

ALASKA LEGISLATURE SPECIAL COMMITTEE/SUBJECT FILE 8672
1892 SCOMM 75: MARICULTURE (FISH FARMING), 1987-1990

129

1 hatchery operations involving

2 (1) a subspecies, race, or variety of Pacific salmon that
3 does not occur and reproduce in the state or the water of rivers that
4 cross the border between the state and Canada;

5 (2) Atlantic salmon.

6 * Sec. 10. AS 16.40.100 is amended by adding a new subsection to read:

7 (e) The commissioner may not issue a permit under this section
8 for aquatic farming of Pacific salmon in nets, pens, or enclosures
9 located in the marine or estuarine water of the state. Aquatic farm-
10 ing of Pacific salmon may be permitted only at an upland location.

11 * Sec. 11. AS 16.40.105 is amended to read:

12 Sec. 16.40.105. CRITERIA FOR ISSUANCE OF PERMITS. The commis-
13 sioner shall issue permits under AS 16.40.100 on the basis of the
14 following criteria:

15 (1) the physical and biological characteristics of the
16 proposed farm or hatchery location must be suitable for the farming of
17 the finfish, shellfish, or aquatic plant proposed;

18 (2) the proposed farm or hatchery may not require signifi-
19 cant alterations in traditional fisheries or other existing uses of
20 fish and wildlife resources;

21 (3) the proposed farm or hatchery may not significantly
22 affect fisheries, wildlife, or their habitats in an adverse manner;
23 and

24 (4) the proposed farm or hatchery plans and staffing plans
25 must demonstrate technical and operational feasibility.

26 * Sec. 12. AS 16.40.120(a) is amended to read:

27 (a) A person may not acquire aquatic plants, finfish, or shell-
28 fish from wild stock in the state for the purpose of supplying stock
29 to an aquatic farm or hatchery required to have a permit under

1 AS 16.40.100 unless the person holds an acquisition permit from the
2 commissioner. A person may not obtain an acquisition permit to ac-
3 quire finfish from wild stock in the state unless the person has
4 received a finfish brood stock license issued under AS 16.40.125.

5 * Sec. 13. AS 16.40.120(c) is amended to read:

6 (c) The commissioner shall specify the expiration date of an
7 acquisition permit and may attach conditions to an acquisition permit,
8 including conditions relating to the time, place, and manner of har-
9 vest. Size, gear, place, time, licensing, and other limitations
10 applicable to sport, commercial, or subsistence harvest of aquatic
11 plants, finfish, and shellfish do not apply to a harvest with a permit
12 issued under this section. The commissioner [OF FISH AND GAME] shall
13 issue or deny a permit within 30 days after receiving an application.

14 * Sec. 14. AS 16.40 is amended by adding a new section to read:

15 Sec. 16.40.125. FINFISH BROOD STOCK LICENSE. (a) An aquatic
16 farm or hatchery that holds a permit issued under AS 16.40.100 and
17 that engages in the propagation, farming, or cultivation of finfish
18 may

19 (1) obtain finfish stock only from the department or
20 another aquatic farm or hatchery; and

21 (2) possess finfish only under terms of a finfish brood
22 stock license issued by the department.

23 (b) A finfish brood stock license allows an aquatic farm or
24 hatchery to possess, propagate, farm, and cultivate finfish under the
25 following conditions:

26 (1) the licensee may farm and cultivate finfish for produc-
27 tion of aquatic farm products for food and finfish byproducts;

28 (2) the licensee may propagate finfish for production of
29 finfish stock, subject to regulations adopted by the department;

1 (3) the licensee may not sell or otherwise transfer live
2 finfish or live finfish gametes except for

3 (A) production of food and finfish byproducts; or

4 (B) farming and cultivation by another aquatic farm or
5 hatchery that holds a finfish brood stock license, provided that
6 the sale or other transfer is approved by the department;

7 (4) ownership of genetic material of finfish brood stock
8 and its succeeding generations is retained by the department;

9 (5) all rights to patents and other commercial rights in
10 genetic material of finfish brood stock and its succeeding generations
11 are retained by the department.

12 * Sec. 15. AS 16.40.130 is amended to read:

13 Sec. 16.40.130. IMPORTATION OF AQUATIC PLANTS, FINFISH, OR
14 SHELLFISH FOR STOCK. A person may not import into the state an
15 aquatic plant, finfish, or shellfish for the purpose of supplying
16 stock to an aquatic farm or hatchery unless authorized by a regulation
17 of the Board of Fisheries.

18 * Sec. 16. AS 16.40.140(a) is amended to read:

19 (a) A private hatchery required to have a permit under AS 16.-
20 40.100 may sell or transfer stock from the hatchery only to the de-
21 partment or to an aquatic farm or other hatchery that has a permit
22 issued under AS 16.40.100, except that

23 (1) shellfish stock may also be sold or offered for sale to
24 an aquatic farm or related hatchery outside of the state;

25 (2) finfish stock may be sold or transferred only to the
26 department or to an aquatic farm or other hatchery that has a permit
27 issued under AS 16.40.100 and a license issued under AS 16.40.125.

28 * Sec. 17. AS 16.40.160 is amended by adding a new subsection to read:

29 (b) The commissioner shall adopt regulations prohibiting the use

1 of lethal means to control vertebrate predators at hatcheries and
2 aquatic farms and establish guidelines for the use of nonlethal means
3 to control vertebrate predators at hatcheries and aquatic farms.

4 * Sec. 18. AS 16.40.170 is amended to read:

5 Sec. 16.40.170. PENALTY. Except as provided in (b) of this
6 section, a [A] person who violates a provision of AS 16.40.100 -
7 16.40.199, a regulation adopted under AS 16.40.100 - 16.40.199, or a
8 term or condition of a permit issued under AS 16.40.100 - 16.40.199,
9 is guilty of a class B misdemeanor.

10 * Sec. 19. AS 16.40.170 is amended by adding a new subsection to read:

11 (b) A person who holds a permit under AS 16.40.100 and who
12 intentionally engages in, or attempts to engage in, aquatic farming of
13 a finfish species, subspecies, race, or variety that is not authorized
14 by a permit and license issued by the commissioner under AS 16.40.-
15 100 - 16.40.199 is guilty of a class C felony.

16 * Sec. 20. AS 16.40.199(2) is amended to read:

17 (2) "aquatic farm product" means an aquatic plant, finfish,
18 or shellfish, or part of an aquatic plant, finfish, or shellfish, that
19 is propagated, farmed, or cultivated in an aquatic farm and sold or
20 offered for sale;

21 * Sec. 21. AS 16.40.199(5) is amended to read:

22 (5) "hatchery" means a facility for the artificial propa-
23 gation of stock, including rearing of juvenile aquatic plants, fin-
24 fish, or shellfish;

25 * Sec. 22. AS 16.40.199(8) is amended to read:

26 (8) "stock" means live aquatic plants, finfish, or shell-
27 fish acquired, collected, possessed, or intended for use by a hatchery
28 or aquatic farm for the purpose of further growth or propagation.

29 * Sec. 23. AS 16.40.199 is amended by adding a new paragraph to read:

1 (9) "Pacific salmon" means pink salmon, chum salmon, coho
2 salmon, sockeye salmon, or chinook salmon.

3 * Sec. 24. AS 16.40 is amended by adding a new section to read:

4 ARTICLE 3. FISH FOR EXHIBITION OR AQUARIUM PURPOSES.

5 Sec. 16.40.210. COMMERCIAL CULTURE OF FISH FOR EXHIBITION OR
6 AQUARIUM PURPOSES. (a) The department may issue a permit for the
7 possession, propagation, and sale of native or exotic fish or their
8 eggs for exhibition purposes or for stocking aquariums and private
9 ornamental ponds.

10 (b) The board may adopt regulations relating to activities
11 permitted under this section that are necessary to protect native
12 stocks of fish.

13 * Sec. 25. AS 17.20 is amended by adding a new section to read:

14 Sec. 17.20.047. LABELING OF FINFISH AQUATIC FARM PRODUCTS. (a)
15 A person may not intentionally sell or offer for sale for human con-
16 sumption a finfish aquatic farm product produced at a facility that
17 holds a permit issued under AS 16.40.100 unless the product is con-
18 spicuously identified as an aquatic farm product.

19 (b) A person who violates this section is guilty of misbranding
20 food under this chapter.

21 (c) In this section, "aquatic farm product" has the meaning
22 given in AS 16.40.199.

23 * Sec. 26. AS 43.75.015 is amended by adding a new subsection to read:

24 (d) Aquatic farm products produced at an aquatic farm are sub-
25 ject to the tax levied under this section.

26 * Sec. 27. This Act takes effect immediately under AS 01.10.070(c).
27
28
29

Original Bill

Pro-fish farming bill

1 IN THE SENATE

BY THE RESOURCES COMMITTEE

2

SENATE BILL NO. 195

3

IN THE LEGISLATURE OF THE STATE OF ALASKA

4

SIXTEENTH LEGISLATURE - FIRST SESSION

5

A BILL

6

For an Act entitled: "An Act relating to commercial finfish farming and aquatic farm and hatchery permits; and providing for an effective date."

7

8

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

10

* Section 1. AS 16.05.940(14) is amended to read:

11

12

13

14

15

16

17

18

(14) "[FISH OR] game farming" means the business of propagating, breeding, raising, or producing [FISH OR] game in captivity for the purpose of marketing the [FISH OR] game or game [THEIR] products, and "captivity" means having the [FISH OR] game under positive control, as in a pen[, POND,] or an area of land [OR WATER] that is completely enclosed by a generally escape-proof barrier; [IN THIS PARAGRAPH, "FISH" DOES NOT INCLUDE SHELLFISH, AS DEFINED IN AS 16.40.199;]

19

* Sec. 2. AS 16.10.420 is amended to read:

20

21

22

23

24

25

26

27

28

29

Sec. 16.10.420. CONDITIONS OF A PERMIT. The department shall require, in a permit issued to a hatchery operator, that

(1) salmon eggs procured by the hatchery must be from the department or a source approved by the department;

(2) no salmon eggs or resulting fry be placed in waters of the state other than those specifically designated in the permit;

(3) no salmon eggs or resulting fry, sold to a permit holder by the state or by another party approved by the department, may be resold or otherwise transferred to another person, unless the person holds a permit issued under AS 16.40.100;

1 (4) no salmon be released by the hatchery before department
2 approval, and, for purposes of pathological examination and approval,
3 the department shall be notified of the proposed release of salmon at
4 least 15 days before the date of their proposed release by the
5 hatchery;

6 (5) diseased salmon be destroyed in a specific manner and
7 place designated by the department;

8 (6) adult salmon be harvested by hatchery operators only at
9 specific locations as designated by the department;

10 (7) surplus eggs from salmon returning to the hatchery be
11 made available for sale first to the department and then, after in-
12 spection and approval by the department, to operators of

13 (A) other hatcheries authorized by permit to operate
14 under AS 16.10.400 - 16.10.470; or

15 (B) aquatic farms and hatcheries authorized by a
16 permit under AS 16.40.100 - 16.40.199;

17 (8) if surplus salmon eggs are sold by a permit holder
18 under (7) of this section [TO ANOTHER PERMIT HOLDER], a copy of the
19 sales transaction be provided to the department;

20 (9) [REPEALED]

21 (10)] a hatchery be located in an area where a reasonable
22 segregation from natural stocks occurs, but, when feasible, in an area
23 where returning hatchery fish will pass through traditional salmon
24 fisheries.

25 * Sec. 3. AS 16.10.450(a) is amended to read:

26 (a) Except as otherwise provided in a contract for the operation
27 of a hatchery under AS 16.10.480, a hatchery operator who sells salmon
28 returning from the natural waters of the state, or sells salmon eggs
29 to another hatchery operating under AS 16.10.400 - 16.10.470 or to an

1 aquatic farm or hatchery operating under AS 16.40.100 - 16.40.199,
2 after utilizing the funds for reasonable operating costs, including
3 debt retirement, expanding its facilities, salmon rehabilitation
4 projects, fisheries research, or costs of operating the qualified
5 regional association for the area in which the hatchery is located,
6 shall expend the remaining funds on other fisheries activities of the
7 qualified regional association.

8 * Sec. 4. AS 16.40.100(a) is amended to read:

9 (a) A person may not, without a permit from the commissioner,
10 construct or operate

11 (1) an aquatic farm; or

12 (2) a hatchery for the purpose of supplying aquatic plants,
13 finfish, or shellfish to an aquatic farm.

14 * Sec. 5. AS 16.40.100(b) is repealed and reenacted to read:

15 (b) A permit issued under this section authorizes the permittee,
16 subject to the conditions of AS 03.05 and AS 16.40.100 - 16.40.199, to
17 acquire, purchase, offer to purchase, transfer, possess, sell, and
18 offer to sell stock and aquatic farm products that are used or reared
19 at the hatchery or aquatic farm.

20 * Sec. 6. AS 16.40.100(c) is amended to read:

21 (c) The commissioner may attach conditions to a permit issued
22 under this section that are necessary to protect natural fish and
23 wildlife resources, including standards for treatment of water dis-
24 charged by a hatchery or aquatic farm to prevent the spread of disease
25 and pollution of fish and wildlife habitats.

