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Evaluation of suspension culture methods for Giant Scallops *(Placopecten magellanicus)* in the Magdalen Islands, Quebec

Summary

This study, conducted from 2001 to 2004 at three lagoon sites in the Magdalen Islands, examined sea scallop survival, losses and growth in suspension culture using five different culture methods: ear-hanging, pocket net, pearl net, oyster table, and Wang-Joncas lantern. The effect of cleaning fouling organisms off of the structures was also assessed.

Although highly variable, the results show a significant effect of the site and type of structure used on scallop survival. The data from the 2001 trial showed that scallop losses were greater in the pocket nets and Wang-Joncas lantern structures than in the pearl nets and oyster tables. Cleaning of the structures had a variable effect and no real trend was noted. Overall, the scallops obtained from the ear-hanging system and from pocket nets reached the largest sizes. Collectively, the technical and biological results appear to show that these two culture structures are the best suited to the lagoons in the Magdalen Islands. The performance of scallops grown in these structures could be enhanced through cleaning done at appropriate times to reduce the effect of mussels on the ear-hanging system and through the modification of the openings of pocket nets to minimize scallop losses.

Introduction

A number of suspension culture systems for Giant or Sea Scallops (*Placopecten magellanicus*) have been tested since the 1990s in Quebec and in the Maritime Provinces. Most of the experiments to date have been conducted in an experimental framework, without taking into account the actual practices of commercial scallop growers. The main purpose of the present study, done between 2001 and 2004 in the Magdalen Islands, was to assess the performance of the equipment available to Quebec-based companies.

This study was aimed primarily at comparing sea scallop survival, loss, and growth in five different culture systems at three different lagoon sites and at assessing the amount and impact of biofouling on the structures.

Methods

The study was done at three culture sites in the Magdalen Islands: two sites in the Grande Entrée lagoon (GE1 and GE2) and one site in the Havre aux Maisons lagoon (HAM) (Figure 1).

Water depth is approximately 6 m at the GE1, GE2 and HAM sites, and the nets were installed about 2 m below the water surface at each site.

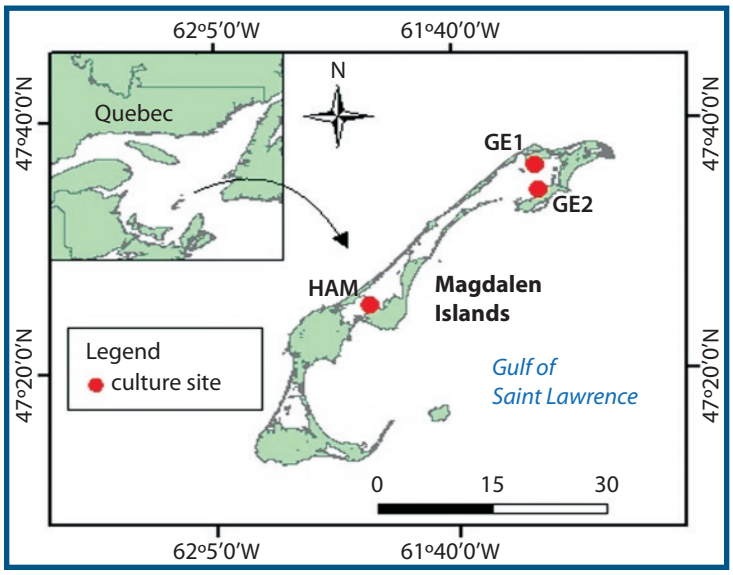

Figure 1.
Location of experimental sea scallop culture sites (GE1, GE2 and HAM) in the Magdalen Islands, in 2001 and 2002.

The following structures were tested (Figure 2):

- ear-hanging line;
- pocket net;
- pearl net;
- oyster table; and
- Wang-Joncas lantern.

The structures tested at the three sites during the two culture periods were selected based on the production scenarios of each of the companies involved in the project. In the fall of 2001, pocket net, pearl net, oyster table and Wang-Joncas lantern structures were set out at the three sites, and then sampled after six months, one year and two years. A second deployment of the five structures was done in the spring of 2002, and sampling was carried out after three months, one year and two years.

