market for commercial fisheries for wild salmon that were impacting vulnerable populations. ASF and their partners continued to pioneer a number of advanced scientific breeding and genetic programs for Atlantic salmon.

In many areas of the world, including Canada, commercial salmon culture and wild salmon share the same water, even if only seasonally. Consequently, potential negative impacts between wild and cultured salmon are a concern and a responsibly for all involved parties. Described in their policy statement on aquaculture, ASF and its Regional Councils work with the salmonid farming industry and government regulatory agencies to achieve environmentally sustainable salmonid farming. In the early 1990s, ASF invested in a commercial-scale evaluation of the use of reproductively sterile salmon in cage culture. Escaped sterile fish could not breed in the wild, eliminating one risk to wild salmon. More recently, close to 500 Atlantic salmon grilse were released near the northern side of the inner Bay of Fundy, in collaboration with the Atlantic Canada Fish Farmers Association, Parks Canada and DFO. These fish, which were captured as smolts and then reared in sea cages before their release, were implanted with acoustic tags to allow tracking of their movements. The intent of this study is to determine if cage-reared fish will return to rivers in which they smoltified.

While ASF no longer operates salmon hatcheries, relationships with the aquaculture industry and associated stakeholders continue. Many of the staff and students who have worked for ASF have also worked within the aquaculture industry. There is a compelling case to be made that this overlap and exchange of personnel has helped improve knowledge transfer and facilitate understanding among diverse stakeholders, which is arguably the first step required for successful collaboration.

In 2003, the Atlantic Salmon Federation Boards updated policy in regard to salmonid farming aquaculture to minimize the industry's impacts on the environment. More on ASF's aquaculture policy can be found at: http://asf.ca/docs/policies/aquaculture-policy2003.pdf. ASF believes that the future

of sustainable salmon aquaculture is in closed-containment systems and, to this end, is conducting research on freshwater closed containment on land in partnership with The Conservation Fund Freshwater Institute in West Virginia. For more information, visit, http://asf.ca/docs/uploads/closed-containmentbackgrounder.pdf

Dr. Wilfred Carter's efforts have not gone unnoticed. In his honour, the ASF has named its Interpretive Centre the Dr. Wilfred M. Carter Atlantic Salmon Interpretive Centre (http://salarstream.ca/). If you are in the area drop by and see salmon "face-to-face".

Acknowledgements

Special thanks to the ASF and in particular, Muriel Ferguson and Sue Scott for their valuable input.

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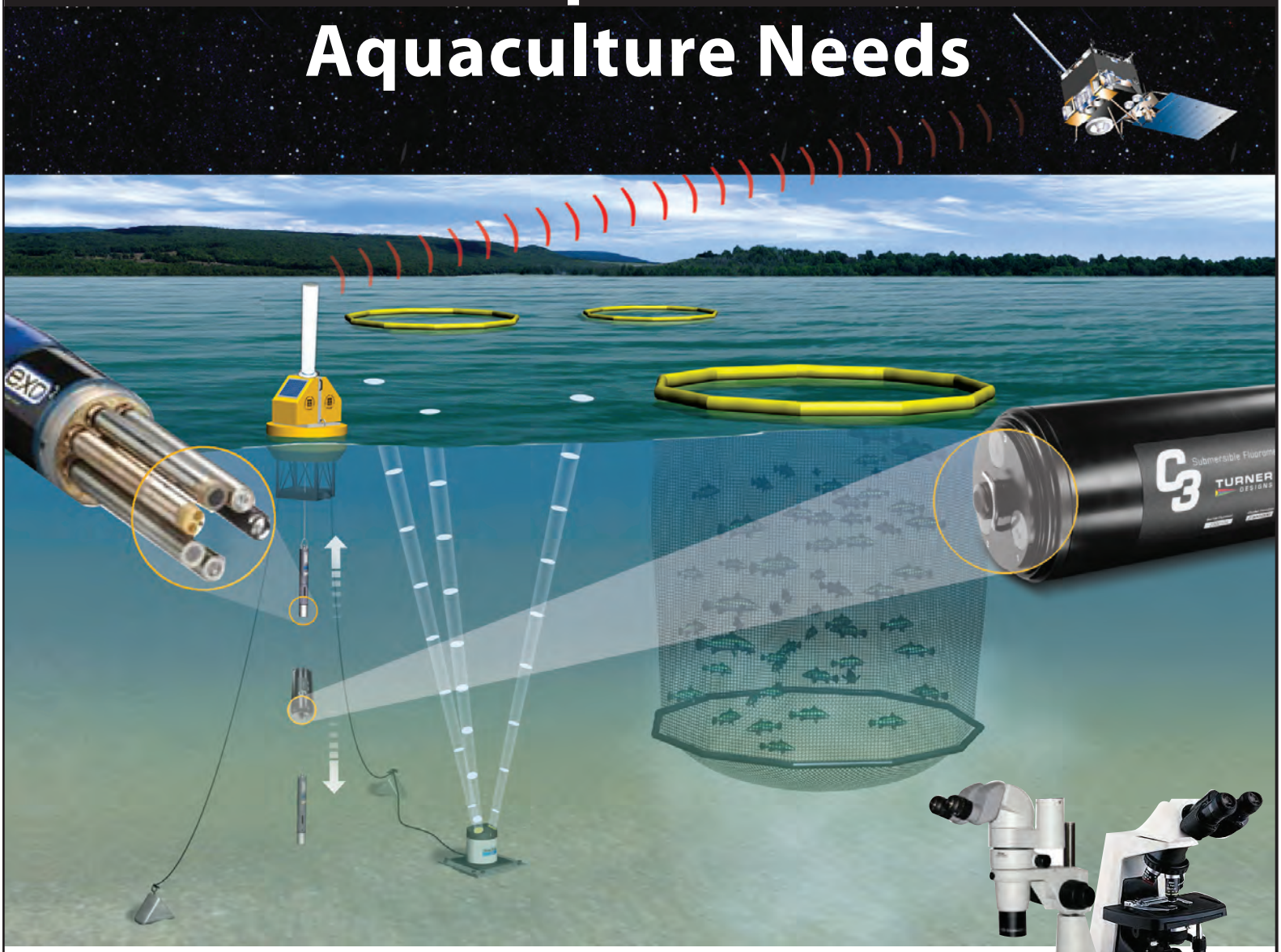
Hoskin's Complete Solution for Aquaculture Needs



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