26 * Sec. 7. AS 16.40.105 is amended to read:

27 Sec. 16.40.105. CRITERIA FOR ISSUANCE OF PERMITS. The commis-
28 sioner shall issue permits under AS 16.40.100 on the basis of the
29 following criteria:

1 (1) the physical and biological characteristics of the
2 proposed farm or hatchery location must be suitable for the farming of
3 the finfish, shellfish, or aquatic plant proposed;

4 (2) the proposed farm or hatchery may not require signifi-
5 cant alterations in traditional fisheries or other existing uses of
6 fish and wildlife resources;

7 (3) the proposed farm or hatchery may not significantly
8 affect fisheries, wildlife, or their habitats in an adverse manner;
9 and

10 (4) the proposed farm or hatchery plans and staffing plans
11 must demonstrate technical and operational feasibility.

12 * Sec. 8. AS 16.40.120(a) is amended to read:

13 (a) A person may not acquire aquatic plants, finfish, or shell-
14 fish from wild stock in the state for the purpose of supplying stock
15 to an aquatic farm or hatchery required to have a permit under AS 16.-
16 40.100 unless the person holds an acquisition permit from the commis-
17 sioner.

18 * Sec. 9. AS 16.40.120(c) is amended to read:

19 (c) The commissioner shall specify the expiration date of an
20 acquisition permit and may attach conditions to an acquisition permit,
21 including conditions relating to the time, place, and manner of har-
22 vest. Size, gear, place, time, licensing, and other limitations
23 applicable to sport, commercial, or subsistence harvest of aquatic
24 plants, finfish, and shellfish do not apply to a harvest with a permit
25 issued under this section. The commissioner [OF FISH AND GAME] shall
26 issue or deny a permit within 30 days after receiving an application.

27 * Sec. 10. AS 16.40.120(g) is amended to read:

28 (g) Aquatic plants, finfish, and shellfish acquired under a
29 permit issued under this section become the property of the permit

1 holder and are no longer a public or common resource.

2 * Sec. 11. AS 16.40.130 is amended to read:

3 Sec. 16.40.130. IMPORTATION OF AQUATIC PLANTS, FINFISH, OR
4 SHELLFISH FOR STOCK. A person may not import into the state an
5 aquatic plant, finfish, or shellfish for the purpose of supplying
6 stock to an aquatic farm or hatchery unless authorized by a regulation
7 of the Board of Fisheries.

8 * Sec. 12. AS 16.40.140(a) is amended to read:

9 (a) A private hatchery required to have a permit under AS 16.-
10 40.100 may sell or transfer stock from the hatchery only to the de-
11 partment to an aquatic farm or other hatchery that has a permit issued
12 under AS 16.40.100, or to a hatchery that has a permit issued under
13 AS 16.10.400; except that finfish and shellfish stock may also be sold
14 or offered for sale to an aquatic farm or related hatchery outside of
15 the state.

16 * Sec. 13. AS 16.40.199(2) is amended to read:

17 (2) "aquatic farm product" means an aquatic plant, finfish,
18 or shellfish, or part of an aquatic plant, finfish, or shellfish, that
19 is propagated, farmed, or cultivated in an aquatic farm and sold or
20 offered for sale;

21 * Sec. 14. AS 16.40.199(5) is amended to read:

22 (5) "hatchery" means a facility for the artificial propa-
23 gation of stock, including rearing of juvenile aquatic plants, fin-
24 fish, or shellfish;

25 * Sec. 15. AS 16.40.199(8) is amended to read:

26 "stock" means live aquatic plants, finfish, or shell-
27 fish acquired, collected, possessed, or intended for use by a hatchery
28 or aquatic farm for the purpose of further growth or propagation.

29 * Sec. 16. This Act takes effect July 1, 1990.

STATE OF ALASKA THE LEGISLATURE

POUCH - STATE CAPITOL
LINEAL ALASKA PRESS
17145 1400

LEGISLATIVE AFFAIRS AGENCY

MEMORANDUM

April 23, 1990

SUBJECT: Sectional Summary of SB 195(); An Act prohibiting the aquatic farming of salmon in marine or estuarine water of the state; relating to commercial finfish farming and aquatic farm and hatchery permits, certification of private fish pathologists, salmon hatchery permits, the fishery business tax, commercial culture of fish for exhibition or aquarium purposes, and labeling of finfish aquatic farm products; and providing for an effective date.

TO: Senator Bettye Fahrenkamp

FROM: George Utermohle *GU*
Legislative Counsel

This memorandum is a sectional summary of SB 195(), dated 3/26/90.

A summary of a bill is not an authoritative interpretation of the bill. The bill itself is the best statement of its contents.

Section 1 of the bill sets out the findings of the legislature and various policies of the state relating to finfish farming.

Section 2 of the bill amends AS 16.05.092 by adding a new duty to the Fishery Rehabilitation, Enhancement and Development (FRED) Division in the Department of Fish and Game. The FRED division shall establish a program for certification of private fish pathologists.

Section 3 of the bill amends the definition of "fish or game farming" in AS 16.05.940 by deleting references to fish, as a result only the term "game farming" would be defined.

Section 4 of the bill amends the conditions attached to private nonprofit salmon hatchery permits under AS 16.10.420.

Salmon eggs or resulting fry or smolt sold to a private nonprofit salmon hatchery by the state or other approved parties may not be resold or transferred without the approval of the Department of Fish and Game. Private nonprofit salmon hatcheries are authorized to sell surplus fry and smolts, as well as surplus eggs, to the department or to other private nonprofit salmon hatcheries.

Section 5 of the bill amends AS 16.05.450(a) to allow private nonprofit salmon hatcheries to sell fry and smolts, as well as eggs. The operator of the hatchery must then use these proceeds from the transaction for operating costs and the fisheries activities of the regional association.

Section 6 of the bill amends AS 16.40.100(a) in order to allow a person to construct or operate a hatchery to supply finfish to an aquatic farm if the person obtains a permit from the commissioner of fish and game.

Section 7 of the bill repeals and reenacts AS 16.40.100(b) in order to allow a person who has an aquatic farm or hatchery permit to buy and sell stock and aquatic farm products used or raised at the aquatic farm or hatchery. The current restrictions relating to the sale of shellfish stock are deleted.

Section 8 of the bill amends AS 16.40.100(c) in order to allow the commissioner of fish and game to attach conditions relating to water treatment standards for discharge water to aquatic farm and hatchery permits.

Section 9 of the bill repeals and reenacts AS 16.40.100(d) in order to prohibit the commissioner of fish and game from issuing a permit for aquatic farming of or hatchery operations involving a subspecies, race, or variety of Pacific salmon that does not occur and reproduce in water of the state or of an Alaska-Canada transboundary river. The prohibition against issuing permits for aquatic farming of Atlantic salmon is retained.

Section 10 of the bill amends AS 16.40.100 by adding a new section prohibiting the commissioner from issuing an aquatic farming permit for aquatic farming of Pacific salmon in nets, pens, or enclosures in the marine or estuarine waters

of the state. Aquatic farming of Pacific salmon may be permitted only at an upland location.

Section 11 of the bill amends AS 16.40.105 by adding a reference to finfish in the criteria relating to the siting of aquatic farms and hatcheries.

Section 12 of the bill amends AS 16.40.120(a) in order to require an acquisition permit for acquisition of finfish from wild stocks to supply an aquatic farm or hatchery. A person may not obtain an acquisition permit for finfish unless the person has already received a finfish brood stock license from the department.

Section 13 of the bill amends AS 16.40.120(c) by exempting the take of finfish for stock of an aquatic farm or hatchery under an acquisition permit from the restrictions placed on commercial, sport, and subsistence fisheries.

Section 14 of the bill adds a new section to AS 16.40 establishing the finfish brood stock license.

An aquatic farm or hatchery that engages in aquatic farming of finfish may only acquire finfish stock from the department or another aquatic farm or hatchery and possess finfish only under the terms of a finfish brood stock license issued by the department. The conditions attached to the finfish brood stock license are set out. The most notable conditions provide that an aquatic farm or hatchery may not sell or transfer live finfish or live finfish gametes except for specified purposes and that ownership of, and commercial rights in, the genetic material of finfish brood stock and its succeeding generations are retained by the department.

Section 15 of the bill amends AS 16.40.130 by adding finfish to the list of aquatic farm stocks that cannot be imported in to the state unless authorized by the Board of Fisheries.

Section 16 of the bill amends AS 16.05.140(a) in order to allow an aquatic farm hatchery to transfer aquatic farm stock to the department. Finfish stock may be sold or transferred only to the department or to an aquatic farm or hatchery that has an aquatic farm permit and a finfish brood stock license.

Section 17 of the bill amends AS 16.40.160 by adding a new subsection that requires the commissioner of fish and game

to adopt regulations prohibiting the use of lethal means to control vertebrate predators at aquatic farms and hatcheries and to establish guidelines for nonlethal control of vertebrate predators.

Section 18 of the bill makes a technical amendment to AS 16.40.170 in order to conform with sec. 19 of the bill.

Section 19 of the bill amends AS 16.40.170 by adding a new subsection that makes it a class C felony for an aquatic farm or hatchery to engage in the farming of a finfish species, subspecies, race, or variety that is not authorized by a permit and license issued under AS 16.40.100 - 16.40.199.

Sections 20 - 22 of the bill amend the definition of "aquatic farm product", "hatchery", and "stock" by adding finfish to the list of organisms included within each definition.

Section 23 of the bill amends AS 16.40.199 by adding a definition of "Pacific salmon".

Section 24 of the bill amends AS 16.40 by adding a new section relating to the commercial culture of fish for exhibition or aquarium purposes. The department may issue permits for the possession, propagation, and sale of native and exotic fish for certain purposes. The department may adopt regulations necessary to protect native fish from the activities permitted under this section.

Section 25 of the bill amends AS 17.20 by adding a new section relating to the labelling of finfish aquatic farm products.

Section 26 of the bill amends AS 43.75.015 by adding a new subsection providing that aquatic farm products are subject to the fishery business tax imposed on fish processors.

Section 27 of the bill provides that the bill takes effect immediately.

Original sponsor(s): Resources Committee

1 IN THE SENATE

BY THE RESOURCES COMMITTEE

2 CS FOR SENATE BILL NO. 195 (Resources)

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 SIXTEENTH LEGISLATURE - SECOND SESSION

5 A BILL

6 For an Act entitled: "An Act prohibiting the aquatic farming of salmon in
7 marine or estuarine water of the state; relating to
8 commercial finfish farming and aquatic farm and
9 hatchery permits, ~~certification of private fish~~
10 ~~pathologists~~, salmon hatchery permits, the fishery
11 business tax, commercial culture of fish for exhibi-
12 tion or aquarium purposes, and labeling of finfish
13 aquatic farm products; and providing for an effective
14 date."

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

16 * Section 1. FINDINGS AND POLICY. (a) The legislature finds that

17 (1) proposals to establish a marine-based salmon farming indus-
18 try in the state have been very controversial, and public response in many
19 coastal communities dependent upon wild salmon resources has been negative;

20 (2) land-based finfish farming is very similar to the state's
21 existing hatchery programs and has a well-documented history of minimal
22 effects on the health of wild finfish stocks and on the environment;

23 (3) the Alaska Finfish Farming Task Force concluded that aquatic
24 farming of nonsalmon finfish species in net pens and land-based aquatic
25 farms poses much less risk to wild finfish stocks than does marine-based
26 salmon farming;

27 (4) establishment of a finfish farming industry in the state
28 should proceed cautiously with appropriate safeguards for the protection of
29 the health of the state's wild salmon stocks;

1 (5) the best interests of the state are served by prohibiting
2 aquatic farming of salmon in the marine environment but authorizing other
3 forms of aquatic finfish farming.

4 (b) It is the policy of the state that

5 (1) the Department of Fish and Game and the Board of Fisheries
6 assist the development of finfish aquatic farms by assisting finfish
7 aquatic farms in obtaining finfish brood stock from surplus production of
8 brood stock by state hatcheries and private hatcheries authorized under
9 AS 16.10.400 or from wild stocks of finfish;

10 (2) scientific research projects relevant to the commercial
11 finfish farming industry be incorporated into the fishery research programs
12 of the Department of Fish and Game and the University of Alaska;

13 (3) aquatic farming of Arctic char and Dolly Varden, steelhead
14 and rainbow trout, sablefish, and sheefish, as well as Pacific salmon in
15 fresh water and salt water at upland locations, be permitted in the state.

