Halibut and Sablefish Aquaculture in BC

Economic Potential

Prepared for:

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Executive Summary: Economic Potential of Halibut & Sablefish Aquaculture in BC

1. Background

- The Province does not have a policy for marine-based, non-salmonid finfish aquaculture
- Pacific halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*) are promising species for aquaculture ("farming")
- One input to the development of a new aquaculture policy is the economic potential of new species

2. Study Objectives and Approach

- Five objectives or tasks:
  - Assess potential market demand for farmed halibut and farmed sablefish
  - Assess potential economic impacts (income and employment) at different production levels
  - Assess potential effects on existing wild fisheries and their markets
  - Identify technical and regulatory constraints
  - Identify "lessons learned" from the development of the farmed salmon industry
- Two main activities
  - Interviews with 34 individuals including 15 seafood buyers across North America
  - Review of existing reports, data, and materials

3. Farmed Halibut Demand and Impacts

- Eight month season Mar 15- Nov 15 for wild fishery
- Existing wild product sold mostly as fresh dressed head off fish into the US market
- Buyers cite the inconsistent quality of the BC wild product
- Farmed Pacific halibut would compete with wild Pacific halibut and farmed Atlantic halibut
- Forecast 40,000 tonnes round wild catch (in BC and US); current farmed Atlantic halibut production small but poised to grow.
- Strong potential demand for farmed Pacific halibut arising from:
  - Selling fresh fish at a price premium into the four month off-season for the wild fishery
  - Selling fresh fish into eight month season of the wild fishery at higher quality than wild fishery currently produces.
  - Serving specialty markets e.g. ethnic live fish markets
  - Selling fish smaller than the minimum size for commercially-caught halibut
- Potential annual demand for farmed Pacific halibut of 1,000 to 8,000 tonnes round by 2021
- Potential wholesale revenues by 2021 of $11 to $70 million annually (compared to current $50 million wholesale revenue for wild)
- Farming of Atlantic halibut around the world likely to proceed independent of BC initiatives
- Potential impact of farmed halibut production (Pacific plus Atlantic) of up to 20% reduction in wholesale price for wild product (but only a tenth of this decline attributed to BC industry alone)
- But BC wild industry could mitigate adverse impacts through improving quality (e.g. bleeding more of their fish, shorter trips) and differentiating their product from the farmed.

4. Farmed Sablefish Demand and Impacts

- Wild fishery operates year-round
- Existing wild fishery product sold mostly to Japan as dressed head off J cut frozen product throughout the year; some high-end restaurants in North America are starting to feature sablefish on their menus
- Buyers are very happy with the quality of BC wild product
- Farmed sablefish would compete with wild sablefish and Patagonian toothfish (also marketed as Chilean sea bass in North America and called mero in Japan)
- Sablefish and mero occupy narrow, supply-sensitive market in Japan for quality white-fleshed fish with high oil content
- Forecast 30,000 tonne wild catch in BC and US combined (a substantial decline in the US component), and imminent decline of mero catches due to overfishing over the next two decades
- Strong potential demand for farmed sablefish arising from:
    - Filling Japanese market void from declining wild sablefish and mero catches
    - Further penetrating North American restaurant market for premium white fleshed fish
    - Serving specialty markets e.g. ethnic live fish markets
- Potential annual demand for farmed sablefish of 2,000 to 16,000 tonnes round by 2021
- Potential wholesale revenues by 2021 of $22 to $114 million annually (current wild fishery wholesale revenues about $30 million annually)
- BC is a world leader in sablefish culture technology and BC would likely have large share of farmed sablefish market over the next 20 years
- Potential impact of farmed sablefish production worldwide could reduce wholesale price of wild fishery by up to 40% (but only a half of this decline would be attributed to BC industry alone)
- Limited opportunity for BC wild fishery to adapt since it already produces a very high quality product (but some market segments will always prefer wild over farmed fish)

5. Technical Constraints

- The farmed halibut and sablefish industries in BC are at the early embryonic stage of development - but the sablefish industry is more advanced (the sablefish rearing cycle has been closed but the halibut rearing cycle has not); there is potential for technology transfer from farmed Atlantic halibut producers on the East Coast
- Halibut and sablefish have a sensitive hatchery and larval phase- the eggs are smaller and more fragile than salmon; and halibut, being a flatfish, undergoes metamorphosis
- Land based systems need to be designed for halibut- as flatfish, halibut appears to need surface area, not depth in the water column, to thrive and appear to be better suited to land-based systems; sablefish appears well suited to seapen culture (the majority of Atlantic halibut farms are on land)
- Appropriate feed formulations need to be developed- both species can have very good feed conversion ratios (FCRs), but appropriate feeds need to be developed. Halibut grows very slowly; sablefish in contrast, grows very quickly
- Disease and parasites such as sea lice pose a risk
- Technical expertise is in short supply in BC- very few people in BC have the essential technical knowledge

6. Regulatory Constraints

- The lack of a provincial non-salmonid finfish aquaculture policy for marine-based facilities is the main constraint
  - Halibut and sablefish can be grown at existing licensed salmon seapen sites
  - But, no stand alone seapen sites for halibut or sablefish are allowed, stifling investment and industry development
  - But this is more of a problem for sablefish if, as appears likely, halibut culture will proceed at least initially on land (there are no policies restricting the development of land-based systems)
- The high cost of obtaining a site if and when new sites are released (e.g. environmental studies, public consultation, etc)
- Requirement for monitoring and enforcement (e.g. broodstock development, product shipments, environmental audits)
- The lack of harmonization of provincial and federal agencies and their requirements

7. Lessons Learned from Farmed Salmon Development

- All new products start as niche products; products which can lower their costs of production through lower FCRs, vaccines to prevent disease etc., can achieve mass market appeal; it is difficult to predict the ultimate market role of a new species
- It is important for the wild fishery to anticipate and not ignore, the development of the farmed finfish industry so as to enact quality improvements, branding, and other measures
- The quality of farmed finfish will raise the quality expectations in the wild fishery
- Japan will buy farmed fish
- It is difficult to restrain or control the spread of aquaculture technology
- The impact of the farmed production on the economics of the wild fishery depends on the role (quality, season, product form) that the wild product serves in the marketplace
- For a farmed product to be sustainable economically in the long run, it will need to be sustainable environmentally

Preface

The BC Ministry of Agriculture, Food & Fisheries retained GSGislason & Associates Ltd. to assess the economic potential of halibut and sablefish aquaculture in the province.

The consultants have benefited from discussions with seafood buyers, scientists, industry leaders, and others. Notwithstanding this assistance, the authors have final responsibility for the analyses and conclusions of the study.

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1.0 INTRODUCTION

Aquaculture is a fast growing food industry around the world. A variety of finfish including salmon, tilapia, sea bream, and sea bass are being grown in Norway, Chile, the UK, Spain, China, and other countries.

In British Columbia, finfish aquaculture has focused on farmed salmon, particularly Atlantic salmon. In fact, the Province at present does not have a finfish aquaculture policy that covers species other than salmon. The government is presently developing such a policy.

