Scallop Workshop Proceedings
January 24, 2004

Aquaculture Association of Nova Scotia
The Village at Bayers Road, Starlite Gallery
7071 Bayers Road, Suite 320
Halifax, Nova Scotia
B3L 2C2
Phone #: (902) 422-6234
Fax #: (902) 422-6248
E-mail: aans@eastlink.ca
Website: www.aansonline.com

This is report MG-03-11-003 for the Aquaculture Collaborative Research and Development Program.

Aquaculture Collaborative Research and Development Program (ACRDP)
PROPOSAL FOR SCALLOP AQUACULTURE WORKSHOP

1. **Workshop title :** Scallop Aquaculture Focus and Research Up-date
2. **Workshop date:** January 24, 2003 / Location: Lord Nelson Hotel Halifax, N.S. in conjunction with the AANS Scotian Pride 2004
3. **Workshop rational / audience targeted / raison d'être**

In 2007, the International Pectinid Workshop will be held in Atlantic Canada, St. John's, NF or **Halifax**, N.S. Due to this upcoming international event, scallop growers in the Maritime and Gulf Region should take a pro-active step to meet and exchange scallop aquaculture research and harvest techniques presently employed. It is anticipated that this proposed workshop will cultivate increased cooperation and information exchange for existing scallop aquaculture research as well as generate new research. Increased focus and collaboration for existing and new scallop aquaculture related research is essential for the development of this aquaculture sector in Atlantic Canada. Outcomes of this workshop will be presented at the 2007 International Pectinid Workshop. This workshop is also intended to foster recent economic development agreements between France and Canada, particularly St. Pierre/ Miquelon and Atlantic Canada.

4. **Workshop objectives**

The objectives of the workshop are 1) to give the scallop growers an opportunity to meet and exchange ideas and experience with cultivation in Atlantic Canada, Quebec and France 2) to provide the Atlantic Canadian shellfish aquaculturists with insight from successful scallop aquaculturists from Quebec and the Magdelene isalands 3) to organize a workshop session with industry and researchers aimed identifying the biological, technical and marketing research priorities for scallop aquaculture in Atlantic Canada.

5. Organizational profile

The Aquaculture Association of Nova Scotia was formed in 1977 to support the fledgling fish and shellfish farming industry. In its early days, the Association, which was operated by volunteers, lobbied governments for improved programs for aquaculture, organized meetings and workshops and served as the focal point for technology transfer.

In 1994, the Association and its government supporters decided that the time for professional staff had arrived and hired its first Executive Director and recently Brian Muise as Executive Director and Jason Mullen as Research and Development Coordinator. Since that time, the AANS has played a major role in the development of the aquaculture industry in Nova Scotia.

The Association has spearheaded the creation of industry development strategies; has provided technical services through its field staff; has facilitated communication among members and with outside organizations including government departments/agencies; has liased with industry in other provinces, countries, and with the research community and the public. The AANS has also taken pro-active steps to develop environmental management guidelines and an environmental monitoring program for its members; has advocated for fair and effective environmental assessment guidelines; has facilitated industry involvement in product quality initiatives and food safety. The AANS provides continual training opportunities for the owners and employees of fish and shellfish farmers in the province. And, Scotian Pride, the annual conference of the AANS has become one of the premiere information-sharing opportunities for industry in the Atlantic Region.

The Aquaculture Association of Nova Scotia is governed by a volunteer board of directors; the current President is Glen Brown, Director of Operations for Cooke Aquaculture Inc.

Scallop Workshop

Sponsored by the Aquaculture Association of Nova Scotia
Scotian Pride 2004
January 24th, 2004
Lord Nelson Hotel and Suites
Admiral Room

8:30-8:40 am Welcome & Workshop Overview – Leslie Ann Davidson
Aquaculture Association of Nova Scotia -Jason Mullen
*****The 16th International Pectinid Workshop*****
Aquaculture Collaborative Research and Development Program

8:40- 9:10 Overview of PecNord -Jean Cote

9:10-9:40 Overview Scallop Aquaculture in St. Pierre & Miquelon -Pierre James

9:40-10:10 Newfoundland Scallop Farming Experience- Cyr Couturier

10:35- 10:50 Nutrition Break

Overview of Scallop Farming Experience- Challenges and Successes

10:50 11:10 Great Maritime Scallop Trading Co. -Mike Dadswell
11:10-11:25 Sea Perfect Cultivated Product Ltd. -Ron Boudreau Presented by L.A. Davidson
11:25-11:45 Jamieson's Giant Scallops -Lorne/Wanda Jamieson –presented by L.A. Davidson
11:45-12:05 Hillsburn Basin Group – Blair Cooper

12:05 Lunch-(*provided-Admiral Room)*

1:00-1:30 REPERE II – Georges Cliche, Presented by L.A. Davidson

1:30-2 :00 Marketing Our Scallops Guy Pascal Weiner Université Sainte-Anne - Collège de l'Acadie
1:30-3:30 Focus groups*

1) Biological research priorities
2) Technical research priorities
3) Marketing research priorities

*Biological, Technical and Marketing priorities will be set and recorded for the workshop report and disseminated back to the group upon publication

3:30 pm Wrap Up

An overview of the Scallop farming Activities of the Groupe Pec-Nord

Jean Côté

Historic

Pec-Nord inc. is a scallop aquaculture company that was established in the province of Quebec at the end of the 80s by its president, Dr. Paul-Aimé Joncas. At first it was a small aquaculture venture, almost a hobby, but it rapidly grew during the 90s to become a larger company that acquired knowledge on the sea scallop, its biology and different methods of production in aquaculture. Today, the company employs nine full time, highly competent workers for the various part of its development, from management to accounting, from scallop production to sales and marketing.

From a sole company producing sea scallop, Pec-Nord inc. evolved and became an integrated group of companies involved in shellfish aquaculture in the eastern part of Canada. Pec-Nord inc. on the Lower North Shore of Quebec, IMAQUA inc. at the Magdalen Islands and Lunenburg Shellfish inc. in Nova Scotia are all parts of the Groupe Pec-Nord. The Groupe has also established key relationships with other aquaculture companies, as well as scientific relationships with many researchers from different government institutes, university, etc…This networking is an important part of its success.

The Groupe Pec-Nord is mainly involved in shellfish aquaculture, but also in various activities such as development and sales of shellfish gear and marine biotechnology equipment. The sea scallop, *Placopecten magellanicus*, is the principal shellfish cultured by the Groupe Pec-Nord, but other shellfish such as Bay scallop, American and European oysters or quahog clams are also produced.

Scallop Culture

Pec-Nord gets its seed supply in two ways. The first approach, used by Pec-Nord inc. and Lunenburg Shellfish inc., is the production of spat in hatchery, followed by a nursery stage done under a controlled environment or directly in nature. Up to now, we were able to increase larval survival and growth as well as the reliability of the production. Production costs were also reduced and domestication of the species started through genetic selection. Nevertheless, lot of work is still needed to achieve a highly reliable production from one year to another. The second way to obtain scallop seeds is the collection of natural spat, using the typical Japanese method of immersing collector bags in the right place at the right time to catch wild spat. IMAQUA inc. is doing so at Magdalen Islands.

The grow-out of the spat is usually done in suspension culture. After about a year, spat are harvested from collectors either produced in the hatchery-nursery or placed in the wild. They are then put in pearl nets suspended on submerged longlines in the site. Small scallops are removed from the nets and graded after about another year of culture in these nets. Although this is quite a labor-intensive process, this handling is essential to avoid excessive fouling on the nets, decreased growth and increased mortality. The grow-out will further continue in various suspended structures until commercial size, that is 50 mm and up. At this time, it’s still unclear which structure is the best for final grow-out. Pearl

nets, lantern nets, pocket nets, Wang-Joncas cages or oyster tables are all alternatives examined. Each one has advantages and problems; the choice will rather depend on the characteristic of the site (ex. depth), the equipment and the method used (mechanized or manual) and also the targeted market (muscle meat only, live in the shell). In some case, the bottom culture method is also used and small scallops are directly seeded on the bottom within the lease.

Marketing of cultured scallops

Once scallops have reached a marketable size, new challenges, questions and costs come up. In 2001, Pec-Nord has started to harvest and sell cultured sea scallops all year-round and since then, most of its energy were put on these marketing issues. For scallop sales, there is two possible markets to exploit. The first one is the traditional market, where live larvae, spat or juveniles are sold to other shellfish producers and scientist and muscle meat is sold to restaurant, caterer or fish market. The second possibility is what we call the “innovative” market, the one that includes live sea scallops, half-shell and roe-on scallops (fresh or frozen), and even the shell itself that might be used for handicrafts of as a mineral source. Pec-Nord is present on both markets but develop mostly the second one by selling live sea scallops.

In the long term, there will be advantages to aim at an innovative market, but it is actually more problematic than profitable to sell live sea scallops. It is hard and costly to do because you have to make a lot of education, provide tons of information, attend at many shows and develop ways to prepare, cook and taste this product unknown from most people. All this work is done for a niche market, thus a very small market. The second major problem is related to the short shelf life of the live sea scallop. It is usually around two to four days, but sometimes of only a few hours. Further, this short period is often spent in shipping and storing, not in the hands of the end client. Finally, this shelf life varies according to the site of production, the season and the handling methods. All this raises many questions to which there are very few answers right now.

