ALASKA LEGISLATURE COMMITTEE FILES 1987-1988 8672
5005 HRES SB 112 577

KLUKWAN FOREST PRODUCTS, INC.

P.O. Box 34659 · Juneau, Alaska 99803-4659 · 907-789-7104 · Fax: 907-789-0675

April 27, 1988

Alaska State Legislature
Representative, Sam Cotton
Pouch V
Juneau, Alaska 99811

The Honorable Sam Cotton:

The bill seems to be adequate in intent, and in most subject areas, but interpretations, unless clarified, could make it a difficult bill to pass, or to implement.

It must be kept in mind that the intent of a Forest Management Agreement is to create a cooperative public/private climate for the benefit of the people and the resources of the State. This is a concession to a private party wherein the State delegates activities, but not responsibilities of ownership. It is not necessary, therefore, for the State to seek third parties to undertake planning or other activities. The State (and public) has, by law and practice the ultimate review and approval of any plans developed to implement such a forest management contract.

Some specific clarifications, through rewording, while continuing drafter's apparent intent are:

(Note: words in parentheses are to be deleted, capitalized words are to be added.)

Page 1, Section 1 (b)(2) (relieve the State of some of the financial burden of developing and managing a timber sale;) CREATE FUNDING EFFICIENCY BY SHIFTING SOME BURDENS OF PLANNING, DEVELOPING AND MANAGING FOREST RESOURCES OWNED BY THE STATE OF ALASKA FROM PUBLIC TO PRIVATE ENTITIES, WITHOUT THE STATE LOSING OWNERSHIP OF ITS LANDS OR ULTIMATE CONTROL OF THEIR PRODUCTIVE CAPABILITIES.

Page 1, Section 1 (b)(3) provide for the long-term management of State timber AND RELATED FOREST RESOURCES, providing stability for the forest products industry, and incentives for the responsible use of State (timber) FORESTLANDS; and

Page 2, Sec. 41.17.510 (3) the FOREST RESOURCE utilization standards proposed by the bidder.

Page 5, 41.17.540 (c)(1) DELETE THIS PARAGRAPH. Reason: This is an open-ended, one-way clause, that has no place in a two-party contract of the nature herein contemplated. The state already has police power to enforce laws, and the forest management contract will have clauses for termination in the event the clauses are not adhered to. The state, through the courts, may assess punitive fines against a private party, if it is proven that a law is broken, and the court can, under law and rules assess costs. This proposed clause is evidently a result of and an attempt to emulate agreements between Akyeska Pipeline Service Co. (and other non-renewable resource transportation type endeavors) which agreed to pay for monitoring during construction. There is a vast technical and philosophical difference between those type of activities, and a two-party agreement wherein one party agrees to be an agent for another, and the final contract is based on mutual trust.

(2) (compensate the State for the) PAY FOR RECOGNIZED AND MUTUALLY AGREED UPON THIRD PARTY scaling services required to account for the timber (sold) HARVESTED.

SEC 41.17.550. (a) At any time between the 5th and (10th) 15th year of an agreement ...

Page 6 (1) The term of the agreement does not exceed (the term of the initial agreement) 20 YEARS FROM THE BEGINNING OF AN AGREEMENT OR THE BEGINNING OF AN EXTENSION OF AN AGREEMENT.

Page 6. Delete (b) line 15, and (b) (2) line 18-22 -- Then redesignate paragraph (b)(1) as (a)(4) and paragraph (b)(3) as (a)(5).

Sincerely,

William Thomas
Lobbiest

WT:skw

Susitna Valley Association
9600 Slalom Drive
Anchorage, Alaska 99516
346-1943

Testimony of Loisann Reeder

Forest Management Agreements Bill No. SB 112
Before the House Resources Committee
April 26, 1988

My name is Loisann Reeder. I am president of the Susitna Valley Association. The SVA is a broad-based group of individuals, businesses, and organizations formed primarily to comment on the proposed Susitna Valley timber sale which will affect all members of the association. Our current mailings to individual members, member businesses, and affiliate organizations reaches over 15,000.

The Susitna Valley Association has some serious concerns regarding the Forest Management Agreement bill.

(1) First, and foremost, **we have serious reservations regarding the Forest Management Agreement concept, in general**. This concept is best applied to state forests and private lands where the primary use is devoted to forestry. Most lands in Alaska are public lands and are designated for multiple use. For instance, in the Susitna Area Plan, in every sub-unit where forestry is designated as a Primary Use, it shares that designation with at least two other Primary Uses. No where in the Plan is forestry the **only** designated use. The FMA concept does not allow for adequate consideration of these other uses. The emphasis and focus is strictly on forestry.

Another concern about the FMA concept, is that long term contracts take the land out of public ownership, and place it in the hands of a private corporation. These are public lands, and public agencies should be managing them. We cannot expect a private corporation whose goal is to make money from the harvest of trees, to be sensitive to the other multiple uses of that land.

(2) **Our second concern is in regards to private property.** The FMA concept being proposed gives no consideration to private properties located within, or adjacent to, the sale areas. Again, we are not dealing with a state forest. We are dealing with multiple-use lands that includes "settlement" as one of the uses. The private properties are not "inholdings". They are one of the multiple uses of the area as determined by the state, and sold to individuals by the state for recreational use and/or permanent residences. For instance, within the area under consideration for the Susitna Valley timber sale, there are over 5000 private parcels. This is quite a sizable community and the state surely must expect those property owners to demand some say in what happens in their backyard.

Therefore, we believe the two following concerns should be included in any timber sale which the state might propose, and certainly should be a consideration for any forest management agreement.

(1) The state should notify the private property owners within and adjacent to a proposed sale area and give them adequate time to comment. The names and addresses can be easily obtained from the respective borough tax office. The borough will even supply mailing labels for a minimal charge.

The Recreation Rivers Bill, HB93, which is currently being addressed by the Senate, has a similar notification clause such as we are suggesting.

(2) Actions should be taken to lessen potential negative impacts on private properties that a large-scale clearcut logging operation would present. Possible ways the latter could be accomplished would be to allow half-mile buffers around subdivisions, Open-to-Entry areas, and lodges. Areas where there are extensive private properties could be removed from the sale proposal entirely. This would help "sustain the characteristics of the region that attracted people to the area", a recognized goal of the Susitna Area Plan, and also would provide the necessary supply of wood for personal use harvest.

(3) Our third concern is that **the FMA concept, as proposed, gives too much power to one department (DNR), and to one individual (the Commissioner of DNR)**. The Departments of Fish and Game and Environmental Conservation would only have the right to "review" any timber harvesting plan. The Commissioner of DNR would only have the obligation to "consult" the other two departments on what DNR had decided to do. Even if the Departments of Fish and Game and Environmental Conservation were totally negative on the plan, they would not necessarily have any power to stop, or reasonably change, the plan. Since the state would be dealing with multiple-use lands, it is imperative that all three departments be equally involved in formulating and approving (or disapproving, as the case may be) the FMAs.

(4) Our fourth, and probably most important, concern at this point, is that **the community has a right to be involved in the public review process on an issue such as this**. We cannot adequately respond to something this complex when we just received the proposal twelve hours before the hearing. The Susitna Valley Association has numerous organizations, businesses, and individuals in its membership that are all directly impacted by this legislation. It is important to have adequate time to get this material dispersed, analyzed, and responded to. Neither the legislature nor the public will be able to do justice to the public process in attempting to deal with this bill in the few days left in this session. A similar lack of opportunity to have reasonable public input and comment last fall is the very type of situation that resulted in the formation of our organization. We would appeal to you to slow down, get more input from the individuals and agencies involved, and start with a new bill next year if that is still what people want.

I appreciate the opportunity to speak to you today and I will be pleased to answer any questions you may have.

Alaska Center for the Environment

700 H Street, Suite 4 • Anchorage, Alaska 99501 • (907) 274-3621

April 28, 1988

Rep. Sam Cotten
PO Box V
Juneau, AK 99811

Attn: Lisa Weissler

Re: SB 112

Dear Rep. Cotten:

The Alaska Center for the Environment appreciates the opportunity to comment on the 4/25/88 draft of SB 112. Attached please find handwritten suggestions on language which indicate some of our concerns. ACE remains opposed to the concept of private management of public lands for single, intensive, industrial uses. We are especially concerned about the fact that the present draft would allow for non-competitive bidding and subjective bidder selection by the commissioner of DNR. Competitive bidding and objective, defensible bidder selection is a cornerstone of the public bid process.

A brief summary of our concerns as expressed in my testimony before the House Resources Committee on April 26 on behalf of the Alaska Environmental Lobby, follows:

-This bill is premature in view of the present study regarding the Susitna Valley Timber Sale and the Governor's committment to review the Forest Practices Act.

-FMA's compromise the public review process.

-The "multiple variable bid process" is inappropriate.

-Planning is inadequate and inappropriate.

-Impact analysis by the state should be required.

-Long term contracts compromise the state's ability to enforce contract requirements and environmental laws.

Please call if you have any questions or comments.

Sincerely,

Alan Phipps

Alan Phipps

Alaska Center for the Environment
700 H Street, Suite 4 • Anchorage, Alaska 99501 • (907) 274-3621

Section 1. PURPOSE

Line 12, after "recreation improvements" add "and fish and wildlife habitat protection"

Line 12, delete "efficient"

Line 13, delete "effective"

Line 18, delete all of item (2)

Line 26, "compliance with existing and future state laws..."

Sec. 41.17.500

Line 3, delete "after consultation with" and add "with the concurrence of"

Sec. 41.17.510

Delete entire section. Replace with language requiring preparation of plans by the state and establishing a competitive bid process.

Sec. 41.17.520

Lines 27, 28, 29, delete "If a land use plan ... more than 1,280 acres"

Page 3, Lines 1, 3, 4, "management" plan should be called "master" plan to not be confused with management plan prepared by state.

There needs to be added language requiring Area Plan and step-down management plan prepared by state prior to bid process.

Alaska Center for the Environment

700 H Street, Suite 4 • Anchorage, Alaska 99501 • (907) 274-3621

Sec. 41.17.520 (cont.)

Page 3, Items (1), (2), (3), (4), and (7) should be prepared by the state

Sec. 41.17.530

Here, or elsewhere, the public process should be expanded to include public review and comment prior to the Request for Proposals, prior to selection of the bidder, and prior to signing the finalized contract.

Sec. 41.17.540

Line 18, revise as follows, "except that the commissioner [contractor] may limit access..."

Line 19, revise as follows, "...conditions exist, subject to public review and comment."

Line 24, revise as follows, "... within 300 feet of rivers, lakes, and streams, including feeder streams, to provide..."

Page 5, Line 6, revise as follows, "and reforestation [regeneration] of timber..."

Sec. 41.17.550

Page 6, Line 13, delete "substantially"

Alaska Center for the Environment
700 H Street, Suite 4 • Anchorage, Alaska 99501 • (907) 274-3621

Section 41.17.560

Page 7, Line 9, item (2)(B), implies that changes can be made to the initial agreement, yet I find no provisions in this draft for how changes are made. Any changes should be subject to public review and comment.

Line 12, item (3), additional silvicultural treatments should be subject to public review and comment and concurrence with the DEC commissioner.

Section 41.17.540

Line 7, revise to read "not to exceed 5 [20] years..."

Miscellaneous Comments

- Environmental, Social, and economic impact studies of a proposal should be required to be prepared. These studies should be done by the state, and should include the negative impacts.

STEVE COWPER, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION
OFFICE OF THE COMMISSIONER
P.O. BOX O, JUNEAU, ALASKA 99811-1800

Telephone: (907)
Address:
(907) 465-2600

April 28, 1988

The Honorable Sam Cotten
Co-Chairman, House Resources Committee
PO Box V
Juneau, AK 99811

Dear Representative Cotten:

We have reviewed the proposed committee substitute for SB 112 that was distributed on Tuesday. We have a few comments.

At page 1, line 10, the words "forest products" should be inserted before the work "plant" to clarify the intent of the requirement.

At line 15, subsection (b) should be amended by changing the word "may" to "will."

A new subsection (c) should be added before item (2) to say "A forest management agreement may . . . ." This change is necessary to make it mandatory that the forest management agreement "provide for equal consideration of other existing beneficial uses of forest land."

Subsection (b)(2) at line 18, the words "financial burden" should be changed to "administrative responsibility."

Subsection (c), at line 25, should become subsection (d) and the wording should be amended as follows:

> (d) The provisions of this Act do not [permit] affect an operator's obligation to comply [to avoid compliance] with state laws or regulations affecting environmental conservation, timber practices, fish and game, or any other resource or use of a resource.

On page 2, at line 7, the agreement should also be required to be consistent with the Alaska Coastal Management Program. In addition the section should require any agreement to be consistent with the purposes in Section 1. This would ensure that the codified, operative sections of the statute reflect the commitment to equal consideration of other existing beneficial uses and to continued obligations under other state laws or regulations.

On page 3, at lines 1-4, review and approval steps for a plan proposed by a bidder should be added. Public involvement is essential.

On page 3, at line 16, the words "water quality" should be added after the words "public recreation."

On page 3, at line 23, it would seem appropriate to describe the content of the operating plan.

On page 3, line 27 should be revised as follows:

> The finding and all <u>operating and management</u> plans shall be <u>submitted for</u> review[ed] by the commissioners of the Departments of Environmental Conservation, Fish and Game, and Commerce and Economic Development.

On page 4, at line 29, a new subsection (10) should be added, to read as follows:

> (10) Specific mitigating measures and monitoring plans to protect water quality;

The following sections would then be re-numbered.

I appreciate the opportunity to comment.

Sincerely,

~~Dennis~~ D. Kelso
Commissioner

From: NRSCFMI --JDCVM1 Date and time 04/28/88 09:17:32
To: NA GMBI --JDCVM1

FROM: FRANK MIELKE
DIV. OF LAND & WATER MANAGEMENT
DEPT. OF NATURAL RESOURCES
SUBJECT: John Galea and Larry Ostrovsky, SB 112 language

1)Bid process regulations: add as (c), line 27, p. 3 : (c)prior to requesting any bids or accepting applications, the commissioner shall adopt regulations detailing the bidding procedure and the method of determining the most qualified bidder.

2)Notice- add as 41.17.525 Notice of proposed agreement. In addition to the requirements of AS 38.05.945, the commissioner shall , after consulting with the commissioners of fish and game, environmental conservation, commerce and economic development and affected municipalities, but prior to the development of a 5 year operating plan or an annuyal harvesting plan, publish notice as required by AS 38.06.945, and hold at least one public hearing on the proposed agreement.

3)Public involvement - add to 41.17.550(a)(1), line 3, p 6, after the word excedd, the phrase "...a term of years equal to..." so that (1)reads:"the tern of the extension does not exceed a term of years equal to the term of the initial agreement."

4)Plans-on page 6, 41.17.550 (a) and (b) - delete (b), change (b)(1) to (a)(4) and change (b)(3) to (a)(5); delete (b)(2).