16 * Sec. 2. AS 16.05.092 is amended to read:

17 Sec. 16.05.092. DUTIES OF DIVISION OF FISHERIES REHABILITATION,
18 ENHANCEMENT, AND DEVELOPMENT. The division of fisheries rehabilita-
19 tion, enhancement, and development shall

20 (1) develop and continually maintain a comprehensive,
21 coordinated state plan for the orderly present and long-range re-
22 habilitation, enhancement, and development of all aspects of the
23 state's fisheries for the perpetual use, benefit, and enjoyment of all
24 citizens and revise and update this plan annually;

25 (2) encourage the investment by private enterprise in the
26 technological development and economic utilization of the fisheries
27 resources;

28 (3) through rehabilitation, enhancement, and development
29 programs do all things necessary to insure perpetual and increasing

1 production and use of the food resources of Alaska waters and conti-
2 nental shelf areas;

3 (4) make a comprehensive annual report to the legislature,
4 containing detailed information regarding its accomplishments under
5 this section and proposals of plans and activities for the next fiscal
6 year, not later than 20 days after the convening of each regular
7 session;

8 (5) establish a program for certification of private fish
9 pathologists qualified to provide fish pathology services to the state
10 and private fish culture facilities and to conduct inspections of fish
11 hatcheries, fish farms, and other fish culture facilities on behalf of
12 the department. *apply only*

13 * Sec. 3. AS 16.05.940(14) is amended to read:

14 (14) "[FISH OR] game farming" means the business of prop-
15 agating, breeding, raising, or producing [FISH OR] game in captivity
16 for the purpose of marketing the [FISH OR] game or game [THEIR] prod-
17 ucts, and "captivity" means having the [FISH OR] game under positive
18 control, as in a pen [, POND,] or an area of land [OR WATER] that is
19 completely enclosed by a generally escape-proof barrier; [IN THIS
20 PARAGRAPH, "FISH" DOES NOT INCLUDE SHELLFISH, AS DEFINED IN AS 16.40.-
21 199;]

22 * Sec. 4. AS 16.10.420 is amended to read:

23 Sec. 16.10.420. CONDITIONS OF A PERMIT. The department shall
24 require, in a permit issued to a hatchery operator, that

25 (1) salmon eggs procured by the hatchery must be from the
26 department or a source approved by the department;

27 (2) no salmon eggs or resulting fry be placed in waters of
28 the state other than those specifically designated in the permit;

29 (3) no salmon eggs or resulting fry or smolt, sold to a

1 permit holder by the state or by another party approved by the depart-
2 ment, may be resold or otherwise transferred to another person, unless
3 the resale or transfer is approved by the department;

4 (4) no salmon be released by the hatchery before department
5 approval, and, for purposes of pathological examination and approval,
6 the department shall be notified of the proposed release of salmon at
7 least 15 days before the date of their proposed release by the hatch-
8 ery;

9 (5) diseased salmon be destroyed in a specific manner and
10 place designated by the department;

11 (6) adult salmon be harvested by hatchery operators only at
12 specific locations as designated by the department;

13 (7) surplus eggs from salmon returning to the hatchery or
14 resulting fry and smolt, be made available for sale first to the de-
15 partment and then, after inspection and approval by the department, to
16 operators of other hatcheries authorized by permit to operate under
17 AS 16.10.400 - 16.10.470;

18 (8) if surplus salmon eggs or resulting fry or smolt are
19 sold by a permit holder under (7) of this section [TO ANOTHER PERMIT
20 HOLDER], a copy of the sales transaction be provided to the depart-
21 ment;

22 (9) [REPEALED

23 (10)] a hatchery be located in an area where a reasonable
24 segregation from natural stocks occurs, but, when feasible, in an area
25 where returning hatchery fish will pass through traditional salmon
26 fisheries.

27 * Sec. 5. AS 16.10.450(a) is amended to read:

28 (a) Except as otherwise provided in a contract for the operation
29 of a hatchery under AS 16.10.480, a hatchery operator who sells salmon

1 returning from the natural waters of the state, or sells salmon eggs
2 or resulting fry or smolt to another hatchery operating under AS 16.-
3 10.400 - 16.10.470 or to the department, after utilizing the funds for
4 reasonable operating costs, including debt retirement, expanding its
5 facilities, salmon rehabilitation projects, fisheries research, or
6 costs of operating the qualified regional association for the area in
7 which the hatchery is located, shall expend the remaining funds on
8 other fisheries activities of the qualified regional association.

9 * Sec. 6. AS 16.40.100(a) is amended to read:

10 (a) A person may not, without a permit from the commissioner,
11 construct or operate

12 (1) an aquatic farm; or

13 (2) a hatchery for the purpose of supplying aquatic plants,
14 finfish, or shellfish to an aquatic farm.

15 * Sec. 7. AS 16.40.100(b) is repealed and reenacted to read:

16 (b) A permit issued under this section authorizes the permittee,
17 subject to the conditions of AS 03.05 and AS 16.40.100 - 16.40.199, to
18 acquire, purchase, offer to purchase, transfer, possess, sell, and
19 offer to sell stock and aquatic farm products that are used or reared
20 at the hatchery or aquatic farm.

21 * Sec. 8. AS 16.40.100(c) is amended to read:

22 (c) The commissioner may attach conditions to a permit issued
23 under this section that are necessary to protect natural fish and
24 wildlife resources, including standards for treatment of water dis-
25 charged by a hatchery or aquatic farm to prevent the spread of disease
26 and pollution of fish and wildlife habitats.

27 * Sec. 9. AS 16.40.100(d) is repealed and reenacted to read:

28 (d) Notwithstanding other provisions of law, the commissioner
29 may not issue a permit under this section for the farming of or

1 hatchery operations involving

2 (1) a subspecies, race, or variety of Pacific salmon that
3 does not occur and reproduce in the state or the water of rivers that
4 cross the border between the state and Canada;

5 (2) Atlantic salmon.

6 * Sec. 10. AS 16.40.100 is amended by adding a new subsection to read:

7 (e) The commissioner may not issue a permit under this section
8 for aquatic farming of Pacific salmon in nets, pens, or enclosures
9 located in the marine or estuarine water of the state. Aquatic farm-
10 ing of Pacific salmon may be permitted only at an upland location.

11 * Sec. 11. AS 16.40.105 is amended to read:

12 Sec. 16.40.105. CRITERIA FOR ISSUANCE OF PERMITS. The commis-
13 sioner shall issue permits under AS 16.40.100 on the basis of the
14 following criteria:

15 (1) the physical and biological characteristics of the
16 proposed farm or hatchery location must be suitable for the farming of
17 the finfish, shellfish, or aquatic plant proposed;

18 (2) the proposed farm or hatchery may not require signifi-
19 cant alterations in traditional fisheries or other existing uses of
20 fish and wildlife resources;

21 (3) the proposed farm or hatchery may not significantly
22 affect fisheries, wildlife, or their habitats in an adverse manner;
23 and

24 (4) the proposed farm or hatchery plans and staffing plans
25 must demonstrate technical and operational feasibility.

26 * Sec. 12. AS 16.40.120(a) is amended to read:

27 (a) A person may not acquire aquatic plants, finfish, or shell-
28 fish from wild stock in the state for the purpose of supplying stock
29 to an aquatic farm or hatchery required to have a permit under

1 AS 16.40.100 unless the person holds an acquisition permit from the
2 commissioner. A person may not obtain an acquisition permit to ac-
3 quire finfish from wild stock in the state unless the person has
4 received a finfish brood stock license issued under AS 16.40.125.

5 * Sec. 13. AS 16.40.120(c) is amended to read:

6 (c) The commissioner shall specify the expiration date of an
7 acquisition permit and may attach conditions to an acquisition permit,
8 including conditions relating to the time, place, and manner of har-
9 vest. Size, gear, place, time, licensing, and other limitations
10 applicable to sport, commercial, or subsistence harvest of aquatic
11 plants, finfish, and shellfish do not apply to a harvest with a permit
12 issued under this section. The commissioner [OF FISH AND GAME] shall
13 issue or deny a permit within 30 days of receiving an application.

14 * Sec. 14. AS 16.40 is amended by adding a new section to read:

15 Sec. 16.40.125. FINFISH BROOD STOCK LICENSE. (a) An aquatic
16 farm or hatchery that holds a permit issued under AS 16.40.100 and
17 that engages in the propagation, farming, or cultivation of finfish
18 may

19 (1) obtain finfish stock only from the department or
20 another aquatic farm or hatchery; and

21 (2) possess finfish only under terms of a finfish brood
22 stock license issued by the department.

23 (b) A finfish brood stock license allows an aquatic farm or
24 hatchery to possess, propagate, farm, and cultivate finfish under the
25 following conditions:

26 (1) the licensee may farm and cultivate finfish for produc-
27 tion of aquatic farm products for food and finfish byproducts;

28 (2) the licensee may propagate finfish for production of
29 finfish stock, subject to regulations adopted by the department;

1 (3) the licensee may not sell or otherwise transfer live
2 finfish or live finfish gametes except for

3 (A) production of food and finfish byproducts; or

4 (B) farming and cultivation by another aquatic farm or
5 hatchery that holds a finfish brood stock license, provided that
6 the sale or other transfer is approved by the department;

7 (4) ownership of genetic material of finfish brood stock
8 and its succeeding generations is retained by the department;

9 (5) all rights to patents and other commercial rights in
10 genetic material of finfish brood stock and its succeeding generations
11 are retained by the department.

12 * Sec. 15. AS 16.40.130 is amended to read:

13 Sec. 16.40.130. IMPORTATION OF AQUATIC PLANTS, FINFISH, OR
14 SHELLFISH FOR STOCK. A person may not import into the state an
15 aquatic plant, finfish, or shellfish for the purpose of supplying
16 stock to an aquatic farm or hatchery unless authorized by a regulation
17 of the Board of Fisheries.

18 * Sec. 16. AS 16.40.140(a) is amended to read:

19 (a) A private hatchery required to have a permit under AS 16.-
20 40.100 may sell or transfer stock from the hatchery only to the de-
21 partment or to an aquatic farm or other hatchery that has a permit
22 issued under AS 16.40.100, except that

23 (1) shellfish stock may also be sold or offered for sale to
24 an aquatic farm or related hatchery outside of the state;

25 (2) finfish stock may be sold or transferred only to the
26 department or to an aquatic farm or other hatchery that has a permit
27 issued under AS 16.40.100 and a license issued under AS 16.40.125.

28 * Sec. 17. AS 16.40.160 is amended by adding a new subsection to read:

29 (b) The commissioner shall adopt regulations prohibiting the use

1 of lethal means to control vertebrate predators at hatcheries and
2 aquatic farms and establish guidelines for the use of nonlethal means
3 to control vertebrate predators at hatcheries and aquatic farms.

4 * Sec. 18. AS 16.40.170 is amended to read:

5 Sec. 16.40.170. PENALTY. Except as provided in (b) of this
6 section, a [A] person who violates a provision of AS 16.40.100 -
7 16.40.199, a regulation adopted under AS 16.40.100 - 16.40.199, or a
8 term or condition of a permit issued under AS 16.40.100 - 16.40.199,
9 is guilty of a class B misdemeanor.

10 * Sec. 19. AS 16.40.170 is amended by adding a new subsection to read:

11 (b) A person who holds a permit under AS 16.40.100 and who
12 intentionally engages in, or attempts to engage in, aquatic farming of
13 a finfish species, subspecies, race, or variety that is not authorized
14 by a permit and license issued by the commissioner under AS 16.40.-
15 100 - 16.40.199 is guilty of a class C felony.

16 * Sec. 20. AS 16.40.199(2) is amended to read:

17 (2) "aquatic farm product" means an aquatic plant, finfish,
18 or shellfish, or part of an aquatic plant, finfish, or shellfish, that
19 is propagated, farmed, or cultivated in an aquatic farm and sold or
20 offered for sale;

21 * Sec. 21. AS 16.40.199(5) is amended to read:

22 (5) "hatchery" means a facility for the artificial propa-
23 gation of stock, including rearing of juvenile aquatic plants, fin-
24 fish, or shellfish;

25 * Sec. 22. AS 16.40.199(8) is amended to read:

26 (8) "stock" means live aquatic plants, finfish, or shell-
27 fish acquired, collected, possessed, or intended for use by a hatchery
28 or aquatic farm for the purpose of further growth or propagation.

29 * Sec. 23. AS 16.40.199 is amended by adding a new paragraph to read:

1 (9) "Pacific salmon" means pink salmon, chum salmon, coho
2 salmon, sockeye salmon, or chinook salmon.

3 * Sec. 24. AS 16.40 is amended by adding a new section to read:

4 ARTICLE 3. FISH FOR EXHIBITION OR AQUARIUM PURPOSES

5 Sec. 16.40.210. COMMERCIAL CULTURE OF FISH FOR EXHIBITION OR
6 AQUARIUM PURPOSES. (a) The department may issue a permit for the
7 possession, propagation, and sale of native or exotic fish and their
8 eggs for exhibition purposes or for stocking aquariums and private
9 ornamental ponds.

10 (b) The board may adopt regulations relating to activities
11 permitted under this section that are necessary to protect native
12 stocks of fish.

13 * Sec. 25. AS 17.20 is amended by adding a new section to read:

14 Sec. 17.20.047. LABELING OF FINFISH AQUATIC FARM PRODUCTS. (a)
15 A person may not intentionally sell or offer for sale for human con-
16 sumption a finfish aquatic farm product produced at a facility that
17 holds a permit issued under AS 16.40.100 unless the product is con-
18 spicuously identified as an aquatic farm product.

19 (b) A person who violates this section is guilty of misbranding
20 food under this chapter.

21 (c) In this section, "aquatic farm product" has the meaning
22 given in AS 16.40.199.