Nevertheless, today the Groupe Pec-Nord invests an important part of its resources in RS&DE, it continues to create various partnerships in Canada and around the world and it develops an expertise in marketing and selling live sea scallops. Pec-Nord believes that even after 40 years of development, the scallop aquaculture is still at the pilot stage only, far behind other animal production. It remains a very risky, unpredictable venture and to succeed and stay into it, one must be a true believer.

Scallop Farming in St. Pierre et Miquelon, France

Pierre James

ARDA (Association de Recherche et de Développement pour l'Aquaculture)

History

Research and Development (R&D) on scallop aquaculture in St.Pierre et Miquelon has been conducted since 1995. Jean-Claude Dao served as the technical expert from 1990 to 2000. In 2001, the "Exploitation des coquilles sarl" (EDC sarl=société à responsabilité limité) was created. Jean-Pierre Carval from the scallop hatchery in Brest France was the technical expert in 2001-2002 and Benoit Vidal-Giraud (Via-Aqua) has conducted a technical economic feasibility study in 2002.

Production

The EDC aims to collect wild scallop spat (shell height = 300µm) from collectors set out in September. In the fall of the following year, when scallops have reached a minimum size of 10mm they are transferred to intermediate grow-out culture gear. The following summer, when scallops have reached a minimum size of 35mm, they are transferred to Japanese lanterns. The scallops are then sorted the following spring when another 10% mortality is expected. The scallops will be marketed when they reach a shell height of 100-105mm. A meat count of 20 per pound or 10 roe on meat per pound is expected.

Culture site

Collection sites, grow-out sites and an intermediate grow-out site are in well define areas just east of Miquelon. A navigational lane is also identified to assure safe navigation of fishing boats around the culture sites.

Scientific Follow-up

Scientific experiments are being conducted by ARDA to gain information concerning the seed quantity, mortality and growth rates and the meat weight shell height relationship of cultured scallops. This information is essential to improve and plan the farming operation and to enhance the commercialization which can lead to increased profitability.

Scallop spat collection

EDC is aiming to capture 400scallop spat/ collector to minimize competitor species in the collectors, and to maximize the growth rate of the scallop spat in the collector bags. The ideal date and ideal depth for spat collector deployment needs to be determined. Scientific follow-up would include documenting the weekly gonado-somatic index (GSI) of adult scallops and estimating the scallop larval concentration. Experiments to determine potential growth rate increases through husbandry practices such as lifting collector-bags in the water column, must also be conducted.

Other source of spat
In the short term, it may be necessary to import scallop spat until the local spat production reaches the required level. The introduction of scallop spat from an other area must meet sanitary and health measures that were set by ARDA and IFREMER (Institut Français de Recherche pour l'Exploitation de la MER) and the Canadian Department of Fisheries and Oceans (DFO).

Remote setting experiments may be put in place in the near future and perhaps in the long run, a hatchery could be set-up. Feasibility and cost studies for remote setting and/or hatchery are preliminary to any settlement of a hatchery.

Intermediate grow-out
There is a need to maximize the growth rate and minimize the presence of competitors (especially mussels). To achieve this goal, ARDA is investigating the efficiency of spat sorting and review the ideal scallop density in the culture gear as well as the effective mesh size and net type of culture gear may need to be re-examined in relation to the selected site. Scientific follow-up concerning the above investigation must be conducted to document their impact on growth and mortality of the cultured scallops.

Final grow-out
At the end of the 2 year final grow-out phase, the cultured scallops will have reached 100-105mm shell height with a roe on meat count of 10 per pound or a meat count of 20 per pound. To achieve this goal, EDC must face various management decisions to select sorting dates, scallop densities in culture gear, culture site location(s) and grow-out gear to be employed (cages, lanterns, or ear-hanging). EDC must also decide how to control fouling. Scientific follow-up concerning these husbandry strategies will be conducted to determine their influence on growth and mortality of the cultured scallops.

Marketing
To ensure a high quality healthy cultured product, a water quality surveillance program in the aquaculture zone will be conducted to monitor concentration of chemical contaminants, bacteria of concern and phytotoxins. A health surveillance program will be launched with the French veterinary and agriculture services.

Research and Development
Further research will be required to investigate:

1) Stress limits of scallops being cultured or handled.
2) Scallop spat supply
   Imported spat must be consistently available and require a sanitary surveillance.
   Remote setting spat experiments are required to determine if the technique is commercially viable.
3) Machinery for sorting and cleaning
   To reduce labour cost and improve yield of the culture project, techniques to sort and clean at a large production scale must be employed. Japanese machinery need to be investigated to determine if they are technically and financially suitable.

Newfoundland Scallop Farming Experiences

Cyr Couturier

Marine Institute of Memorial University
Box 4920, St. John's, NL A1C 5R3
T 709.778.0609, F 709.778.0535, email:cyr@mi.mun.ca

Introduction

The first trials for commercial scallop farming started in the 1960s in Newfoundland in response to declining wild stocks in the inshore areas of the Province. Today, there are 4 licenced commercial scallop farms in Newfoundland and Labrador, however, production has been negligible since 2001 (Fig. 1). In fact, commercial scale Canadian cultured scallop production has been highly variable over the past two decades (Fig. 1), and there are a number of constraints to address for a full-fledged industry to develop. Some of these challenges are common to all areas of the country, and are discussed below with a view of providing a synopsis of future areas of endeavour.

Historical Perspective

Table 1 provides a chronological synopsis of the sea scallop culture efforts in Newfoundland. Memorial University was the first to undertake R and D efforts on seed collection and hatchery production during the 1960s and early 1970s. During the1970s, the Department of Fisheries and Oceans Canada led efforts in the development of commercial scale sea scallop cultivation techniques, focusing in the Placentia Bay area (Fig. 2). In the 1980s Memorial once again undertook most of the efforts to commercialize seed procurement (via hatchery technology) and growout (intermediate and final growout)(Table 1). Mass mortalities, lack of working capital and seed scallops, and general uncertainty in the industry in the early 2000s has led to a hiatus in the industry.

Seed Procurement

Throughout the 1980s and early 1990s the main source of scallop spat was the Port-au-Port area (Fig. 2) (Details in Couturier et al. 1995). Lack of recruitment at this location for several consecutive years in the early 1990s meant aspiring scallop farmers had to source their seed from either hatchery or other commercial sources. A decision was made by the industry to establish a commercial scale scallop hatchery in 1995 at Belleoram (Figs. 2, 3) while at the same time sourcing seed scallops opportunistically from Maritime or Québec sources to meet commercial production objectives for individual farms.

In its first year of production, the hatchery produced 30 million 1.5mm scallops by September but late availability for deployment to field sites resulted in losses of 99%. The following four years at the hatchery were met with varying success, with some years

showing substantial production and others less than 500 thousand juveniles. Considerable research was undertaken to understand all aspects of larval, post-larval and nursery production in the hatchery culminating in several published reports. Efforts were made to focus on reducing costs of production and increasing efficiencies so that the average cost of a 7mm juvenile scallop from hatchery-nursery trials were in the 1.5 to 2.5 cent per animal range by the time the hatchery ceased operations in 2000, owing to lack of capital and buyers for the seed. One such trial focused on remote set of eyed larvae from the hatchery which showed that the cost of production for 7mm juveniles from post-larvae could be reduced as much as 40% under favorable conditions (Fig. 4).

Commercial Scale Culture Technology

A variety of intermediate and final growout techniques were evaluated at commercial scales during the 1990s including bottom culture, off-bottom culture in racks and tray systems, and various suspended culture methods suchs as ear-hanging, pearl nets, floating trays or bags (Fig. 5). Each scenario was evaluated at commercial scales involving several hundred thousand animals. Efforts were made to minimize the costs of production per scallop by estimating labour components (via time-motion analyses), capital and other expenses and developing various financial models. The findings indicated that the type of ongrowing system employed depended to a large extent on the desired final size to market; labour costs were reduced significantly for intermediate and final growout using rack, bags, or tray systems however capital costs varied significantly. Overall, the traditional pearl net met favourably against all other suspended culture techniques, when considering growth, survival, ease of use, capital and labour costs, whereas bottom seeding and ear hanging were not considered viable options for large scale commercial production (> 1,000,000 animals).

Periodic mass mortalities have occurred at all cultured sea scallop farm sites in Newfoundland and in all areas of Eastern Canada (Couturier et al. 1995). The reasons are variable, however, in many cases there are no obvious explanations for these mortalities. The most likely scenarios are natural environmental perturbances in nearshore rearing areas which are not fully understood in the context of this stenohaline, oceanic species. There is accumulating evidence that even small variations in salinity or temperature at farm sites may stress the animals and render them susceptible to opportunistic pathogens or to irreversible tissue damage from relatively minor environmental challenges (Nicole Brun, unpublished data). If this is the case, then site selection and handling will be crucial in future developments for this species.

Constraints

A number of constraints have been indentified as impeding full commercialization of sea scallop culture in Newfoundland and Labrador. These impediments are associated with large scale production of 1,000,000 or more animals at a farm site deriving its entire revenue from scallops, and not for small scale (<200,000 scallops) farming scenarios. They include:

1. Lack of consistent, reliable and high quality seed supply, from either hatchery or wild sources.

2. Requires large capital investment, generally in excess of $1 million per commercial farm. Access to such capital is limited given uncertainties in production.

3. Grower and investor confidence is low, given uncertainties in production. Rate of return is marginal at present, for commercial scale production.