One input to this new policy is the potential economic opportunities related to Pacific halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*) aquaculture in British Columbia. These are two of the most promising species for finfish aquaculture and several formative initiatives are now underway. Typically, aquaculture development of a species passes through embryonic, growth, and mature phases. The development of both halibut and sablefish culture in BC is in the embryonic phase, although sablefish culture is further developed.

Study Objectives

This study addresses the following topics for each species:

- The market demand for farmed production of each species including product differentiation;
- Potential economic impacts in terms of income and employment at different production levels;
- Technical and regulatory constraints that may limit development; and
- Comparisons to and "lessons learned" from the development of the farmed salmon industry;

The study also outlines any potential effects on existing wild fisheries and their markets.

It is important to note that this study does not assess the net benefits of halibut and sablefish aquaculture development. To do so would require analysis of environmental and other issues beyond the scope of this study. Rather, the intent of this study is to assess the economic potential of halibut and sablefish aquaculture development and to provide more information to the BC Ministry of Agriculture, Food and Fisheries to develop a new non-salmonid finfish policy.

Study Approach

The study involved both a review of existing reports and materials and an interview program with 34 individuals. In particular, 15 seafood buyers and marketers across North America were interviewed. In addition, we spoke with scientists from the Pacific Biological Station in Nanaimo,

proponents of pilot projects to date, leaders of the wild halibut and sablefish industries, and several academic experts.

Report Outline

The next section analyzes the potential market, the economic impacts of industry development, and the impacts on the existing capture (or wild) fishery in BC. The remaining sections of the report are:

Section	Topic
2	Market Analysis & Economic Impacts
3	Technical and Regulatory Constraints
4	"Lessons Learned" from Farmed Salmon

Our interviewees are listed in the Appendix.

2.0 MARKET DEMAND & ECONOMIC IMPACTS

Market demand for any seafood product is driven by the tastes and wants of consumers, the attributes of the seafood product, the attributes of any substitute products, and other factors. The seafood industry worldwide has changed dramatically over the past two decades in response to market, technological, and institutional forces.

Worldwide landings from the "capture" or wild fishery have remained unchanged since the late 1980s. In contrast, over the same period, worldwide aquaculture production tripled. Currently, the seafood production of all types (wild and farmed) totals approximately 130 million tonnes. Of this, about 70% arises from capture fisheries. Culture technology developed in one country is transferred around the world e.g. salmon culture technology from Norway.

Increasing populations and rising economies have fuelled world seafood demand. With the worldwide trend to free trade, international trade barriers have been removed, resulting in very competitive markets.

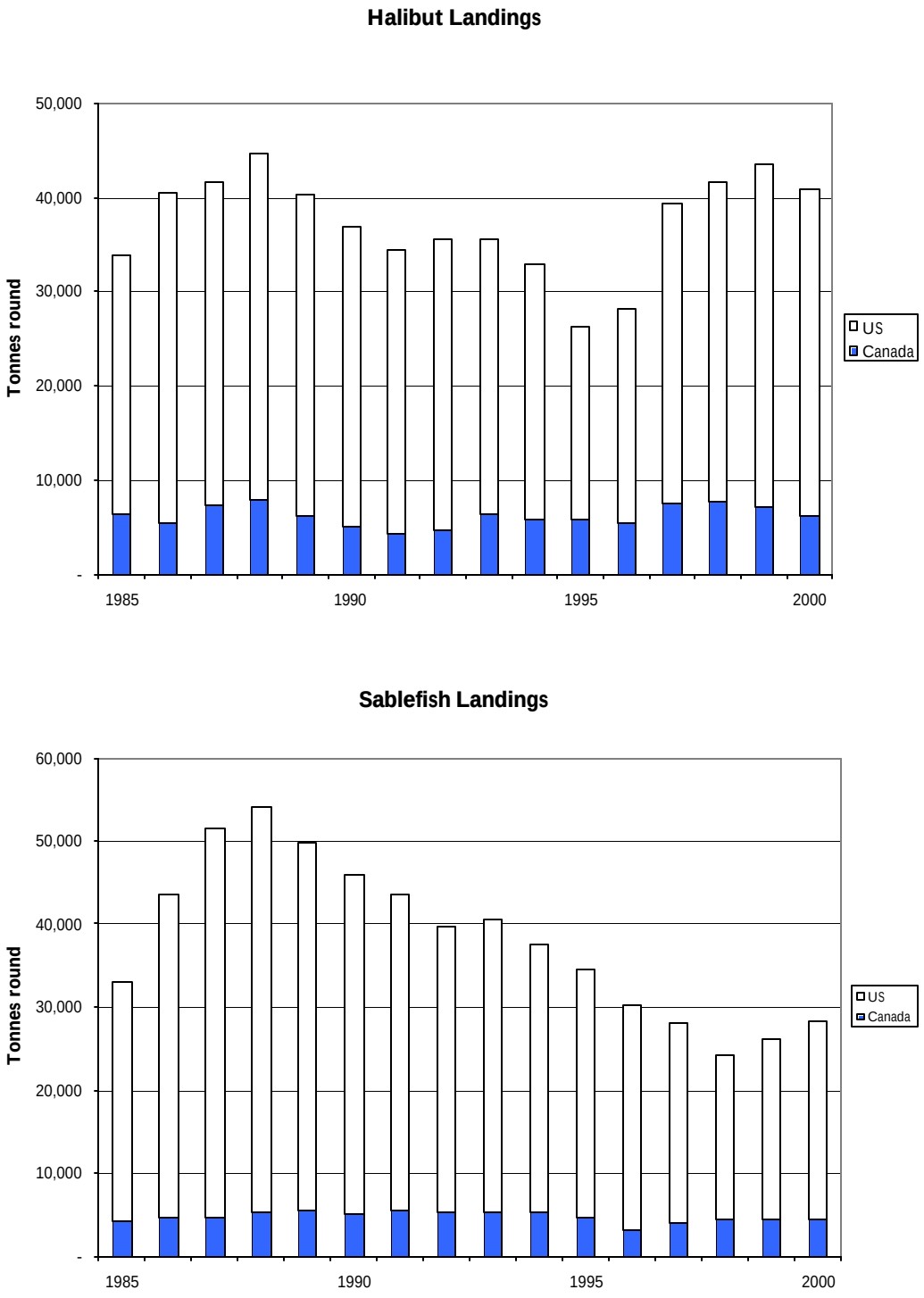
Some tastes and attitudes of seafood consumers have emerged over the past 20 years:

- Increasing demand for quality and freshness (most consumers prefer fresh over frozen),
- Increasing concerns over pollution and human health issues (histamines, e coli, mercury and metal contaminants),
- Greater interest in environmental responsibility and sustainability (witness the Marine Stewardship Council Certification process),
- Greater desire for quality assurance, date stamping and traceability of products, and
- A trend to a healthier diet (fish has omega-3 oils which help prevent heart disease)

Farmed seafood consuming have increasingly been accepted in the marketplace because they offer consistency of supply, quality, and price throughout the year. Shipments can be tailored to the specific needs of different consumer segments. In some cases, markets for capture and aquaculture products are converging as wild fishery seasons are extended in response to individual quota management systems and wilder product is sold in fresh form.

In Japan, the largest seafood consuming country in the world, changing consumer tastes, such as growing preference for red meat and the acceptance of farmed fish as a substitute for wild, the country's changing economic structure, and weak economy have affected seafood markets. Japan is still a very discerning market that demands high quality seafood.