5)Compensation - One page to add to 41.17.520(b) at the end of the first sentence add a new sentence: "If the commissioner determines that the operating or harvesting plan is inadequate, the commissioner may require the operator to revise the plan or may require the preparation or revision of plans at the expense of the operator, either by department staff or by a third party."

Also on page 3, beginning with line 1, delete the word "submit" with the words "provide for the preparation of, at his own expense, by a third party or by department staff,"

Also on pa. 5, line 11, delete the words "compensate the state" and replace with the words "enter into a reimburseable services agreement"

Also add as (4), line (20):(4)The commissioner of administration shall separately account for money received under this section that the Department of natural resources deposits in the general fund. The annuyal estimated balance in the account may be used by the legislature to make appropriations to the department tro carry out the purposes of this section.

6)Municipal involvement - one page 3, line 29 add the words "and a municipality if the land is within its boundaries". Also same language on page 6, line 11 and page 2, line 4.

7)Conform with existing and future laws - Add to 41.17.540, top of page 5 as (11)terms and conditions requiring the compliance with any and all laws, regulations and ordinances existing at the time or subsequently enacted.

Change (11) to (12)

8)Purposes - page 1, (b)(2), lines 18 and 19, change to read (2)provide for thge shifting of some or all of the financial burdens of the costs associated with the preparation, development and management of a timber sale.

9) Small operators, p. 5, lines 17-19, add at end: "A small operator is a timber business which (a) employs 25 or fewer employees; (b) is not owned, in whole or in part by the timber operator and (c) is not controlled by contract or agreement by the timber operator.

10) Plans have been defined in an earlier memo done by Dave Wallingford. I'll send again to be sure. Definitions of land use plans are contained in 11 AAC 55 (should forward copies of proposed amendments to 11 AAC 55 to HRes).

After you get a chance to look these over, call if you things we should change.&

762-2692

1003 B Street
Juneau, Alaska 99801
Tel. 586-4409
28 April 1988

✓Representative Sam Cotten, &
Representative Adelheid Herrmann,
Co-Chairs
House Resources Committee
Alaska State Legislature
P.O. Box V
Juneau, Alaska 99811

RE: CSSB 112

Dear Representatives Cotten & Herrmann:

I would like to suggest certain features to be included in a draft CS for CSSB 112 now under consideration in the Resources Committee. I will limit my suggestions to matters of stumpage revenues, regional economic development, and industrial structure.

As currently drafted (Work Draft 5-0567N, Bradley, 4/25/88), the CS does not address problems of monopolization by an FMA holder. This could occur immediately upon establishment of an FMA if the region's entire annual allowable cut (AAC) were committed to the FMA. More likely would be the gradual development of a monopoly if the FMA holder were allowed to bid on regular state timber sales in the region. The FMA holder in this case could buy out other mills, and/or outbid other state timber sale bidders until they went out of business or were effectively marginalized. This would make it very difficult for a region to produce timber products for its own market, let alone try to develop its ability to replace imports with locally-produced timber products, or to venture into exports of products not produced by the FMA holder.

It should be recognized that the regional dominance of an FMA holder, enjoying a long-term assured supply at favorable prices, may present difficulties for other local operators, with negative implications for public policy as regards regional economic development and public revenues. The following are suggested as minimum protections against these effects.

The planning for an FMA should determine a maximum percentage of the region's AAC that could be allocated to the FMA, and assure that sufficient, potentially accessible timber remained for other existing and potential local uses. The FMA holder should not be allowed to bid on state timber sales held off the FMA; the FMA holder would, however, be allowed to purchase logs or other timber products from non-FMA operators cutting on regular state timber sales. This would help to preserve competition, prevent excessively depressed stumpage prices and revenues, reserve a supply for local operators, and allow for market-derived determination of stumpage rates. This planning and determination of maximum percentage of AAC should be done by the state; it might best be incorporated into the draft CS as a new subsection (c) under Sec. 41.17.520 PLANS, on P. 3, after line 22.

In cases where the state will require the establishment of a production or export facility, or expansion of an existing facility, as a condition of an FMA, its maximum capacity should not be allowed to exceed its supply area's AAC less that area's annual projected local demand for timber products at import-replacement levels in each species of timber. Similar limits for round-log export should be imposed. This is necessary to allow survival of an area's local demand-oriented industry and its expansion into import replacement.

The Resources Committee should review and determine the adequacy of existing legislation prohibiting surrogate or "front" bidding for competitive timber sales on non-FMA state lands. If found to be adequate, their application to FMA holders should be noted in the bill; if existing statute is inadequate, the draft should incorporate a new section of safeguards. Without such safeguards, FMA holders could "sponsor" other operators, including their own contract loggers, who could front for them using the market advantage of the FMA's large assured supply of timber at low prices, to outbid others. Non-FMA state timber would then be bought by whichever operator could cut the sweetest deal with the FMA holder, or by operators financially dependent on the FMA holder, not by the most efficient operator, thus severely eroding competition. House Research Agency Report 83-149, p. 3 relates to this problem in Southeast Alaska, and there is evidence of the problem in British Columbia as well.

The justification for FMA legislation is often stated as a need to assure a long-term stable timber supply to a firm at favorable prices, in return for investments in productive capacity. If the committee accepts this argument, it need not necessarily accept that the firm should be subsidized with low-priced public timber in perpetuity, or indeed for any period of time beyond the amortization of the productive capacity that the FMA was designed to encourage. Once the FMA holder's investment is amortized, his dominant position in the region should be sufficient to allow profitable competition with other buyers of state timber, without further subsidy. The bill should include a requirement that the transactional evidence stumpage appraisal method be used to determine the floor price for negotiation of stumpage after the original term of the FMA (not more than 20 years) has expired.

On the matter of the term of the FMA, the current draft's extension provisions are unnecessarily liberal, considering the dominant position an FMA operation will enjoy after the 20-year original term. Five year extensions contingent upon satisfactory performance would be adequate, not renewals of the 20-year term every five years.

These suggestions should not be construed as approval of the FMA concept or of other features of the CS. Nevertheless, I appreciate the opportunity to participate in trying to improve this legislation.

Sincerely,

John Dunker

cc: Members, House Resources Committee
Representative Niilo Koponen

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER

STEVE COWPER, GOVERNOR

400 WILLOUGHBY AVE.
JUNEAU, ALASKA 99801-1796
PHONE: (907) 465-2400

May 5, 1987

The Honorable Adelheid Herrman, Co-Chairman
House Resources Committee
Alaska State Legislature
P.O. Box V
Juneau, Alaska 99811

Dear Representative Herrman:

Subject: SB 112 - An Act Relating to Forest Management Agreements.

Response: The Department supports this bill.

Discussion: The idea of private management of public lands for commercial development is a good one. Such an agreement with a timber operator could provide savings to the State and reduce manpower needs, while at the same time providing a long term commitment of timber to private enterprise.

Please contact me should you need any additional information on this proposed legislation.

Sincerely,

Judith M. Brady

Judith M. Brady
Commissioner

cc: Senator Jones
Senator Sturgulewski
Committee Members
George Sullivan
Rod Swope

10-J9LH

STATE OF ALASKA 1987 LEGISLATIVE SESSION
FISCAL NOTE

Bill Version :
Publish Date :

REQUEST:

Revision Date: 3/5/87
Title : An act relating to Forest Management Agreements
Sponsor : Jones
Requestor : House Resources

Agency Affected : Natural Resources
BRU : Forest Management

Components :

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	-0-	-0-	-0-	-0-	-0-	-0-
CAPITAL	-0-	-0-	-0-	-0-	-0-	-0-
REVENUE	-0-	-0-	-0-	-0-	-0-	-0-

FUNDING: (Thousands of Dollars)

GENERAL FUND						
FEDERAL FUNDS						
OTHER						
TOTAL	-0-	-0-	-0-	-0-	-0-	-0-

POSITIONS:

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS : (Attach a separate page if necessary)

An agreement with a timber operator could provide savings to the State and reduce manpower needs, while at the same time providing a long term commitment of timber to private enterprise.

Prepared by : James L. McAllister
Phone : 465-2491
Division : Forestry
Date : 5/5/87

Approved by Commissioner : [signature]
Date : 5/5/87
Agency : Natural Resources

Distribution (by preparer):

- Legislative Finance
- Legislative Sponsor
- Requestor
- Office of Management and Budget
- Impacted Agency(ies)
- Senate Secretary

MEMORANDUM

TO: HOUSE RESOURCES COMMITTEE:
CO-CHAIR REP. ADELHEID HERRMANN
CO-CHAIR REP. SAM COTTEN

FROM: REP. NIILO KOPONEN

DATE: 14 APRIL 1987

RE: CSSB 112 (RES) am / HB 141 (Forest Management Agreements)

I wish to express some concerns I have regarding this bill, and to urge you to postpone scheduling it. This measure would enact radical and far-reaching changes in the way the state's timber lands are managed and timber rights conveyed.

SB 112 grants broad powers to the Commissioner of Natural Resources to negotiate with purchasers the rights to harvest public timber. No time or area limits are placed on these Forest Management Agreements (FMA's) in the bill, and the Commissioner responds to industry proposals rather than planning and initiating management of the state's forest lands in accordance with the various needs of the affected public or broader public policy. Stumpage amounts (the timber revenues) would be negotiated, not competitively determined; no formula or method for this is prescribed.

I think it is evident that larger and better-financed companies will be better able to prepare proposals for FMAs, and once the FMA is in place they will have an even greater competitive advantage over existing smaller, local logger/mill operators. Not having to pay competitive prices for their stumpage, they will then be able to out-bid local firms for timber sales that may occur outside of the FMAs. Their long-term, large-area timber rights could also serve as financing collateral to permit them to simply buy out smaller operators. This pattern of consolidation and concentration has been the case in large areas of British Columbia, one of the jurisdictions that served as models for the FMA concept in this bill. Once this pattern is established, there is no longer an effective market determination of stumpage values, and the state loses its ability to determine fair value for its forest resources. This is also well documented in B.C.

State Forests are not exempt from this bill. Before acting on it, I believe we should determine what effect it would have on the management planning process now underway for the Tanana Valley State Forest and due for completion later this year. Whereas this process includes consideration for adjacent and affected land owners, such as native corporations and municipalities, no such process is provided for in this bill. Several groups of rural residents, recreationists, village councils, and native corporations have registered opinions about timber development, coordination of state and private timber sales and preservation of fair market prices for timber, road and trail access, and other matters in the Tanana Valley State Forest. How will these be addressed if industry does the planning via FMA proposals?

These are but a few of my concerns about this bill, which in two pages creates the potential for a great many threats to the public interest, to say nothing of its possible flouting of the Alaska Constitution by allowing harvest in excess of sustained yield. To compound the legislative-regulatory problem, the bill requires the Commissioner to request proposals from the industry within one year after the effective date.

This superficially simple bill is, in fact, extremely complex. Some jurisdictions where FMAs or similar systems have been tried are engaged in controversy over them; my staff is now collecting information on the experiences of these jurisdictions, but much information remains to be received. What I have seen so far is enough to convince me that FMAs require close study and thorough debate, and I would like to be sure that we have more information than is now at hand before we begin this effort.

I have begun informing constituents about this bill and my concerns with it. Due to the complexity of the issues involved, considerable time may be required for them to prepare to inform us of their views.

Thus, for several reasons I feel that more time is necessary to adequately prepare to consider SB 112 / HB 141, and that scheduling it for hearing at this time would be premature.

Ron - avoid the classification process.

HOLD UNTIL - NEXT TIME

Introduced: 2/9/87
Referred: Resources

5-0567A

Coghill - how do we get the state forests into this bill.
If we have to amend the state forest statutes to include SF lands into this management system.
Steve Kailick - strongly disapprove - multiple use, sustained yield, timber strip mining, just give it away to any logger who wants it.
Taylor in the house

IN THE SENATE

BY JONES, STURGELEWSKI and Jim Clark

No meaningful public input - new category - no limit of the amount of land to be handed over to timber operators.

No regulations, no process

SENATE BILL NO. 112

IN THE LEGISLATURE OF THE STATE OF ALASKA

FIFTEENTH LEGISLATURE - FIRST SESSION

A BILL

For an Act entitled: "An Act relating to forest management agreements."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. AS 38.05 is amended by adding a new section to read:

Sec. 38.05.122. FOREST MANAGEMENT AGREEMENTS. (a) Notwithstanding AS 38.05.110 - 38.05.120 and 38.05.300, (amend #1 = consistent w/ land management plans auth. by title 38 then in effect) the commissioner may enter into an agreement with a contractor (amend #2 purchaser) doing business in the state for the sale of timber from state land (including State forests (sugg. J.C.) amendment #3) on which the right to harvest timber has not been specifically prohibited by law. An agreement entered into by the commissioner under this section shall be used to foster the development of the state's forest products industry. In each agreement entered into by the commissioner under this section, timber harvest is the exclusive beneficial use of the land subject to the agreement. (not meant to do away with multiple use) (amend #4 delete; sponsor amend delete)

(b) The commissioner shall establish by regulation requirements for the selection, harvest, and regeneration of timber on state land that is subject to an agreement under this section. (No bid process)

(c) In an agreement for the harvest of state timber entered into under this section, the commissioner may provide for

(1) the term of the sale and an extension of the term; (1,000 years?)

(2) the stumpage prices to be charged for the timber;

(3) incentives to the contractor for the completion of the agreement;

(4) compensation from the contractor for the scaling services required to account for the timber sold; (J.C. we're willing to do this for the state.)

F.P. industry - under - developed -
Negotiated sales rather than reacting to bids } Jones -
Mike Abbott - RDC - projects co-ordinator - issue of forest management agreements
① give commissioner authority
② Sec 2 get started right away

Jim McAllister - DOF - DNR - position paper - support private management of state land, doesn't cover state forests ⊖ fiscal note providing state does not have to pay for roads + incentives

32 million acres north of Yukon

(5) the construction and maintenance of access roads necessary to the harvest of the timber, including the sale of materials from state land for the construction of the access roads;

(6) timber harvest to be at a volume in excess of that permissible under the nondeclining (yield) method of calculating sustained yield; ARTICLE 8 CONSTITUTION

(even flow method) -amendment-

(7) penalties for violation of the terms of the agreement and termination of the agreement;

(8) areas sized to the capability of small (contractors;) purchaser

(9) other terms, conditions, and limitations determined to be in the public interest by the commissioner; and

(10) the preparation of reports determined necessary by the commissioner.

(d) In entering into an agreement under this section, the commissioner shall consider

(1) the economic activity to be generated in the state by the proposed operation of the contractor;

(2) the technical and financial qualifications of the (contractor;) purchaser

(3) the stumpage payments proposed to the state by the (contractor;) purchaser

(4) the experience of the contractor in the state.

(e) The commissioner may SHALL consult with other agencies of the state or with federal agencies when considering an agreement under this section.