During the two culture periods, some of the structures were cleaned in order to assess the impact of fouling.

The actual timing of the sampling varied somewhat depending on weather conditions and the availability of the participating companies. Several structures were lost between June 2003 and June 2004 at the GE1 and GE2 sites, possibly due to the presence of ice cover.

Four batches of scallops were used depending on the site and the culture period. These scallops were from two different cohorts, that is, 1999 and 2000. The initial mean size of the scallops ranged from 37.6 mm to 63.9 mm, depending on the batch. A total of 25,680 scallops were set out in 120 structures in the fall of 2001, and 45,880 scallops were set out in 229 structures in the spring of 2002.

During each sampling period, various structures were randomly selected, recovered and brought to land for analysis. To evaluate scallop survival and losses, a count of the live and dead scallops was carried out for each structure recovered. Size measurements were also carried out on both live and dead scallops.

At the time of gear recovery, information was recorded on the presence of predators and blue mussels (*Mytilus edulis*) on the structures. In addition, four methods were tested to quantify fouling on the different structures: weight by immersion of the structure, wet weight of the structure, dry weight of the fouling organisms, and photographic analysis.

Results

Scallop survival

At the three sites, scallop survival in the culture structures set out in the fall of 2001 was low from the first sampling event onwards (17–54%). For the

Figure 2.
Photographs of the scallop rearing structures used. Left to right: ear-hanging line; pocket net; pearl net; oyster table; Wang-Joncas lantern.

structures deployed in the spring of 2002, survival was 48–81% after 3 months, 49–77% after 1 year and 31–58% after 2 years.

The mortality observed during the study was attributed to a number of factors. An initial mortality event, which occurred shortly after the experimental devices were placed in the water, was likely due to handling during the deployment operations. A second, less severe event was observed between late fall of 2002 and the spring of 2003 and may have been the result of adverse environmental conditions (storms, water mixing), unsuitable culture methods, or degradation of the physiological condition of the organisms.

Owing to the loss of nets during the 2002 trial, only the data from the 2001 trial can be used to compare scallop survival at the three sites after two years of sampling. For the 2001 trial, scallop survival was significantly lower at the HAM site for the two structures compared, namely Wang-Joncas lanterns and pocket nets. The low survival recorded at this site may not be due to the site itself; but could instead be due to the thermal shock experienced by the scallops when they were set out in the structures; the air temperature of about 0°C may have created additional stress.

Scallop survival two years after deployment of the culture structures in the fall of 2001 was higher in the pocket net and pearl net systems at the GE1 site, and in the pocket nets at the GE2 site. In the 2002 trial, scallop survival was generally higher in the ear-hanging line, the oyster table and the Wang-Joncas lantern structures after a year of culture. In light of the variability of the results obtained at the different sites in the two trials, it is difficult to provide a clear assessment of the performance of the different structures in terms of scallop survival.

Scallop losses

In the case of structures that were not cleaned, two years after deployment in 2001, the greatest losses were recorded in the pocket nets and Wang-Joncas lanterns regardless of the site, with values ranging from 14.1% to 59.6%. In contrast, the pearl net and oyster table structures showed losses lower than 5.9%. The 2002 results were similar, with losses being higher in the ear-hanging line, pocket net and Wang-Joncas lantern structures. The high level of losses could be linked to the design of these three structures.

Scallop losses appear to be attributable mainly to handling during the deployment operations and to cleaning of the structures. Scallop growers should exercise great care when handling culture structures and handling should be kept to a minimum.

Scallop growth

Two years after gear deployment in 2001, mean scallop size was found to have increased from 35–41 mm to 68–84 mm, depending on the site and the culture system used. The largest mean size values were obtained in the pocket net structures at GE1 and GE2, and in Wang-Joncas lanterns at HAM.

The mean size of the scallops set out in 2002 increased from 64 mm to 84–99 mm after two years of growth at the HAM site. Unfortunately, several structures were lost between June 2003 and June 2004, and it was not possible to assess scallop growth at the GE1 and GE2 sites after two years of sampling. The results obtained at these two sites one year after gear deployment in the spring of 2002 show that scallop growth was greater in the pocket net and Wang-Joncas lantern structures at GE1, in the Wang-Joncas lanterns at GE2 and in the ear-hanging line and pocket nets at HAM.