Exhibit 1: Landings in the Canadian and US Commercial Fisheries for Halibut and Sablefish, 1985 to 2000



Source: FAO; IPHC; "Pacific Fishing", March 2001

Ethnic markets in North America are gaining importance following increased immigration of Asian peoples over the past twenty years. There is a growing market in ethnic fish dealers, fish markets, and restaurants for live fish and shellfish.

This section explores the potential markets for farmed halibut and sablefish from British Columbia, their dimensions and attributes, and anticipated economic impacts on the BC economy and on the existing wild fisheries. The exploration of market potential largely does not take into account technical and regulatory constraints. These are addressed in the section 3 to follow. All prices and values in the report are quoted in Canadian dollars.

2.1 FARMED HALIBUT MARKETS AND ECONOMIC IMPACTS

This section outlines different scenarios for farmed halibut market demand from British Columbia 20 years from now. The analysis is based on our interviews with seafood buyers and marketers, a review of available reports, and our previous work on the seafood industry. The analysis starts with an overview of the wild halibut fishery and its markets.

The Wild Halibut Fishery and Markets

The Pacific halibut inhabits the continental shelf of the US and Canada ranging from California north to the Bering Sea. The commercial fishery uses longline gear and is concentrated off the waters of British Columbia and Alaska.

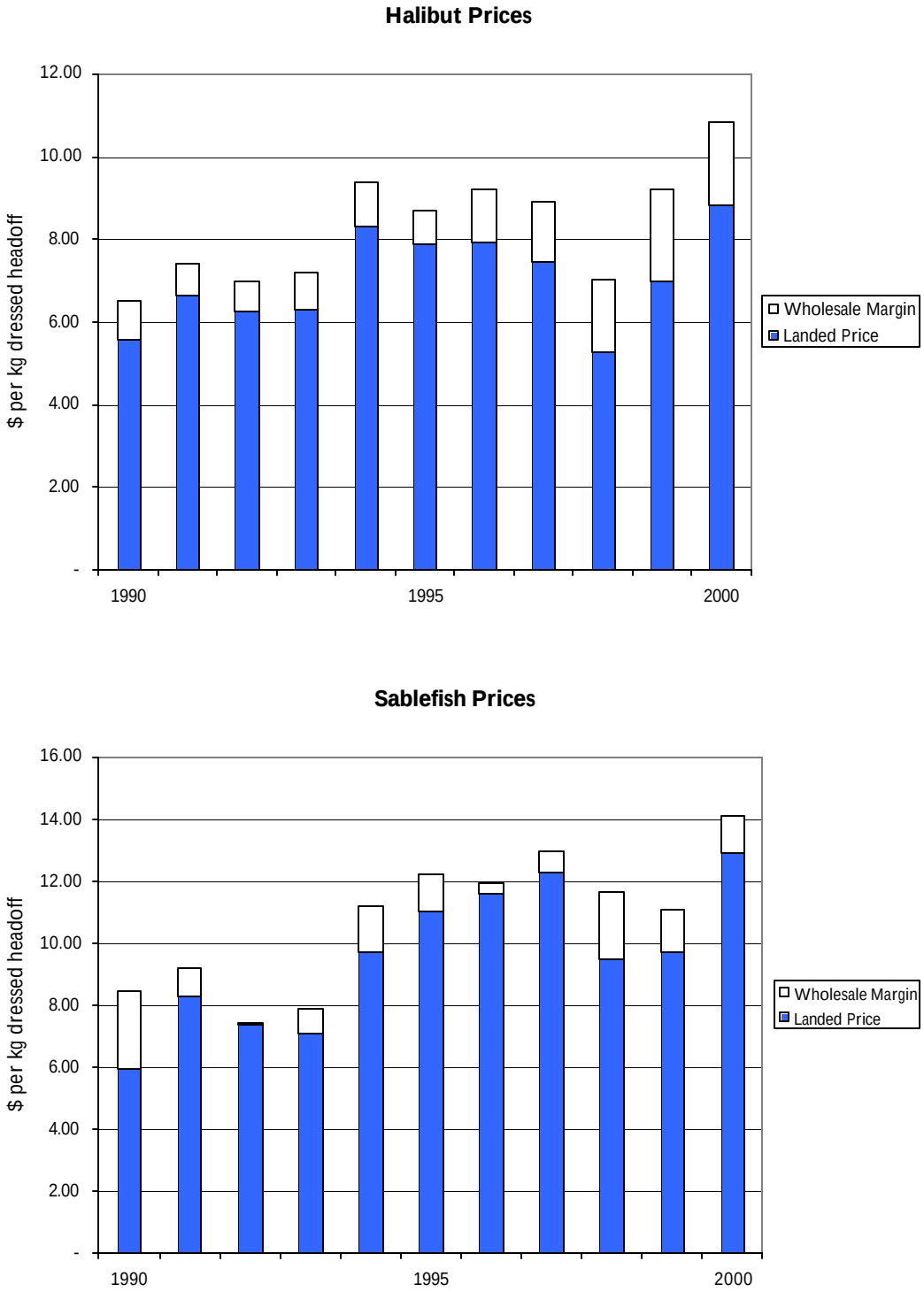
Biological Management. Since 1923, the wild fishery has been managed by the International Pacific Halibut Commission (IPHC) based in Seattle. The IPHC sets an overall Total Allowable Catch (TAC) and the allocation between Canada and the US, conducts stock assessments, and enacts other regulatory measures. The wild fishery has a minimum fish size of 61cm head-off (about 4.5kg to 5kg in dressed head-off weight).

Landings. Exhibit 1 displays the landings history for the two countries since 1985. Landings have increased in recent years in response to improved stock biomass. The US (Alaska primarily) catches 80% to 90% of the combined harvest. All Canadian wild halibut caught is individually tagged.

Fleet Management. The Canadian fishery adopted limited entry licensing in 1979 and an individual vessel quota (IVQ) system in 1991 for the 435 license holders. The US fishery went to a system of individual quotas (IQs) in 1995. In Canada, the halibut industry engages in co-management with DFO through an industry association and pays for a variety of measures – dockside monitoring of catch offloads, a dedicated enforcement presence, and a fishery manager.

Markets. Prior to the introduction of IQs, the commercial fishery in each country lasted 10 days or less. Today, both countries have the same 245 day season extending from March 15 to November 15 each year. The result of the longer season and a slower harvest has been a much greater proportion of the fish being directed towards the fresh market, with less product sent to the frozen market. Today, about 95% of the Canadian catch and about 80% of the US catch is sold by processors in fresh form. The fresh product reaps a price premium over the frozen product.

Exhibit 2: Average Prices for Canadian Halibut and Sablefish, 1990 to 2000



Source: BC Ministry of Agriculture, Food & Fisheries; DFO.

Exhibit 2 displays wholesale price trends for fresh, dressed head off Canadian halibut over the last decade. Dressed head off weight is generally about 75% of the round whole weight. The price has risen by two thirds over the decade.

Over the 1996 to 2000 period, i.e. after the US went to IQs, the Canadian wholesale price has averaged $9.06 per kg dressed head-off of which $7.29 or 80% represents the average landed price to fishermen. Prices vary from year to year depending on supply, inventory levels, exchange rates and other factors.