4. Market development for value added products is required.

5. Indentification of *suitable* rearing sites and enhanced knowledge of species culture biology is required.

Conclusions

There is a future for scallop farming in Newfoundland and Labrador, provided some of the technical constraints are solved with respect to seed supply, site and biological suitability. The challenge will be to convince investors to take the risk with an alternate, as yet unproven, commercial species of mollusc, that does offer some potential for diversification and economic gain.

References

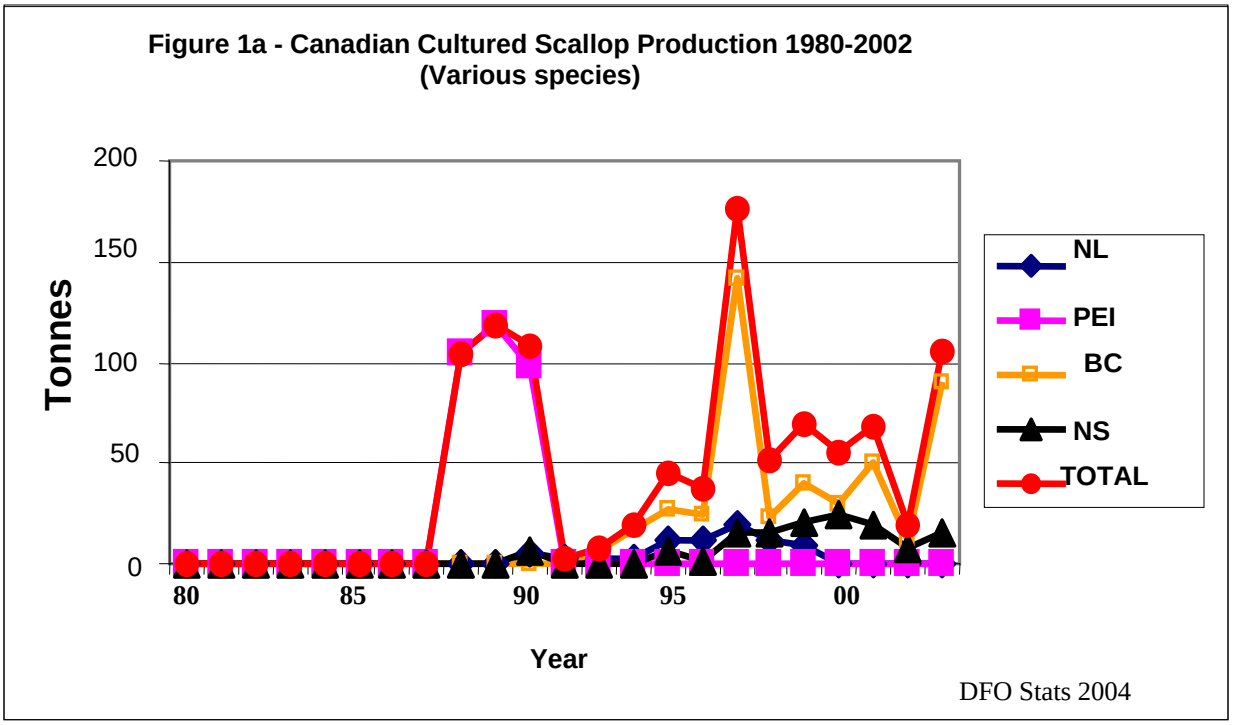
Couturier, C., Dabinett, P. and M. Lanteigne. 1995. Scallop culture in Atlantic Canada, pages 299-340. In: Cold-Water Culture in Atlantic Canada, A. Boghen (ed.), The Can. Inst. for Res. on Regional Develop., Univ. Moncton, Moncton, NB.

Acknowledgments

We wish to thank all scallop farming pioneers, past and present, for their dedication, effort and willingness to discuss the issues. In particular, the following deserve special mention: Pat Dabinett, Ron Scaplen, Doug and Jennifer Caines, Terry Mills, Mike Dadswell, Jay Parsons and our various technicians, colleagues, graduate students who took part in the R and D efforts over the past.

Table 1. Chronological development of commercial sea scallop, *Placopecten magellanicus*, cultivation efforts in Newfoundland and Labrador. From Couturier et al. 1995.

Time Period	**Milestone**
1950s-1960s	Japanese developing bottom and suspended scallop culture following natural stock declines.
Late 1960s	First sea scallop spat collection trials by Memorial University (Scaplen, Evans) around the island of Newfoundland.
Mid 1970s	Larval rearing trials at Memorial University to pediveliger stage (Idler et al.).
Late 1970s	Biological feasibility of cultivating scallops from wild spat collection to market size animals (>100mm) demonstrated in Placentia Bay (Naidu et al.).
1980	First commercial sea scallop farm established in Little Mortier Bay, NL.
1980s	Wild spat collection in Port-au-Port area suggests excellent seed supply
1981-1989	Memorial University "perfects" pilot hatchery production of sea scallops to 5mm shell height (Dabinett et al.).
Late 1980s	Two commercial scallop farms established on south and north coasts.
1992	Patented sea scallop hatchery methodology (Dabinett).
Early 1990s	Spat collection no longer economical in Port-au-Port. Low spat numbers thought to be due to over-exploitation of wild broodstock.
1995-2000	Trials on developing farm best practices and lowering costs of production for growout (Parsons, Couturier).
1995	Technical constraints to commercialization outlined and industry R and D project established to address them. Commercial scallop hatchery built in Belleoram.
2000	Belleoram seed hatchery closes doors after 5 years due to variable production and uncertain industry interest.
2000-2001	Sudden, unexplained mass mortalities at two commercial farms (Pooles Cove and Charles Arm) in age classes 1-4 years results in 80% or more dead scallops. Industry lacks confidence, and stops production.
2004	4 commercial sea scallop farming licences, but no production.



*** Excluding production from seabed culture in Québec**

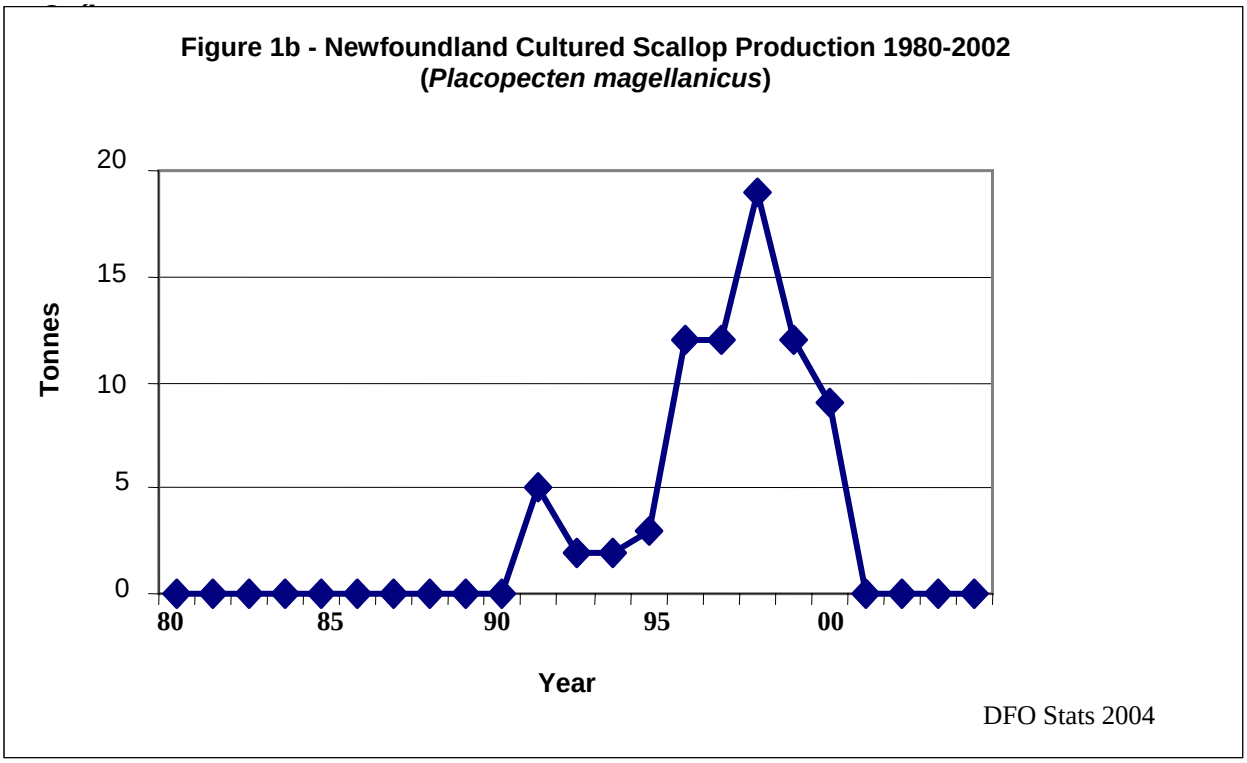


Figure 1. (A) annual production of cultivated scallops in Canada over the past two decades (excl. Québec) and (B) annual production of sea scallops, *Placopecten magellanicus*, in Newfoundland over the past 20 years.