Overall, the scallops in the ear-hanging line and pocket net structures reached a larger size. Conversely, growth was generally lower in the oyster table structures.

Since the water temperature and possibly salinity were fairly similar and stable in the three lagoons, other factors such as food availability may explain the variations in scallop growth. In theory, the so-called "pelagic" structures (ear-hanging line, pocket net, pearl net and Wang-Joncas lantern) should enhance scallop growth, because the scallops can access food throughout the water column. The design of these structures should also promote better water circulation: with the ear-hanging system, which has no protective net, and pocket nets, which have a large mesh size, resistance to water flow is reduced, permitting readier access to food. Furthermore, these systems theoretically allow scallops to build up larger energy reserves because they restrict their movement.

Predators and fouling organisms

The main predators observed in the structures were rock crabs and sea stars. Sea stars were much more abundant than crabs. The largest numbers of sea stars (>150 stars) were observed on the oyster tables at the GE1 and GE2 sites. Few or no crabs were observed in the pocket nets and Wang-Joncas lanterns, as compared with the pearl nets and oyster tables. It is important to ensure that culture structures do not touch the sea bed, because this could lead to a substantial increase in predation, particularly for ear-hanging lines and pocket net structures, which provide little protection for scallops.

Of the four methods used to quantify fouling, calculation of dry weight, although time-consuming and tedious, was the most accurate. A number of bivalve, crustacean and other invertebrate species were observed. The blue mussel is by far the dominant species among the fouling organisms; the dry weight of these mussels sometimes made up more than 50% of the weight of all fouling organisms in the Wang-Joncas lantern and ear-hanging line structures at HAM. The Wang-Joncas lantern was found to be the most prone to fouling, and the pocket net the least prone to this problem.

Effect of cleaning

After the first and second years of the experiment, there was no apparent trend in the effect of cleaning the structures on scallop survival, losses and growth. Although no improvement in scallop survival and growth was found with cleaning, cleaning helps to maintain buoyancy of the structures. Structures that touch the bottom are more likely to be invaded by predators and this also exposes the scallops to environments unfavourable to their survival and growth.

Conclusions

A detailed evaluation of the different structures was undertaken in relation to scallop survival, losses and growth in suspension culture. Ease of handling, maintaining, cleaning and storing the structures was also considered in evaluating their functionality.

- The ear-hanging line is light, compact and easy to handle. However, it can become tangled and provides no protection for scallops, which can easily become fouled. The accumulation of fouling organisms, particularly mussels, is a major problem.
- The pocket net is long, wide and difficult for one person to handle alone. It is subject to a low level of fouling and is easy to maintain, and maintenance could be mechanized. However, scallop losses through the pocket openings are high.
- The pearl net is easy to handle and maintain, but it is subject to a higher level of fouling. Nonetheless, cleaning is easy and could be mechanized.
- The Wang-Joncas lantern is heavy, cumbersome and difficult to maintain because of significant fouling.
- The oyster table accommodates a large number of scallops, but it is bulky and difficult to handle because it is installed on a benthic table.

Collectively, the technical and biological results appear to show that the ear-hanging line and pocket net structures are the most promising for use in the lagoon environment of the Magdalen Islands. Scallop survival and growth in these structures was good. It is essential to ensure that the structures do not touch the sea bed, because this could result in significant predation. Cleaning done at appropriate times could help to reduce the effect of mussels on the ear-hanging system. In addition, the pocket net could be modified to minimize scallop losses.

Biological constraints, adverse weather conditions and delayed follow-up increased the variability of the results and made them somewhat difficult to interpret. The findings should nonetheless help to guide scallop farmers in their decision making.

This ACRDP project (Q-01-06-005) was a collaborative effort among the Department of Fisheries and Oceans (DFO Science) and Pétoncle 2000 and IMAQUA. The lead scientist on this project, Sylvie Brulotte, can be contacted at **Sylvie.Brulotte@dfo-mpo.gc.ca**.

For further information on this and other ACRDP projects, visit:
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