23 * Sec. 26. AS 43.75.015 is amended by adding a new subsection to read:

24 (d) Aquatic farm products produced at an aquatic farm are sub-
25 ject to the tax levied under this section.

26 * Sec. 27. This Act takes effect immediately under AS 01.10.070(c).

SCOMM

75:26

THE FOLLOWING DOCUMENT HAS
NOT BEEN FILMED BUT IS
AVAILABLE IN THE ORIGINAL
FILE



1986

NORWAY

A major player in the U.S. fishing industry



Norway's ties to American fishermen run deep, both technologically and culturally. The names of Norwegian gear manufacturers are as common to U.S. fishermen as are the names and accents of fellow skipper and crewmen. Seattle, more than any other domestic port, has been influenced by Norwegian-Americans. Our special eight-page section on Norway by Field Editor Kris Freeman leads off with a look at this connection.



Norway's varied fleet produces enough seafood to account for 10%-12% of that nation's exports to the rest of the world. Exported along with seafood is the fishing gear and technology for which Norway is famous. Additionally, the United States has benefitted from a large number of Norwegian fishermen who immigrated from ports such as Aalesund (left photo) and are helping to develop the American fisheries.

Story and photos by
KRIS FREEMAN

Norway is a land of water and rock — pine-covered mountains that slide straight into the sea. From the air it looks as though somebody dropped Norway and broke it; the coast shattered into innumerable islands and the interior dented into sharp, snow-covered peaks.

One city on the island-dotted southwest coast is Aalesund. There, a statue of a deckhand is wrapped deep in fog as a 33' gillnetter pulls up to the dock to sell the night's catch of mackerel. The day's first commuter ferries begin arriving at the pier. As in many Norwegian cities, the primary logistical problem is getting from one island to another.

The people of Aalesund are working on a more direct method of traversing their

home fjord — burrowing two giant tunnels to connect three islands by underwater freeway. On my visit there, residents would proudly drive me up to a viewpoint overlooking the gray sea, hazy sky and maze of green islands to point out the route of the tunnel, two-thirds complete.

Since the tunnel has yet to break through on the airport side, I took the ferry into Aalesund this August, a mode of transportation that was familiar to me since my home of Seattle is also linked to many islands by public boat service.

It was my first trip to Norway. I am not Norwegian, but stepping off the Aalesund ferry was strangely like coming home. It wasn't just the scenery, which looks like

Washington state, all water and conifers, or the ferry ride, or the many fishing boats. It was people. Almost everywhere I went I ran into someone who knew somebody I knew back in the states.

"Oh, from Seattle." The Aalesund skipper softens a bit toward the stranger taking photos of his 48' gillnetter. "My sister lives in Seattle," he says through a translator. "My brother-in-law Sverre Johanson is the processing boss on the Golden Alaska."

"Bob Jensen," says the salesman at an electronics company. "We sold him one of our new color sonars." And the fellow who owns the Sea Wolf? "Bob Watson," I answer. My escort from the Norwegian export council grows increasingly puzzled. "You talk about this Bob and this Fred and

this Sverre," he says. "You know these fishermen?"

The Norwegian-American connection runs deep and long. A bronze statue of Leif Erickson — who historians say may have been the first European to discover the new world — stands in Ballard's Shilshole Bay, facing the wrong ocean but fostering Norwegian pride nonetheless.

I'm a native of Ballard, a small north Seattle neighborhood that is home to many recent and not-so-recent immigrants from Norway, Sweden and Denmark. I went to school with a lot of kids named Johnsen and Jensen and Johanson and was confronted with the concept of herring for breakfast early in life. So Scandinavia seemed much more familiar to me than it

Norwegian shipyards handle quite a bit of work for vessels owned by U.S. fishermen. At the Myklebust Mek. Verstedt A/S yard, two hours south of Alesund, three oil supply boats await conversion to fishing vessels for duty off Alaska.



might to someone from, say, San Diego.

In addition, I spent much of my time in Norway traveling in an area called Sunnmøre, a remote area of the southwest coast of Norway that is the original home to many of the Norwegians in Ballard or to their parents or grandparents.

Check around at the Norse Club or the Deep Sea Fishermen's Union in Ballard and you'll find more than a few fishermen from Alesund, the factory trawler capital of southern Norway, or from Maløy, a tiny village not too far to the south but so inaccessible that one Norwegian I spoke to referred to it as the "end of the world."

It is not just that my neighbors are from Sunnmøre, but that they keep going back. And they take their children with them. Ask a Norwegian when he emigrated and he'll tell you how many times he's bought a ticket home. "Fifteen times in 40 years," says an old tugboat captain, pointing out his home village on one of two large maps of Norway posted in the new Leif Erickson Lodge in Ballard. "Twelve times since 1930," says a New Bedford grandmother I met on the Aalesund ferry, coming from perhaps her last visit home.

Business is business

Ballard Norwegians take their business back to the old country as well. "This boat was insured and financed in Norway," declares a skipper with the highly appropriate name of John Johannessen during the recent christening of a new

Taking care of business

Norway is much too cold to grow its own food and so for centuries has traded fish for grain. Although oil buys most of the groceries now, the government still considers a healthy fishing industry to be a high priority. Seafood accounts for 10% to 12% of the nation's exports.

Norway's concern for the health of its fishing industry stems from several reasons. One is that fishing is traditional. Another is a need to maintain as many local food supplies as possible. A third reason is a government policy of support for industries that will maintain population in Norway's remote regions.

As a result, Norwegian skippers enjoy some financial supports that their American cousins do not. For example, Norwegian skippers are generally astonished at the idea of paying 10% of the value of a vessel for one year's P&I insurance — conservative rates in Alaska these days. To insure the 102' longliner Holmeset Senior, valued at \$1.3 million, owner/skipper Jarle Holmeset and his partner and brother, Arnstein, pay a rate of just over 2%. Insurance for catch and crew runs \$7,700 a year — about what a U.S. factory trawler will pay for a single deckhand.

If a fisherman is injured at sea or even on shore, the government pays his medical expenses plus a monthly salary equivalent to his average income over the past three years. Fishermen can also retire with a government pension, just like shore-side workers.

Until recently, fishermen were also guaranteed a minimum income. There isn't a minimum wage, fisheries bureaucrats explain. But the government does support fish prices, which amounts to the same thing since Norwegian deckhands are paid by crew share.

These subsidies are being phased out in response to the worldwide increase in whitefish prices and an overall change of policy by Norway's Socialist government. Yearly subsidies were cut by half in 1987 but they're still enormous — over \$100 million. Most of this money is being used to retire surplus vessels or to support new ventures like development of the scallop fishery, which recently began to harvest virgin beds of the

Svalbard and Jan Mayen islands near Greenland.

To support Norway's extensive system of social services, fishermen hand over 30% to 40% of their pay in income tax and lose another substantial chunk of their disposable income through a sales tax that ranges from 20% to 25% throughout Scandinavia. High taxes fuel a lively black market in salmon and other goods as well as a major industry in one-day "international" tax-free cruises with cheap liquor.

Many Norwegian fishermen earn the median full-time Norwegian income of about \$23,000 a year. That's the average annual crew share on Holmeset's longliner for approximately eight months at sea. Holmeset says this is equivalent to about two years work on a standard nine to five shore-side schedule.

Shares are divided up after expenses are paid, which run about \$50,000 per trip on Holmeset's boat. That includes food, fuel (currently running about 58¢/gal. compared to \$1.25 two years ago), bait, spare hooks and line. That means the crew has to salt and freeze some 40 tons of fish on each six-week trip to break even. As a result, Holmeset is not fond of recent vessel quotas instituted in the Barents Sea cod fisheries. Each vessel is limited to 250 round tons of fish per season, not much for the average 100' to 140' automated longliner with a 12-man crew.

Despite the carefully regulated nature of Norwegian fishing, there are still fortunes to be made on the slime line. I was told stories of young crewmen coming ashore with wads of thousand-kroner bills hanging out of their shirt pockets. "Some of the guys hire a helicopter to take them to the hotel from the boat," says a shipyard worker. "One guy forgot to take his sunglasses out to the boat, so he hired a helicopter to go and get them."

And then there are the busts. Lofoten cod fishermen have had a bad year as have the 100-plus mackerel and capelin seiners. In Norway, as in Alaska, you can make enough money for a year in a matter of weeks or fish six months for nothing.

At 128', Karakim Stolem's seiner is relatively small among the fleet of Norwegian seiners that target primarily on fish for meal and oil. Filling the vessel's 380-ton-capacity hold can take anywhere from a few hours to two weeks.



American-built vessel. They buy Norwegian winches and floats and hooks, sometimes even time in Norwegian shipyards — that is, if the price is right. Home country loyalties aside, there are many Norwegian fishermen who would buy their gear from Hong Kong if the quality were equivalent and the discount deep enough.

In that respect they are not too different from their uncles and cousins in the fishing fjords of Sunnmøre. It turns out that the folks from Aalesund are not unlike the typical Ballard fisherman who owns \$5 million worth of crab boats and one sport coat. Like their Ballard cousins, well-to-do Sunnmøre fishermen display their status on their wrists. Instead of gold king crab watches, however, the fishermen wear Rolexes.

There are other similarities between the Norwegian fishermen of Aalesund and Ballard. One is their attitude toward marine mammals. For generations the Norwegians have done what many an Alaskan would like to do — hunt and skin seals. This attracted the attention of Greenpeace.

Naval architect Lars Eldoy remembers the day a group from Greenpeace in rubber rafts buzzed an Aalesund sealing vessel at the dock, boarded and chained themselves to the crew's nest. The skipper ignored them, continuing to take on supplies. Just after nightfall he headed out to sea. In March in Aalesund, as the locals say, the weather isn't good. After the Greenpeaceers bounced around the top of the mast long enough to get good and seasick, the skipper cut them down and dropped them off on the nearest dock.

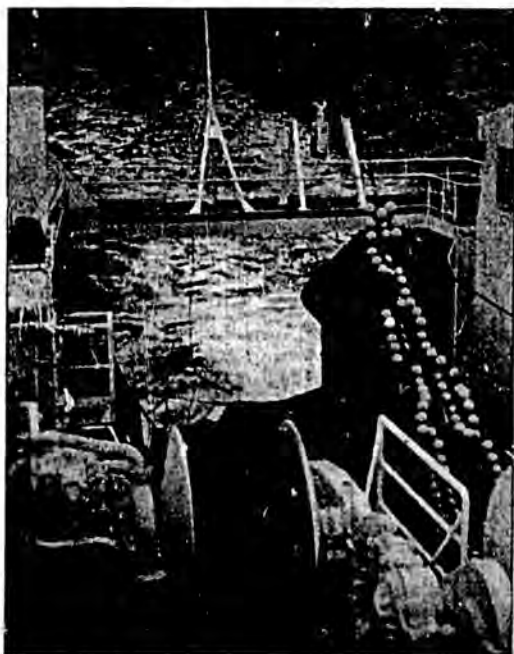
Greenpeace has never been back. But most of the old wooden sealing boats are tied up just the same, casualties of shrinking quotas and a declining market for seal pelts. As a result, Norwegian coastal fishermen have noticed a corresponding increase in the seal population. This, combined with a decrease in the capelin stocks that are an important component of the seal's diet, have driven the seals inshore where they cause the usual problems — eating fish off hooks and out of nets, scaring the fish and tearing web.

Greenpeace is an ally, however, when it comes to fighting the industrial pollution and wholesale dumping that have turned much of the Baltic Sea into a fishery wasteland. Greenpeace has also sided with fishermen in disputes with the oil industry in this "Kuwait of the North." Although Norway's 25,000 fishermen make up nearly 1% of the population, they are outnumbered two to one by workers in oil and related industries. And oil has made Norway rich since it first began exporting North Sea crude in 1972.

A torsk is a torsk

Not only does English permeate the airwaves, but all Norwegian school children begin studying it at the age of 10 and continue until graduation. As a result, Norwegian adults under the age of 40 understand some English even if they're too out of practice to feel comfortable speaking it.

A full trawl with Datasynchro



The Datasynchro System developed by Hydraulik Brattvaag has completely revolutionized trawling techniques.

Datasynchro provides skippers with better information and improves the safety of the gear. More hauls can be made each day, meaning better earnings, at the same time as the stress on watchkeepers is reduced.

Datasynchro monitors and adjusts the trawl continuously, ensuring that it is set to best advantage and thereby maximizing the catch. Programming and operation are extremely simple, and the integral microcomputer gives instant confirmation of every step.

For further information about Datasynchro get in touch with:

HYDRAULIK BRATTVAAG

A/S HYDRAULIK BRATTVAAG - N-6270 BRATTVÅG - NORWAY
TEL. + 47 71 15 900 - TELEX 42 356 HYDRA N - TELEFAX + 47 71 15 900

AGENT IN USA WEST COAST:
Pacific Marine Equipment Sales Inc.
Fishermen's Terminal C 10 Bldg.
Seattle, Washington 98119

Phone 1-206-281-7383 FAX 1-206-284-1710

SEE US AT THE NORWEGIAN STAND AT
FISH EXPO '87, OCT. 28-31, 1987, SEATTLE, WA.

Pr. AUG 87: 97 new trawlers with our Datasynchro systems.