The vast majority of Canadian halibut is sold to the US which comprises 95% of our export market.

Future Catch Levels. The overall Pacific halibut TAC may decline slightly from recent levels to about 40,000 tonnes round annually over the next two decades. The Canada and US allocations, based on historical shares, may be 6,000 tonnes for Canada and 34,000 tonnes for the US.

Potential Farmed Halibut Market Demand

Consumer demand for wild Pacific halibut, farmed Pacific halibut and cultured Atlantic halibut will likely be similar. Therefore, to investigate demand for farmed Pacific halibut, we investigate the product and market attributes of wild Pacific halibut and Atlantic halibut that is currently sold in the market. The recent work conducted for the Alaska Department of Commerce and Economic Development is a valuable reference on halibut markets (Forster, 1999).

Product Attributes. Halibut is a desirable fish to consumers for which they are willing to pay a high price. The attributes favoured by consumers include: white meat, firm texture, mild flavour, few bones, good shelf life, and freezability without loss of flavour or texture (Forster, 1999). Restaurant and retail consumers both value halibut.

Pacific halibut also has several desirable attributes from a processing and distribution point of view. The fish's large size facilitates cost-effective handling and processing. A 10 kg halibut is a good size for steaking by restaurants and retail stores. Halibut also has a very good fillet yield of up to 60% compared to only 30% for rockfish, soles and cod.

Size Preferences. Large fish generally command higher prices. Size preference for wild Pacific halibut varies by region within the US. The West Coast buyers prefers fish over 18 kg dressed head-off while the East Coast buyer prefers smaller fish in the 4.5 to 9 kg range (the US Mid West buyer prefers a size range in between). European buyers also prefer a small fish. Farmed Atlantic halibut of 3 to 7 kg is presently sold in the Eastern US. Potential buyers of live fish would want fish under 9 kg.

Seasonal Pricing. Wild Pacific halibut prices typically start high after the March 15 opening date and then decline to a lower but stable base. Prices typically increase near the end of the season as fewer boats fishing and bad weather make landings more intermittent. However, some of the late caught halibut (caught after August) can be plagued by a "chalkiness" in the flesh, a condition which puts downward pressure on prices.

Competition and Market Opportunities. Pacific halibut faces less competition in the Western US market where it is perceived as more of a unique product. In the Eastern US market, Pacific halibut competes with Atlantic halibut and a variety of other white-fleshed fish including cod, haddock, and flounders. East Coast consumers historically have had access to, and are used to consuming a variety of white -fleshed seafood.

The commercial fishery for Atlantic halibut by Canada and the US, the Faroe Islands, Iceland, Norway and other countries is in decline. Total catch in recent years has been in the 3000 to 4000 tonne range or less then half the amount caught in the 1970s.

Several countries including Iceland, Norway and Canada (Nova Scotia) are culturing Atlantic halibut and selling into European and US markets. Scotian Halibut, a joint venture between Icelandic and Canadian interests, is farming Atlantic halibut and selling into the US market. World production for farmed Atlantic halibut totals less than 1,000 tonnes, but is poised to grow.

Buyers and marketers report that fresh Atlantic halibut, mostly farmed, reaps a $6-$8 per kg dressed head-off price premium in the Northeast US when the commercial fishery for Pacific halibut is closed. When both Atlantic and Pacific halibut are available, Atlantic halibut still commands a price premium, albeit much reduced (about 10% to 15% price premium). Buyers will typically quote prices for one species when negotiating purchases for the other species. Scotian Halibut also reports a limited market in the Toronto area for one to two kg live halibut.

The price premium for Atlantic halibut is based on two factors: tradition and perceived quality. Atlantic halibut, although fattier with a somewhat softer flesh, is a traditional seafood product in the Eastern US. The Atlantic halibut on the market is generally fresher and has a longer shelf life than the Pacific. Buyers want halibut that is 48 to 72 hours old from time of slaughter- the farmed Atlantic halibut industry can produce this. Several buyers commented on the inconsistent quality of Pacific halibut reflecting handling issues and time at sea after capture. Farmed Atlantic halibut is bled which enhances shelf life; only about half of wild Pacific halibut from Canada is bled.

Strong Market Demand for Farmed Halibut. We conclude that there would be a strong market for farmed halibut because:

1) it would be sold at a premium price in the four month off season for the wild fishery;
2) it would produce better quality fish the other eight months than the current wild fishery; (farmed halibut would have a quality advantage due to reduced time between slaughter and point of sale).
3) it could serve specialty markets, e.g., ethnic live fish markets; and
4) it could market fish smaller than the minimum size for wild-caught fish

Four Scenarios. We present below four scenarios of farmed Pacific halibut demand. These four scenarios represent different demand outlooks in 20 years rather than predictions of production

based on growth projections.

		Annual BC Production of Farmed Halibut tonnes round			
		Low	Mid Low	Mid High	High
Existing Markets		0	0	1,000	4,000
New Markets		1,000	2,000	3,000	4,000
	Total	1,000	2,000	4,000	8,000

The bulk of the fish would be sold in the 3 to 9 kg weight range (dressed head off).

We also see much of the BC farmed halibut being distributed by the Canadian arms of large international salmon farming companies, such as Stolt, Marine Harvest, and Pan Fish, to realize synergies and economies of scale in marketing. These companies are in the forefront of Atlantic halibut culture. It is likely that many companies will try to culture Pacific halibut initially, but over time industry rationalization and concentration will occur due to competitive forces.

The low scenario may not be achievable if regulatory and technical bottlenecks remain. Alternatively, market demand would exceed the high projection if the regulatory policy in the province becomes more favourable and technical challenges are quickly met. In short, the future of the farmed halibut industry in BC will be shaped largely by regulatory and technical issues and not by market demand issues.

Economic Impacts of Farmed Halibut Development

The development of a farmed halibut industry in the province will spur jobs in hatchery, farming (growout), processing, transport, and distribution. Estimated direct contributions to provincial Gross Domestic Product (GDP), wages and salaries including benefits , and employment (in person years or PYs) associated with each of the four production scenarios is presented in Exhibit 3.

Initially, we see the industry concentrating on selling in the November to March off-season to reap a high price to defray the expected initial high cost of production. At higher levels of production, costs would decline but so would prices as the industry expanded into year-round markets. This is the path of development of the farmed salmon industry.

Direct economic impacts under the four different scenarios are (Exhibit 3):

Scenario	BC Production (tonnes)	BC Revenue ($ million)	BC Employment (PYs)
Low	1,000	11.0	55
Mid Low	2,000	20.9	105
Mid High	4,000	39.6	200
High	8,000	70.4	350

Exhibit 3: BC Farmed Halibut Scenarios

	British Columbia Production Scenario [a]			
	Low	**Mid Low**	**Mid High**	**High**
Production tonnes round [b]				
Existing Markets	0	0	1,000	4,000
New Markets	1,000	2,000	3,000	4,000
	1,000	2,000	4,000	8,000
Average Wholesale Price $ per kg round	$11.00	$10.45	$9.90	$8.80
Industry Wholesale Revenue $ million	11.0	20.9	39.6	70.4
Direct Industry Impacts to BC [c,d]				
GDP $ million	6.1	11.5	21.8	38.7
Wages & Salaries $ million	2.2	4.2	7.9	14.1
Employment PYs	55	105	200	350

[a] Possible production scenarios 20 years from now- All prices and values are expressed in constant, inflation-adjusted year 2001 dollars Canadian.