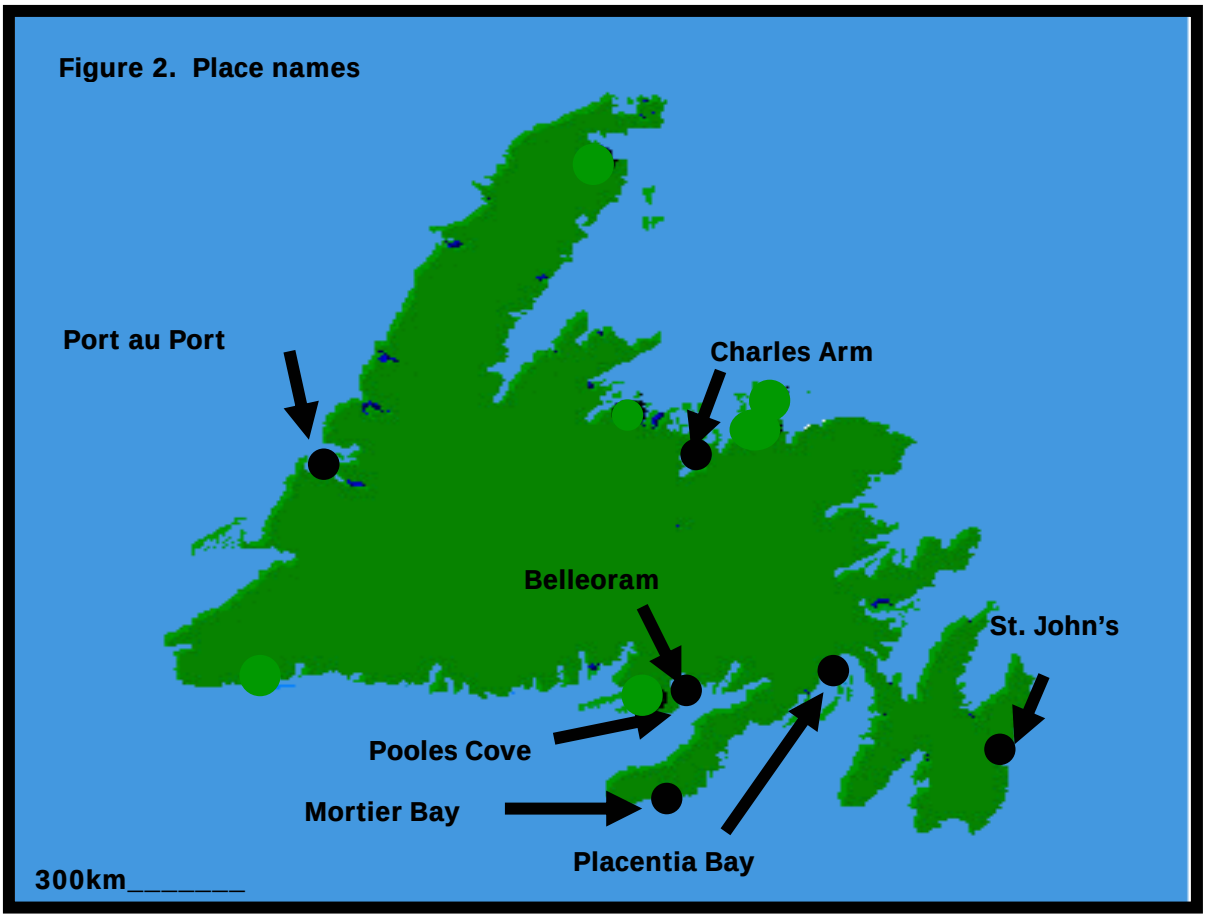


Figure 2. Generalized map showing place names mentioned in the text. Scale is shown in left hand bottom corner.

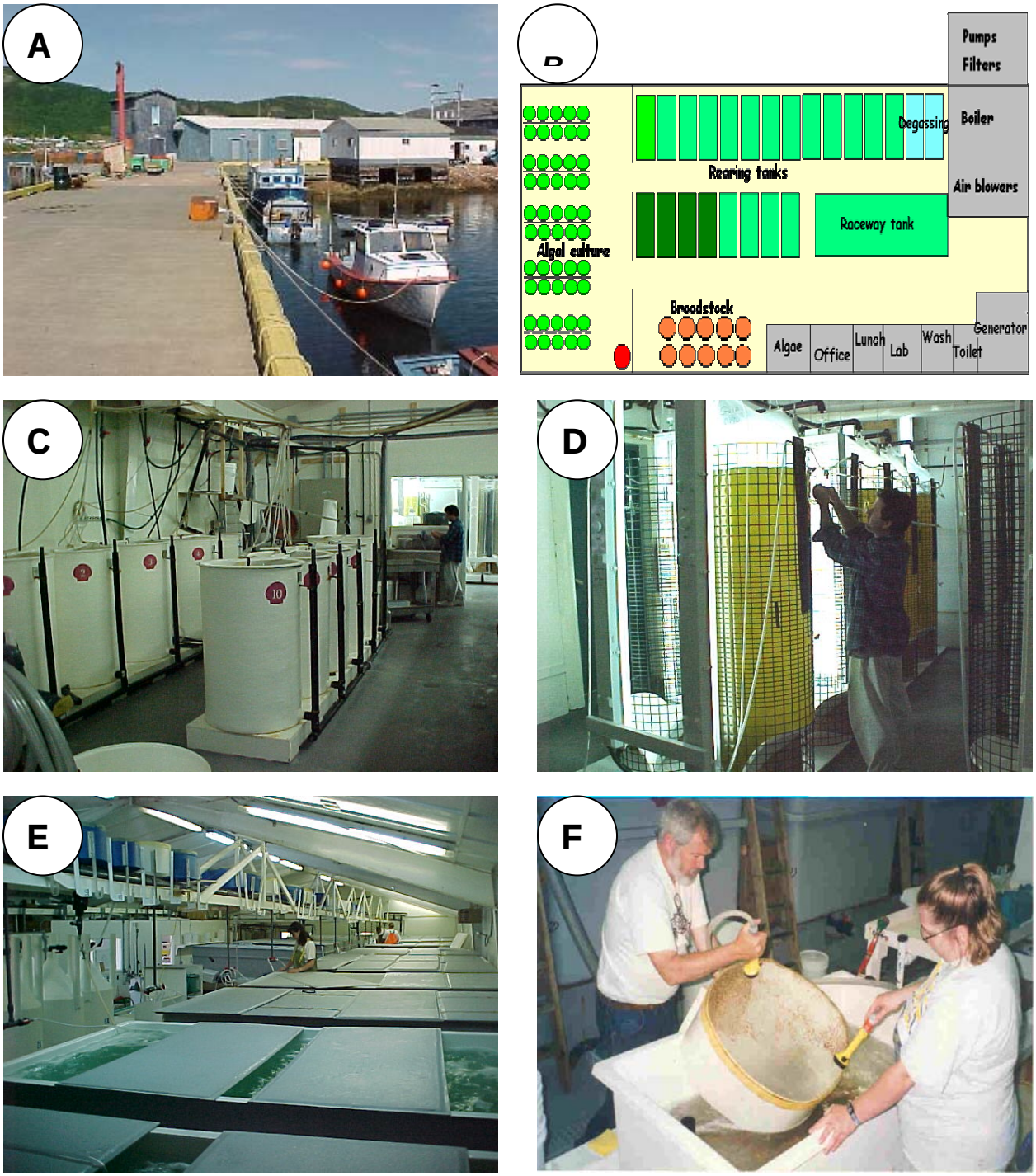
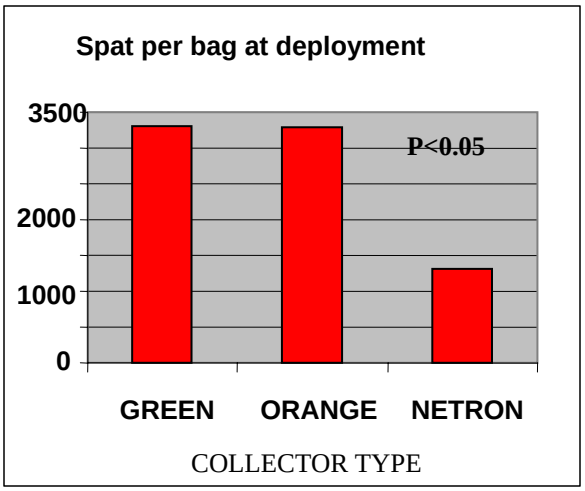
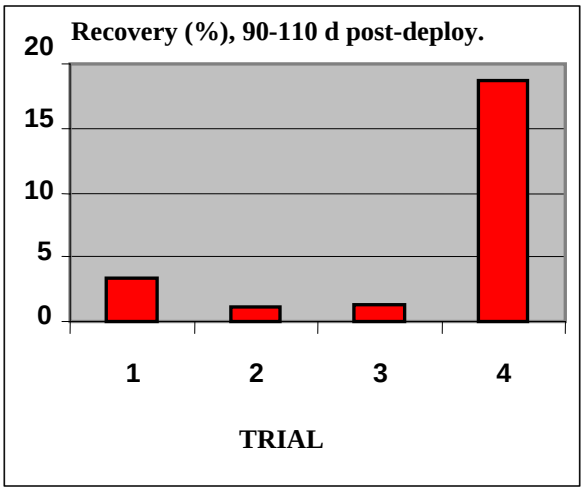
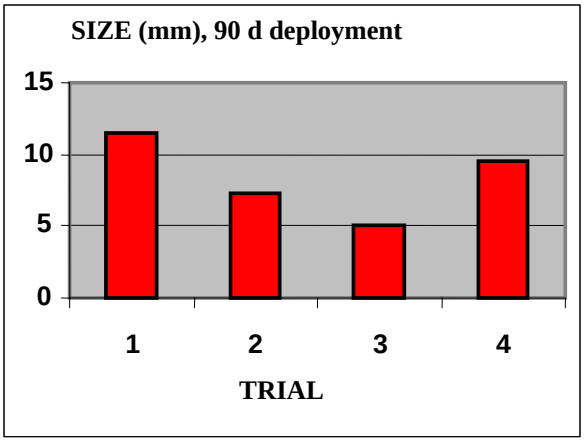


Figure 3. Belleoram scallop hatchery. (A) view of hatchery from public wharf, (B) schematic overview of hatchery layout, (C) broodstock conditioning tanks, (D) continuous algal culture facility, (E) larval and post-larval rearing tanks, (F) washing and grading post-larval downwelling units. All photos courtesy Dr Pat Dabinett.