Typical of many inshore boats is Lorentz Johanson's 48' gillnetter Olav Dalen, which is powered by a 180-h.p. engine. Johanson, like so many other Norwegians, is related to people working in the U.S. seafood industry.

Population pressure is one major reason for Norway's extensive regulatory system. Back before the turn of the century, 30,000 fishermen fished Lofoten cod. An old photo in Oslo's Maritime Museum shows their open skiffs jammed into the mouth of a fjord awaiting the opening gun, just like a pack of gillnetters crowding the line in Bristol Bay. I suspect many of the Norwegian fishermen who emigrated to the United States were just trying to get away from the crowd.

Aalesund native Per Slinning spent a year and a half in Ballard during 1978-79, attending high school and the University of Washington. When he returns for Fish Expo this year he will see something else that

looks familiar, a model of Seattle's new Fisherman's Memorial. The monument — a 28' granite pillar covered with sinuous bronze fish — will be a good deal more impressive than the statue in Aalesund. But at heart the idea is the same.

Atop the pillar will be a young deckhand in oilskins struggling with a halibut. Like the boy in Aalesund's statue, he is a symbol of the thousands of young men who have chased the cod and halibut on both sides of the Pole, not only of those who never came back but also of the fishermen who lived to marry Scandinavian sweethearts and to grow old drinking coffee, chewing snoose and telling fish stories of the far Northwest of America. □

And it's usually not too difficult to find a translator on the street. Nevertheless, conducting an interview was still a challenge.

"They're catching torsk," says yet another one of my guides, pointing to a longliner offloading at a pier near Aalesund.

"Right, cod," I say, having carefully studied the list of Norwegian fish names in my Berlitz guide.

"No," he says, "not cod, torsk."

"But cod is torsk . . . isn't it?"

"Yes, cod is torsk but this is torsk."

"Cod?"

"No, TORSK, not torsk."

Turns out cod is the English name for torsk. And torsk (or tusk or cusk depending on your preference) is the English name for another species (Latin name *Brosme brosme*) that Norway's longliners harvest along with white ling and haddock during the summer season. The cod fishery takes place in the winter when the fish congregate for spawning.

Automation helps

On board, the longliner's cook served meatballs, potatoes and peas covered with dark, glossy gravy — the Norwegian equivalent of a meatloaf dinner. Most of the crew were offloading the catch of frozen and salted torsk, ling, halibut and Atlantic pollock. Half were bound for furlough, to be replaced by the six-man relief crew, and half would stay on for another six-week trip.

The schedule on this 102' deep-sea longliner is similar to that of an Alaskan blackcod boat or joint-venture vessel. The difference is that the Norwegians consider eight months sea duty a year a vacation while most Alaskans, especially those with experience in king crab, view it as something akin to imprisonment.

Skipper Jarle Holmeset, son and grandson of fishermen, remembers the days he trawled for pollock out of the Faroe Islands. On the weekend of his wedding in 1970 he got home on Thursday, married on Saturday and left on Monday. He says his wife likes the current system of two trips on, one off, much better although at the end of the six-week leave she's ready to boot him out of the house. The advent of automated longlining is one reason hook-and-line fishermen can afford to take a little more time off than they used to. Of eight 100'-plus longliners in the Holmesets' small home village of Hærem, seven have automated baiting and hauling systems.

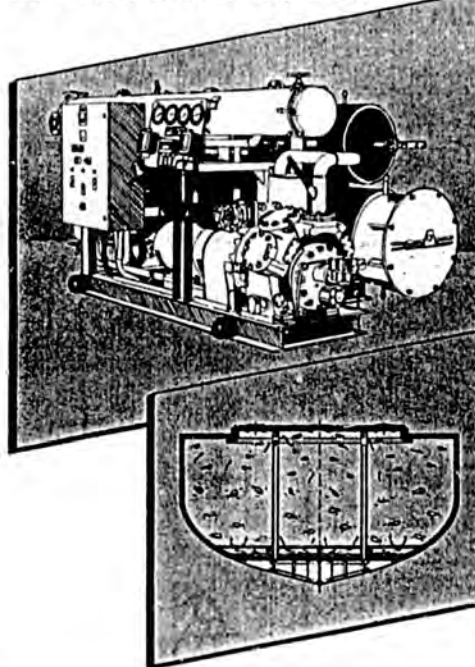
However, some of the fishermen's shorter hours are by mandate rather than choice. Because of closures and vessel quotas, Holmeset can't fish as much as he would like. Alaskan longliners have only recently been reined in compared to their Norwegian cousins. Norway actually held the first longline derby common now on American halibut and blackcod grounds where a season can be measured in hours. The government instituted time and area closures in 1814 and has been adding to them ever since.

2 ways to land your catch

Your catch can reach land in one of two ways: frozen or fresh/chilled. Either way, Kvaerner Kulde offers a well proven and competitive answer. The prime factor in our product development — and improvement, is **innovation** — offering our customers fresh, effective technology which helps You compete on a progressive market.

Together with experience in close cooperation with the owners of the finest fishing vessels in the world, we have developed and tailor made heavy-duty marine refrigeration plants for long liners, processor factory trawlers and purse seiners, installed onboard vessels sailing on "The Seven Seas". In order to give You an edge over the competition in a very competitive market.

1 Fresh/chilled



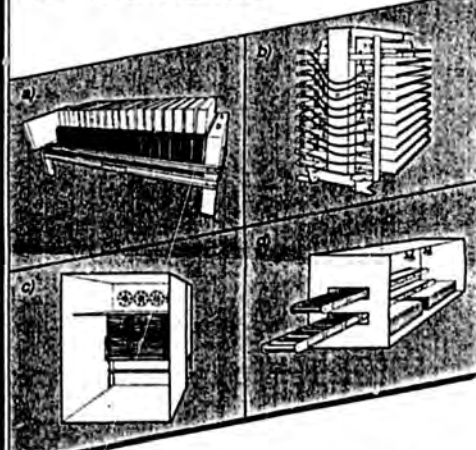
To preserve the good quality of fresh fish, it must be cooled to a temperature as close to -1°C (30.2°F) as possible after catching.

With RSW the temperature of the fish is kept slightly below 0°C (32°F), yet avoiding freezing and prolonged storage life and good quality are obtained.

The Kvaerner RSW systems have been developed over many years in close co-operation with the owners and crews of some of the most efficient fishing vessels in the world. Above all, the Kvaerner systems are practical, reliable, and require little maintenance.

To keep the systems clean — and easily cleanable — Kvaerner provides large RSW filters and special shell- and tube coolers.

2 Frozen



a) Kvaerner's latest Vertikal Platefreezer is designed for side- or top unloading.

b) Kvaerner's twin-cylinder heavy-duty marine Horizontal Platefreezer.

c) Air-blast freezer. Careful design and selection of components for optimal performance.

d) Advance continuous tunnel freezing (IQF), ensure top-market value for your product.

The freezing plates are the key feature of the Kvaerner Horizontal Plate Freezer.

Because the aluminium plates are 32 mm (1.1/4") thick, they have sufficient strength and rigidity to secure perfect flatness and close tolerances of the frozen products, as required for instance for mechanical cutting of blocks for fish sticks. The plates will withstand the rough working conditions of the fishing industry and ensure reliable and continuously high output for many years with almost non-existing maintenance costs.

NEW, VERTICAL PLATE FREEZER

Everybody with the knowledge of manual handling of large fish blocks will appreciate the new freezers' features, such as possibilities for mechanical top- as well as front unloading. Manual unloading is made simpler with less physical exhaustion to workforce handling blocks on site. Other features are easy access to blocks due to lifting device placement underneath freezing station. Block thickness can easily be adjusted by operator.

New vertical freezer is delivered in varying numbers of freezing station with 100 mm, 75 mm and 50 mm thickness.



KVÆRNER KULDE

P.O. Box 115, N-1301 Sandvika Norway
Tel: (02) 54 49 60 - Telex 76 480 kulde n
Telefax (02) 54 49 68

U.S.A. Office - Unitor Ships Service
1800 West Emerson Place, Seattle
Washington 98107

Tel: 206-762 8455
Telefax 206-762 2653
Telex 4740 089

Researchers aim for better gear and lower operating costs

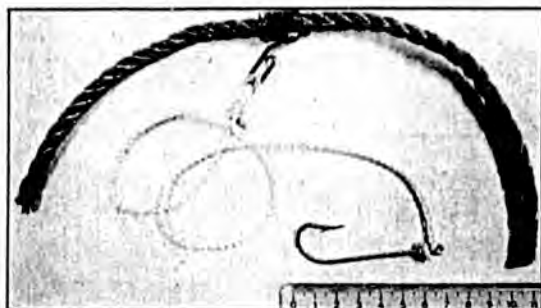
New projects at Norway's Fishery Technology Research Institute (Norwegian acronym FTFI) reflect Norway's shift in emphasis from catch efficiency to cost efficiency.

Increasing catches and gear efficiency is less important now that Norway's fishing capacity exceeds its resources, says institute director Anders Endal. "In the future, there won't be any [additional] fish to catch. So we have to make more of what we catch and catch it with less expense," he says.

With that in mind, gear researchers are experimenting with minced and artificial baits to supplement declining supplies of whole, natural bait fish, and the vessel division is working with microchips instead of hull models.

Artificial bait

FTFI has begun to test a product that's become popular with sport anglers — artificial bait. So far, the results are promising. During an April research cruise, polyurethane (flavored with a few amino acids) appeared to attract cod as effectively as shrimp. This research is of great interest to Norwegian longliners who have watched



the price of their preferred natural bait — squid — quadruple in a few years.

Currently, Norwegians import food-quality squid from Poland and the U.S.S.R. at up to \$2.25/lb. They used to

FTFI researchers are experimenting with the use of swivel connections between ganglions and heavy "Alaska-style" longlines (top left). They point to the success that swivels have had when used with monofilament main lines (lower left), which tangle and break easily. FTFI also helped Mustad test its new E-Z Baiter hook (top right).

pay just 60¢/lb. for smaller Norwegian-caught squid, but catches have declined in recent years. Many longliners have switched over to mackerel as a bait for ling and haddock, but nothing works like squid for

catching cod. That is, possibly, until now.

Catch rates on hooks threaded with artificial bait were equal to those of hooks set with whole, boiled shrimp. The polyurethane attracted fewer cod than natural bait, but the cod that bit were larger so that the total poundage from both types of sets was about equal. At the same time, fewer haddock were caught on the hooks baited with man-made chow.

FTFI biologist Asmund Bjordal speculates that the artificial bait caught larger fish because the pieces used were so big. The 2-gram sheets tested expanded to 18 grams in water, swelling to the size of a cigarette lighter. Big cod could handle the bait, but smaller fish, like haddock and young cod, evidently spurned the artificial bait for something more bite size.

Bjordal declined to name the source of the artificial bait but did say that his department was cooperating with the University of Florida on the research.

In other bait news, a chopped-herring longline bait developed by FTFI is ready for commercial production. The herring is sewn into a small nylon pouch or "teabag." The herring teabags were as successful in catching haddock, tusk and ling as traditional baits. Cod was the only major

MAR CATCH SCANMAR CATCH SCANMAR CATCH SCANMAR CATH SC

PROFITABLE FISHING WITH SCANMAR 1000 SYSTEMS IN 30 COUNTRIES PROVIDE:

- Improved efficiency
- Reduced costs
- Improved catch quality
- No cables - No winches

The Scanmar gives you a practical simplicity of equipment handling. The modular Scanmar enables you to expand your system and gives you an opportunity to have the latest equipment at all times.



SCANMAR
*Your natural choice
of catch control.*

Scanmar s.s. P.O. Box 44 N-3155 Asgardstrand - Norway
Phone: +47 33 31 033 · Tlx: 70264 Scan n · Fax: +47 33 30 934



**What is ScanRope's
contribution to the
world's most efficient
fishermen?**



**Highly durable wire ropes
for all fishing applications.**



**Karat® fibre ropes —
unmatched strength to weight
ratio of any comparable
man-made fibre.**



See us at the Norwegian stand
at "Fish Expo", Seattle 28-31 October 1987.



ScanRope

P.O. Box 295 - 3101 TØNSBERG - NORWAY
Tel.: +47 33 11 670 - Telefax: +47 33 14 861
Telex: 70 521 scaro n.

longline species that preferred a firmer mouthful, shunning the teabags for chunks of mackerel and squid.

Hooks and swivels

FTFI often coordinates its gear research with that of private companies, testing specific products like Mustad's new E-Z Baiter hook. Results from this type of product research are made public.

The researchers found that hooking gangions to the groundline with a swivel (similar to those on the Mustad "Quick Snap" line) increased catch rates. That's because the gangions don't tangle and break as often, says Bjordal, who has observed longline action during experiments with the help of an underwater camera.

Norwegian coastal fishermen, particularly those in the Lofoten, have used gangion swivels for quite some time on monofilament-suspended longline rigs. Monofilament has the advantage of being difficult for fish to see. However, it is difficult to work with and tangles and breaks easily. It can't be used with an Autoline system and takes some skill to hand bait because it's quite stiff. (Some Lofoten fishermen use monofilament for groundlines as well as gangions.)