[b] Production would be sold mostly in fresh, dressed head-off form, (the conversion factor from round to dressed, head-off is approximately 0.75).

[c] Direct impacts based on assumed cost structure (after Forster, 1999): 20% labour, 35% for capital return of interest, depreciation, interest; 25% feed, and 20% other. Halibut farms will be more capital intensive and less labour and feed intensive than salmon farms.

[d] Total industry impacts – direct impacts plus indirect supplier impacts plus induced consumer respending impacts- would be 1.5 to 2.0 times the direct impact e.g. under the high scenario, the total employment impact would be 525 to 700 PYs of employment.

[e] Assumed $40,000 in wages, salaries, benefits per person-year (PY)

The bulk of farming and economic activity likely would occur on Vancouver Island. In addition to direct industry effects, income and jobs will accrue to feed, equipment, and other suppliers and to the retail sector through the respending of wage incomes earned.

The revenue projections depend on how the farmed halibut industry proceeds in the rest of the world. It is not very likely that the farmed halibut industry will stagnate in the rest of the world while that in BC develops. The reverse is more likely, i.e., that the farmed halibut industry elsewhere will develop, given the technological lead of other jurisdictions such as Iceland, Norway, and Nova Scotia, regardless of what happens in British Columbia.

Impacts on the Wild Fishery in British Columbia

We see the farmed Atlantic halibut industry developing around the world regardless of what happens in British Columbia. It is likely that BC's share of farmed halibut production, Pacific or Atlantic, will be less than 10% (as is our share of total wild farmed salmon production). Furthermore, we do not see a major product differentiation in the marketplace between farmed Pacific and farmed Atlantic halibut of similar quality.

The impacts of this aquaculture production on the capture (wild) halibut fishery depend on the industry response or strategy. If they "do nothing" (the response of the wild salmon industry 20 years ago after the launch of the farmed salmon industry), then there could be significant negative impacts. Alternatively, if the wild industry adopts a "market response" strategy to improve quality, brand the product, and cultivate markets, then both farmed and wild product can thrive in the future. The wholesale value of the wild halibut fishery in BC is about $50 million annually.

Under the reactive "do nothing" strategy, we see the price of wild halibut dropping by up to 20% but only a tenth of this, or 2% could be attributable to the development of the farmed halibut industry in BC alone. The main result of this price decline to wild producers would be lower returns to commercial licence holders and crew (if they are paid on a share of catch value basis). The purchase price and lease cost of quotas also would decline. But, direct industry employment impacts should be minimal as the same amount of fish will be caught and processed e.g. the main impact to the wild fishery would be an income loss and not a job loss.

In contrast, under the proactive "market response" strategy, we see the industry actually increasing the prices received for the wild product due to quality improvements, market branding and segmentation, and improved marketing. Fisherman could bleed more of their fish, undertake shorter trips and enact other quality improvement measures. The improved wild product could be marketed as a gourmet product differentiated on the basis of origin, size, and other quality attributes (Forster, 1999). For example, wild halibut will likely be larger than farmed halibut and particular markets want large fish. In addition, some high-end buyers and restaurants deal only with wild seafood products. The finite supply of high quality wild halibut can confer a market advantage.

Some wild producers in BC are demonstrating that they are up to this challenge. Some are capturing wild halibut in the conventional fishery, holding and feeding them in pens, and butchering and delivering them to the market during the off season when the wild fishery is closed. Other producers are selling live halibut to ethnic fish dealers.

2.2 FARMED SABLEFISH MARKETS AND ECONOMIC IMPACTS

This section outlines different scenarios for farmed sablefish market demand from British Columbia 20 years from now. The analysis is based on our interviews with seafood buyers and marketers, a review of available reports and our previous work on the seafood industry. The analysis starts with an overview of the wild sablefish fishery and its markets.

The Wild Sablefish Fishery and Markets

Sablefish is widely distributed along continental shelf of the North Pacific Ocean ranging from California north to Alaska and the Bering Sea. The commercial fishery uses trap and longline gear and is concentrated off the waters of British Columbia and Alaska.

Biological Management. The sablefish fishery in the US and Canada is managed separately by the two countries. Each country sets an overall TAC, conducts stock assessment work, and enacts other regulatory measures. DFO manages the fishery in Canada and the Pacific Fishery Management Council manages the fishery in the US. The Canadian fishery has a minimum fish size limit of 39cm head-off (about 1kg in dressed head-off weight).

Landings. Exhibit 1 displays the landings history for the two countries since 1985. US Landings have decreased in recent years in response to reduced stock biomass. Canadian landings have been relatively stable. The US (Alaska primarily) catches 80% to 90% of the combined harvest. Current landings in both countries combined are 20,000 tonnes less than the 45,000 tonnes caught ten years ago.

Fleet Management. The Canadian fishery adopted limited entry licensing in 1981 and an individual vessel quota system in 1990 (for the 48 license holders). The US fishery moved to a system of individual quotas (IQs) in 1995. In Canada, the sablefish industry engages in co-management with DFO through an industry association and pays for a variety of measures - dockside monitoring of catch off loads, a dedicated enforcement presence, a fishery manager and stock assessment work.

Markets. Prior to the introduction of IQs, the commercial fishery in each country lasted 10 days or less. Today, the season is year-round. The result of the longer season and a slower harvest has been a substantial quality improvement. Many fisherman bleed and freeze the fish on board to enhance quality.

Exhibit 2 displays wholesale price trends for frozen, J cut, dressed head off Canadian sablefish over the last decade. Note that J cut dressed head off weight is generally about two thirds of the round whole weight. The price has risen by two thirds over the decade.

Over the 1996 to 2000 period, i.e., after the US went to IQs, the Canadian wholesale price has averaged $12.35 per kg dressed head-off of which $11.18 or 90% represents the average landed price to fishermen. Prices vary from year to year depending on Canadian supply, US supply, inventory levels, exchange rates and several other factors.

The vast majority of Canadian sablefish is sold to Japan, which comprises 90% of our export market. Increasing amounts are being sold to Taiwan, China and other Asian countries.

Future Catch Levels. It appears that the US has been overly aggressive in setting sablefish TACs in recent years with the result that, in the short term, a 30-50% drop in the US TAC will be required. In contrast, Canada has taken a conservative approach to setting it's TAC. We project total Pacific landings of sablefish to average about 30,000 tonnes round over the next 20 years- 26,000 tonnes US and 4,000 tonnes Canada. The US share is substantially less than in the 1990's.

Potential Farmed Sablefish Market Demand

To investigate the potential demand for farmed sablefish, we investigated the product and market attributes of wild sablefish. The recent work by the US Department of Commerce is a valuable reference on sablefish markets in Japan (Sonu, 2000).

Product Attributes. Sablefish is a very desirable fish for which Japanese consumers are willing to pay a high price. The attributes of the fish are: premium quality white flesh, delicate texture with good flavor, and high fat content.