Remote set summary:

Spat yields: 20 % achievable
Spat recovery (90 day): 20 % achievable
Yields and recovery dependent on:
- site
- time of deployment
- larval age/quality
- method of remote set
- cost of producing spat as low as $0.01 per scallop or 40% lower than traditional nursery

Figure 4. Summary of remote set trials conducted in 1999 with 8.5 million eyed veligers from Belleoram hatchery. (A) remote set tanks near deployment site, (B) remote set substrates.

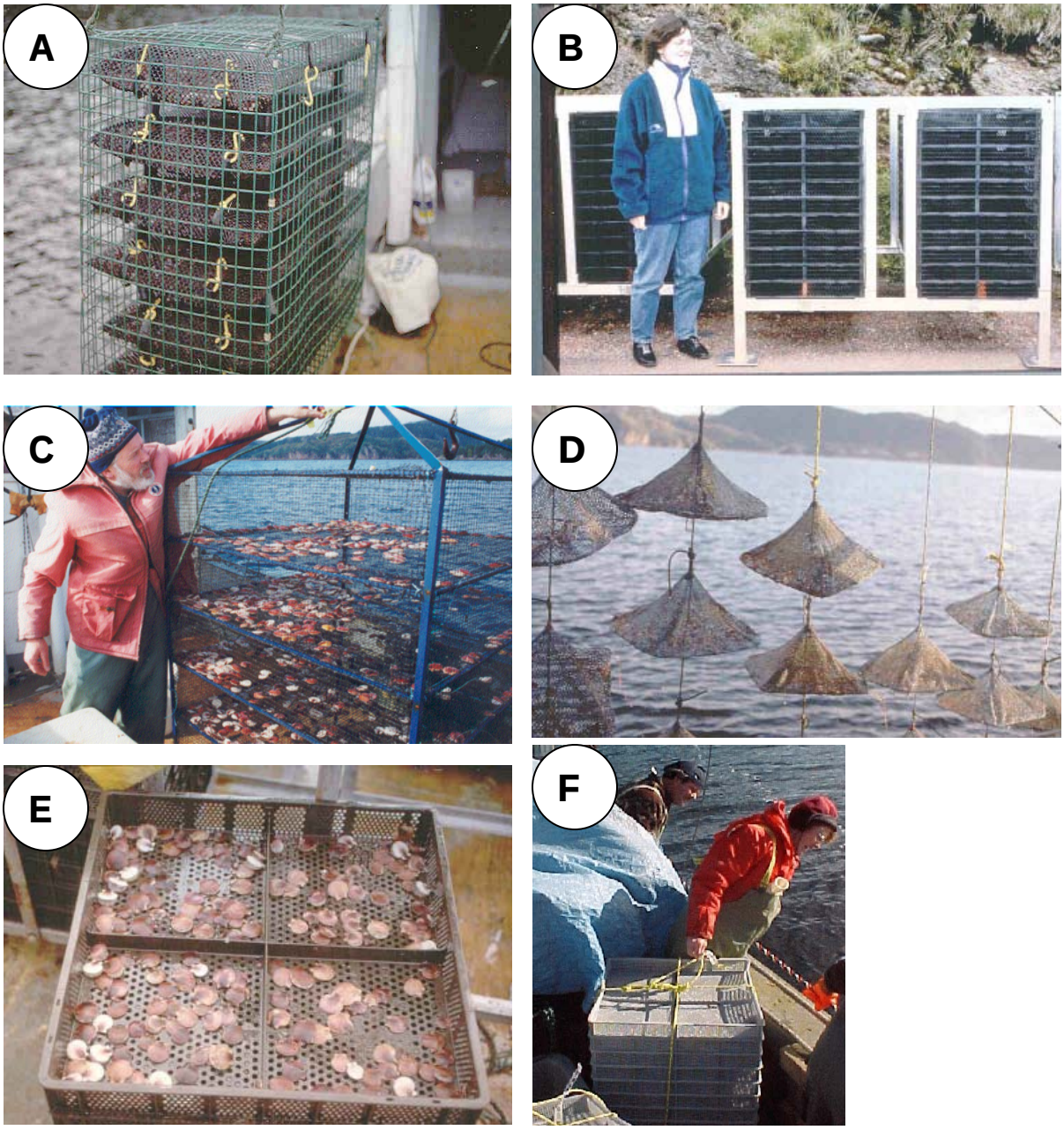


Figure 5. Examples of intermediate and final growout scallop gear evaluated for commercial production in Newfoundland. (A) oyster bags, (B) off-bottom rack and tray, Norwegian version, (C) “Savory” tray, (D) pearl nets (10 nets per drop), (E) close-up of Mexican tray, (F) stacked tray system for suspension from subsurface line. Photo credit C. Couturier, except (F) P.Dabinett.

Great Maritime Scallop Trading Co.

Dr. Mike Dadswell

Philosophy

In the Maritimes or Atlantic Canada, scallop aquaculture can be developed as a family farm. For example: An inshore lobster fisherman who already has a boat would be able to keep his cost and investment low to diversity to scallop aquaculture. We recommended a set-up using a system that is proven, like the Japanese pearl and lantern nets. This equipment is lightweight and can easily be handled by women and even children. The standard protocol for this equipment may have to be adjusted for the Giant Scallop *(Placopecten magellanicus),* but it is essentially similar to the methods used for the Japanese scallop (*Patinopecten sp*).

Site selection

The Great Maritime Scallop Trading Co. selected Mahone Bay to culture scallops because this bay supported commercial scallop beds in the past. In 1888, scallop dragging in North America began in Mahone Bay, however the local stock had collapsed by 1920. The bay has excellent oceanographic parameters for culturing Giant Scallop. The salinity is stable around 30ppt and the temperature seldom rises above 18^{o}C. The bay is usually ice-free in winter, however there has been a sheeting of ice during the last two winters. Mahone Bay has no record of extreme or extended shellfish toxicity problems (PSP, DSP, ASP). Monitoring of our farm on a weekly or biweekly basis in summer and monthly in winter for the past 15 years has never found PSP levels above the harvestable limit (80 ug/g). There have only been two closures for DSP (1) and ASP(1), both of which were coast wide blanket closures because of problems at other sites.

The Great Maritime Scallop Trading Co. cultures about ½ million scallops on a 4 hectare site with an annual yield of approximately 200,000 market animals. The site has a good culturing capacity because of its depth of 20-30 metres, allowing grow-out in 10 floor stacks of either pearl or lantern nets. The farm has been operating commercially since 1991. The farm has excellent growth rates, has not had major ice problems and has not experienced any mass mortality.

Culturing experience

When culturing scallops, you can expect a 5 to 10 year learning curve. You can design research programs but often the questions to be answered at your site do not arise until you start doing the work. So roll-up your sleeves and get in there.

The Great Maritime Scallop Trading Co. started by bringing scallop spat from Passamaquoddy Bay, New Brunswick. At the time there were few resident, adult scallops in Mahone Bay due to over fishing and spat were not readily available from hatcheries. Since 1996 we have been able to collect scallop spat in large quantities in

Mahone Bay, partly because we have learned the correct methods to employ here and partly because the population of wild, adult scallops has increased dramatically. We employ Japanese collectors, filled with old monofilament gillnet and suspended from long lines to depths of 30m. Average catch/collector at sorting, from depths of 20-30m, has ranged between 200-1000 spat over the last 5 years.

In Mahone Bay, scallop spat settle in mid-July and again at the end of September or early October. The spat are left to grow in the collectors for about eight months. After the growth period, when they attain a mean size of 10mm, the spat are transferred from the collectors to pearl nets at densities of 100 to 200/net. After 2-3 months, at a size of 20-30mm, they are down stocked to pearl nets at 15-20/net. Finally, the scallops are transferred after a period of 8-10 months and a size of 60-70mm to lantern nets or onto ear-hanging lines. Presently, the survival rate is about 90-95% since all the transfer work is done on site. In the past, when scallops were brought into a building or kept inshore for any period of time to have them processed, large mortality rates were experienced. *Placopecten* survival is poor if they are handled too much, prevented from continuously feeding, exposed to air for long periods or maintained in dirty water.

Tunicates have made their way to our site but the problem has been kept in check because the gear is never deployed for more than eight months before scallops are transferred and the gear is cleaned. We also try not to put clean equipment in the water during June and July when tunicate settlement is at its peak and we use scuba diving to clean submerged lines.

Market

The Great Maritime Scallop Trading Co cannot supply all the demands they receive for their cultured scallops. The live, whole market is developing rapidly and it takes about 80% of our production. Scallops have been shipped to Halifax, Toronto, Montreal, New York, San Francisco and Acapulco. Meats are harvested for local restaurants and buyers.