* Sec. 2. The commissioner of natural resources shall request proposals for the management of state timber land under AS 38.05.122, as enacted in sec. 1 of this Act, within one year after the effective date of this Act.

Sturgulewski - no interest in development - demand for it - She says she has a constituency who wants to use the land this way.

FMA's - Ontario Canada -

MEMORANDUM State of Alaska

TO: Distribution

DATE: March 16, 1988

FILE NO:

TELEPHONE NO:

THRU:

SUBJECT: Cost of Production Model for Pen Rearing and World Markets for Salmon: Pen Reared Salmon Impacts

FROM: Paul Peyton, Program Manager
Division of Business Development
Department of Commerce & Economic Development

Attached is the final report on Costs of Production. The World Market report is still being worked on due to difficulties in identifying existing domestic markets for Alaska's salmon. This information is not compiled anywhere and must be derived indirectly. The task has proved more difficult than anticipated and the completion date has been moved to March 23.

Please call if you have any questions or suggestions concerning these findings. I have asked the contractors to be available for hearings next week and they will be available the 22nd and later.

PP/1t0138r
Attachment
031688a

COST OF PRODUCTION MODEL
FOR PEN-REARING OF SALMON IN ALASKA
AND CURRENTLY PRODUCING REGIONS

FINAL REPORT

Prepared for:
State of Alaska Department
Department of Commerce
and Economic Development
Juneau, Alaska

Prepared by:
The DPA Group Inc.
In association with
Hatfield Consultants Ltd.
and Dr. Trond Bjorndal
Vancouver, B.C.

March, 1988

EXECUTIVE SUMMARY

A. PURPOSE OF STUDY

The purpose of this study is to determine costs of production for net-pen rearing of salmon in Alaska. The State Department of Commerce and Economic Development commissioned the study in December, 1987 in conjunction with a second study to assess the impacts of projected farmed salmon supplies on markets for Alaska's wild salmon. Together, these studies can be used to determine the potential economic viability of production in Alaska.

The study first analyzes costs of production in the regions projected to be the largest suppliers. It then develops costs of production for Alaska from an analysis of biological, environmental and logistic conditions in the state.

B. SCOPE OF STUDY

Costs of production (COP) for Norway and Scotland were developed largely from recent studies. Costs of production for Chile were developed from recent studies and from COP models developed by Hatfield Consultants Ltd. for the Chilean industry. Costs of production for British Columbia were developed from a unit cost model recently developed by the DPA Group Inc. for the industry.

Costs of production for Japan were not developed because no cost of production data is available in the public domain or from the firsthand experience of study team members. However, sufficient data was obtained from previous studies and a recent visit by a study team member to draw some important conclusions about its cost structures and its development potential. These are presented in a narrative form.

In order to assess conditions for pen rearing salmon in Alaska we conducted reviews of previous environmental studies in Alaska. We also held telephone interviews with several fisheries officials in the state of Alaska Department of Fish and Game and the National Marine Fisheries Service.

In order to develop growth data and feed conversion ratios we compared published results of the National Marine Fisheries Service salmon farming research projects at Little Port Walter and Auke Bay to those of a recent broodstock management program in British Columbia.

C. COSTS OF PRODUCTION IN CURRENTLY PRODUCING REGIONS

A summary of unit costs for farmed salmon in each major supply region is shown in Exhibit 3.13. In all cases, product is assumed to be sold in a head-on, dressed form. In the exhibit, a yield factor is applied to the unit costs previously calculated on a round weight basis. Yield factors range between 85% and 90%. Yields are highest with larger fish.

EXHIBIT A: COMPARATIVE DRESSED-WEIGHT UNIT COSTS IN US DOLLARS

	Norway	Scotland	B.C.	Chile	Japan
Unit Costs Per kg Round Wt. Basis	$5.05	$5.46	$3.32	$3.20	$5.67
Average Size	4 kg	2.5 kg	3.4 kg	2.5 kg	2.0 kg
Processing Yield	.90	.87	.89	.87	.85
Unit Costs Per kg Dressed Wt. Basis	$5.61	$6,28	$3.73	$3.68	$6.67
Unit Costs Per lb	$2.55	$2.85	$1.70	$1.67	$3.03

Exchange rates to US dollars are 1987 year-end rates:
NOK: 6.2325; UK pound: 1.8715; CDN$: 0.7693; Yen: 0.0081.

Source: As in Exhibit 3.12.

Chile and British Columbia have the lowest unit costs. Japan has the highest. However, the lower unit costs of the Chilean and British Columbian industries do not necessarily mean that higher returns are being earned in these regions. Freight costs to major markets are a significant factor. Pricing is based on numerous factors including size, species, and grade. Generally larger sizes and high quality are preferred attributes. Preferences for particular species will generally vary by area. Time of harvests and level of marketing effort will also influence net returns.

Large areas of southcentral and southeast Alaska are not suitable for salmon culture due to the presence of ice, icebergs and large river systems. Salinities are generally more consistent throughout the year in areas away from mainland waters, where blooms are also less likely to occur.

Smolt production capacity in both southcentral and southeast Alaska is likely adequate to meet potential demand from a salmon farming industry. Some fish feed production capability exists in southcentral, however fish feed would most likely be imported from Washington State or British Columbia because of more specialized production in these regions.

The following areas would be favoured for development in terms of their proximity to population centers, airports and processing plants:

- along the eastern half of southeast Alaska near Juneau, Ketchikan and Petersburg/Wrangell;
- along the western side of Baranof Island near Sitka;
- in southcentral Alaska near Kodiak, Homer, Seward, Cordova, Valdez and Whittier.

Netpen operations in these areas would also be less likely to be affected by phytoplankton blooms. However, all areas are likely to be affected by predators.

D. COSTS OF PRODUCTION IN ALASKA

The area around Ketchikan is probably the best area for development of pen rearing of salmon in Alaska because of warmer summer and winter temperatures. This area also has more constant salinities throughout the year. Chinook could be expected to reach a harvestable size of two kilograms during the second winter in saltwater. However, the Ketchikan area would have lower growth rates and higher conversion rates than in most areas of British Columbia where salmon farming occurs because of seasonally lower water temperatures.

The cost profile of a farm assumed to be located in the Ketchikan area is summarized below.

Capital Investment

Capital investment is assumed to be similar to that of British Columbia. However, cage systems and equipment are assumed to be imported and slightly more expensive. The estimated total capital investment for the farm is shown below.

	U.S. $
Sea cage system and equipment	$380,000
Facility on floating barge with equipment	250,000
	$630,000

The total capital investment is $2,520 per tonne. Like British Columbia accommodation and other facilities are assumed to be on a floating barge due to the lack of extensive road systems in the south central portion of southeast Alaska.

Unit Costs

Unit costs are shown in Exhibit B. Unit costs are $4.49 per kilogram.

EXHIBIT B: ESTIMATED UNIT COSTS PER KG FOR CHINOOK SALMON IN ALASKA

	Unit Costs (US Dollars)	%
Variable Costs		
Smolts	0.40	9
Feed	2.00	45
Stock Insurance	0.07	2
Processing	0.52	11
Interest on Working Capital	0.27	6
Total Variable Costs	**3.26**	**73**
Fixed Production Costs		
Wages	0.32	7
Overhead	0.24	5
Depreciation	0.49	11
Interest	0.18	4
Total Fixed Costs	**1.23**	**27**
Unit Costs per Kilogram	**4.49**	**100%**

Source: The DPA Group Inc.

Assuming a yield factor of about 85%, unit costs on a dressed weight basis would be $5.28/kg or $2.40/lb.

E. SUMMARY

The landed costs of farmed salmon from each major supply region and from Alaska in three major markets are shown in Exhibit C.

EXHIBIT C: COMPARISON OF LANDED COSTS PER LB IN MAJOR MARKETS (U.S. DOLLARS)

	Supply Region					
Market	Norway	Scotland	B.C.	Chile	Japan	Alaska
Los Angeles	3.80	4.17	2.06	2.63	N/A	2.77
New York	3.46	3.83	2.44	2.63	N/A	3.18
Tokyo	4.25	4.62	2.89	3.85	3.21	3.36

As indicated in the exhibit, Alaska is competitive from a cost standpoint in all markets.

However, costs at an industry level are only well known for Norway. As a result, the cost comparisons should be viewed with caution. Alaska would be selling farmed salmon in smaller sizes than Norway, Scotland and British Columbia and would compete more directly with Chile. British Columbia and Chile have cost advantages over Alaska in both Los Angeles and New York.

Alaska would also likely have a short window period in which to sell. This would also likely result in more direct competition with the Chileans.

Landed costs in major markets are sensitive to exchange rates. Fluctuating exchange rates could make Alaskan farmed salmon more or less competitive in all markets. However, the U.S. and Canadian currencies are closely linked and generally shift from each other only slowly. As a result, British Columbia would likely have cost advantages over Alaska in all major markets.

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE OF STUDY

Purpose of Study

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In order to assess conditions for pen rearing salmon in Alaska we conducted reviews of previous environmental studies in Alaska. We also held telephone interviews with several fisheries officials in the state of Alaska Department of Fish and Game and the National Marine Fisheries Service.

In order to develop growth data and feed conversion ratios we compared published results of the National Marine Fisheries Service salmon farming research projects at Little Port Walter and Auke Bay to those of a recent broodstock management program in British Columbia.

In the following section of the report we present an overview of worldwide farmed salmon production. In Section 3.0 we analyze and compare costs of production in each major supply region. In Section 4.0 we estimate costs of production in areas suitable for pen-rearing salmon in Alaska. In Section

5.0 we summarize Alaska's potential cost advantages and disadvantages.

2.0 OVERVIEW OF WORLDWIDE FARMED SALMON PRODUCTION

2.1 Introduction

Aquaculture is defined as the culturing of finfish, shellfish and aquatic plants. Species currently being cultured commercially include shrimp, oysters, carp, tilapia, catfish and salmon. Worldwide production from aquaculture has grown rapidly from about 2.6 million tonnes in 1970 to about 10 million tonnes in 1986, accounting for 10-12% of total fisheries output worldwide. China and Japan account for 35 percent of world aquaculture production. The United States produces two percent of the world total. Production is mostly catfish.

Aquaculture production can be classified as either extensive, semi-intensive or intensive. The extensive method is the simplest. Aquatic environments such as oceans and lakes are stocked at low densities with little management of the species and little or no supplemental feeding. The semi-intensive method involves higher stocking densities in smaller culture units, more intensive management and some supplemental feeding. The intensive method employs still higher stocking densities in a controlled environment.

Salmon ranching, roe on kelp and scallop spat collection in Alaska can be classified as extensive forms of aquaculture. Pond rearing of catfish and trout in several other states and seapen rearing of salmon in Washington and Maine are classified as semi-intensive production.

Intensive forms of aquaculture for the most part have only been successful with some tropical species although rearing of trout in Idaho could possibly be classified as such. Intensive rearing of Atlantic salmon in land-based tank farms has been attempted but has generally not been successful. Much greater success with rearing salmon has been achieved with netpen rearing of Atlantic salmon in Norway. Production has increased from 1,500 tonnes in 1975 to over 45,000 tonnes in 1986. Along with growing demand for fresh seafood in major markets, this industry has spurred the development of netpen rearing of salmon around the world.

The first phase of the production cycle is in a freshwater hatchery. Fertilized salmon eggs reach the smoltification stage anywhere between six and 18 months. Juveniles are then placed in netpens supported by floating cages situated in marine locations. The growout period in saltwater can take up to three years.

Supplemental feeding exists through most of the freshwater phase and virtually all of the saltwater phase. Pen-reared fish are typically fed commercially-produced pelleted feed.

World production of farmed salmon in 1986 is shown in Exhibit 2.1.

EXHIBIT 2.1: WORLDWIDE PRODUCTION OF FARMED SALMON IN 1986
(Metric Tonnes)

	Atlantic	Chinook	Coho	Total
Norway	45,675	-	-	45,675
Scotland	10,300	-	-	10,300
Ireland	650	-	-	650
Faroes	600	-	-	600
Iceland	100	-	-	100
Sweden	150	-	-	150
Finland	40	-	-	40
Spain	150	-	-	150
France	-	-	180	180
Italy	50	-	-	150
Eastern Canada	297	-	-	297
B.C.	-	89	400	489
Washington State	-	-	1,400	1,400
Chile	-	-	1,000	1,000
New Zealand	-	500	-	500
Japan	-	21	7,200	7,221
	58,012	610	10,180	68,802

Source: The DPA Group Inc. Worldwide Farmed Salmon Production Forecasts to Year 2000, Department of Fisheries and Oceans, 1988.

As indicated in the exhibit, Norway was the world's largest producer of farmed salmon in 1986, producing about two thirds of the world supply (or about 8% of the 1986 total supply of farmed and wild salmon). The other supply region with considerable Atlantic salmon production in 1986 was Scotland.

The culturing of Pacific species has been more recent and Japan was the only significant producer in 1986. In Washington State, pan-sized Coho production is well established but relatively static.

The production figures in 1986 significantly understate the production potential of British Columbia and Chile, where rapid expansions in the number and size of farms has occurred during the last three years. In British Columbia, emphasis has been with production of Chinook and Coho, with more limited production of trout and Atlantic salmon.

In a recent study conducted by the DPA Group Inc., we estimated that due to economic and biological factors, Norway, Scotland, B.C., Chile and Japan would emerge as the leading producers of farmed salmon, producing nearly 82% of the world's supply of farmed salmon by the year 2000.

A summary of actual farmed salmon production in 1986 and projections for 1990 and 2000 by major producing regions is shown in Exhibit 2.2.

EXHIBIT 2.2: PRODUCTION OF FARMED SALMON TO 2000 (tonnes)

	1990	(%)	1995	(%)	2000	(%)
Norway	100,000	63	150,000	56	200,000	51
Scotland	25,000	16	37,500	14	50,000	13
British Columbia	15,600	10	25,500	9	33,000	8
Chile	5,500	4	14,370	5	23,000	6
Japan	10,000	6	15,100	6	15,100	4
Other	2,260	1	27,590	10	72,860	18
Total	**158,460**	**100**	**270,060**	**100**	**393,960**	**100**

Source: The DPA Group Inc. Worldwide Farmed Salmon Production Forecasts to the Year 2000, Department of Fisheries and Oceans, 1988.

Norway and Scotland are projected to continue as world leaders in farmed salmon production to the end of the century because there is still significant opportunities for both industries to become more efficient and new cage technologies should allow them to continue with new site development in more exposed marine environments.

British Columbia and Chile have considerable areas with undeveloped coastlines and are generally believed to have better growing conditions than their European counterparts. To a large extent the salmon farming industries in these regions are less mature and opportunities to reduce costs are greater.

Japan on the other hand is affected by lethal water temperatures in summer which prevents long growout periods and requires harvesting within a short time period. Production is expected to continue to increase substantially however because farmed salmon can reach market size in less than one year.