Sablefish is a popular fish in Japan and is prepared in various ways for the table. During winter months, a fish stew consisting of sliced sablefish, vegetables and soup stock is popular. Sliced sablefish with the skin on and skinned sablefish marinated in Japanese red wine are used in grilled, broiled, or baked forms and consumed year-round (Sonu, 2000).

Sablefish is not a well-known fish in North America other than as a smoked fish (Its high fat content makes it ideal for smoking). However, in the last 5 years, several high-end restaurants are starting to showcase it on their menus. Restaurants note that sablefish is a very "forgiving" fish in cooking i.e. cooking times can vary slightly without major issues in either dryness or rawness. Some restaurants brine the sablefish overnight before cooking to control its odor and to enhance flavor.

Sablefish has a good fillet yield of 40% compared to only 30% for rockfish, soles and cod.

Size Preferences. Larger fish generally command higher prices. The main size categories are: under 2.3kg, 2.3kg to 3.2kg, and 3.2kg + (all frozen J cut, dressed head off). North American restaurants prefer the 3.2kg + size due to better yield for the largest size. Japan prefers the 2.3kg to 3.2kg size.

Seasonal Pricing. Prices in Japan usually rise from late fall through winter, and then fall during summer (Sonu, 2000).

Competition and Market Opportunities. The main competition in existing wild sablefish markets is the Patagonian toothfish often called a Chilean sea bass in North America markets (although this is a different species), and mero in Japan. The Japanese consumer preference is strong for white-fleshed fish with good oil content. Sablefish and mero are two of the few fish that meet this criteria.

The commercial fishing for mero occurs in the Southern Ocean (the area around Antarctica where the Southern extremes of Atlantic, Pacific and Indian Oceans meet). The areas fished are remote, enforcement is minimal, and illegal fishing is rampant. Scientists predict commercial extinction by the year 2005 (National Audubon Society, 2000).

At present, there are no countries other than Canada trying to farm sablefish.

With the decline in US landings of sablefish, Canadian prices have remained high in spite of the weakness in the Japanese economy. The recent decline in mero landings has also buoyed sablefish demand. Buyers report that when mero prices escalated due to declining supply, many buyers switched to sablefish.

Buyers are very happy with the quality of Canadian sablefish. It meets the high quality standards of the Japanese market (but Alaskan sablefish, with its higher oil content, reaps a lightly higher price). North American buyers do not perceive any major quality differences between fresh and frozen product.

In fact, many buyers prefer frozen over fresh noting the frozen product is frozen immediately after capture at sea and after the fish is bled. Some buyers note that wild sablefish, being eaters of small fish near the ocean bottom, can have problems with worms, mostly confined to the belly cavity. This is another reason they prefer to purchase frozen sablefish. However, farmed fish fed with dry feeds would not have a worm problem.

Some buyers note that the Canadian fishery operates in an environmentally sustainable manner and this plays a role in the purchase of Canadian fish (one indicated that he would buy farmed sablefish from land-based farms but not from seapens). They note that mero is no longer an acceptable fish for restaurant menus because of over fishing.

Some buyers note that there is a market, albeit limited, for live sablefish in ethnic restaurants. A 1kg sablefish could compete with rock cod and other finfish species.

Finally, we note that the sablefish market in Japan traditionally has been a narrow, specialty market. Significant supply increases bring significant price declines.

Strong Market Demand for Farmed Sablefish. We conclude that there would be a strong market for farmed sablefish because:

1) it could immediately fill supply shortfalls in Japan from the wild sablefish fishery and the wild mero fishery, its closest competitor

2) in the longer term, it could increasingly penetrate the North American market, and

3) it could serve specialty markets eg ethnic fish markets.

Four Scenarios. We present below four scenarios of farmed sablefish demand. These four scenarios represent different demand outlooks in 20 years rather than predictions of production based on growth projections.

	Annual BC Production of Farmed Sablefish tonnes round			
	Low	**Mid Low**	**Mid High**	**High**
Existing Markets	1,800	4,800	9,000	12,000
New Markets	200	1,200	3,000	4,000
Total	2,000	6,000	12,000	16,000

We see the North American markets as being primarily a restaurant market rather than a retail market.

The majority of the fish likely would be sold in the 2-4kg dressed head off weight range. Initially, the sales would be concentrated in frozen product going to Japan. The higher production scenarios assume increased penetration of the North American market.

We see much of the BC farmed sablefish product being distributed in North America by the Canadian arms of large international salmon farming companies to realize synergies and economies of scale in marketing. Companies such as Stolt Seafarms and Omega Salmon on Vancouver Island are very interested in growing and selling farmed sablefish. It is likely that many companies will try to culture sablefish initially, but over time industry rationalization and concentration will occur due to competitive forces.

The low scenario may not be achievable if regulatory and technical bottlenecks remain. Alternatively, market demand would exceed the high projection if the regulatory policy in the province becomes more favorable and technical challenges are quickly met. In short, the future of the farmed sablefish industry in BC will be shaped largely by regulatory and technical issues and not by market demand issues.

Economic Impacts of Farmed Sablefish Development

The development of a farmed halibut industry in the province will spur jobs in hatchery, farming (growout), processing, transport, and distribution. Estimated direct contributions to provincial Gross Domestic Product (GDP), wages and salaries including benefits , and employment (in person years or PYs) associated with each of the four production scenarios is presented in Exhibit 4.

Exhibit 4: BC Farmed Sablefish Scenarios

	British Columbia Production Scenario [a]			
	Low	**Mid Low**	**Mid High**	**High**
Production tonnes round [b]				
Existing Markets	1,800	4,800	9,000	12,000
New Markets	200	1,200	3,000	4,000
	2,000	6,000	12,000	16,000
Average Wholesale Price $ per kg round	11.00	9.90	8.25	7.15
Industry Wholesale Revenue $ million	22.0	59.4	99.0	114.4
Direct Industry Impacts to BC [c,d]				
GDP $ million	13.2	35.6	59.4	68.6
Wages & Salaries $ million	4.4	11.9	19.8	22.9
Employment PYs	110	295	495	570

[a] Possible production scenarios 20 years from now. All prices and values aare expressed in constant, inflation-adjusted year 2001 dollars Canadian.

[b] Production would be sold mostly in frozen, dressed head-off form, (the conversion factor from round to dressed, head-off is approximately 0.67).

[c] Direct impacts based on assumed cost structure: 20% labour, 40% for capital return of interest, depreciation, pretax profit, 20% feed, and 20% other. Sablefish farms will be more capital intensive and less labour and feed intensive than salmon farms.

[d] Total industry impacts – direct impacts plus indirect supplier impacts plus induced consumer respending impacts- would be 1.5 to 2.0 times the direct impact e.g. under the high scenario, the total employment impact would be would be 855 to 1140 PYs of employment.

[e] Assumed $40,000 in wages, salaries, benefits per person-year (PY)

Initially, we see a focus on selling frozen product into Japan to address the supply shortfall caused by declines in US sablefish and Southern Ocean mero catches. At higher levels of production, we see greater penetration into the North American restaurant market. At these higher levels, costs would decline, but so would prices. This is the path of development of the farmed salmon industry.