Bjordal says Lofoten fishermen often suspend their longlines, using the same gear for both midwater and bottom operations. They snap floats to the groundline for suspended sets, floating the hooks anywhere from a few fathoms to 30 or 40 fathoms below the surface.

The difference in FTFI's research is that Bjordal is attaching gangions to heavier Alaska-style groundlines. He's found that

much of the twisting on standard gangions occurs as the fish is being hoisted to the surface. Not only does the fish swim in circles trying to free itself, but as it arches and curves its body, the upward momentum and friction of the water spin it around the hook like a propeller blade. The torque causes the line to shorten and twist up on itself, making it easier to snap.

Big-mesh seines

Steinar Olsen of the FTFI gear division reports that he and his researchers are experimenting with large mesh in purse seines. Large mesh is inserted from the corks to the headline in the areas of the seine that hit the water last and come out first. Standard mesh is retained in the bunt of the net.

Two nets are being tested. The first was built for one of Norway's giant mackerel seiners, which reports that it doesn't seem to be losing any fish through the large web. One third of the seine was constructed from 6"-8" diamond mesh instead of the usual 1"-1 1/2" mesh.

"I personally think you could go much bigger, but the fishermen won't go for it," says Olsen. He would like to try 20"-24" or even 3' mesh. The division's 41' experimental vessel has just started work with a much smaller seine partially made from 5"-6" hexagonal mesh.

The idea behind big-mesh seines is similar to that of rope and supermesh trawls. The big mesh herds, rather than confines, the fish. The fish only try to escape the seine when they become crowded and see the web closing in around them, says Olsen. He adds that more underwater observation of fish behavior is needed to determine the mesh-size limit on various seines.

The big meshes are intended to save

materials, making seines less expensive to build and lighter to handle. That's the same idea behind seines made of hexagonal web, which sinks faster and is less expensive than conventional webbing, according to FTFI tests. Hexagonal seines are beginning to become popular among Norwegian seiners, says Olsen.

Small boat autolining

Norway's big boat longline fleet is almost fully mechanized with Mustad Autoline systems. But these rigs are far too costly for small coastal vessels, says Olsen. He and FTFI researchers are testing a less complicated Canadian system that costs only \$1,500-\$2,300 compared to \$80,000-\$160,000 for a full-fledged Mustad system.

The Mustad system is very precise, says Olsen. It takes a hook, holds it, puts on the bait and releases it. The system Olsen is experimenting with is a snag baiter. "The Norwegians abandoned this idea. The Canadians didn't. With a reasonable slush of water and bait, there will be bait on about 90% of the hooks when they leave the tray," he says.

There's a trick to the proportion of bait and water and to the shape of the tray to make the system work, says Olsen. "If you don't aim for perfection, you can make things much cheaper. If you can get by with 80%-90% of the hooks baited, it's still a great help. If you want 100% baiting, then you have to go to a more expensive system."

Info management

In 1986, "National Fisherman" reported that the FTFI vessel division was concentrating its efforts on fuel efficiency and stability programs. Those projects are now

complete, and through the use of computer programs, the division is shifting its focus from design and construction to operations, i.e., helping skippers run more cost-efficient operations as opposed to catch-efficient ones.

The division is mapping various good and bad fishing practices in an attempt to draw up an information bank and "Expert" computer programs for fishermen. Endal describes the new programs as "decision support systems to help fishermen estimate or calculate the results of a set of decisions, to fish here or there." The expert programs will draw on the experience of Norwegian highliners and will cover things like long-range budget planning as well as day-to-day tactical decisions.

"There is a great difference between good and bad fishermen in their ability to collect, manipulate and use information," says Endal. "Even if they do it on an intuitive level, what is intuition? The baby in the cradle has no intuition on how to fish." The programs are operating on the assumption that since fishing knowledge is acquired, it can also be shared.

Endal says he's heard concerns from the fleet that expert programs would eliminate the differences between fishermen so they would all become equal. Endal doesn't think that would happen. "There would still be a large difference between good and bad fishermen. Even the best fishermen should be able to benefit [from the programs]."

The division has also begun an artificial intelligence project that Endal declined to discuss in detail. This work could eventually link computer programs directly with sounders, sonars and other electronics.

—K. Freeman

MUSTAD

"LONGLINING IS THE FUTURE"

MUSTAD has successfully involved themselves in the longline field, and over the years we have developed an entirely new technology for commercial longlining.

MUSTAD products for longline fishing:

AUTOLINE SYSTEM

mechanized longlining system for boats from 40 feet and up. Installed on about 250 longliners.

QUICK SNAP LINE

New groundline with stainless steel two-way swivels

HOOKS

Different types of circle hooks and complete line of hooks for sport and commercial fishing

MODULAR SYSTEM

mechanized longlining system for smaller boats.

You have a choice between a variety of components, and get a complete system at a low price

SEE US AT
FISH EXPO '87
Seattle, October 28-31
Booth 447-448
Lower Level, Coliseum

Sales Office Lines and Mechanized Longlining Systems:

O. Mustad & Son (Canada) Ltd.
1248 Bedford Highway
Bedford, N.S. B4A 1C6
Canada
Tel: (902) 835-0063
Tlx: 19 21669 Koppemaes hfx

Sales Office Hooks:

O. Mustad & Son (U.S.A.) Inc.
P.O. Box 838
Auburn, N.Y. 13021
U.S.A.
Tel: (315) 253-2793
Telefax: (315) 253-0157



There is a lot hanging on a Polyform buoy.

"When I drop a Polyform buoy, I know it'll be there when I return"

Can a skipper working in one of the world's toughest fisheries be so certain?

The answer is that not only him, but fishermen worldwide have come to rely on the many years of experience which have gone into the development of Polyform quality. After all, there is a lot hanging on a Polyform buoy. Valuable gear and catch might easily be lost if the buoy cannot be relied on.



Polyform A series

The first Polyform buoy was developed over 30 years ago, and its construction was based on a unique idea.

Continual product development over the years has made Polyform the world's leading supplier of floats for a wide range of applications.

POLYFORM
— always dependable

POLYFORM A/S, P.O. BOX 2025, N-4001 ALESUND, NORWAY - PHONE: + 47-71 20 038 - TELEX: 43 701 PFORM N

What would you expect from a country with

- 13000 miles of coastline
- 1.2 mill. square miles of ocean waters under its jurisdiction
- the world's 6th largest fishery catch amounting to 3 million tons a year caught by 30 000 fishermen
- hundreds of years of marine experience in some of the most hostile waters anywhere
- a modern, high-tech based industry



Have the answer at the Norwegian national stand at

FISH EXPO '87 OCTOBER 28-31, 1987 SEATTLE CENTER

*You may meet representatives from
the following companies:*

Dyikorn/Moereplast A.s
Hydraulik Brattvaag A.s
Jotron Electronics A.s
Kvaerner Kulde A.s
Polyform A.s
Soelvkroken A.s
Scanmar A.s
ScanRope A.s
Selma A.s
Ulstein Trading Ltd. A.s

ORGANIZED BY  **THE EXPORT COUNCIL OF NORWAY**
Drammensveien 40, N-0255 Oslo 2 - Tel: + 47 2 43 77 00 - Tlx: 78 532 n - Telecopy: + 47 2 55 26 28

FOR FURTHER INFORMATION PLEASE CONTACT:
TRADE COMMISSION OF NORWAY
Two Embarcadero Center, Suite 2910
San Francisco, California 94111
Tel: + 1 415 986 0770
Telex: 340940 norkoms slo
Telecopy: + 1 415 986 6025

PRODUCT DIRECTORY

Making floats right

A Polyform worker methodically shreds a flawed buoy at the Polyform packing room, cutting it to pieces with a large knife. The PVC scraps, like others piled in small stacks here and there through the Polyform factory, will be returned to the recycling bin for reincarnation into a perfect Polyform buoy.

This failed buoy was not outwardly flawed. But while checking it prior to packing, the Polyform inspector detected a slight thin spot and rejected it. Any variation in buoy wall size is unacceptable, according to Polyform.

"It is a well-known saying that a chain is no stronger than its weakest link," reads a Polyform brochure. "This also applies to a buoy. The importance of even wall thickness cannot be emphasized enough. The Polyform production process, contrary to some imitations, fully controls every inch of thickness in the buoy." When comparing products, Polyform says fishermen should remember that a heavier buoy probably has thicker walls and will last longer.

Polyform buoys are recognizable by their blue, rib-reinforced ropeholds. The blue PVC is stronger and harder than the rest of the buoy, yet still flexible enough to run through a powerblock, says Polyform. In addition, the ropehold and body of the buoy are molded in one process, which means that the ropehold cannot be ripped off from the rest of the buoy.

Polyform buoys are available in a wide range of sizes, shapes and colors, including fenders and buoys molded with a central channel to fit a longline flagpole. The popular A series is widely used by crab fishermen in Alaska.

Contact: Polyform A/S, P.O. Box 2025, N-6021 Aalesund, tel.: 47 71 20038.

Keeping tabs on your trawl

Simrad's new FS 3300 Trawl Surveillance Sonar consists of a headrope-mounted color scanning sonar. The system operates in the same way as a standard sonar except that instead of displaying a horizontal picture of the area around your vessel, it provides a vertical picture centered on your trawl. This picture shows the shape of the trawl opening and the quantity and type of fish entering it, as well as objects in the water column. The sonar's focus can be narrowed and targeted on the area just below the headrope for better fish monitoring.

The system also is equipped with sensors for monitoring depth, temperature and the amount of catch in the cod end.

Simrad's surveillance system provides the fisherman with information on the optimum geometry of the trawl opening under various conditions; the position of sand clouds; the position of the footrope in relation to the seabed; trawl parameters such as height and width; temperature; and depth to headrope. Information from the Simrad sonar can also help ensure that the bulk of the potential catch is actually entering the net and not escaping over or under the headrope or through the wings.

Simrad's other recent development is an echo sounder that produces a hard color record on color recording paper. This combines the easy-to-access, permanent record of black and white paper machines with the detailed definition of color sounders. A variety of screen displays are available, including an echo for bottom strength. While the main picture gives you the contour of the bottom, the echo strength graph on the bottom of the screen will tell you whether you're over mud or rock.

The easy-to-use unit (with push-button controls) will interface with other CRT units and navigation instruments. As a result, it can print your current position on the paper record for better marking of fish spots.

Contact: Simrad Inc., 620 N.W. Bright St., Seattle WA 98107, tel.: 1-800-426-5565.

Splicing fid

The Selma splicing fid is a one-tool splice shop. Unlike many other tools that can only handle one kind of line, the Selma fid will successfully splice stranded, braided and double-braided rope as well as soft wire.

Made of highly polished stainless steel, Selma fids have a hollow opening which allows the rope to fit snugly inside. A sharp cleat inside the opening holds the rope in place so the fid can be used much like a needle. This simple modification reduces both time and energy while performing splices, says Selma.

Available in a complete range of sizes, Selma fid kits can be used to repair hollow-braided lines from 4 mm (.15") to 14 mm (.4") in diameter and three-strand ropes from 2 mm (.08") to 28 mm (1.1") in diameter. A special large needle can handle double-braided lines from 19 mm (.75") to 40 mm (1.5") in diameter. The smallest Selma needles can be used for winding rope ends or sewing sacks with twine. Because of the sharp internal cleat, the needles will sew with a single strand of twine, eliminating the need to thread twine through a needle eye. The needles can be purchased individually or in sets.

Contact: Selma Ltd., P.O. Box 51, N-8230 Suliijelma, tel.: 47 81 40640/60089.

Hooks, baiters and autolines

Mustad produces a total longlining system, from hooks and gangion, to baiting machinery. This allows O. Mustad & Son A/S to make good use of the information it obtains from longliners in Scandinavia and the United States.

The most recent result of the Mustad/longliner relationship is the E-Z baiter circle hook (see NF January 1987 p. 40.) The new hook combines some of the catching superiority of the circle hook with the straight shank needed to work with automated baiting and hauling systems.

Although Mustad routinely sells complete automated longline packages, it still takes care of individual parts sales too. In fact, that's the basis of the company's building-block modular operation. Mustad will custom design a longline system to fit any size vessel. A fisherman can start with a partially automated line with manual hook loading and later move up to complete mechanization.

The Mustad system can also be containerized to simplify removal and reinstallation on combination vessels. Mustad claims that only a few hours work are needed either way.

Mustad flew a technician to Seattle this October to assist in the installation of Auto-line systems on several blackcod longliners. This fits with its policy of offering professional installation service and assistance to all customers as well as crew, engineer and skipper training.

Contact: O. Mustad & Son Inc., P.O. Box 838, Auburn NY 13021, tel. (315) 253-2793.

Turnkey trawl systems

Ten Alaskan factory trawlers have ordered or installed auto trawl packages from Hydraulik Brattvaag in the last few years. They are the Northern Glacier, Royal Sea, F/T Northern Eagle, Arctic Storm, Dakota Creek 1, Dakota Creek 2, Aurora 1, Aurora 2, Aurora 3 and the Aleutian Speedwell.

