Economic Performance of Atlantic Salmon in the SEA System II Relative to Conventional Net Cages

During the summer of 2002, Marine Harvest Canada completed its first commercial grow-out of Atlantic salmon using the SEA System II at their site at Cusheon Cove on Saltspring Island, British Columbia. Here, the SEA System II is operated as full-scale commercial units alongside conventional net cages under the terms of a five-year marine pilot project license. The pilot project license was awarded to Marine Harvest Canada in the Fall of 2000. Cusheon Cove currently hosts the world's largest floating enclosed containment farm, in terms of rearing space.

The objective of the pilot project is to evaluate the production and economic performance of new technologies that are designed to prevent or mitigate environmentally sensitive factors such as organic waste output, escapement and interaction with wild fish stocks and predators. The SEA system, composed of six 2000m3 units (SEA Bags), was installed at Cusheon Cove in the Spring of 2001. Two large 30 x 30 metre (14,400 m3) steel construction net cages (Net Cages) provide a conventional-technology control.

The initial trial took place over a 14 month period and provided the opportunity to develop management routines adapted to the SEA System II and to local operating conditions. It also yielded benchmark production and economic figures for the system. This paper summarises the relative economic performance obtained for the SEA Bags in comparison to the control Net Cages.

Results for the initial trial at Cusheon Cove are presented in Figure 1 and Table 1. The cost categories are as follows:

1. Fingerlings: The cost of the juvenile Atlantic salmon introduced into the rearing systems includes smolt costs and all other rearing expenses in net cages up to the time the fish were transferred into the SEA Bags in June 2001. The trial started with fish that weighed an average of 477 grams.
2. Feed: Feed prices were the same for both the SEA Bags and the Net Cages and included both regular and medicated feeds.
3. Labour: Labour expenses included regular, overtime and diving wages; vacation pay; food; and contract labour.
4. Operational: This included all management and maintenance expenses, contract divers, farm supplies and equipment rentals, water taxi and freight related to the SEA Bags and the Net Cages. It does not include office overhead, laboratory, veterinary, or fish health consulting expenses.
5. Oxygen: This figure represents the total costs of liquid oxygen (LOX) and the rental costs of oxygen generators. LOX was supplied to the site in bottles varying in size from 125m3 to 400m3.
6. Power: This is the electricity purchased from BC Hydro to operate the pumps.

The farm gate costs of production presented in Table 1 do not account for interest payments on capital borrowed to engage in production, or for depreciation of assets (bags, cages, feeders, etc.).

Table 1 - Farm Gate Costs of Production for the SEA Bags in comparison Net Cages. Total COP for the Net Cages is used as a comparative basis.

Relative Costs of Production

Cost Categories	Nets	Bags	Variance (Bag - Steels)
Fingerlings	38%	39%	0.7%
Feed	50%	51%	0.9%
Labour	8%	10%	2.1%
Operational Expenses	2%	8%	5.4%
Oxygen	0%	17%	17.5%
Power	0%	2%	2.0%
Depreciation	1%	10%	8.4%
Total COP (Farm Gate)	**100%**	**137%**	**37%**