Direct economic impacts under the four different scenarios are (Exhibit 4):

Scenario	BC Production (tonnes)	BC Revenue ($million)	BC Employment (PYs)
Low	2,000	22.0	110
Mid Low	6,000	59.4	295
Mid High	12,000	99.0	495
High	16,000	114.4	570

The bulk of farming and economic activity would likely occur on Vancouver Island. In addition to direct industry effects, income and jobs will accrue to feed, equipment, and other suppliers and to the retail sector through the respending of wage incomes earned.

The revenue projections depend on how the farmed sablefish industry proceeds in the rest of the world (see below).

Impacts on the Wild Fishery in British Columbia

Unlike the situation in halibut culture, British Columbia is the world leader in sablefish culture. If the farmed sablefish industry develops in BC, the technology likely would be transferred to other countries. British Columbia would still have a significant lead. If the industry does not develop in BC, for example, due to an unfavorable regulatory climate, the development of sablefish aquaculture in other countries would be delayed but not arrested. Over the next 20 years, we see the British Columbia having a 50% + market share of world farmed sablefish production.

In contrast to the halibut situation, the wild industry will have little room to adapt and improve quality. It already produces an excellent product. However, the wild fishery could sell live fish to local and short-haul markets

The wholesale value of the wild sablefish fishery in BC is about $30 million annually. We see the price of wild sablefish dropping by up to 40% under the scenarios presented, but only half of this decline, or 20% could be attributable to the development of the BC industry alone. The main result of this price decline to wild producers would be lower returns to commercial license holders and crew (if they are paid on a share of catch value basis). The purchase price and lease cost of quotas also would decline. But, direct industry employment impacts should be minimal as the same amount of fish will be caught and processed e.g. the main impact to the wild fishery would be an income loss and not a job loss.

3.0 TECHNICAL AND REGULATORY CONSTRAINTS

This section outlines the technical and regulatory constraints that could inhibit the ability to meet the market demand projected in Section 2. First the current status of culture initiatives for halibut and sablefish in BC are discussed.

3.1 CURRENT STATUS OF BC INITIATIVES

The challenge in farming fish is to replicate the life cycle in captivity (called "closing the rearing cycle"), and at a cost that allows the fish to be sold at a profit. The two main life cycle components are the hatchery phase – broodstock holding and spawning, egg incubation and larval development, and rearing to a juvenile size- and the growout or farming phase from juveniles to market-ready adults. Typically, the hatchery phase provides the more daunting challenge in the growth cycle. This is particularly true for flatfish, such as halibut, that undergo metamorphosis.

The culture or farming of Pacific halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*) are at different stages of development in British Columbia.

Farmed Halibut

The Pacific Biological Station has spawned and reared wild Pacific halibut, bringing 23 larvae through metamorphosis to the juvenile stage. However, there are no halibut hatcheries in British Columbia. The rearing cycle is not closed for the culture of Pacific halibut as farmed broodstock have not been developed.

In contrast, the rearing cycle has been closed for the culture of Atlantic halibut, a similar species for which scientists feel the technology should be directly transferable to Pacific halibut. For example, Scotian Halibut in Nova Scotia has developed their own broodstock, own and operate a hatchery, and own and operate a (land-based) growout facility. There is opportunity for the transfer of Atlantic halibut rearing technology to British Columbia.

Some commercial halibut fisherman in BC have caught wild halibut under commercial licenses, held them in pens, fed them, and then sold them when the commercial fishery was closed. Apparently, mortalities were minor but weight gain was also minor with the type of feed used.

Farmed Sablefish

Island Scallops Ltd. on Vancouver Island has a license to collect wild sablefish and from these fish have developed their own sablefish broodstock. The company hatches and rears sablefish to the 5-10 gram size at which time they are sold to several operators for growout to market size. Many of these fish will be going to market in 2002.

The Kwakuitl Nation Development Corporation has just launched a sablefish hatchery using dry land tanks near Nanaimo. The company plans to have 5-10 gram juveniles for sale in the summer of 2002. Another company, the Blackfin Partnership, is also planning a hatchery and growout facility.

The sablefish rearing cycle therefore is closed, and the technical aspects of the culture of sablefish is more advanced than for halibut in British Columbia.

Some salmon farmers have experienced juvenile sablefish entering their net pens, growing rapidly when fed in conjunction with the salmon, and then becoming too large to escape through the pen webbing. Farmers report that these "pen-held" sablefish appear to be hardy and resistant to disease.

3.2 TECHNICAL CONSTRAINTS

A number of technical constraints exist.

Closing the Rearing Cycle for Halibut. The rearing cycle for Pacific halibut needs to be replicated in an aquaculture environment. This process likely would be facilitated through negotiating a technology transfer agreement with Scotian Halibut or European interests.

A Sensitive Hatchery and Larval Stage. In the wild, halibut and sablefish both spawn and spend a significant part of their early life cycle in deep water. The eggs of both species are very small and more delicate relative to salmon and experience significantly higher mortalities. A challenge to the farming industry for both species will be to keep mortalities and associated costs of juvenile rearing down.

Land-based Systems for Halibut. Halibut appear not to be suited for sea pen-growout, at least over the near to medium term. Halibut need surface area not volume because they lie flat near the bottom. They require more rearing space than salmon. Increased depth provides little benefit. Most, if not all Atlantic halibut production to date has come from on shore systems e.g. the Scotian Halibut operation.

Land-based rearing systems typically are more expensive than seapen-rearing systems. But Scotian Halibut indicate that disease is less a problem and antibiotics are not needed i.e. land-reared fish can be marketed as "organic". There is also the opportunity to control water temperature and therefore fish growth in a land-based system.

Feed Formulation and Growth Rates. Feeds suitable to halibut and sablefish species will need to be developed and adapted. There may be potential to use plant protein feeds instead of fish meal feeds, especially for sablefish which has a varied diet in the wild.

The feed conversion ratios or FCRs of both species, at 1.1 or less, are excellent and better than salmon (the FCR for halibut is for a land operation).

The slow growth of halibut is a problem. The age of recruitment to the wild fishery of a 4.5kg dressed head-off Pacific halibut is about eight years. Growth to this size for farmed Atlantic halibut takes about half this time or four years (Forster, 1999). In contrast, sablefish grows quickly during its early years. Sablefish farmers report that the fish reach a weight of 1kg within one year and a weight of 3kg within two years.

Disease. A variety of diseases or parasites, such as sea lice, could create problems.

Shortage of Expertise in BC. There are only three or four people in the province who have the expertise to culture sablefish, and even fewer people are familiar with culturing halibut. This narrow talent pool could create a constraint to industry expansion.

3.3 REGULATORY CONSTRAINTS

A number of regulatory constraints exist.

The Lack of a Provincial Finfish Aquaculture Policy. The Province of British Columbia does not have an aquaculture policy for finfish other than salmon. There are 121 licensed farmed salmon sites in the province; of these about 90 are active. Finfish species other than salmon can be grown at these sites but no stand-alone halibut or sablefish sites are presently allowed. This is the main impediment to the development of a non-salmonid finfish aquaculture industry in the province.

Apparently, the Province is considering a Request for Proposal (RFP) process for allocating new stand alone sites for halibut and sablefish. The average active farmed salmon site in the province produces about 500 tonnes of production annually. This would suggest that up to 50 new licensed sites might be needed over the next 20 years.