The four largest supply regions are all expected to export most of their production. Japan is expected to consume all of its production to the end of the century. The major markets for farmed salmon are in the U.S., Japan and Europe. As indicated in Exhibit 2.2, the total production of farmed salmon in the year 2000 is projected to be about 0.4 million tonnes. The five major producing countries are expected to produce 0.32 million tonnes. Competition in these markets is therefore expected to increase, particularly in the U.S. where all of the major exporters currently compete.

In order to determine the viability of production in Alaska, the costs of producing pen-reared salmon in these supply regions should be compared to estimated costs of production in the state.

In the following section of the report we describe the costs of production in each major supply region.

3.0 COMPARATIVE COSTS OF PRODUCTION

3.1 Introduction

Costs of production of farmed salmon are largely determined from biological, environmental and technological factors. Industrial structure and political factors also influence costs. Industrial structure refers to the number and size of farms and their degree of vertical integration. Political factors include government support and restrictions.

However, there are several important factors to consider in the analysis. Firstly, the economics of salmon farming in most supply regions is not well understood. Industry-wide cost of production surveys in Norway, for example, have often overstated costs because many farms surveyed were in their development phases (Bjorndal, 1987). Surveys similar to those periodically undertaken in Norway have also yet to occur in British Columbia and Chile. Even if they had, the surveys would also likely not be very representative of the future cost structure of these industries since most farms established since 1984 first began production at small (pilot) scales and have yet to complete their second production cycle at larger scales.

Secondly, particularly with Pacific species, there is a considerable amount of experimentation being undertaken with genetic selection, sex manipulation, size and time of entry of smolts into saltwater, and stocking densities. The impacts of rapid improvements in broodstock and husbandry on costs of production are difficult to measure.

Empirical data from Norway suggests that there are modest economies of scale in production at the farm site level (Salvanes, 1986). However, the size of farms in Norway is restricted for the most part to small and medium-sized farms, yet in Scotland, B.C. and Chile hoirzontal integration, i.e. multi-site farms, is common. The level of vertical integration in these industries is also higher. Assessing how these structural differences and political constraints impact on costs of production are beyond the scope of this study. Structural aspects of each major supply region can however be described.

The approach adopted in the study is to develop unit costs for an efficient, industrial-scale growout site in each major supply region. This makes sense from several perspectives:

- there is a general trend worldwide towards larger, industrial scale production units;
- even though some industries have salmon farms with production capacities in excess of 1,000 tonnes annually, these tend to be spread over several

sites, in order to reduce risk; a typical site has a production capacity ranging between 100 and 400 tonnes;

- it requires an assumption as to the location of the site which simplifies estimations of freight costs for inputs and shipments of production to market;

- with increased competition for markets worldwide only the more efficient producers will likely survive.

Another factor to consider is how farms in each supply region are financed. The debt to equity ratio of farms in all regions is highly variable. To some extent they are dependent on the amount of government financial support available to farms in each region. However, as will be explained, government financial support in all regions is becoming less important. The rate of return therefore can be expected to equate to a firm's long run cost of capital. In the analysis a real rate of interest of 7% is assumed for all regions. Also land costs are disregarded.

A related factor is the tax structure to pay for the level of government support. However, only in Scotland is there a direct tax on production, although Norway may soon introduce an application fee for licences.

Also disregarded are general taxes. General tax rates vary considerably from region to region. In addition to income taxes, there are sales taxes, tax allowances and depreciation rates to consider. Comparative analyses of these by region would be very complex and are beyond the scope of the study.

Two final considerations are worthy of mention. While costs of production in various industries have been described in previous studies, they are not all in the same year and are not expressed in the same currencies. The approach taken is to first discuss costs of production in their local currencies. This should allow an easier comparison of costs in future years should exchange rates fluctuate. Costs of production from each major supply region are however translated to US dollars in the summary of this section.

The metric system is the recognized system of measurement in most countries. As a result, unit costs of production are first presented in this fashion and are also later converted to the U.S. system.

3.2 Norway

Structural Aspects

Norway is projected to continue as the world's largest producer of farmed salmon to the end of the century.

Production of Atlantic salmon in the year 2000 is forecasted to be 200,000 tonnes.

In 1985, there were about 559 growout farms with total growout capacity of about 3.4 million m^3. Also there were about 150 new licences issued in 1985 (Bjorndal, 1987). By 1987, there were also 611 smolt producers with a total capacity of about 183 million smolts (Hempel, 1988).

The most important structural aspect is the presence of the large number of small farms because both pen volume and ownership of multiple site farms are restricted. These restrictions reflect the regional development policies of the Norwegian government. With the exception of some of the earliest farms, the size of farms is limited to a maximum of 8000 m^3 of netpen capacity.

The Norwegian government is considering a proposal from the Fish Farmers Association to allow a 50% increase in the maximum size of each farm, to 12,000 m^3. Smolt production capacity is limited to one million smolts annually per unit although multiple unit ownership is permitted. Sea Farm A/S was the largest producer in 1985 and produced 9% of total output (Bjorndal, 1987).

The distribution of farms surveyed in the profitability survey in 1984 by size category is shown in Exhibit 3.2. Except for new entrants, the distribution is considered representative of the total population of farms. Most farms in the >7000 m^3 category are between 7000 m^3 and 8000 m^3. A summary of the profitability study itself is shown in Appendix B.

EXHIBIT 3.2: DISTRIBUTION OF FARMS BY SIZE CATEGORY IN NORWAY IN 1984

	<3000m^3	3000-4999m^3	5000-6999m^3	>7000m^3	Total
No. of farms	19	31	20	27	97
Percent of Total	19%	32%	21%	28%	100%

Source: Profitability Study of Fish Farms, Directorate of Fisheries, 1984.

A regional breakdown of farms in 1985 is shown in Exhibit 3.3

EXHIBIT 3.3: DISTRIBUTION OF FARMS BY REGION IN NORWAY IN 1985

	Finnmark, Troms and Nordland	Nord- and Sor-Trondelag, More and Romsdal	Sogn og Fjordane, Hordaland	Rogaland, Skagerakkyst
No. of Farms	161	183	156	59
Percent of Total Production	22%	34%	38%	6%

Source: T.Bjorndal, Fiskeoppdretts - økonomi (Economics of Aquaculture) Oslo: Cappelen, 1987.

The area with the largest amount of production includes the counties of Sogn og Fjordane and Hordaland which are located in the south. The city of Bergen is located in Hordaland. Profitability of farms in this area is also highest (see Appendix B).

The industry is supported by a strong marketing organization which negotiates with exporters minimum prices for producers and manages promotion campaigns for the industry. A levy of 1.25% of sales is assessed to both producers and purchasers/ exporters to support these activities.

Government Support

Considerable government support has been provided to the industry since its inception. Financial assistance is provided mostly through the Regional Development Fund, in the form of loans, loan guarantees and grants to new business establishments in the regions. Financial support provided by the Regional Development during the period 1961-1986 totalled 1,279.3 million kroner as shown in Exhibit 3.4. However, in 1986, the Norwegian government made a decision to reduce financial support to farms. Further, it eliminated financial support programs for smolt producers.

EXHIBIT 3.4: NORWEGIAN GOVERNMENT FINANCIAL SUPPORT TO SALMON FARMING 1961-1986 (MILLION NOK)

Year	Loans	Guarantees	Grant	Total
Total	388.0	678.9	212.4	1,279.3

Source: The Royal Norwegian Ministry of Fisheries

Significant public funds for scientific research and development are also allocated to the industry. Funding provided to government research institutions, universities, and research councils increased from 52.2 in 1984 to 152.1 million NOK in 1987 (Hempel, 1988).

The government does not provide any direct marketing support. However, two special marketing programs were recently introduced to increase exports of Norwegian seafood products to Japan and the U.S. No subsidies for export credit or transportation exists. However, between 1978 and 1980, Scandinavian Airline Systems (SAS), cooperated with major exporters in developing a transport and distribution system for fresh fish. During this period, SAS did offer preferential rates, but no longer does so. The government does not levy special taxes against the industry. However, it is considering charging an application fee for new licences.

Production Plan

Scale and Location

The analysis is undertaken for a fish farm raising Atlantic salmon in 8000 m^3 of pen volume. The farm is assumed to be relatively efficient and can support stocking densities as high as 25 kg/m^3 and therefore produce about 200 tonnes annually.

The farm is assumed to be located in an area between Bergen and Trondheim with nearby access to road connections.

Capital Investment

The total capital investment for the farmer is shown below.

	NOK (000's)
Sea cage system with equipment	1,835
Facility on land with equipment	1,765
	3,600

Source: Bjorndal, 1987.

The total capital investment is 3.6 million NOK or 1,800 NOK per tonne.

Operating Expenses

The estimated operating costs are based on the following assumptions:

- 60,000 salmon smolts are set out every year in May;
- The smolt price is 14 kr;
- The feed price is 6 kr per kilogram;
- The feed conversion ratio is 1.7:1;
- Mortalities are:
    - 7% in the first month after release
    - 4% during the next four months
    - 2% per half year for the balance of the production cycle;
- Processing costs are 5 kr per kilogram;
- Stock insurance is 3% of the average carrying value of inventory;
- Labour: 4 person years;
- Wages including benefits are:
    - 250,000 kr for a farm manager
    - 200,000 kr for three farm labourers;

- Overhead costs include insurance on fixed assets, electricity, fuel, repair and maintenance, medicine, and administration;
- Harvesting begins about 20 months after the release of smolts and continues at the same rate over the year;
- Average weight of fish is 4 kg at harvest.

With these assumptions this farm will be capable of producing about 50,000 fish for a total production of 200 tonnes per year after the third year from startup.

Fixed assets are depreciated on a straight line basis over the following periods:

	Years
Buildings	20
Seapen system and equipment	6
Site investments	50

The investment in buildings includes a processing facility. The seapen system is depreciated over a 6-year life. However the economic life of newer steel cage systems used in Norway is not yet well known. Technological obsolescence may also become a factor beyond a certain period.

Unit Costs

Unit costs are shown in Exhibit 3.5. They are derived from 1986 cost data. Unit costs per kilogram are 31.45 kroner (14.30 kr/lb).

EXHIBIT 3.5: UNIT COSTS PER KG FOR ATLANTIC SALMON PRODUCTION IN NORWAY

	Unit Costs (kr)	%
Variable Costs		
Smolts	4.20	13
Feed	10.70	35
Stock Insurance	0.85	3
Processing	4.40	14
Interest on working capital	2.00	6
Total Variable Costs	**22.20**	**71**
Fixed[1] Costs		
Wages	4.25	14
Overhead	2.00	6
Depreciation	1.70	5
Interest on capital	1.30	4
Total Fixed Costs	**9.25**	**29**
Unit costs per kilogram	**31.45**	**100**

Source: Bjorndal, 1987.

1 includes some semi-variable costs such as wages.

3.3 Scotland

Structural Aspects

Scotland is projected to produce 50,000 tonnes of farmed salmon in the year 2000 and remain the world's second largest producer of farmed salmon to the end of the century. Like Norway, Scotland will continue to produce Atlantic salmon.

No restrictions on size or ownership exist in Scotland. In 1987, 126 companies operated 196 cage sites and 11 tank sites. There were also 72 smolt production companies who operated 80 tank and 51 cage sites.

Groupings of sea farm sites by their scale of production in 1987 is shown in Exhibit 3.6. As indicated in the exhibit, the largest concentration of farms are in the 101-200 to 201-300 tonne range.

In contrast to Norway, there is more concentration of production and more vertical integration. In 1987, 45% of production was from the largest 20 farms.

EXHIBIT 3.6: DISTRIBUTION OF SEA FARM SITES IN SCOTLAND BY SCALE OF PRODUCTION IN 1987

Production (tonnes)	Number of Sites	% Share of Production
0	49	0
<10	21	0.9
10-25	41	5.5
26-50	15	4.4
51-100	24	13.9
101-200	26	30.5
201-300	13	24.2
300-400	5	12.9
400-500	1	3.4
>500	1	4.3
Total Sites	**196**	**100**

Source: Department of Agriculture and Fisheries for Scotland.

Salmon and smolt production in various regions of Scotland are shown in Exhibit 3.7.

EXHIBIT 3.7: SALMON AND SMOLT PRODUCTION IN VARIOUS REGIONS OF SCOTLAND

	Western Isles	**Northern Isles**	**Rest of Scotland**	**Totals**
1987 salmon (tonnes)	1,830	2,211	8,680	12,721
1987 smolts (numbers '000)	2,059	112.8	11,122.6	13,294.4

Source: Department of Agriculture and Fisheries for Scotland.

Most production is off the mainland of Scotland, particularly on its western shores.

The Scottish Salmon Growers Association provides marketing support to the industry through advertising campaigns. The Association charges a levy on smolts in inventory to pay for the costs of promotion.

Government Support

The Highlands and Islands Development Board has been central in channelling UK government financial support to the industry. Most farms are sited within the area covered by its jurisdiction. Between 1965 and the end of 1987 the Board itself had provided a total of 50.7 million pounds in financing to the industry. Most of this was in the form of grants which after a qualifying period, are non-repayable, but part constituted loans and equity participation. During the same period, about 4.1 million pounds have gone to scientific research and development. Two EEC programs, FEOGA and IDP, have also provided funding to the industry. However, like HIDB, funds have not increased with the growth in the industry.

A royalty is now being collected by the government on output. A royalty of 50 pounds per metric tonne applies to farms with production in excess of 50 tonnes. For those with less than 50 metric tonnes of production, a royalty of 45 pounds per metric tonne applies. Royalties in 1987 could have represented as much as 15% of the research and development funds provided to the industry through HIDB.

Production Plan

Scale and Location

The analysis is undertaken for a fish farm raising Atlantic salmon at annual production levels of 200 tonnes.

The farm is assumed to be located on the Scotland's west coast.

Capital Investment

The total capital investment for the farms is shown below.

	Pounds Sterling (000's)
Sea cage system and equipment	220.0
Facility on land with equipment	146.3
	366.3

Source: Shaw and Muir, 1987.

The capital investment is 0.366 million pounds or 1,831.5 pounds per tonne.

Operating Expenses

The estimated operating costs are based on similar assumptions to those of Norway except for the following:

- smolt prices are slightly lower at 1.25 pounds
- smolt to harvest survival rate is 80%
- wages are also lower:

Farm Manager	25,000 pounds
Labour	7,500 pounds

The average size of fish at harvest is also lower at 2.5 kg. As a result, about 100,000 smolts are initially required to reach production of 200 tonnes.

Unit Costs

Unit costs are shown in Exhibit 3.8. They are derived from 1986 cost data. Unit costs per kilogram are 2.92 pounds (1.33 pounds/lb).