Sea Perfect Cultivated Products Ltd.

Ron Boudreau, Rodney Fougère and Earl Fougère

Overview

Sea Perfect Cultivated Products Ltd. was created in 1998 however members were involved in scallop aquaculture since 1992. Presently, each member of the company has other income so the farm is a small supplementary operation.

Grow-out site

The 12 hectares (~30 acres) grow-out site is located in LeBlanc Harbour, N.S near Isle Madame. It has a depth of 40 feet and in winter it is usually ice free except for thelast two winters. Tunicates were a problem only one year when the water temperatures were higher than usual.

Spat Collection

Spat collection is not conducted at the grow-out site because of fouling problems: silt, mussels and seastars and Hiatella. It is expensive and time consuming to sort scallop from fouling. Therefore, spat collection is carried out in Chedabucto Bay where collectors remain relatively clean collecting mostly only scallops (Figure 1).

Figure 1. Scallop spat collector from Chedabucto Bay remains relatively clean, collecting mostly only scallop.

Gear

A 45’ fishing boat and a 23’ aluminium boat are required to conduct the operation. A floating building is located on the site where scallops can be handled. Scallop culture gear includes, spat collectors, pearl nets, lantern nets and Savory cages. A fence installed on the bottom was used for predator control on a bottom culture on an experimental basis.

Operation

Approximately, 1,400 collectors are deployed every September 25. The following year, the collectors are retrieved in August and moved to the grow-out site. In the fall, scallop spat are graded in three sizes using screens (20-25mm, 10-20mm and 5-10mm). Larger spat go in 9mm pearl bags (200/bag) (90% of spat) and smaller spat are placed in 6 mm pear bags (300/bag). When possible, spat is sold as seed. The remaining spat is over-wintered. The following year, spat are transferred from pearl nets to lantern nets (50/level) or to Savory cages (3000/cage).

Market

When Hillsburn Basin Scallop Group Ltd was in operation, Sea Perfect Cultivated Products Ltd. was their scallop spat supplier. Presently, various sizes of spat are sold as seed to small scallop farms or for research. When possible, 3 year old scallops are sold live for the half shell market. Also, scallop meat (1000 to 2000 pounds) is sold each year however the profitability of this market in questionable.

Research

Sea Perfect Cultivated Products Ltd. participated in a research project entitled "Fencing the Seabed to Protect Scallops from Predation". Funding was received from the Aquaculture Collaborative Research Development Program (ACRDP).

Methodology

The fencing is constructed from 38.1 mm plastic covered mesh wire (same material used in lobster traps with an overturned edge made from a sheet of galvanised steel (27 gauge). The fencing was embedded about 20 cm into the substrate and stood approximately 1m above the substrate (Figure 1). To stabilise the fence, anchors, consisting of fish crates filled with cement, were placed at each corner and at midway points on each side. The fenced-in area is 15.24 m X 15.24 m that gives a seabed area of 232.25 m^2 for the scallops.

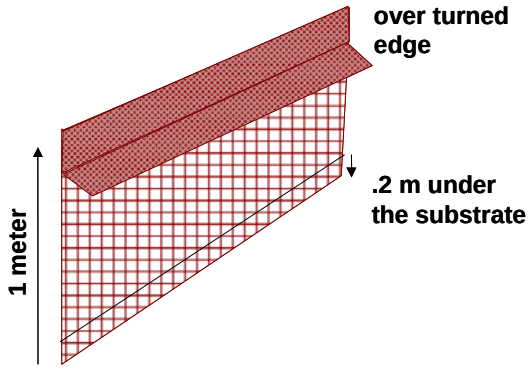


Figure 1. Fence design

Before seeding the scallops in the fenced-in area, all native animals within the fenced-in area were removed. An estimated 25,000 scallops obtained from the 1999 spat collection

were their seeded in this protected area. The seeded density of scallops is estimated to be 107/m^2. Scallops from the same year class were also placed in 2 lantern nets with 10 levels each, one of the traditional culture nets used by Sea Perfect Cultivated Products, at a density of 13 scallops per level. Throughout 2002, divers surveyed the site and removed the predators that were later counted and measured. The site was not visited during the winter. The following spring, the diving surveys were resumed.

Results

At the end of the 2002 sample season, results looked promising (Figure 2). Most predator species except for moonsnail were able to find their way into the enclosed area but were at much lower densities. The following spring, the density of predators was low however only a handful of live scallops could be found. Divers observed empty shells in the corners of the enclosed site and noted that the selected bottom was subjected to various strong currents and gyres that may have been detrimental to the scallops. .

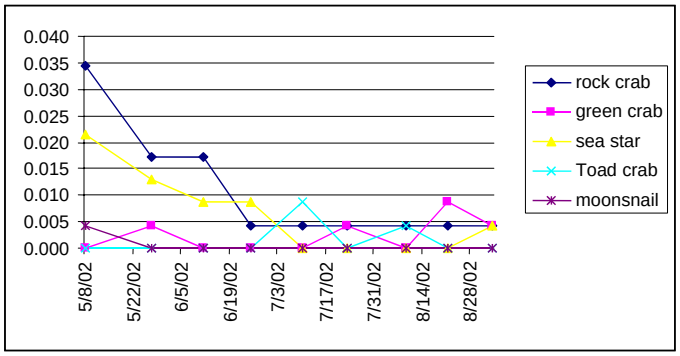


Figure 2. Density of predators (/m^2) in the fenced-in area.

Conclusion

Seabed enclosures can serve to prevent predators from accessing scallops; however the seabed selected must provide a suitable environment for scallops. More work is needed to evaluate enclosures as a predator control technique.

Jamieson's Giant Scallops

Lorne and Wanda Jamieson

Grow-out site

The Jamieson's Giant Scallops farm which is situated in Tor Bay, Nova Scotia started up in the summer of 1995. It took 1 1/2 to 2 years to acquire the 10 hectare (25 acres) lease. During this time, information on growing scallops in other parts of the world was gathered and other sites were visited: Great Maritime Scallop Trading Co (Mike Dadswell), Country Harbour Sea Farms and a grower in Arichat. The lease is also licensed to grow Blue Mussels since June 15, 1998.

The grow-out site has a water depth of 30 to 40', at low tide. From late spring to late fall the water temperature usually holds between 10 and 15 ^{o}C and rarely reaches above 18 ^{o}C. In the winter, the grow-out site remains ice free. Tunicate fouling has not been a problem at this site. All the culture gear is suspended 15' below the surface. The grow-out site is accessed from a government wharf that is ~3/4 mile from site.

Gear

Most of the work is conducted on site on Lorne's 30' lobster boat. Pearl nets are used to grow-out the scallops. Pearl nets are easily handled and the growth of the scallops is reasonably good. The company owns 6,500 to 7,000 pearl nets (9mm mesh however 600-700 pearl nets has 6mm mesh). Other essential gear includes ~800 plastic buoys, 32 large cement anchors at 1,500 lbs each and a number of small weights for sinking plastic buoys. Two sets of buoys for marking the perimeter of the site are required (winter and summer). Also, 200 to 1,000 spat collector bags are part of the inventory.

Personnel

Lorne does most of the work however Wanda a helps fair amount of the time and occasionally help is received from other family members. Also, Wanda took an aquaculture course and wrote the business plan for the farm. Labourers are often hired during the busiest season (4-6 weeks in the fall) and summer student are sometimes hired. Lorne has a scallop dragging license and did this type of fishing for years. He also has a lobster license and finds that having experience in the fishing industry is a great asset to the learning curve in fish farming. Just being aware of the adverse conditions one can encounter from one day to the next is a challenge.

Spat collection

Spat collection is not conducted at the grow-out site. An ideal spat collection site was located where ~1,200 spat/bag is collected with very little clams, mussels or other fouling. The spat that collected at this site is about the size of a Looney one year later. (Figure 1) Collectors deployed at other locations can collect higher count of spat per

bag, but there is more dirt to clean out therefore it take more time and work. Timing is the key for successful spat collection. Depending on the date you deploy the collectors in the water will be a determining factor in how dirty the gear becomes, and on the amount of spat collected and on their survival. Since finding a good collection site, only 200 collectors are deployed site annually however up to 1000 collectors were deployed in the past.

Figure 1 Scallop spat from collectors that were in water for approximately one year.

Operation

Each year, scallop spat collectors are deployed on September 15 at the collection site. Two months later they are retrieved and moved to the grow-out site. The following August, the collectors are cleaned and scallops are transferred to pearl nets (~200/net). In October, after the last set of mussels and seastars, scallops are thinned down to 35 scallops per pearl net. One year later, pearl nets are cleaned and thinned down to 15 scallops per pearl net and left to grow for another year. Overall, 20% mortality is estimated.

Production

At peak production, 100,000 to 200,000, 1yr old scallops were place in pearl nets yearly. In 2003, the operation was downsized to 20,000 1 yr old scallops in pearl nets. The operation is kept small otherwise it would require more labour. Presently, the farm is a source of supplementary income, but the potential is there to collect and grow out a larger number of scallops. Site capacity is estimated at 300,000 1 yr old scallops per year.

Marketing

To this date, only the meat of the 3 year old scallops has been sold to several markets: A.C. Coverts, Fisherman's Market and other small businesses. The meat only market is the easiest way to go for this scallop farm. The meat count is 35-40 per pound.