However, there is no provincial restriction on the development of land-based sites. If as seems likely, any halibut farming in the near term proceeds on land, then the demand for seapen sites would be only 30 sites (assuming 500 tonnes per site).

The High Costs of Obtaining a Site. Under the RFP or other permitting processes, the Province will likely require an environmental survey, public consultation and a public meeting held, and fees paid for a proponent to obtain a site. The total cost of these processes could easily exceed $100,000 per individual site.

Costs of Monitoring and Enforcement. It is likely that special monitoring and enforcement activities, especially on broodstock capture, environmental practices and product shipments, will need to be implemented. For example, the wild fishery has minimum size restrictions: about 4.5kg for halibut and 1kg for sablefish. The farmed halibut industry may wish to sell product at weights below this threshold. Every wild halibut sent to market is tagged. A farm identification or tag system may be needed for farmed halibut shipments using independent validation/verification.

Harmonization of Federal and Provincial Agencies. Federal and provincial requirements need to be better harmonized to facilitate the development of the industry.

4.0 SOME LESSONS LEARNED FROM FARMED SALMON

The development of the farmed salmon industry in British Columbia and elsewhere offers several important "lessons learned' for the culture of other finfish species. These lessons cover a variety of topics including market role, technical improvements and cost reductions, and environmental sustainability. We offer seven lessons below:

Lesson 1: All new aquaculture species start as niche products. Some remain as niche products, others eventually serve the mass market. It is difficult to predict the ultimate market role.

Farmed salmon started as a novel and high priced food product. Today it is a mass market protein source that competes with chicken and wild salmon in the marketplace. Farmed salmon became a mass market staple though: a lower price/cost of juveniles, lower feed conversion ratios (FCRs), genetic improvements, vaccine development, production improvements, etc. These efficiencies significantly lowered the cost of production and lowered the industry's break-even price, and therefore expanded the market potential. The development of the farmed salmon industry took longer and cost more than any of its proponents expected. However, once the key technical hurdles were overcome, production increased quickly (Forster, 1999).

Lesson 2: It is important for the wild fishery to anticipate and not to ignore, the development of the farmed finfish industry. The wild fishery can enact quality improvements, branding and other measures to differentiate its product.

Generally, the wild salmon industry of North America did not try to differentiate its products when the farmed salmon industry started. The result was a 50% + decline in the price for wild salmon. One exception is the development of the wild Copper River salmon brand in Alaska, one of the most powerful in the food industry today.

Lesson 3: The quality of farmed finfish will raise the quality expectations of buyers in the wild fishery.

Many seafood buyers purchase both farmed and wild salmon and are well acquainted with the quality differences between the two. The quality standards of wild salmon of 15 years ago are no longer acceptable today. The development of a farmed halibut industry will raise quality expectations for wild halibut. In fact, this process is starting to occur in the Eastern US and European markets.

Lesson 4: Japan will buy farmed fish.

Chilean farmed coho has made significant inroads into traditional wild salmon markets in Japan. Japan has always been very quality conscious for food products. However, increasingly both price and quality have become decision criteria for seafood sales to Japan.

Lesson 5: It is a difficult to restrict or control the spread of aquaculture technology.

Aquaculture technology for farmed salmon sped quickly around the world. At the same time, capital is mobile. During the 1990s there was a strict moratorium on new salmon sites in BC and many BC farmed salmon companies and their European parents invested in aquaculture ventures in South America and other parts of the world.

Lesson 6: The impact of the farmed product on the wild fishery depends on the role (quality, season, product form) of the wild product in the marketplace.

Farmed salmon filled a fresh market niche because the four month wild salmon fishery did not meet latent consumer needs for year–round availability for fresh salmon. In contrast, the BC halibut fishery is an eight month fishery, and the BC sablefish fishery operates year round. For both species, there is not the same market gap or opportunity that existed for salmon.

Lesson 7: For a farmed product to be sustainable economically in the long run, it will need to be sustainable environmentally as well.

The salmon farming industry in BC and elsewhere is constantly being challenged and prodded to operate in a better manner. As a result, significant improvements have been made. However, the environmentally standards of society as a whole are constantly rising, the sea pen rearing of finfish is a contentious issue, and the marine environment has many alternate values and uses. To meet recognized criteria for responsible aquaculture, environmental assessment processes should take place prior to the implementation of commercial culture of new aquaculture species, such as halibut and sablefish (Archipelago Marine Research, 2001). The finfish culture industry would be well advised to not only meet today's environmental standards, but also to anticipate what they are likely to be in the future. At the same time, there are market opportunities related to the perceived environmental sustainability of farming practices.

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Appendix A

List of Interviewees

Exhibit A.1: List of People Interviewed

Name	Affiliation	Location
Anderson, Jim	University of Rhode Island	Providence, USA
Austin, Jamie	Blackfin Partnership	Qualicum Beach, BC
Beamish, Dick	Pacific Biological Station	Nanaimo, BC
Bowles, Lawrie	Kwaikiutl Nation Dev. Corp	Pt. Hardy, BC
Chiong, Jimin*	Oakridge Fish Market	Vancouver, BC
Clark, Rob*	C Restaurant	Vancouver, BC
Clarke, Craig	Pacific Biological Station	Nanaimo, BC
Clayton, Lorne	Live Marine Fish Research Society	Victoria, BC
Egan, David	PriceWaterhouse Coopers	Vancouver, BC
Hamer, Mike*	Kelsey Seafoods	Lantzsville, BC
Herrmann, Mark	University of Alaska	Fairbanks, USA
Hicks, Brad*	Taplow Feeds	Surrey, BC
Jennings, Michelle*	Stolt Seafarms	Connecticut USA
Knapp, Gunnar	University of Alaska	Anchorage, USA
Mauriks, Kim	Seafood 4 Life Products Inc	Nanoose Bay, BC
McFarlane, Sandy	Pacific Biological Station	Nanaimo, BC
Minkoff, Gidon	Blackfin Partnership	Parksville, BC
Mirau, Brad*	Aero Trading	Prince Rupert, BC
Morimoto, Tak*	Pioneer Food Corp.	Los Angeles, USA
Nagle, Charlie*	Nagle Fisheries	Boston, USA
Nordmann, Jorn*	SM Products	Delta, BC
Nuez, Fernando*	Stolt Seafarms	Seattle, USA
Olsen, Erling	Leader Fishing	Delta, BC
Saetren, Arne*	Omega Salmon	Campbell River, BC
Saunders, Rob	Island Scallops Limited	Qualicum Beach, BC
Sporer, Chris	Pacific Halibut Mgmt Association	Burnaby, BC
Stewart, Neil*	Stolt Seafarms	Campbell River, BC
Swim, Peter	Scotian Halibut	Nova Scotia
Tekeda, Ken*	North Sea Products	Vancouver, BC
Tipton, Blake*	SM Products	Delta, BC
Tojo, Hidekazu*	Tojo's Restaurant	Vancouver, BC
Van Grootel, Herb	Double Dutch Fishing	Delta, BC
Turris, Bruce	Canadian Sablefish Association	New Westminster, BC
Webb, Allison	OCAD	Ottawa, Ontario

*Seafood Buyers or Marketers