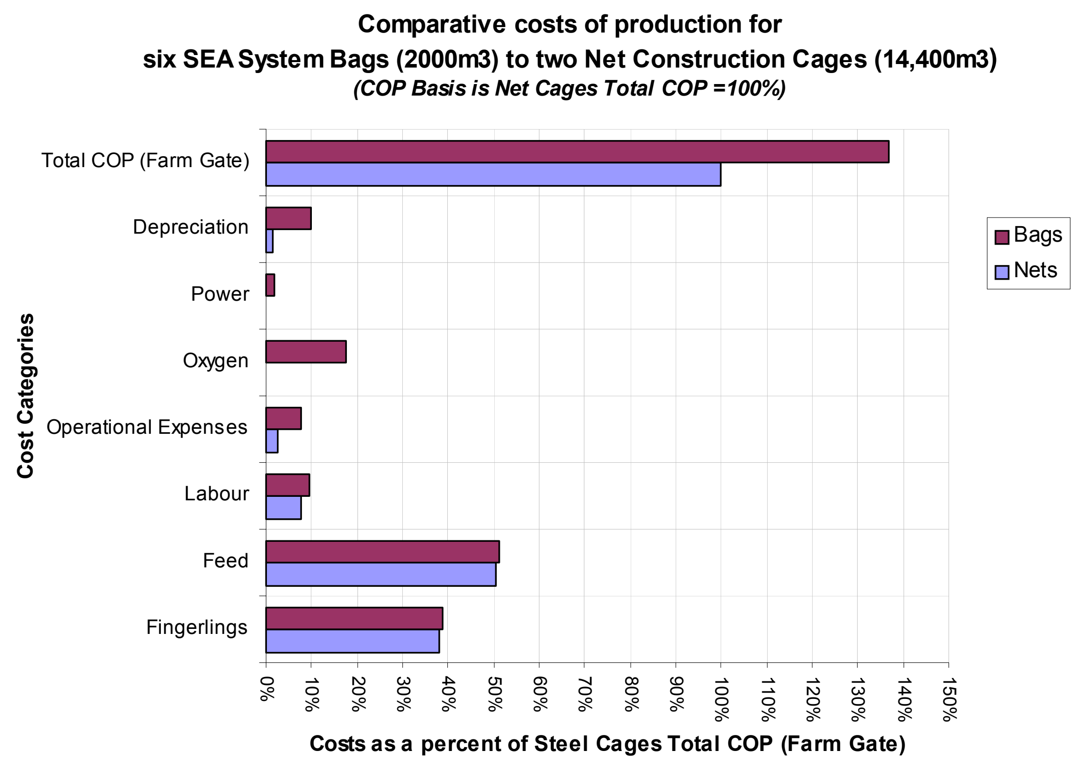

Figure 1 - Relative Farm Gate Costs of Production for the SEA Bags compared to Net Cages.

For the initial trial, costs of production were 29% higher with the SEA Bags than with the Net Cages. The categories that contributed most to the higher costs observed in the SEA Bags are oxygen, operating expenses and labour. The most important of these was oxygen. High costs for oxygen were due to both supply and transportation constraints. These problems had significant impacts on both fish production and the COP.

While the forecasted amount of oxygen required for production was close to the actual requirements, the costs associated with transporting bottles of oxygen and the costs of the liquid oxygen itself were prohibitively high. The location of the site did not allow for the installation of a large oxygen reservoir, either on land, or on a barge. Consequently, supplemental oxygen was supplied using small 125 and 135 m3 bottles. Despite efficient bottle rotation procedures, the LOX supplier had difficulties keeping up with the demand. As a result, the fish were subjected to lower dissolved oxygen levels than recommended. This impacted growth (mid-summer 2001 and fall 2001), and also increased the amount of labour required to manage the oxygen situation. The gradual introduction of bigger bottles (400 m3) improved the oxygen management and reduced logistical costs, but not the LOX costs. The use of aerators starting in the Spring of 2002 helped reduce the need for LOX. Oxygen generators were also installed in the Spring and Summer of 2002. However, due to technical difficulties, the oxygen generators contributed little oxygen to the system. Once these issues are resolved the oxygen generators are expected to reduce the costs of supplemental oxygen by more than 65% from last year's average of $1.39/m3 down to approximately $0.47/m3 (combined LOX and oxygen generators).

Operating expenses were 5.5% higher in the SEA Bags than in the conventional Net Cages. The most important costs in the SEA Bags were freight, related to the transport of LOX bottles (32% of operating costs), cage maintenance (22%), equipment rental (10%) and contract diving expenditures (3%). For the Net Cages the main costs were net repairs (36%), contract diving (20%), tools and supplies (13%), and freight (11%).

Electrical power costs for the SEA Bags were within the expected range and accounted for 2% of the base COP. Electrical power is required predominantly for operating the SEA System pump. Each pump consumes approximately 6.2 kWh and delivers 40,000 to 60,000 lpm, depending on operating conditions.

The difference in feed costs between the two types of growing systems was less than 1%. This difference is attributed to a lower EFCR in the Net Cages (1.30 versus 1.33) and to the slightly higher mean harvest weight. It also reflects the extended period of time over which the fish in the SEA Bags were harvested during the summer, because of market related issues.

The difference of 29% in costs between the two systems amounts to a difference of $0.85 per kilogram harvested. In the next trial, significant improvements to the delivery of oxygen to the site and to the fish in the SEA Bags is expected to result in lower oxygen, labour and operating expenditures. Improvement in general husbandry practices and management routines should contribute to improving production performance, especially fish growth and the feed conversion ratio. These improvements will significantly narrow the gap between SEA Bags and Net Cages.

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