Although the equipment supplied to each vessel varies slightly, the current basic package consists of: two trawl winches, pull 30-51 tons; two sweep line/net drum winches, 11-20 tons; two gilson winches, 18-38 tons; one cod end winch, 10-15 tons; two net drum winches, 15-20 tons; auxiliary/outhaul winches; remote control from wheelhouse or trawl deck; tension control system

for trawl and sweep line winches; "Data-synchro" automatic trawl system; and pump units and accessories.

In the last few years, Hydraulik Brattvaag has installed its sophisticated "Data-synchro" autotrawl system on 97 vessels worldwide. The system is built on the same principal as the well-known Synchro 1000 and Synchro 1010 equipment. The Datasynchro system, however, further simplifies and improves trawl control. Wear on brake linings is greatly reduced through a hydraulic net-shooting operation. The Datasynchro system also permits shooting and hauling to be automatically controlled to maintain preset warp tension.

Hydraulik Brattvaag winches can be serviced by Foss Shipyard in Seattle and by Fritz Culver, Inc. in Covington, La.

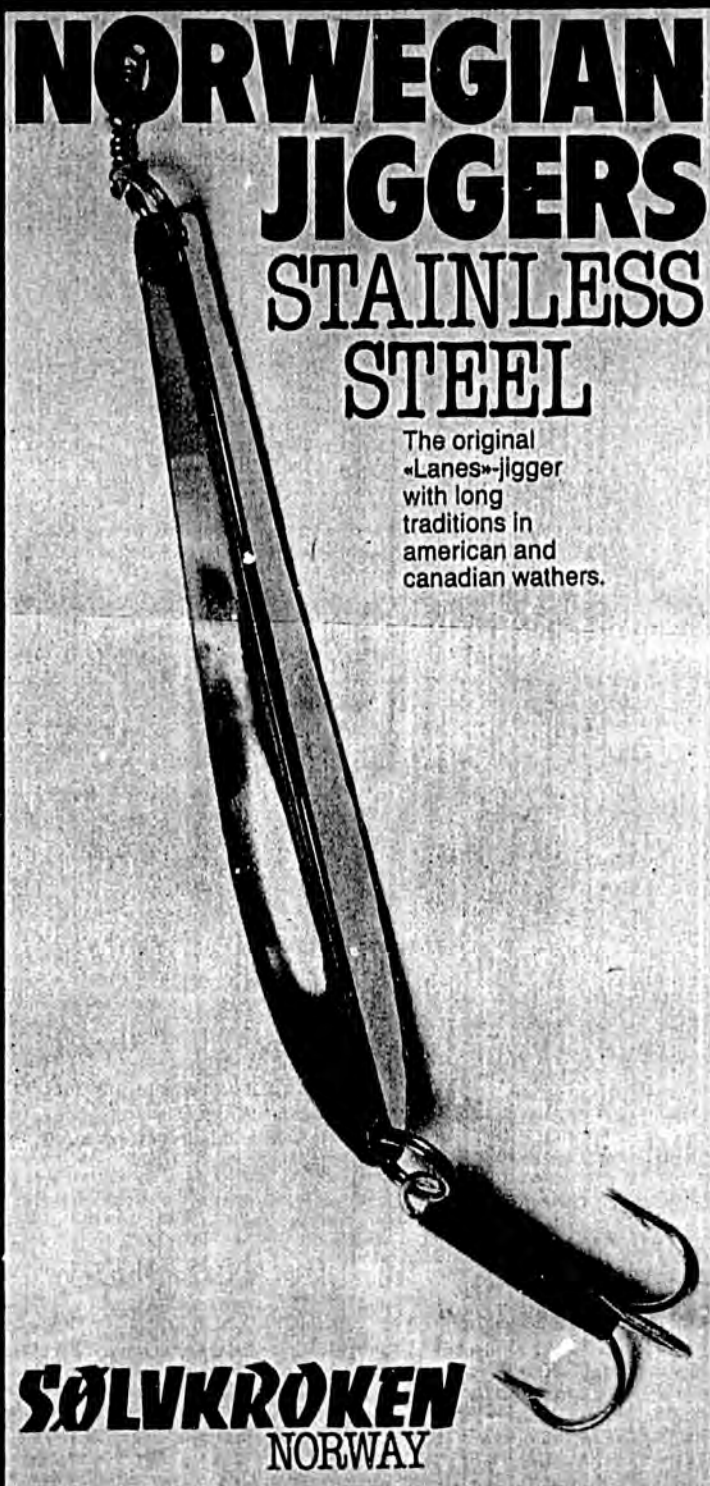
Contact: Hydraulik Brattvaag A/S, N-6270

Brattvaag, tel.: 47 71 15500.

CP props and gearboxes

Ulstein's integrated gearbox and controllable-pitch propellers are being installed on the Alaska factory trawlers Snow King and Arctic Storm and the Nova Scotia vessel Atlantic Horizon. In addition, the systems are specified for a series of Icelandic trawlers under construction in the Ulstein shipyard.

The Ulstein integrated CPP/transmission system has several advantages, according to the manufacturer. First, all the complicated parts of the system are inside the vessel and more easily accessible for maintenance and repair. Second, the system is self-contained with no need for tanks or cooler pumps.



**NORWEGIAN
JIGGERS
STAINLESS
STEEL**

The original
"Lanes"-jigger
with long
traditions in
american and
canadian waters.

**SØLVKRØKEN
NORWAY**

Third, a fisherman only has to deal with one supplier and doesn't have to worry about incompatibilities between prop and gearbox.

The Ulstein Integrated system controls pitch with a mechanical connection via push-pull rods running from the gear box to the prop blades as opposed to a hydraulic system with a pump in the prop hub.

Two-speed PTOs are available to allow the shaft generator to run at a lower speed than the diesel when this would be more fuel efficient than lowering the pitch of the prop.

Ulstein CP Props are available to match any medium-speed engine from 300 h.p. to 10,000 h.p.

Contact: Ulstein Tradin Ltd. A/S, N-6065 Ulsteinvik, tel.: 47 70 10050.

Strong rope and cable

A ScanRope line recently held up to the largest recorded tow job in the world — a 12-million-ton iceberg. A 4600', 4"-diam-

eter Karat Maxi line from ScanRope was used by the support vessel Maersk Master to move the 1,000' berg away from a drillship. The 13-hour tow was performed during a blizzard and hurricane-force winds.

Alaska crab fishermen are familiar with Karat ropes under the brand name of Ice-line. Recently produced under license by Tubbs Cordage Co. of Orange, Calif., Ice-line is now available exclusively from ScanRope. The estalon fiber in Ice-line combines nylon's high strength with polypropylene's lightness and cost efficiency.

According to ScanRope, Ice-line is 90% stronger than polypropylene and 24% stronger than nylon in equal diameters. In equal strengths, Ice-line has a significantly smaller diameter. It also floats. This means less drag, an important consideration in any kind of pot fishing. With Ice-line, says ScanRope, your buoys will have their heads above water when you go looking for them.

For trawlers, ScanRope says Ice-line's ease of handling allows new speed and con-

trol. The rope also works easily in cold temperatures.

In addition, ScanRope is a major manufacturer of specialty cable, producing a range of top-quality wire ropes for trawlers. Cable in sizes including 6 x 7, 6 x 19, and 6 x 26 with either fiber or independent wire rope cores is available.

Contact: ScanRope A/S, P.O. Box 295, N-3101 Toensberg, tel.: 47 33 11670.

Trawl monitoring system

The Scanmar Teknisk sales staff vividly remembers the day a skipper called in late to say he needed a complete new set of trawl monitors — by the next afternoon. He'd lost his trawl and needed a replacement pronto. The staff worked through until they got the gear on the plane and then sat back to relax — until they got another call. Same skipper. When he got back to the spot where he'd lost his rig, he picked up signals

from the battery-operated Scanmar sensors on his transducer. Using them he was able to dredge up his old gear — as good as new. So he was wondering if he could return the new set of sensors since he didn't need it anymore.

Scanmar's hydroacoustic trawl monitoring system eliminates the need for costly and vulnerable cables and winches. Each rechargeable unit transmits directly. Signals are sent in codes customized for each vessel to avoid interference from other trawlers working nearby, and the units are activated by salt water to avoid unnecessary battery drain between sets. A variety of units are available to monitor temperatures, depth and amount of catch in the cod end.

Information from the monitors can be displayed both digitally and in color diagrams on Scanmar's new screen. The diagrams show the trawl's position in the water, allowing a skipper to see whether it is in contact with the bottom. The graphics also display the status of cod end catch monitors and the shape of the trawl mouth.

For seiners, Scanmar's system monitors the depth of the footrope and the rate of its descent. This allows a fisherman to purse the seine at the most opportune time, just below the school. It can help him avoid pursing the seine too fast, which can lift the footrope off the bottom, catching only the top half of the school.

Contact: Scanmar A/S, P.O. Box 44, N-3155 Aasgaardstrand, tel.: 47 33 31033.

Plate freezers

Check the name on an Alaskan factory trawler's freezer and it might just be Kvaerner Kulde A/S. The Norwegian company, a leading supplier and highly specialized manufacturer of refrigeration and freezing equipment to the world fishing industry, has developed a new labor- and time-saving vertical plate freezer and a new heavy-duty, less expensive horizontal plate freezer.

The vertical freezer has features intended to ease handling. These include the possibility for mechanical top as well as front unloading. Kvaerner Kulde claims its freezers make manual unloading and handling of frozen fish blocks simpler and less tiring.

The freezers also feature a lifting device placed underneath the freezing station to allow easy access to blocks. Block thickness can easily be adjusted by the operator.

The new vertical freezer is available with varying numbers of freezing stations with 100 mm (4"), 75 mm (3") and 50 mm (2") thicknesses. The models are built to withstand the severe working conditions found at sea.

According to Kvaerner Kulde, the company's horizontal freezers meet industry requirements for durability and low maintenance, as well as superior plate strength and the ability to maintain absolute plate flatness.

Contact: Kvaerner Kulde A/S, P.O. Box 115, N-1301 Sandvika, tel.: 47 2 544960.

Gear makers' co-op

Three Norwegian gear suppliers — Scanmar, Mustad A/S and Hafi Ltd. — have combined their efforts to form the Norwegian Fishery Technology Group (NFTG). In addition to marketing their products together, representatives from the three companies will also collectively gather comments about their equipment from the fishermen they serve. "We want to be in good communication with fishermen, and we can do that better together than individually," says a NFTG representative. "This will not only improve the company's knowledge about market needs and requirements, but will also serve as input in furthering product modifications and product development."

Scanmar is known for its hydroacoustic fishing electronics and Mustad for its mechanized longline systems and hooks. Hafi Ltd., founded in 1982 by a netmaker and fishing skipper, offers a range of specialized, high-efficiency trawls and seines. Hafi develops, produces and markets complete fishing systems as well as provides installation and training services.

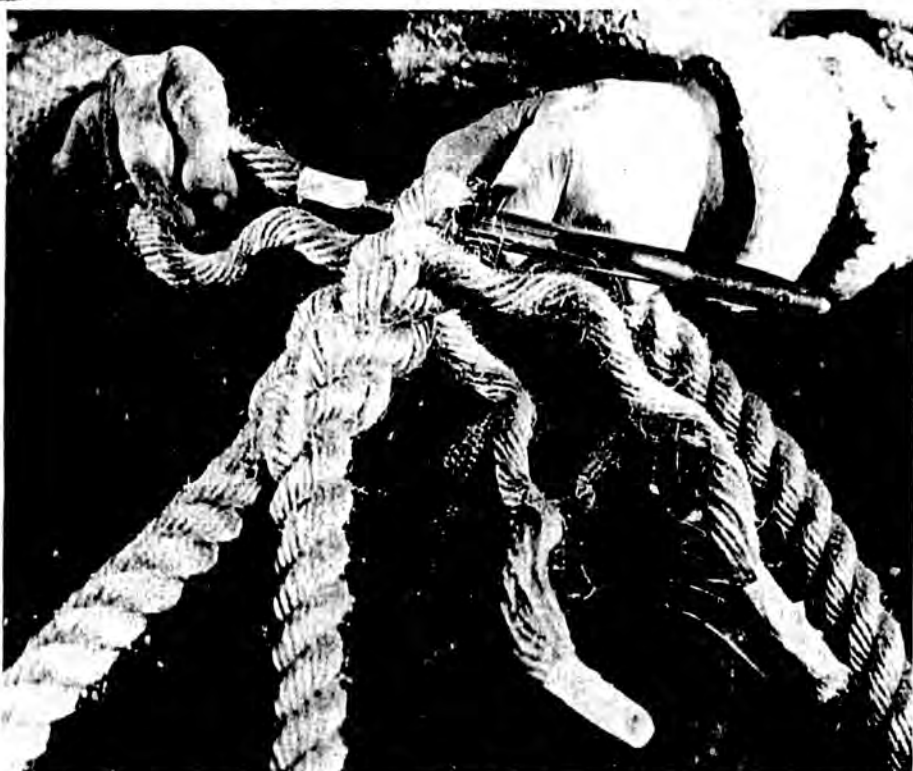
END OF NORWAY SUPPLEMENT



Revolutionary!

Selma fid (needle)

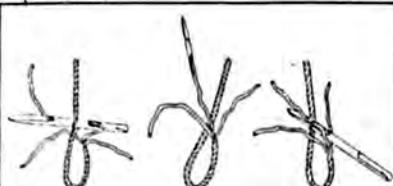
The only one for splicing all kinds of rope!