Hillsburn Basin Scallop Group Ltd. (1994 to 2000)

Blair Cooper

Public Perception of Aquaculture

The general public does not hear about aquaculture except in the form of negative media information. The Hillsburn Basin Scallop Group Ltd. met with traditional fishermen and with media to inform them of their culture activities. It is important to promote aquaculture by educating traditional fishermen, recreational water users, landowners, elected officials, and the communities youth (who will in turn pass on the information to their parents). Work must be done by the aquaculture industry for aquaculture activities to be perceived positively by society.

Marketing

Hillsburn was aiming to be a large commercial farm producing up to 10 million scallops in the water to be marketed each year.
The meat only market was deemed not to be financially feasible for Hillsburn due to unit price and direct competition with the traditional wild capture fishery.
The live market (scallop with shell height of 50 to 75mm) could have been profitable however there were a number of hurdles. An essential live animal protocol was required by CFIA, assuring that scallops did not contain toxins, this was written and accepted. Live scallops have a limited shelf life so there are constraints on when and how they may be shipped. The markets are low volume niche markets requiring numerous low volume orders which increase shipping costs and reduce profitability. Knowledgeable brokers to distribute product were not available.
Hillsburn decided to sell their scallops as frozen on the half shell (meat only or meat and roe). Some processing and specialized packaging were required however each scallop sold for $0.50 Canadian or $0.35 US. Advantage of this product is that it provided a means of differentiating the cultured scallops from the wild ones and it could be stored in cold storage to allow for larger shipping volumes.

Successes

Hillsburn had a well defined site selection R& D program. The general public in their region was not supportive of aquaculture therefore a good public relations program was developed. They were able to secure a 100 hectare site in the Annapolis Basin. They owned 500 efficient grow-out cages that had been developed for the high current environment of their culture site. They purchased scallop spat from Sea Perfect Cultivated Product Ltd. however they also successfully developed a remote setting hatchery system for future requirements.
One of their greatest successes is that they were able to develop and market an unique cultured product (IQF scallop on the half shell). The buyer was pre-paying for shipments of this quality product.

Failures

At times, it was difficult to conduct profitable business development because funding agency programs led the company into research initiatives which sometimes conflicted with production. The company did attempt to expand too quickly and the goals and objectives of the company were not well defined.
The major reason that the Hillsburn Basin Scallop Group Ltd. is not in operation today is that the company structure and decision making system were not practical or efficient. At the time of the companies closing they had 1.5 million scallops in the water and a committed buyer however many of the 17 shareholders were no longer interested. Uninterested shareholders would not attend meetings so the required quorum to make decisions was never reached. The legal structure of the company prevented changes from being implemented without a quorum so the company had to be dissolved.

REPERE

Georges Cliche
Ministère de l'agriculture, des pêcheries et de l'alimentation du Québec

REPERE is a network structure involving 2 levels of government (provincial and federal), the local scallop fishermen association (21 fishermen) and 2 scallop processors. In French the a acronym REPERE stands for "***RE***cherche sur le ***P***étoncle à des fins d'***É***levage et de ***Re***peuplement" and in English it is "*RE*search on *PE*ctinid *RE*stocking".

Time Frame : 1991-1998

Goal : Develop a profitable technology for the bottom seeding of the Giant scallop (*Placopecten magellanicus*) in order to rebuilt the scallop beds of the Magdalen Islands, Québec, Canada

REPERE II : New program put in place in 1999 involving the same partners plus producers of other regions (Gaspésie and North Coast)

Time Frame : 1999 – 2004

Goal : 1.-Main goal is still to develop a profitable technology for the bottom seeding of the Giant scallop (*Placopecten magellanicus*) in Magdalen Islands

2.- New goal is to evaluate potentiel of suspension culture and bottom seeding in other régions of Québec

Evolution of the fishery in Magdalen Islands

In 1965 to 1996 the scallop landings were low. The reduced catches reflected the poor stock status of the scallop population in the Magdalen Islands. To restore scallop stocks an aquaculture approach was initiated in 1990.

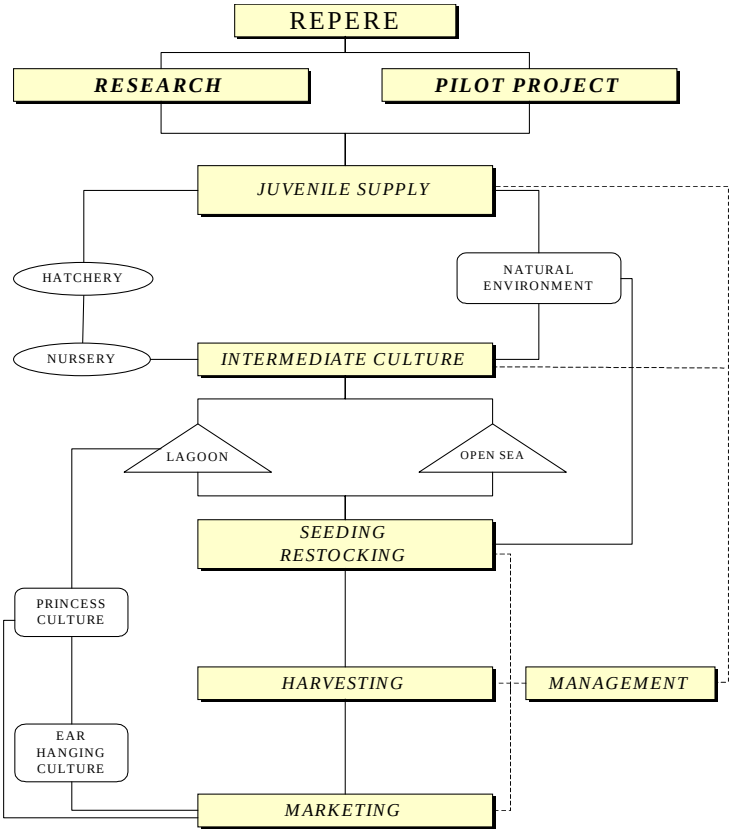
Financial feasibility study

- Bottom seeding appears profitable under certain conditions
- Up-date of the study every year between 1994 and 1997
- Technological improvements and manpower increasing expertise help to reduce production costs and to precise production scenario bringing financial profitability on long term projection
-

Programming

- Financial feasibility study
- Juvenile supply for seeding purposes
- Seeding and harvest
- Commercial technology and pilot project
- Annual transfer of technology meeting
- Reports

SUMMARY OF THE PROGRAM AND ITS COMPONENTS



R&D effort associated to the program

- Important program of R&D has been put in place in 1990 by provincial and federal government to characterize biological parameters related to spat collection, intermediate culture, seeding operations and to help to find solutions to technical problems
- Very close association of scientific team and producers has helped to orientate R&D works on the main problems of the industry.
- Annual meeting has permitted to transfer rapidly experimental results to the industry and to identify research priorities year after year.

Bottom seeding pilot project associated to REPERE

- Pilot project started in 1992 by fishermen Association to do transfer and integration of « know – how » obtained at experimental scale
- Pilot project has permitted to avoid important financial losses related to lack of technical expertise and to develop progressively expertise for large scale operations
- Financial support of government has been very important during the first five years

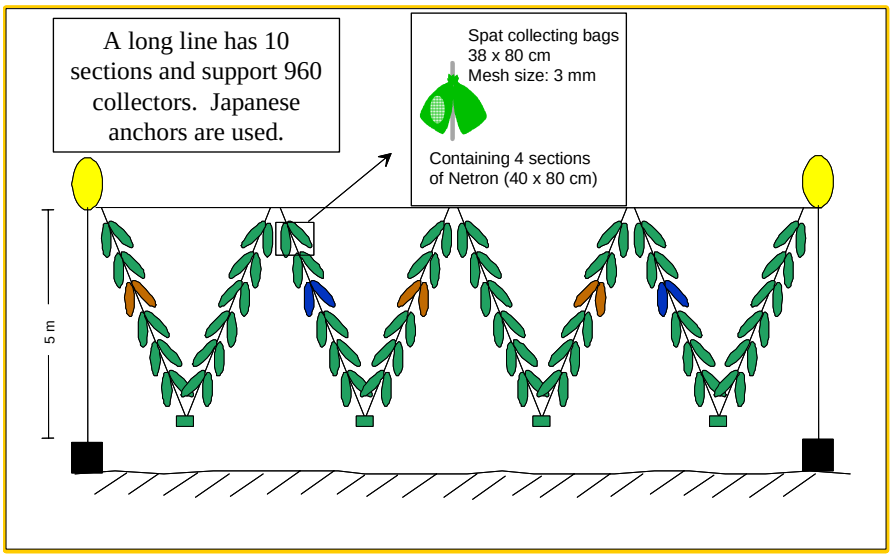
- Pilot project has permitted to the fishermen to evaluate the potential of seeding operations

LOCATION OF DIFFERENT SITES ASSOCIATED TO REPERE PROGRAM AND COMMERCIAL OPERATIONS

Juvenile supply for seeding purposes

- Rather discouraging results with hatchery-nursery trials in the Magdalen Islands (1990)
- On Lower North Coast, important efforts to develop commercial size operations in hatchery-nursery with good results
- Encouraging results with natural spat collection in early 90 in Magdalen Islands
- Natural spat collection choosen to supply spat for seeding in Magdalen Islands
- Presently, company Pétoncles 2000 immersed 60 000 collectors on two collecting sites