EXHIBIT 3.8: UNIT COSTS PER KG FOR ATLANTIC SALMON PRODUCTION IN SCOTLAND

	Unit Costs (Pounds)	%
Variable Costs		
Smolts	0.65	22
Feed	1.00	34
Stock Insurance	0.10	3
Processing and Packaging	0.20	7
Interest on working capital	0.12	4
Total Variable Costs	**2.07**	**72**
Fixed Costs		
Wages	0.28	9
Overhead	0.27	9
Depreciation	0.17	6
Interest on capital	0.13	4
Total Fixed Costs	**0.85**	**28**
Unit Costs per Kilogram	**2.92**	**100%**

Source: S.A. Shaw and J.F. Muir, Salmon: Economics and Marketing, Croom Helm, 1987.

3.4 British Columbia

Structural Aspects

British Columbia is projected to be the world's third largest producer of farmed salmon by the end of the century. Production is forecast to be 33,000 tonnes in 2000, 75% of which is projected to be comprised of chinook salmon.

No restrictions on size or ownership exist in British Columbia. In 1987, 85 farms operated 115 sites. Smolt production is concentrated to a few producers. Eight smolt producers produced about 90% of production in 1987. Total production capacity was about 30 million smolts. (B.C. Salmon Farmers Association).

No breakdown by production size or geographic area was available for 1987. However, DPA conducted a study in 1986 which projected the number and size of farms for 1987 through to 1990 (the projected number of farms for 1987 was 82 farms operating 113 sites). The study projected a trend towards increased concentration of production: 60% of the production in 1990 would be from 12% of the farms. The area projected to have the largest amount of production through to 1990 was the Sunshine Coast.

The study also projected a trend towards more vertical integration, including backward integration by fish processing companies through the provision of working capital financing to farms.

Technologies employed are similar to those of Norway and Scotland. However, stocking densities, particularly with chinook, are much lower than in the Norwegian or Scottish industries. Stocking densities are generally less than 8 kg/m^3, significantly lower than in Norway.

The B.C. Salmon Farmers Association (BCSFA) provides marketing support to the industry. The BCSFA began a generic promotion campaign in 1987. A levy was previously charged on wild salmon eggs distributed to producers. In 1988, the levy is being shifted to smolt sales, since increasingly the industry is becoming self sufficient in egg supplies.

Government Support

Direct financial assistance to the industry has been mostly loans provided by a joint federal/provincial program for industrial development and an agricultural credit program of the provincial Ministry of Agriculture and Fisheries. The total outstanding loans at the end of 1987 from these programs were $3.8 million (57 loans) and $0.3 million (11 loans) respectively. The joint federal/provincial program expires in 1988.

Aquaculture is also a qualifying industry for a provincial venture capital corporation (VCC) program in which investors can qualify for a credit of up to 30% of their investment. A total of five aquaculture VCC's have been formed.

Support for scientific research and development is also being provided by the provincial Ministry of Agriculture and Fisheries and the federal Department of Fisheries and Oceans. Total support in 1987 was about $3 million.

There are no special taxes or royalties levied against the industry. Annual lease costs for aquatic land are ususally less than $2,000.

Production Plan

Scale and Location

The analysis is undertaken for a fish farm raising chinook salmon at an annual production level of 250 tonnes.

The farm is assumed to be located in the Sunshine Coast area.

Capital Investment

The total capital investment for the farm is shown below.

	$Cdn (000s)
Sea cage system and equipment	442
Facility on floating barge with equipment	308
	750

Accommodation and storage facilities are assumed to be on a floating barge. The total capital investment is $3,000 per tonne.

Operating Expenses

The estimated operating costs are based on the following assumptions:

- 104,000 salmon smolts are set out every year in June;
- the smolt price is $.75 which includes a BCSFA levy of $.08;
- the feed price is $1.00 per kg;
- the feed conversion ratio ranges between 1.3 and 1.9;

- Mortalities range between 1% and 3% per month;
- Processing costs are $0.77 per kg;
- Stock insurance is calculated as 4% of the average carrying value of inventory;
- Labour - 4 person years;
- Wages including benefits are:

General Manager	$35,000
Farm Manager	25,000
Labourer 1	17,500
Labourer 2	17,500
	$95,000

- Fixed costs include insurance on buildings and equipment, electricity, fuel, repair and maintenance, medicine and administration;
- Harvesting occurs between 16 and 24 months in saltwater;
- Average weight of fish is 3.4 kg at harvest.

With these assumptions the farm will be capable of producing about 73,500 fish for a total production of 250 tonnes per year. The harvest weight of 3.4 kg reflects the current production strategies of most farms. However, the average size of chinook harvested to date has been less than 3 kg (B.C. Salmon Farmers Association).

Fixed assets are depreciated on a straight line basis over the following periods:

	Years
Buildings	20
Seapen system and miscellaneous equipment	6
Site investments	50

The economic life of fixed assets in British Columbia is assumed to be the same as Norway's and Scotland's because similar technologies are employed in each industry.

Unit Costs

Unit costs are shown in Exhibit 3.9. They are derived from 1987 cost data. Unit costs are $4.32 per kilogram ($1.96/lb).

EXHIBIT 3.9: UNIT COSTS PER KG FOR CHINOOK SALMON IN BRITISH COLUMBIA

	Unit Costs $Cdn	%
Variable Costs		
Smolts	0.26	6
Feed	1.47	34
Stock insurance	0.09	2
Processing and packaging	0.77	18
Interest on working capital	0.29	7
Total Variable Costs	**2.88**	**67%**
Fixed Costs		
Wages	0.38	9
Overhead	0.30	7
Depreciation	0.56	13
Interest on capital	0.20	5
Total Fixed Costs	**1.44**	**33%**
Unit Costs per Kilogram	**4.32**	**100%**

Source: The DPA Group Inc., 1988

3.5 Chile

Structural Aspects

Chile is projected to be the world's fourth largest producer of farmed salmon by the end of the century. Production by the year 2000 is forecast to be 23,000 tonnes, about 60% of which is expected to be coho salmon. The balance is expected to be mostly Atlantic salmon, with only limited production of chinook salmon. Chinook production is mostly limited by shortages of eggs available for import.

In 1986, 22 farms producing salmon and/or trout were in operation.

No restrictions on size or ownership exists. Groupings of farms by their installed capacity in 1986 is shown in Exhibit 3.10. The data includes an unspecified amount of trout production capacity.

EXHIBIT 3.10: DISTRIBUTION OF FARMS IN CHILE BY SCALE OF OPERATION IN 1986

Production Range	No. of Farms	Total
1-10	3	14
11-100	3	14
101-300	6	27
301-500	6	27
501-1000	2	9
>1000	2	9
	22	100%

Source: Ricardo Mendez Zamorano Desorrollo Y Estado De Situacian Actual De La Salmoniculture En Chile, Fundacion Chile, 1987.

Salmon production in Chile is concentrated in an area south of Puerto Montt.

The industry is characterised by sizeable companies rather than small family operations. A number of the companies also own seafood processing plants in southern Chile.

Growing conditions in Chile are generally considered to be slightly better than British Columbia. To date the industry has been mostly reliant on imports of coho salmon from the states of Washington and Oregon. Typically, juveniles are placed in saltwater after 10 months in freshwater which is usually in December when they have reached 35 grams. The reliance on wild coho eggs has meant that production has been mostly harvested after 12 to 16 months in saltwater in sizes ranging from 1.5 to 2.5 kilos. If fish are not harvested in this time period, early maturation usually occurs and they cannot be held over until the following fall and winter.

Government Support

No direct financial assistance is provided to the industry. There are also no export credits or transportation subsidies. Some support for research and development is provided through Fundacion Chile, CORFO and some state universities. Some marketing support is also provided through PROCHILE (Mendez (1988).

Production Plan

Scale and Location

The analysis is undertaken for a fish farm raising coho salmon at annual production levels of 200 tonnes.

The farm is assumed to be located in an area south of Puerto Montt.

Capital Investment

The total capital investment for the farm is shown below (prices in Chile are usually quoted in U.S dollars):

Sea cage system and equipment	$124,000
Facility on land with equipment	83,000
Total	**$207,000**

Source: Mendez, 1987.

The total capital investment is about $1,000 per tonne.

Operating Expenses

The estimated operating costs are based on the following assumptions:

- 93,000 salmon smolts are set out every year in December;
- the smolt price is $0.40;
- the smolt size is 35 grams;

- the feed price is $0.65 per kg;

- the average feed conversion ratio is 2:1;
- Mortalities are:

  - 7.5% in the first quarter;
  - 4.5% in the second quarter;
  - 1.5% in subsequent quarters;

- Labour:

. Farm General Manager	14,400
. Operations Manager	12,000
. Technical Support (2 Advisors)	24,000
. Labourers (17)	20,400
	70,800

- Fixed costs include annual lease costs, insurance, electricity, fuel, repair and maintenance, medicine, and administration;

- Harvesting begins in mid December, 12 months after the release of smolts and continues until the end of March;

- Average weight of fish is 2.5 kg at harvest.

With these assumptions the farm will be capable of producing about 80,000 fish for a total production of 200 tonnes per year.

Fixed assets are depreciated on a straight-line basis over the following periods:

	Years
Building	10
Seapen system and miscellaneous equipment	3
Site investments	25

Fixed assets are depreciated over fewer years than in Europe or British Columbia because lower quality designs, i.e. wooden cages, are typically used.

Unit Costs

Unit costs are shown in Exhibit 3.11. They are derived from 1987 cost data. Total unit costs are $3.20 per kilogram ($1.45/lb).

EXHIBIT 3.11: UNIT COSTS PER KG FOR COHO SALMON PRODUCTION IN CHILE

	Unit Costs USD	%
Variable Costs		
Smolts	0.19	6
Feed	1.21	38
Stock insurance	0.10	3
Processing	0.50	16
Interest on working capital	0.18	6
Total Variable Costs	**2.18**	**69**
Fixed Production Costs		
Wages	0.60	18
Overhead	0.26	8
Depreciation	0.09	3
Interest on capital	0.07	2
Total Fixed Costs	**1.02**	**31**
Unit Costs per Kilogram	**3.20**	**100%**

Sources: Hatfield Consultants Ltd. (1987), Mendez (1987), Wurmann (1987).

3.6 Japan

Japan is projected to be the world's fifth largest producer of farmed salmon by the end of the century. Production by the year 2000 is projected to be 15,000 tonnes and almost entirely comprised of coho salmon. Virtually all production in 1986 was coho salmon. About 20-25 tonnes of chinook was reportedly produced. Experimentation with Atlantic salmon rearing is also being undertaken.

Production is largely at small scales and organized through cooperatives. In 1986, a total of 19 organizations operated 264 sites. Average production per site in 1986 was 28 tonnes, indicating small scale production. Bjorndal confirmed this in a visit in 1987. Further he indicate low level technologies for cage design and feeding systems are employed.

Eighty seven percent of the sites were located around Miyagi, near the northeast end of Honshu. In 1986 these sites produced 81% of the total production.

Although the scale of growout sites is very small compared to other industries, processing and marketing is concentrated to three large processing companies, most notably Nichero Fisheries.

Since the industry began in 1973, it has relied on imports of coho salmon eggs from Washington and Oregon.

Feed production is also not undertaken at a large scale. Supplies of mackerel, sardine and mysid shrimps are available year around for feed production from local parts.

Government Support

No direct financial assistance has been provided to the industry.

Production Plan

Coho smolts are usually one year olds (SI's) when they are placed in saltwater at average sizes of 150 grams from mid-October to early November. The fish are then raised in net pens for about 7-9 months at stocking densities of 10 to 15 kg/m^3.

The coho can grow to 2.5 kilograms by July and are harvested between 1.5 kg and 2.5 kg. Coho must be harvested before August because lethal temperatures are reached.

Unit Costs

Unit cost data for Japan is not available in the public domain. However, the production cost of farmed salmon in 1986 was reportedly about 700 yen/kilo (318 yen/lb) (Sato, 1987). Prices for eggs were six yen per egg. Prices for smolts weighing between 100 grams and 250 grams were 1,000-1,500 yen per tonne. Feed consists of moist pellets manufactured from mostly raw fish (sardine, mackerel and filefish) with some formulated feed added.

3.7 Summary

A summary of capital investment per tonne is shown in Exhibit 3.12.

EXHIBIT 3.12: COMPARATIVE CAPITAL INVESTMENT PER TONNE IN U.S. DOLLARS

	Norway	Scotland	B.C.	Chile	Japan
Capital Investment per tonne (local currency)	18,000	1,832	3,000	238,140	N/A
Capital Investment per tonne					
1987	2,888	3,428	2,308	860	-
1986	2,432	2,701	2,173	1,000	-

Conversion to U.S. dollars are at 1987 (1986) year-end rates:[1]
NOK: 6.2325 (7.400); U.K. pound: 0.5343 (0.6782);
Cdn $ 1.2998 (1.3805); Peso: 238.14 (204.73).

1 International Financial Statistics, Vol. XLI No. 1, January, 1988. International Monetary Fund, Washington, D.C.

Scotland has the highest capital investment per tonne. The significant difference in capital costs between Scotland and Norway in 1987 is largely due to exchange rate fluctuations. However, sites are generally more costly to develop in Scotland because they are located in areas more remote from population centres. Also, sites with greater exposure are more common in Scotland. In addition, cage systems tend to be imported from Norway. British Columbia has lower investment costs than Norway because facilities are assumed to be on floating barges and they do not conclude processing facilities.

The economic life of fixed assets in the regions is assumed to be the same since similar technologies in cage design are employed in each area. Chile has the lowest capital investment cost per tonne because of the use of lower quality cage systems and lower building costs. However the economic life of fixed assets is assumed to be half that of other regions. The capital investment per tonne in Japan is not known but is assumed to be similar to Chile's.

A summary of unit costs for farmed salmon in each major supply region is shown in Exhibit 3.13. In all cases, product is assumed to be sold in a head-on, dressed form. In the exhibit, a yield factor is applied to the unit costs previously calculated on a round weight basis. Yield factors range between 85% and 90%. Yields are highest with larger fish.

EXHIBIT 3.13: COMPARATIVE DRESSED-WEIGHT UNIT COSTS IN US DOLLARS

	Norway	Scotland	B.C.	Chile	Japan
Unit Costs Per kg Round Wt. Basis	$5.05	$5.46	$3.32	$3.20	$5.67
Average Size	4 kg	2.5 kg	3.4 kg	2.5 kg	2.0 kg
Processing Yield	.90	.87	.89	.87	.85
Unit Costs Per kg Dressed Wt. Basis	$5.61	$6,28	$3.73	$3.68	$6.67
Unit Costs Per lb	**$2.55**	**$2.85**	**$1.70**	**$1.67**	**$3.03**

Exchange rates to US dollars are 1987 year-end rates:
NOK: 6.2325; UK pound: 1.8715; CDN$: 0.7693; Yen: 0.0081.

Source: As in Exhibit 3.12.

Unit costs in local currencies are not all expressed for the same years. As previously indicated they are not converted to US dollars in the year collected because the impact of fluctuations in exchanges rates would then be difficult to gauge. In addition a domestic inflation factor for each country since the year the data is collected is also not applied because for the most part input costs do not correlate directly with general price indices. For example, the cost of feed is largely dependent on the world price of fish meal and fish oil which can fluctuate significantly due to biological factors such as El Nino's in South America.

As indicated in the exhibit, Chile and British Columbia have the lowest unit costs. Japan has the highest. However, the lower unit costs of the Chilean and British Columbian industries do not necessarily mean that higher returns are being earned in these regions. Freight costs to major markets are a significant factor (these are discussed in Section 5.0). Pricing is based on numerous factors including size, species, and grade. Generally larger sizes and high quality are preferred attributes. Preferences for particular species will generally vary by area. Time of harvests and level of marketing effort will also influence net returns.

Exchange rates can affect costs significantly, particularly since the largest producers (except Japan) export most of their production. Exhibit 3.14 compares the same unit costs translated at average rates in 1986.

EXHIBIT 3.14: IMPACT OF EXCHANGE RATES ON UNIT COSTS PER LB

	Norway	Scotland	B.C.	Chile	Japan
Unit Costs/lb 1987	2.55	2.85	1.70	1.67	3.03
Unit Costs/lb 1986	2.18	2.25	1.60	1.44	2.35
% Change	7%	27%	6%	6%	29%

Exchange rates to U.S. dollars are at 1987 (1986) year-end rates:
NOK: 6.2325 (7.400); U.K. pound: 0.5343 (0.6782);
Cdn $ 1.2998 (1.3805); Peso: 238.14 (204.73); Yen: 0.0081 (0.0063)

Source: As in Exhibit 3.12

The exhibit indicates that all unit costs expressed in US dollars were lower in 1986. The impact was most dramatic with the change in value of the pound sterling. The analysis partially explains some trends in the industry, including less than anticipated sales by Norway in the US in 1987. Norway did however place more emphasis on penetrating the Japanese market. In 1987 Chile also began selling to Japan.

4.0 COST OF PRODUCTION MODEL FOR ALASKA

4.1 Introduction

Development of likely costs of production in Alaska requires an analysis of conditions for rearing. British Columbia is considered the best model for analysis of Alaska's potential for three important reasons:

- British Columbia more closely parallels Alaska socio-economically and environmentally than other regions;
- the predominant species reared in British Columbia are Pacific species and these would also be the predominant species reared in Alaska because of restrictions on imports of exotic species into the state;
- British Columbia and Alaska would likely serve similar markets.

In this section we summarize the following analysis described in a technical appendix prepared by Hatfield Consultants Ltd.:

- general environmental and logistic conditions for pen-rearing salmon in Alaska;
- differences in growth and feed conversion rates between British Columbia and Alaska.

We then develop likely unit costs of production for Alaska from these for the area with the best development potential.

4.2 Environmental and Logistic Conditions

Conditions which are important in considering the location of a netpen site can be classified under environmental or logistic categories.

Environmental factors include water quality characteristics and potential problems with plankton blooms and predators. Logistic factors include access to critical inputs such as smolts, feed, labour and transportation routes.

These conditions are discussed for southcentral and southeast Alaska, the two areas which according to state fisheries officials contacted, development of net-pen rearing of salmon would most likely occur.

4.2.1 Physical Marine Conditions

An overview of ice formation and iceberg conditions, temperatures and salinities in southcentral and southeast Alaska is presented. The information is then used to develop assumptions about growing conditions, growth rates and feed conversions.

Southcentral Alaska

Ice Formations and Icebergs

Ice formation and the presence of icebergs in embayments and low winter air temperatures impose constraints on development of netpen sites in southcentral Alaska; in particular, these are:

- the presence of pack ice and fast ice in Cook Inlet;
- the presence of ice and icebergs in embayments connected to Prince William Sound and near Seward; and
- the potential for ice formation on floating structures.

Apart from the presence of sea ice and glacier ice in embayments in southcentral Alaska, the air temperature and wind conditions in that area make it generally susceptible for ice formation on floating structures (La Belle et. al. 1983).

Water Temperatures

Studies have shown that growth of salmon fed normal rations is highest at approximately 15°C (Brett, 1982). Below 5°C, conversion drops off appreciably. Mean winter surface temperatures in South Central can be expected to be between 2.5 and 5.0°C and mean summer surface temperatures can be expected to range between 7°C and 13°C.

Salinity

Lower and fluctuating salinities can affect the physiological condition of the salmon (i.e. in relation to the osmoregulatory adaptation to ambient salinity levels) and can influence outbreaks of harmful phytoplankton. In other words sudden variation in salinity levels can cause stress in fish. Generally growth is best under conditions of moderate salinity.

Xiong and Royer (1984) state that average surface salinities in summer are 27.3% and in winter are 31.2%, based on intensive studies near Seward. At greater depths (i.e. 250 m), salinities are approximately 33% year round. Colonell (1980) and Muench and Nebert (1973) describe the presence of relatively fresh water lying in a thin surface layer in Valdez Arm and Port Valdez during summer and autumn. Muench and Nebert (1973) indicate that minimum mean surface

October period, though salinities in the upper 20 m were, at times, less than 1% near the head of Port Valdez (in late July/early August). Lower surface salinities over the summer period are attributed to freshwater runoff from land areas and high precipitation.

Southeast Alaska

Icebergs

Icebergs are present in several bays and straits in northern and eastern Southeastern Alaska (LaBelle et al, 1983):

- Cross Sound, Icy Strait and Glacier Bay;
- Taku Inlet;
- Tracy Arm and Endicott Arms; and
- the end of Frederick Sound.

The presence of icebergs suggests a potential for damage to floating structures and, in general, these areas would be avoided. Also, the icebergs apparently can greatly reduce summer temperatures in surface waters (Pickard, 1967).

Water Temperatures

Mean monthly surface temperatures for the coastal waters along southeast Alaska (Brower et al, 1977) and five lighthouse installations (Jones, 1978) in southeast Alaska and in Auke Bay near Juneau (Bruce et al, 1977) were analyzed.

These data show mean high temperatures in summer to range between 9.0^{C} and 14.6^{o}C. Mean low temperatures in winter range between 2.3^{o}C and 5.2^{o}C. The mean low temperature for the general coastal area (Brown et al, 1977) is slightly higher than these values at 6.0^{o}C.

Salinities

Larger rivers along the mainland shoreline can produce lower and fluctuating salinities (Pickard, 1967) and consequently make nearby areas unsuitable for locating netpens for adult growout. These areas include the mouths of the Stikine River, Taku River, Unuk River, Chilkat River and Speel River.

4.2.2 Phytoplankton and Marine Mammals

Phytoplankton

Two phytoplankton species, Chaetoceros convolutus and Heterosigma akashiwo, have caused serious mortalities amongst salmon cultured in marine netpens in British Columbia. Chaetoceros convolutus causes asphyxiation through physical damage of the gills by silicate processes projecting from the diatom. Heterosigma akashiwo can also lead to asphyxiation because they are toxic to salmon and cause irritation and mucus buildup in gills. Conditions appear suitable for both species in southcentral and southeast Alaska (Gaines and Taylor, 1986). Chaetoceros diatoms have been responsible for chinook salmon mortalities in seapens at Little Port Walter (National Marine Fisheries Service, unpublished). Chaetoceros convolutus has also been collected during surveys near Valdez in Prince William Sound (Horner et al 1973.) The occurrence and intensity of phytoplankton blooms vary greatly both geographically and temporally and prediction is difficult (Gaines and Taylor, 1987). In general, Heterosigma blooms tend to occur in early summer, often in association with lower salinities resulting from increasing river flow, while Chaetoceros blooms tend to occur in the late summer or fall.

Harmful phytoplankton could affect sites in both southcentral and southeast Alaska. As in British Columbia, the effects on production could be direct mortalities or reduced growth when oxygen depletion occurs and rations are restricted.

Marine Mammals

Marine mammals such as otters and sea lions have affected production at sites in British Columbia by killing fish in pens, by damaging netpens allowing fish to escape, and by causing high stress levels in the fish thereby reducing growth rates. A National Marine Fisheries Service report (unpublished) indicates that otters, seals and possibly sea lions have killed fish at the experimental facilities near Little Port Walter. Steller's sea lions and harbour seals occur essentially along the entire Gulf of Alaska coastline (U.S. Department of the Interior, 1984).

Predation from marine mammals will likely be a similar problem in southcentral and southeast Alaska waters to that which occurs in British Columbia. This will require investment in predator control measures such as predator nets. Again, density levels would likely be kept low so that if stress develops when predators are nearby (but do not necessarily attack fish in the pens), it would not compound stress already resulting from high densities.

4.2.3 Smolt Production Capabilities

Southeast Alaska

Four state hatcheries in southeast Alaska produce chinook salmon and three hatcheries produce coho salmon (Hansen, 1987). In addition, 10 private non-profit hatcheries operated by regional aquaculture associations and other non-profit groups raise chinook or coho or are permitted to raise these species.

In 1986, nearly 5 million chinook eggs were collected from these facilities and more than 2.7 million juvenile chinook were released. Similarly, slightly more than 4 million coho eggs were collected and 1.5 juvenile coho were released.

In 1986, private non-profit hatcheries in southeast Alaska had total permitted chinook egg capacities of 6.73 million and total permitted coho egg capacities of 15.47 million eggs. Most fry production of both species is in the Whitman Lake and Neets Bay hatcheries operated by the Southern Southeast Regional Aquaculture Association.

Southcentral Alaska

Five state hatcheries in southcentral Alaska produce chinook salmon and five hatcheries produce coho salmon. In 1986, 1.5 million chinook eggs were collected and 1.5 million juvenile chinook were released. Slightly more than 6.5 million coho eggs were collected and 7 million coho juveniles were released.

Three private non-profit hatcheries operated by regional aquaculture associations and other non-profit groups raise chinook or coho salmon or are permitted to raise these species. In 1986, the private non-profit hatcheries had total permitted chinook egg capacities of 1.15 million and total permitted coho egg capacities of 3.1 million.

Clearly, a large smolt production capability exists in both southcentral and southeast Alaska and this production is spread throughout each region. Hansen (1987) indicates that a number of hatcheries are constructed below lakes and water intakes in the lakes are placed at different depths so temperatures can be adjusted. This means juvenile growth rates and smolt timing can be manipulated to achieve release objectives.

4.2.4. Fish Feed

Currently there is fish feed production capacity in southcentral. However, capacity is limited and technologies employed in production are not as advanced as those in Europe, British Columbia or Washington State.

The main ingredients in commercial fish feeds are fish meal and fish oil. These are manufactured in the reduction process from whole fish or fish waste from the processing sector. Alaska's reduction industry is not well developed, despite the availability of significant quantities of fish waste. In addition the reduction plants in Alaska produce fish meal and fish oil which is unsuitable for fish feed. According to representatives of a fish feed manufacturer in Washington State, if a new feed plant were to be constructed, it would likely be constructed in tandem with a new reduction plant, both of which would require significant capital investment. Alaska would more likely be supplied by fish feed manufacturers in Washington State or British Columbia since transport by barge to Alaska is not a significant cost.

4.2.5 Potential Development Areas

Initial development could be expected to occur in suitable bays or shoreline areas (protected from high winds or waves) away from areas affected by water ice cover, icebergs and large river systems and as close to transportation centers and processing/packing facilities as possible.

Small to medium-sized communities having airport and port facilities are distributed throughout both southcentral and southeast Alaska. Apart from the major airport in Anchorage, smaller airfields and port facilities are located throughout the area (e.g., Homer and Seward).

Larger airports and port facilities are situated along eastern southeast Alaska (Juneau, Petersburg, Wrangell and Ketchikan) and Sitka. These are also the major population centers. Ideally, fish farms would locate within three to four hours by boat from logistic centers to minimize the amount of time that harvested fish are in transit prior to boarding flights to market areas.

The following areas would be favoured for development in terms of their proximity to population centers, airports and processing plants:

- along the eastern half of southeast Alaska near Juneau, Ketchikan and Petersburg/Wrangell;
- along the western side of Baranof Island near Sitka;
- in southcentral Alaska near Kodiak, Homer, Seward, Cordova, Valdez and Whittier.

4.3 Growth and Conversion Rates

4.3.1 Generalized Temperature Regimes

The temperature data reviewed f[illegible] South Central and southeast were used to develop four ger[illegible]ralized temperature regimes in which salmon culture might take place:

- relatively cool winter temperatures and warm summer temperatures (that might occur in bays in southcentral Alaska and near Juneau);
- relatively warm winter temperatures and warm summer temperatures (that might occur in bays near Ketchikan);
- relatively warm winter temperatures and cooler summer temperatures (that might occur in the Frederick Sound/Petersburg area); and
- relatively cool winter temperatures and [illegible] summer temperatures (that might occur in the r[illegible]rn inlets of southeast Alaska close to iceberg a[illegible]

Clearly, general good-case and poor-case growing conditions would be, respectively, warm winter/warm summer conditions and cool winter/cool summer conditions. Since specific conditions can vary from site to site and from year to year, extreme best case and worst case conditions would likely lie outside these general scenarios.

Probable monthly growth rates for chinook were developed for a scenario of relatively warm winter temperatures and warm summer temperatures that might occur in the south central portion of southeast Alaska. Chinook would likely be preferable to coho for net pen rearing in Alaska since they have shown greater survival rates than coho during longer growout periods in British Columbia (B.C. Salmon Farmers Association). The fish sizes and growth rates obtained for chinook salmon at Little Port Walter and at five locations in British Columbia, together with unpublished growth rate data from the Pacific Biological Station in Nanaimo, B.C., have been used to develop the growth profile. These are shown in Exhibit 4.1.

Juvenile chinook are assumed to be placed into saltwater in June at 7 grams. In the warm winter, warm summer temperature regime, they are projected to reach a harvestable size of at least 2 kilograms after 21 months and are projected to grow to 2.5 kilograms after 24 months in saltwater.

In the cool winter/cool summer temperature regime, chinook are projected to reach only about 1 kilogram after 24 months in saltwater. If chinook were held over a third summer and harvested in October they would still be less than 2 kilograms.

4.3.2 Feed Conversion

Feed conversion rates are influenced by environmental variables (such as temperature, salinity, photoperiod, oxygen concentration) and operational variables (such as fish size, ration, food quality). Food conversion efficiency is normally greater for smaller fish sizes, decreasing as the fish grow (Brett and Groves, 1979). Over a given temperature range, on the other hand, food conversion efficiency usually reaches a maximum at a particular temperature and is lower at both lower and higher temperatures. Similarly, the optimum ration amount for maximum food conversion is normally lower than the maximum ration that the fish will consume. In turn, maximum conversion efficiency occurs at a lower ration quantity, as temperature is reduced below the optimum. Generally, optimum feed conversion efficiency for salmon appears to occur at temperatures between 10°C and 15°C at ration levels at 60-90% of maximum.