Section of long line with collectors



Juvenile supply for seeding purposes
Natural spat collection on experimental stations located near the commercial collection sites

Seeding size and time
2 scenarios
Intermediate culture equipment

- Franken SCS-1TM scallop spat sorter (new system presently tested)
- 300 000 square pearl nets (35 x 35 cm and 4,5 mm mesh size)
- 450 long lines in Havre-aux-Maisons lagoon
- Pearl net and collector Japanese washing machine
- 9 meters catamaran for operations in lagoon

- Scallop fishing boat with star wheels for open sea operations (spat collection and seeding operation)
-

Objectives of Pétoncles 2000

- To deal with the 70% losses during the year spat stay on collectors, Pétoncles 2000 aimed to collect annually 100 to 125 millions juveniles
- Presently, Pétoncles 2000 immersed 60 000 collectors on two collecting sites
- Pétoncles 2000 needs to have 120 long lines on collection sites to support 2 series of collectors in same time (collectors spend 1 year in water before cleaning)
- Recuperation rate after one year is presently around 30% but the objective is to recuperate around 50%
- Pétoncles 2000 aims to get annually from collectors (1 year after immersion) around 40 millions scallops for intermediate culture operations in lagoon and to seed annually 30 to 35 millions scallops of 35-45 mm

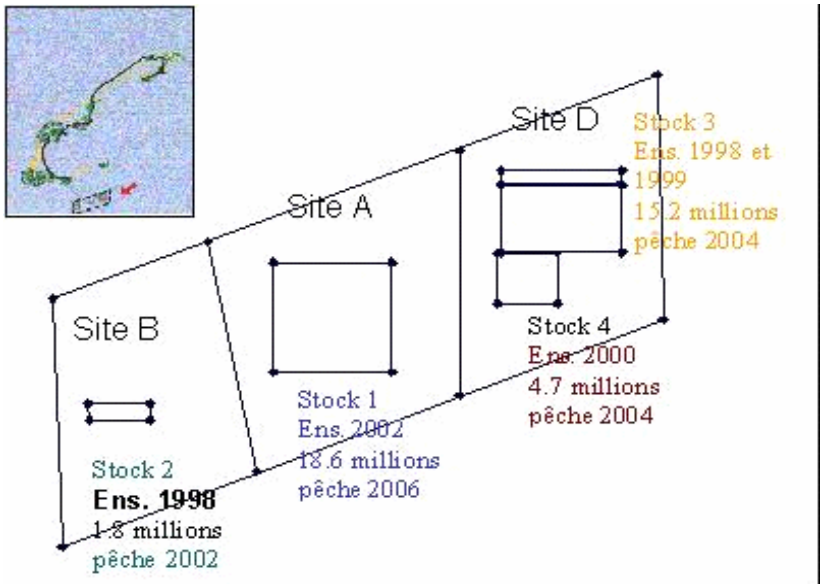


Figure 1. Localisation des sites d'ensemencement sur la Chaîne de la Passe

Evaluation of survival, dispersion and growth of seeded scallops

- Proportion of scallops seeded are tagged
- Under-water camera mounted on a support is used to assess scallop survival and predators abundance
- Experimental dredging with double netting also used for abundance assessment
- Sampling by observers on boats during fishing operations on seeded beds
- Commercial fishing every year on one opened seeded site (5 sites seeded and opened in rotation)

Survival, Dispersal and Growth

- Rapid dispersal (85 to 99 %) after few months especially for fall seeding (s)
- Survival of 33 to 50 % after few months for surveys were a minimum of 25 % of the seeded scallops were found on the site
- Example: 1996 survey (120 days after seeding) gave: 45 % of seeded scallops found on the site. Of those 49% survivors
- Growth rate on seeded beds is around 18 mm/year
- **On seeded sites opened to commercial fishery, catching rates of seeded scallops estimated between 10 and 20 %**
- Catching rates need to be improve to reach 20 to 30 %

Predation

- Important predation on scallops seeded
- 3 species of Starfish: Asterias vulgaris, Leptasterias polaris and Crossaster Papposus
- 2 species of Crab: Cancer irroratus (rock crab) and Hyas sp.
- # 1 predator: Starfish
- Better control of predation is required to improve catching rates

Financial structure

- « Pétoncles 2000 » is a company owned by Scallop Fishermen Association (51%) and private investments
- Pétoncles 2000 has to realize collecting operations, intermediate culture in lagoon, seeding operations, stock assessment on seeded bottoms, distribution of quotas to scallop fishermen and to prepare fishing plan and control the landings
- Pétoncles 2000 employ 30 seasonal workers for period going from 4 to 7 months a year
- Quota of each fisherman is related to his share in the company
- **For each kilo of scallop fished, fisherman has to pay around 30 % of the value of his landing to Pétoncles 2000**

Operations management

- 21 of the 23 scallop fishermen are participants in Pétoncles 2000
- Pétoncles 2000 own leases for collecting, intermediate culture and seeding sites and the company is responsible for the management of the fishery on the seeding sites
- Fishermen have accepted an important reduction of their fishing sites and the two fishermen non-participants cannot fish on the sites of Pétoncles 2000
- Before to open a site to the fishery, Pétoncles 2000 assess the volume of scallop available and establish a global quota
- In collaboration with fishermen, fishing plan is established to decide the number of days and hours the fishermen are allowed to fish
- When the global quota is caught, if landings are still good, a new quota can be allowed

Main problems remaining

- Recuperation rates of scallops on collectors cleaned 1 year after immersion have to be improved to increase number of scallops seeded (important effort of R&D directed on that problematic with interesting results)
- Catching rate has also to be improved to reach more than 20% of scallops seeded to reach commercial profitability (control of predation is the key factor and R&D project are presently realized to search solution)
- Difficulties to find financing because important delay before to have a return on investment

Conclusion

- Scallop culture is a new sector of aquaculture activities still fragile because more expertise is needed and there are still biological, technical and financial unknowns
- Financial support of government has been important and is still required to support the industry
- Important to prove rapidly financial profitability to secure actual producers and investors and attract new ones
- Structured R&D is essential to help the industry to find solutions to remaining biological and technical problems

Marketing our Scallops – A retail perspective

Guy-Pascal Weiner

The retail advantage

It is important to meet the customers and determine their needs and their interest. There may be a marketing opportunity for cultured scallop as a high quality seafood product. Presently, the seafood markets displays shellfish for the regular customers. Get acquainted with these customers to promote your product.

Distinguishing the product

Cultured scallop meats are not readily distinguished from wild scallop meats. However, there are two products currently available that a customer could identify as being cultivated: 1) Frozen scallop meat on the half shell with the roe and 2) live, whole scallop.

The Peruvian scallop (*Argopecten purpuratus*) is a species of scallop that has a very attractive shell. This attractiveness contributes to it's marketability.

Live Scallops

Unfortunately, there are many problem associated with marketing live scallops. When kept on a ice bed, the meat will have a dry appearance within 2 days. After 3 days, they will gap excessively and the mantle will retract. They must be removed from the display on the fourth day.

Value Added product

Consumers willingly pay a higher price for prepared meals. A popular example of a pre-made dish is scallops in a cream sauce topped with grated cheese and circled with a ring of puréed potatoes.

New Trends

Scallop meat can be served raw in Suchi bars.

Areas of Research

- Linking environmental conditions to the shelf life potential of live scallops;
- Improving rearing techniques for the absence of fouling organisms on frozen half shell or live in-shell products;
- A culinary panel to determine taste, texture, appearance, …, of our scallop compared to the other species available;
- Design of a holding/display salt water tank for live shellfish;

- Improve shipping. methods
- *Identification seals/tags:*
- *Confirms product authenticity;*
- *Complies with traceability;*
- *Inventory control for the producers.*
- *Product development:*
- *Smoked scallops, …*
-

Recommendation from participants

At the end of the scallop workshop, participants were asked to suggest biological, technical marketing research priorities that would be beneficial to commercial scallop growers.

The following is a summary of the recommendations:

1) Biological Research Priorities
    - Stress responses in post-larval to adult sea scallops
    - Determining cause of mortality/disease issues
    - Physiological tolerance limits/coping with temperature and salinity changes at certain times of the year
    - Influence of environment, genetics, and microbes on scallop performance
    - Managing around phycotoxins
    - Biofouling control mechanisms

2) Technical Research Priorities
    - Development of extended shell-life methods for live, whole scallops
    - Demonstration of reliable, cost-effective seed procurement for commercial scale production
    - Demonstrate financial viability of commercial scale farming to encourage investors
    - Develop uses for byproducts (enzymes, shells, discard tissues)
    - Enhance mechanization to reduce costs of production

3) Marketing Research Priorities
    - Develop value added products
    - Marketeting and promotion of new products

4) Financial Priorities
    - Federal and provincial governments needs to support the scallop aquaculture process by tax write-offs, grants, loans
    - Develop / promote alternate species development funds for scallops and others
    - Develop sound financial prospectus for commercial farming based on best-practices to encourage investment in the sector

5) Other
    - Translation services for Japanese, Chinese, Norwegian, etc and put it into support of the growers.
    - Electronic database of scallop aquaculture literature especially the grey literature
    - Networking/ More focused workshops
    - Identifying areas of scallop spat collection eg Atlantic coast of NS
    - Handbook of recommended procedures for culturing scallop which would include hatchery and wild spat collection techniques