EXHIBIT 4.1: ESTIMATED GROWTH RATES FOR CHINOOK SALMON GROWN UNDER TWO GENERALIZED MEAN MONTHLY TEMPERATURES REGIMES IN SOUTHEAST ALASKA

	WARM WINTER/WARM SUMMER				COOL WINTER/COOL SUMMER			
	Temp.	Approx. Size (grams)	Daily Growth Rate (%)	Food Conver-sion	Temp.	Approx. Size (grams)	Daily Growth Rate (%)	Food Conver-sion
June	10.0	13	2.2	1.5	8.0	12	2.0	1.7
July	11.0	25	2.1	1.5	9.5	24	2.1	1.7
August	12.0	49	2.2	1.5	9.5	45	2.1	1.7
September	10.5	92	2.1	1.5	8.5	79	1.9	1.7
October	7.5	125	1.0	1.7	7.5	108	1.0	1.9
November	5.0	149	0.6	1.7	5.0	125	0.5	1.9
December	3.5	174	0.5	1.7	3.5	133	0.2	1.9
January	5.0	197	0.4	1.7	3.5	142	0.2	1.9
February	5.0	222	0.4	1.6	3.0	146	0.1	1.8
March	4.5	243	0.3	1.6	5.0	165	0.3	1.8
April	5.0	266	0.3	1.6	5.0	165	0.3	1.8
May	6.0	301	0.4	1.6	6.0	187	0.4	1.8
June	10.0	406	1.0	1.7	8.0	237	0.8	1.9
July	11.0	570	1.1	1.7	9.5	323	1.0	1.9
August	12.0	851	1.3	1.7	9.5	439	1.0	1.9
September	10.5	1181	1.1	1.7	8.5	575	0.9	1.9
October	7.5	1512	0.8	1.9	7.5	736	0.8	2.0
November	6.0	1704	0.4	1.9	5.0	805	0.3	2.0
December	5.5	1870	0.3	1.9	3.5	830	0.1	2.0
January	5.0	1990	0.2	1.9	3.5	856	0.1	2.0
February	5.0	2104	0.2	3.0	3.0	881	0.0	2.1
March	4.5	2170	0.1	2.0	3.0	908	0.0	2.1
April	5.0	2236	0.1	2.0	5.0	936	0.1	2.1
May	6.0	2454	0.3	2.0	6.0	1027	0.3	2.1

For potential sites in Alaska having similar temperatures and salinities to those in British Columbia (e.g., the north B.C. coast site), similar conversion rates could be expected. However, potential locations in southeast Alaska will likely have winter temperatures lower than those experienced in British Columbia (i.e., less than 5°C). Food conversion rates under these conditions will be slightly poorer than for comparably sized fish grown at higher temperatures.

Also the feed conversions obtained from dry feeds at British Columbia sites were mainly under conditions of moderate salinity. Similar conditions can be expected in areas of southeastern Alaska, particularly along the mainland side. However, along the western side, salinities could, on average, be higher. The feed conversion efficiency of dry feeds could be reduced at high salinities (greater than 25%) given higher energy requirements for osmoregulatory functions (Shaw et al, 1975; Brett, 1979).

Probable feed conversions for dry feeds utilized in southeastern Alaska for the two temperature regimes are also shown in Exhibit 4.1. These feed conversions have been adjusted to reflect a decrease in feed conversion efficiency as the fish increase in size, and decreases that might occur at seasonally lower temperatures.

4.3.3. Summary

Large areas of southcentral and southeast Alaska are not suitable for salmon culture due to the presence of ice, icebergs and large river systems. Salinities are generally more consistent throughout the year in areas away from mainland waters, where blooms are also less likely to occur.

Smolt production capacity in both southcentral and southeast Alaska is likely adequate to meet potential demand from a salmon farming industry.. Some fish feed production capability exists in southcentral, however fish feed would most likely be imported from Washington State or British Columbia because of more specialized production in these regions.

The following areas would be favoured for development in terms of their proximity to population centers, airports and processing plants:

- along the eastern half of southeast Alaska near Juneau, Ketchikan and Petersburg/Wrangell;
- along the western side of Baranof Island near Sitka;
- in southcentral Alaska near Kodiak, Homer, Seward, Cordova, Valdez and Whittier.

Netpen operations in these areas would also be less likely to be affected by phytoplankton blooms. However, all areas are likely to be affected by predators.

The area around Ketchikan is probably the best area for development of pen rearing of salmon in Alaska because of warmer summer and winter temperatures. This area also has more constant salinities throughout the year. Chinook could be expected to reach a harvestable size of two kilograms during the second winter in saltwater. However, the Ketchikan area would have lower growth rates and higher conversion rates than in most areas of British Columbia where salmon farming occurs because of seasonally lower water temperatures.

A profile of a salmon farm can now be developed to allow comparison to costs in other supply regions by assuming that the growth of chinook in this area would approximate that of the warm winter/warm summer condition shown in Exhibit 4.1. Costs for major inputs such as smolts, feed and labour will be estimated for this area.

4.4 Estimated Costs of Production

4.4.1 Production Plan

Scale and Location

The analysis is undertaken for a fish farm raising chinook salmon at an annual production level of 250 tonnes, or the same at British Columbia.

The farm is assumed to be located in the Ketchikan area.

Capital Investment

Capital investment is assumed to be similar to that of British Columbia. However, cage systems and equipment are assumed to be imported and slightly more expensive. The estimated total capital investment for the farm is shown below.

	U.S. $
Sea cage system and equipment	$380,000
Facility on floating barge with equipment	250,000
	$630,000

The total capital investment is $2,520 per tonne. Like British Columbia accommodation and other facilities are assumed to be on a floating barge due to the lack of extensive road systems in the south central portion of southeast Alaska.

Operating Expenses

The estimated operating costs are based on the following assumptions:

- 140,000 salmon smolts at 7 grams are set out every year in June
- smolts are assumed to be supplied from Alaskan hatcheries
- the smolt price of $0.54 is the same at that of British Columbia except without the BCSFA levy
- feed is imported from Washington State by barge and the feed standard price is $1.01 per kg
- the feed conversion ratio is slightly higher than British Columbia and ranges between 1.5:1 and 2.0:1
- processing costs of $0.52 per kg are slightly lower than British Columbia because of lower labour rates in the processing sector
- stock insurance, farm wages and fixed costs are comparable to British Columbia
- harvesting occurs after 20 to 24 months in saltwater
- average weight of fish is 2.5 kg at harvest (this assumes slightly better growth than that shown in Exhibit 4.1).

With these assumptions, the farm will be capable of producing about 73,500 fish for a total production of 250 tonnes per year.

Depreciation is based on the following assumptions:

Buildings	20
Seapen system and equipment	6
Site investments	50

The economic life of fixed assets is assumed to be similar to that of British Columbia, Norway and Scotland.

Unit Costs

Unit costs are shown in Exhibit 4.2. Unit costs are $4.49 per kilogram.

EXHIBIT 4.2: ESTIMATED UNIT COSTS PER KG FOR CHINOOK SALMON IN ALASKA

	Unit Costs (US Dollars)	%
Variable Costs		
Smolts	0.40	9
Feed	2.00	45
Stock Insurance	0.07	2
Processing	0.52	11
Interest on Working Capital	0.27	6
Total Variable Costs	**3.26**	**73**
Fixed Production Costs		
Wages	0.32	7
Overhead	0.24	5
Depreciation	0.49	11
Interest	0.18	4
Total Fixed Costs	**1.23**	**27**
Unit Costs per Kilogram	**4.49**	**100%**

Source: The DPA Group Inc.

Assuming a yield factor of about 85%, unit costs on a dressed weight basis would be $5.28/kg or $2.40/lb.

5.0 SUMMARY

In order to assess Alaska's potential competitiveness with other supply regions, the landed costs of production in major markets must be compared. In order to do so, we first determine selling and freight costs per unit. These are shown in Exhibit 5.1.

EXHIBIT 5.1: SHIPPING AND SELLING COSTS PER LB TO MAJOR MARKETS[a] (U.S. DOLLARS)

	Supply Region					
	Norway	Scotland	B.C.	Chile	Japan	Alaska
Selling Costs	0.06	0.11	0.14	0.14	0.14	0.14
Freight to shipping point	0.05	0.07	0.10	0.09	0.04	0.09
	0.11	0.18	0.24	0.23	0.18	0.23
Additional Freight[b] to:						
Los Angeles	1.14	1.14	0.12	0.73	N/A	0.14
New York	0.80	0.80	0.50	0.73	N/A	0.55
Tokyo	1.59	1.59	0.95	1.45	as above	0.73

[a] Shipping and selling costs are current to March, 1988.
[b] All shipments were assumed to be air freighted to their destinations, except for shipments from B.C. to L.A. which were assumed to be trucked. The bulk rate for fresh fish or an LD3 container rate from current tariff sheets were used for shipments by air. No allowances were made for ice in containers since the increased costs associated with ice can often be offset by volume discounts.

Selling costs in Norway are less than other regions because of the participation of the Fish Farmers Sales Organization. Scotland's selling costs are also less because of a higher level of vertical integration.

With regard to the major exporters, freight costs from Norway and Scotland to major markets are comparable. British Columbia has the best freight cost advantage to Los Angeles and New York. However, Alaska has the lowest freight cost to Japan.

The landed costs of farmed salmon from each major supply region and from Alaska in three major markets is shown in Exhibit 5.2.

EXHIBIT 5.2: COMPARISON OF LANDED COSTS PER LB IN MAJOR MARKETS (U.S. DOLLARS)

	Supply Region					
Market	Norway	Scotland	B.C.	Chile	Japan	Alaska
Los Angeles	3.80	4.17	2.06	2.63	N/A	2.77
New York	3.46	3.83	2.44	2.63	N/A	3.18
Tokyo	4.25	4.62	2.89	3.85	3.21	3.36

As indicated in the exhibit, Alaska is competitive from a cost standpoint in all markets.

However, as previously indicated, costs at an industry level are only known for Norway. As a result, the cost comparisons should be viewed with caution. Alaska would be selling farmed salmon in smaller sizes than Norway, Scotland and British Columbia and would compete more directly with Chile. British Columbia and Chile have cost advantages over Alaska in both Los Angeles and New York.

Alaska would also likely have a short window period in which to sell. This would also likely result in more direct competition with the Chileans.

As discussed in Section 3.7, landed costs in major markets are sensitive to exchange rates. Fluctuating exchange rates could make Alaskan farmed salmon more or less competitive in all markets. However, the U.S. and Canadian currencies are closely linked and generally shift from each other only slowly. As a result, British Columbia would likely have cost advantages over Alaska in all major markets.

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APPENDIX A

METRIC CONVERSION RATES

APPENDIX A
Metric Conversion Rates

1 kilogram = 2.2046 pounds
1 Kilogram = 1,000 grams
454 grams = 1 pound

1 metric tonne = 2204.6 pounds
1 metric tonne = 1,000 kilograms
1 metric tonne = 1.1 ton

1 metre = 1.1 yards
1 kilometre = 1,000 metres
1 kilometre = 0.62 miles

APPENDIX B

PROFITABILITY STUDY OF FISH FARMS IN NORWAY, 1984

Production cost per kilo farmed salmon, 1984. Figures in 1984 kroner.

	Size of facility			
	Under 3.000 m^3	3.000-4.999 m^3	5.000-6.999 m^3	7.000 m^3 & over
Smolt	7.93	5.45	6.82	5.97
Feed	10.99	9.97	10.98	10.57
Other variable cost	0.60	0.69	0.62	0.58
Wages	6.51	5.06	4.82	4.80
Total variable costs	26.03	21.17	23.24	21.87
Fixed operating costs	3.77	3.38	4.37	4.16
Depreciation	1.42	1.40	1.43	1.61
Interest[a)]	2.65	3.03	3.18	3.10
Total	33.87	28.98	32.22	30.74
Production (tonnes)	28.30	69.80	101.20	141.10
Man-years per farm	1.59	2.50	3.98	5.07
Sample size	19	31	20	27

a) Interest includes interest on debt and calculated interest on equity.

Source: Directorate of Fisheries: Profitability Study of Fish Farms, 1984.

APPENDIX C

POTENTIAL DEVELOPMENT AREAS FOR SALMON FARMING IN ALASKA:

TECHNICAL SUMMARY

Prepared for:
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Department of Commerce
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Juneau, Alaska

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Vancouver, B.C.

March, 1988

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this study is to determine the feasibility of pen-rearing salmon in Alaska. The approach is to develop likely costs of production for pen-rearing of salmon in Alaska and compare these costs to those of existing supply regions.

Development of likely costs of production in Alaska requires an analysis of conditions for rearing. British Columbia is emerging as a major supply region and is considered the best model for analysis of Alaska's potential.

This technical report summarizes the following:

- general environmental and logistic conditions for pen-rearing salmon in Alaska;
- differences in growth and feed conversion rates between British Columbia and Alaska.

In order to assess conditions for pen rearing salmon in Alaska we conducted reviews of previous environmental studies in Alaska. We also held telephone interviews with several fisheries officials in the state of Alaska Department of Fish and Game and the National Marine Fisheries Service.

In order to develop growth data and feed conversion ratios we compared published results of the National Marine Fisheries Service salmon farming research projects at Little Port Walter and Auke Bay to those of a recent broodstock management program in British Columbia.

In the following section of the report we determine areas suitable for pen-rearing salmon in Alaska. In section 3.0 we estimate growth and conversion rates. Also, in this section we describe how the analysis of the potential for pen-rearing salmon in Alaska from a biophysical standpoint will be used to determine its economic viability.

2.0 ENVIRONMENTAL AND LOGISTIC CONDITIONS

2.1 Introduction

Conditions which are important in considering the location of a netpen site can be classified under environmental or logistic categories.

Environmental factors include water quality characteristics and potential problems with plankton blooms and predators. Logistic factors include access to critical inputs such as smolts, feed, labour and transportation routes.

These conditions are discussed below.

2.2 Physical Marine Conditions

This section contains an overview of ice formation and iceberg conditions, temperatures and salinities in southcentral and southeast Alaska. According to fisheries officials contacted, these are the two areas where development of net pen-rearing would most likely occur. The information is then used to develop assumptions about growing conditions, growth rates and feed conversions.

Southcentral Alaska

Ice Formations and Icebergs

Ice formation and the presence of icebergs in embayments and low winter air temperatures impose constraints on development of netpen sites in southcentral Alaska; in particular, these are:

- the presence of pack ice and fast ice in Cook Inlet;
- the presence of ice and icebergs in embayments connected to Prince William Sound and near Seward; and
- the potential for ice formation on floating structures.

LaBelle et al (1983) indicate that during late December open pack ice can normally be expected along Cook Inlet between the head of the inlet and a line approximately between Cape Douglas and a point just south of Ninilchik. At times, close pack ice can extend further to a line approximately between Cape Douglas and Homer. Within Prince William Sound, LaBelle et al (1983) indicate that icebergs from glaciers can normally be encountered in the vicinity of Glacier Island (at the mouth of Valdez Arm), in Unakwik Inlet and Port Wells (between Valdez Arm and Whittier), in Blackstone Bay (to the south of Whittier), in the head of Port Nellie Juan and in Knight Island Pass (to the south of Port Nellie Juan). Near Seward they indicate icebergs are present in Aialik Bay and Harris Bay (southwest of Seward) and in the East Arm of Nuka Bay.

Apart from the presence of sea ice and glacier ice in embayments in southcentral Alaska, the air temperature and wind conditions in that area make it generally susceptible for ice formation on floating structures (La Belle et. al. 1983).

Water Temperatures

Mean monthly sea surface water temperatures are summarized in Exhibit 2.1. These data suggest that, in general, mean winter surface temperatures can be expected to be approximately 2.5 - 5.0°C and mean summer surface temperatures can be expected to be approximately 0 - 13°C.

Surface temperatures are often recorded as routine measurements because they are easier to measure than temperatures at greater depths. However, salmon are suspended in structures that place them below the surface, but in the upper 6-10 m of the water column (depending on the net depth selected by individual operators). Therefore, subsurface temperatures (between 0 and 10 m) are usually more appropriate for determining the growing conditions for salmon. Temperatures recorded at 10 m near Seward are also shown in Exhibit 2.1. These data indicate that at that depth mean spring and early summer temperatures are slightly lower than the surface temperatures, while mean fall and winter temperatures are approximately the same.

EXHIBIT 2.1: SUMMARY OF MONTHLY SEA SURFACE TEMPERATURE IN SOUTHCENTRAL ALASKA

	Coastal[1]		Seward[2]	
Month	Kodiak-Cook Inlet	Prince William Sound	0 Meters	10 Meters
January	4.0	4.5	4.0	4.0
February	3.0	5.0	4.0	4.0
March	4.0	4.0	2.8	2.8
April	4.0	5.0	3.3	3.3
May	5.0	6.0	6.0	5.4
June	7.0	9.0	9.2	7.0
July	9.0	11.5	12.9	10.8
August	11.5	12.5	12.8	12.8
September	10.5	12.0	11.4	11.7
October	9.0	9.0	7.6	8.2
November	7.0	8.0	7.0	7.1
December	5.5	6.0	5.0	6.0

1 Estimates based on isopleths and cumulative percent frequency graphs

2 Based on graphed monthly means, 1979-1983.

Source: Brower et. al. 1977; Xiong and Royer 1984.

Salinity

Xiong and Royer (1984) state that average surface salinities in summer are 27.3% and in winter are 3.12% based on intensive studies near Seward. At greater depths (i.e. 250 m), salinities are approximately 33% year round. Colonell (1980) and Muench and Nebert (1973) describe the presence of relatively fresh water lying in a thin surface layer in Valdez Arm and Port Valdez during summer and autumn. Muench and Nebert (1973) indicate that minimum mean surface salinities (0-125 m) were approximately 3% over the July - October period, though salinities in the upper 20 m were, at times, less than 1% near the head of Port Valdez (in late July/early August). Lower surface salinities over the summer period are attributed to freshwater runoff from land areas and high precipitation.

Southeast Alaska

Icebergs

Icebergs are present in several bays and straits in northern and eastern Southeastern Alaska (LaBelle et al, 1983).

- Cross Sound, Icy Strait and Glacier Bay;
- Taku Inlet;
- Tracy Arm and Endicott Arms; and
- the end of Frederick Sound.

The presence of icebergs suggests a potential for damage to floating structures and, in general, these areas should be avoided. Also, the icebergs apparently can greatly reduce summer temperatures in surface waters (Pickard, 1967).

Water Temperatures

Mean monthly surface temperatures for the coastal waters along southeast Alaska (Brower et al, 1977) are presented in Exhibit 2.2. Mean surface temperatures recorded at five lighthouse installations (Jones, 1978) in southeast Alaska and in Auke Bay near Juneau (Bruce et al, 1977) are also summarized.

These data show mean high temperatures in summer (August) to range between 9.0°C (Decision Rock) and 14.6°C (Guard Island). Mean low temperatures in winter (February/March) range between 2.3°C (February at Point Retreat) and 5.2°C (February at Lincoln Rock). The mean low temperature for the general coastal area (Brown et al, 1977) is slightly higher than these values at 6.0°C. The Five Fingers location is at the junction of Stephens Passage and Frederick Sound. The cooler summer temperatures at the Five Fingers location (and possibly further westward at Decision Rock) could reflect the cooling influence of glaciers in Stephens Passage and Frederick Sound. Pickard (1967) notes that Stephens Passage appears to receive considerable freshwater from the Taku River and Juneau Icefield and that flow from Stephens Passage could influence water property features at its junction with Frederick Sound. He also notes that water in the eastern portion of Frederick Sound is cool in summer as a result of nearby glaciers. Pickard (1967) reported average temperatures of 6.7°C for Stephens Passage and 8.0°C for Frederick Sound in the upper 10 m of water during August, 1965. Average temperatures in other locations range from approximately 4.0°C (in inlets containing icebergs, for example, Tracy and Endicott Arms along Stephens Passage and Glacier Bay) to approximately 12-14°C in other locations (such as Lynn Canal, near Juneau and Boca de Quadra, near Ketchikan).

EXHIBIT 2.2: **SUMMARY OF MEAN MONTHLY SEA SURFACE TEMPERATURE IN SOUTHEAST ALASKA**

Month	Coastal[1]	Guard Island	Lincoln Rock	Decision Light	Five Finger Light	Point Retreat	Auke Bay
January	6.5	5.2	4.4	3.9	3.6	2.6	3.2
February	6.5	4.9	5.2	4.2	3.0	2.3	2.5
March	6.0	5.2	5.3	4.5	3.4	2.9	3.0
April	6.5	6.2	6.2	5.1	4.3	3.6	4.8
May	8.0	8.3	8.1	6.0	5.4	4.9	8.0
June	10.0	12.4	11.4	7.1	7.8	8.5	12.0
July	12.5	14.5	12.8	9.2	9.6	11.4	13.2
August	13.0	14.6	13.6	9.0	9.6	12.3	13.5
September	12.5	12.9	11.5	8.7	8.1	10.2	11.0
October	10.5	10.4	9.3	7.5	6.5	7.3	7.2
November	9.0	7.8	6.7	5.6	5.5	5.3	5.0
December	7.5	5.9	5.1	4.0	4.2	3.7	4.5

1 Estimates based on isoplaths and cumulative percent frequency graphs

Source: Brower et. al. 1977; Bruce et al. 1977; Jones 1978.

In general, winter temperatures are lower, as expected, and show less variation amongst locations (compared to summer values); with a trend from south to north of approximately 4.5 - 5.0°C in southern locations (i.e., near Ketchikan) to 2.5 - 3.0°C in more northern locations (i.e., near Juneau).

As described previously, surface temperatures are commonly recorded as routine measurements because they are easier than temperatures taken at greater depths. Temperatures can differ between surface and greater depths in southeast Alaska, particularly over the summer (Bruce et al. 1977; Pickard, 1967). Bruce et al (1977) show little difference over the fall, winter and spring period between the surface and 5 m but show water at a 5 m depth to be 2.0 - 3.0°C cooler in summer (July). Pickard (1967) shows a similar trend amongst vertical depth profiles developed for inlet site samples in August, 1965. Data recorded by the National Marine Fisheries Service for several years at facilities in Auke Bay near Juneau and Little Port Walter on Baranof Island are summarized in Exhibit 2.3. These data suggest winter temperatures at 4 - 5 m are similar to surface measurements near those locations (see Exhibit 2.2). However, the summer temperatures at the greater depth appear to be several degrees cooler than surface temperatures in Auke Bay (as noted above). The temperatures at Little Port Walter appear to be similar to surface measurements recorded nearby (e.g. Decision Light shown in Exhibit 2.2). The August data in Pickard (1967) indicate lowr surface temperatures (9°C) in portions of Chatham Sound (where little Port Walter is located) south of its junction with Frederick Sound, compared to locations further north (e.g., near Angoon) where surface temperatures were approximately 12°C.

EXHIBIT 2.3: SUMMARY OF AVERAGE MEAN MONTHLY TEMPERATURES RECORDED AT 4-5 M DEPTHS AT AUKE BAY AND LITTLE PORT WALTER

Month	Auke Bay[1]	Little Port Walter[2]
January	4.5	5.2
February	3.0	5.0
March	3.0	5.4
April	4.0	4.8
May	6.5	5.6
June	10.0	8.1
July	12.0	9.6
August	12.0	9.4
September	11.0	8.4
October	9.5	7.3
November	6.0	5.8
December	3.5	5.4

[1] Approximations based on averaged graphical data, 1960-68.
[2] Average mean monthly temperatures, 1984-1987.

Sources: Bruce _et al._ 1977, Thrower pers. comm.

Salinities

Larger rivers along the mainland shoreline can produce lower and fluctuating salinities (Pickard, 1967) and consequently make nearby areas unsuitable for locating netpens for adult growout. These areas include the mouths of the Stikine River, Taku River, Unuk River, Chilkat River and Speel River.

Lower and fluctuating salinities can affect the physiological condition of the salmon (i.e. in relation to the osmoregulatory adaptation to ambient salinity levels) and could influence outbreaks of harmful phytoplankton.

Pickard (1976) shows that most larger rivers in southeast Alaska (e.g. Stikine, Taku, and Chilkat) have peak flows over the summer period from melting glaciers and snow packs. Smaller rivers either have high flows in both summer and fall/early winter (from precipitation) or high flows primarily in fall/early winter. Low flows for all systems generally occur over late winter and early spring.

As a result, one would expect:

- generally higher surface salinities during late winter and early spring; and
- generally lower surface salinities and greater fluctuation in salinities, in waters closer to the mainland (where most large and moderate-sized river systems are located) relative to seaward coastal areas.

In general, Pickard (1967) found surface salinities over the summer in inlets without icebergs were lower at the head ends (range 1-11% compared to the inlet mouths (range of 17-32%). Salinities in deeper waters during summer ranged from 31.2 to 34%, which are similar to surface values recorded at ocean recording stations off the western shore of southeast Alaska.

Bruce et al (1977) indicate that in Auke Bay, surface salinities are typically much lower (16-17%) in summer (July) than in winter and early spring (30% January and April), and in winter/early spring are similar to deep water values (30-31%). They also show that at depths of 5 m, the summer values (20-21%) are typically more saline than surface values. Lower summer surface salinities are attributed to peak runoff from nearby large, glacial-fed streams. At Little Port Walter (which is located further from the mainland streams), mean monthly salinities at 4 m depth are generally higher ranging from 26-30% in summer/early fall to 31-33% in winter. Pickard (1967) shows high surface salinities (greater than 30%) in southern Chatham Sound (near Little Port Walter), Sumner Sound and Clarence Strait, recorded during June and August.

2.3 Phytoplankton and Marine Mammals

Phytoplankton

Two phytoplankton species, Chaetoceros convolutus and Heterosigma akashiwo, have caused serious mortalities amongst salmon cultured in marine netpens in British Columbia. Conditions appear suitable for both species in southcentral and southeast Alaska (Gaines and Taylor, 1986). Chaetoceros diatoms have been responsible for chinook salmon mortalities in seapens at Little Port Walter (National Marine Fisheries Service, unpublished). Chaetoceros convolutus has also been collected during surveys near Valdez in Prince William Sound (Horner et al 1973.) The occurrence and intensity of phytoplankton blooms vary greatly both geographically and temporally and prediction is difficult (Gaines and Taylor, 1987). In general, Heterosigma blooms tend to occur in early summer, often in association with lower salinities resulting from increasing river flow, while Chaetoceros blooms tend to occur in the late summer or fall.

Harmful phytoplankton could affect sites in both southcentral and southeast Alaska. As in British Columbia, the effects on production could be direct mortalities or reduced growth when oxygen depletion occurs and rations are restricted. In British Columbia, the strategy in stocking is to maintain densities at low levels (e.g., less than 8 kg/m3) to minimize losses should bloom conditions occur.

Marine Mammals

Marine mammals such as otters and sea lions have affected production at sites in British Columbia by killing fish in pens, by damaging netpens allowing fish to escape, and by causing high stress levels in the fish thereby reducing growth rates. National Marine Fisheries Service (unpublished) indicate otters, seals and possibly sea lions have killed fish at the experimental facilities near Little Port Walter. Steller's sea lions and harbour seals occur essentially along the entire Gulf of Alaska coastline (U.S. Department of the Interior, 1984).

Predation from marine mammals will likely be a similar problem in southcentral and southeast Alaska waters to that which occurs in British Columbia. This would likely require investment in predator control measures such as predator nets. Again, density levels would be kept low so that if stress develops when predators are nearby (but do not necessarily attack fish in the pens) it will not compound stress already resulting from high densities.

2.4 Smolt Production Capabilities

Southeast Alaska

Four state hatcheries in southeast Alaska produce chinook salmon and three hatcheries produce coho salmon (Hansen, 1987):

Hatchery	Location	Species Reared
Snettisham	near Juneau	chinook, coho
Hidden Falls	northeastern Baranof Island	chinook
Crystal Lake	near Petersberg	chinook, coho
Deer Mountain	near Ketchikan	chinook
Klawock	near Craig	coho

In 1986, nearly 5 million chinook eggs were collected from these facilities and more than 2.7 million juvenile chinook were released. Similarly, slightly more than 4 million coho eggs were collected and 1.5 juvenile coho were released.

In addition, 10 private non-profit hatcheries operated by regional aquaculture associations and other non-profit groups raise chinook or coho or are permitted to raise these species:

Hatchery	Location
Whitman Lake, Neets Bay, Meyers Chuck and Burrard Inlet	near Ketchikan
Gunuk Creek	near Petersburg
Medvejie Creek, Sheldon Jackson College and Port Armstrong	near Sitka
Salmon Creek and Sheep Creek	near Juneau

In 1986, private non-profit hatcheries in southeast Alaska had total permitted chinook egg capacities of 6.73 million and total permitted coho egg capacities of 15.47 million eggs. Most fry production of both species is in the Whitman Lake and Neets Bay hatcheries operated by the Southern Southeast Regional Aquaculture Association.

Southcentral Alaska

Five state hatcheries in southcentral Alaska produce chinook salmon and five hatcheries produce coho salmon:

Hatchery	Location	Species Reared
Big Lake	near Anchorage	coho
Fort Richardson	near Anchorage	coho, chinook
Elmendorf	near Anchorage	coho, chinook
Trail Lake	near Seward	coho, chinook
Kitoi Hatchery	near Kodiak	chinook, coho.

In 1986, 1.5 million chinook eggs were collected and 1.5 million juvenile chinook were released. Slightly more than 6.5 million coho eggs were collected and 7 million coho juveniles were released.