Splicing hollow braided lines

Selma fid (needle) for splicing double braid yacht line

Five golden eggs in one shell

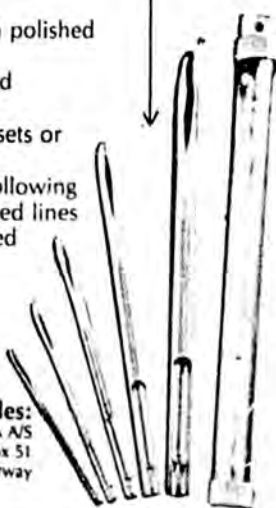


Three ways of splicing three-stranded rope.

Selma Fids (Needles) are made from high polished stainless steel. This is a Norwegian product and patented World Wide.

Selma Fids (Needles) are to be sold in sets or individually.

One set of Fids (Needles) is covering following area of line, twine or rope: Hollow braided lines - 3.5 up to 14 mm line dia. Three stranded twine or rope, 2 up to 28 mm dia.



One pkg. of five Selma tools — only \$39, — prepaid. (Also available a big splicing fid — inner dia. 22 mm. Only \$36 prepaid).

Washington State Res. Add sales tax 7.5%

Visa or Master cards

Mail your order to:
SELMA A/S — 106-232nd Pl. S.W.
Bothell, WA 98021 206-483-0978

Production and sales:
SELMA A/S
P.O. Box 51
8230 Sulitjelma, Norway

SCOMM

75:27



MARKET RESEARCH SERIES

The Atlantic Salmon Farming Industry

Past Performance and Future Potential

EXECUTIVE SUMMARY

Issued by:

An Bord Iascaigh Mhara/Irish Sea Fisheries Board
Crofton Road, Dun Laoghaire, Co. Dublin

THE ATLANTIC SALMON FARMING INDUSTRY:
PAST PERFORMANCE AND FUTURE POTENTIAL

EXECUTIVE SUMMARY

An Bord Iascaigh Mhara,
Irish Sea Fisheries Board,
Crofton Road,
Dun Laoghaire,
Co. Dublin.

October 1986

FOREWORD

Successful salmon farming in Ireland will be governed in the years ahead by the harsh reality of a highly competitive marketplace. To take this view is not alone prudent but to take any other view would be to ignore indicators which are already evident.

Although less than 1500 tonnes of farmed salmon will be produced in Ireland in 1986, the emerging industry has nevertheless already come through two phases successfully. During the first phase, technical and production problems were successfully overcome leading to a highly profitable second phase during which market demand kept pace with expanding production.

The salmon farming industry is now entering a new era where growth in production is leading to reduced prices and tightening margins. For the future given the prospect of rapidly increasing supplies, there will be a need for increasing emphasis on marketing with effective performance in this area making the difference between success and failure.

Notwithstanding these constraints Ireland can still become a substantial and profitable producer of farmed salmon during the next decade, provided that it recognizes the market realities and responds by developing an agreed strategic plan for the industry.

The basis to successful planning is sound research and during 1986 BIM has attempted to create a sound information base by analysing both production and market trends internationally.

These analyses had the aim of establishing:-

- (a) the quantity of farmed salmon that will be available over the next decade
- (b) the response of the marketplace to this increased production.

In establishing these key variables, topics such as production and technical developments, future production capacity and the economics of salmon production have necessarily been addressed.

A resumé of the results of these investigations and the conclusions drawn are presented in this summary report. It is hoped that this will provide a focus of attention which will act as a catalyst for debate leading to agreement on a framework within which all concerned with the development of salmon farming can agree on a common approach. This in my view will enhance the chances of successful growth in the years ahead.

R.A. Meaney
CHIEF EXECUTIVE.

CONTENTS

	Page
1. THE SPEED OF DEVELOPMENT - AN OVERVIEW	
1.1 Origins	1
1.2 Techniques	2
1.3 The Market - present and future	5
1.4 Imbalance and implications	6
2. SALMON AND THE SALMON INDUSTRY	
2.1 Atlantic and Pacific differences	7
2.2 Evolution of technology	9
2.3 Main European producers	14
i) Norway	14
ii) Scotland	16
iii) Ireland	19
2.4 Projected output 1990	21
3. TRADE, MARKETS AND PROFITS	
3.1 The salmon export trade	22
3.2 Imports, present and future	23
3.3 Consumption	26
3.4 National markets	27
i) United Kingdom	27
ii) France	28
iii) United States	28
iv) West Germany	29
v) Denmark	30
vi) Spain	31
3.5 Supply/demand imbalance and price effects	31
4. IMPLICATIONS FOR THE INDUSTRY	34

1. THE SPEED OF DEVELOPMENT: AN OVERVIEW

1.1 Origins

Salmon farming in Europe has only a short history, but a spectacular one. It commenced in the early 1970s in Norway, where fjords on the west coast and local fishing traditions conferred natural advantages which were rapidly exploited by a combination of small-scale crofter fishermen, dynamic corporate enterprises and a generous government offering financial incentives. Although less endowed with natural advantages, the west coasts of Scotland and Ireland became sources of interest to salmon farmers at about the same time. In contrast to the Norwegian pattern, the origins of Scottish salmon farming were largely corporate based and initially neither sought nor received substantial crofter collaboration. As with Norway, however, official support from government and the EEC was evident from the outset. In both Norway and Scotland that support has paid off handsomely. In ten years, production of fresh salmon from farms in Norway and Scotland has risen from less than a thousand tonnes to over forty times that figure. The affluent markets of Europe and the United States have readily absorbed farmed Atlantic salmon, employment has been maintained or created in the farming areas and profits have been high. Growth of salmon output in Norway, Scotland and other countries in the immediate future is guaranteed. The question is, can a further rapid rise in production be absorbed into the world market without inducing severe price falls and more arduous conditions for salmon farmers? The answer appears to be a qualified no.

Although salmon farming in Europe is comparatively new, the Pacific coast of North America has over twenty years of experience in this kind of aquaculture. Unlike many modern developments, the experience of salmon farming in the new world is probably a poor guide to the destiny of its recent old world imitators because of perceived differences in product quality and real differences in scale of exploitation. Very broadly, there are two kinds of salmon in the world; Atlantic salmon and Pacific salmon. The life cycle of both salmon types begins in the fresh waters of rivers, streams and lakes. Young salmon or smolt then migrate to the sea where they congregate in feeding grounds in the high latitudes of the North Atlantic or the North Pacific. Usually after about two years in sea water, mature salmon return to the rivers in which they were born to spawn another generation of salmon. Knowledge of this life-cycle has won a living for fishermen down the ages. In the approaches to the spawning estuaries of the North Pacific and the North Atlantic, salmon have been caught by net and line by generations of commercial fishermen and sports fishermen. Landings of wild Atlantic salmon have always been considerably less than the landings of wild Pacific salmon. The total world catch of the former is about 10,000 tonnes a year whereas the total of the latter is about 500,000 tonnes a year. Consequently, Atlantic salmon has always been an expensive rarity aimed at the affluent minority. In contrast, most Pacific salmon (but not all) is canned and sold around the world at competitive prices through a wide range of retail outlets.

During the early 1960s states in the north western USA attempted to increase the yield of fisheries for the two most rare and valuable species of Pacific salmon - the coho and chinook - which are not canned but which are consumed as prestigious smoked or fresh fish. Fish hatchery schemes were initiated and smolt release programmes began, usually within the public sector of the economy. Two interesting entrepreneurial developments followed: the idea of 'ocean ranching' was conceived whereby fish were bred and released commercially in the hope that after a few years they would return to their release point where they would be netted by those who bred and released them; secondly, the concept of salmon farming based on 'pens' or sea cages evolved. The second idea proved to be more successful than the first. Located in suitable inlets on the Pacific coast of the USA, salmon pen farming appeared to take-off rapidly. By the mid-1970s production from this source was estimated at between 7,000 and 11,000 tonnes of small 'pan size' fish. Subsequently, production fell to 1,900 tonnes by the early 1980s but has since recovered to former levels. Meanwhile, the initiative in salmon farming technology passed to the Europeans and the Japanese. Two factors may have accounted for the attenuation of salmon farming development in the USA. First, it was entrepreneur-based rather than government assisted and could only proceed as long as profits were in prospect. Second, as Table 1 shows, the wild salmon supply of even the rare coho and chinook species, at 60,000 tonnes, was high, which presumably kept salmon farmers' profit margins low and ultimately hindered their expansion.

1.2 Techniques

Future growth of production of farmed Pacific salmon is expected to come from Japanese producers rather than North American. At least one development introduced by the Japanese has been adopted by several Atlantic salmon producers in Europe. That is the Bridgestone cage - a large-volume rubberised sea cage for raising smolt to mature salmon. The experience of both Pacific and Atlantic salmon farmers shows that there are considerable savings in capital costs if salmon are raised in sea cages anchored in suitable off-shore sites instead of in land-based sea water tanks. Norway has tended to lead the field in European sea cage development but because it has an abundance of suitable fjordic sites and a small-scale crofter approach to salmon farming development, it has limited the size of sea cages. In other parts of Europe capable of producing salmon, such as Scotland and Ireland, there are fewer protected sites and already there is a need for larger, more robust sea cages, capable of withstanding the conditions in exposed locations. The Japanese Bridgestone cage appears to be meeting this need.

TABLE 1 WORLD PRODUCTION OF WILD AND FARMED SALMON - SELECTED YEARS

	Wild		Farmed	
	1976 (tonnes)	1984 (tonnes)	1976 (tonnes)	1985 (tonnes)
Atlantic salmon	12,200	9,300*	1,571	37,349
Pacific salmon				
(all species)	397,600	582,400	11,000(E)	11,000(E)
chinook & coho	62,000	58,400	11,000(E)	11,000(E)

* = 1982

E = estimated

Source: Annex 1 of main report

During the year or so that very young salmon (parr) spend in fresh water tanks, and the subsequent one to two years that they spend in sea water cages maturing to harvestable fish, food is the single most significant item of a farmer's costs. In the early days of Norwegian salmon farming, low-cost wet fish were used as feed. With the spread of Atlantic salmon farming to areas where abundant low-cost wet fish feeds were not available, a more appropriate feed was required. The animal feed industry responded by producing a high protein product, based on fish meal and soya bean. With modern fish feeds, the ratio of food consumed to harvested fish weight is between 1:1 and 2:1. Comparable food conversion ratios for domestic animals are higher than this; for example, broiler chickens (usually considered to be a good food converter) have a feed conversion ratio of about 2.5:1, pigs about 3:1 and cattle about 5:1. The very positive developments in fish feeds of the last ten years still have some way to go however. One major problem yet to be solved is the development of an appropriate feed additive responsible for the pink or red colour of salmon flesh. Currently, feed compounders use the artificial carotenoid common to pig and poultry feeds, namely canthaxanthin. Unfortunately, salmon feeds containing canthaxanthin produce flesh which loses its pink or red colour after prolonged freezing. The market for farmed salmon is a little constrained as a result.

Technical developments in salmon farming, especially in the areas of disease control and breeding, have been, and are being assisted by research stations in Norway, in the United Kingdom (at Aberdeen and Lowestoft), and in Ireland. The rate of developmental research has probably matched the rate of farm development, and progress has been notable in controlling the major diseases of Atlantic salmon (furunculosis of smolt and vibrio diseases). Attention in salmon breeding has been given to the development of late maturing fish so that maximum harvest weight is achieved for each smolt reared. The speed of technical developments has outpaced the technical training facilities required by fish farm personnel. In the United Kingdom at least, it takes about two years to train a fish farm employee. Growth in the business has been so rapid that by 1986, there was a shortage of trained employees. In all, Scotland employed about 700 people at an

annual output per head of about 10 tonnes. This compared with about 2,000 people employed in the industry in Norway, each of whom produced an average of 14 tonnes a year. In Ireland, employment is at an early stage, with only about 80 persons engaged, each producing between 9 and 12 tonnes of salmon a year (Table 2).

TABLE 2 MANPOWER AND OUTPUT IN EUROPEAN SALMON FARMS - 1985

	Norway	Scotland	Ireland
Total output - tonnes	28,656	6,921	722
No. of employees (approx)	2,000	630	80
Output per employee per year	14	11	9 to 12

Source: Annex 1, Table 2.15, main report

The speed of salmon farming development in Norway, and the social and political restrictions imposed on farm scale and farm location, contributed to a 'Klondyke' spirit. Many small crofter-type fish farms were started only to be sold to large corporate interests at very high values. The profits of Norwegian fish farms have generally been high because of favourable producer prices achieved through the discipline and promotional activities of the farmers' and wholesalers' organisation, the Fish Farmers' Sales Organisation (FFSO). Farmers' profits have recently been at the expense of fish wholesalers and traders. A joint levy on farmers' and wholesalers' turnover pays for the FFSSO's promotional and other work. Continued official restrictions on Norwegian farm size have frustrated some fish multinationals who have sought expansion of salmon farming in New Zealand, Chile, Tasmania, Scotland and Ireland.

Like Norway, Scotland has experienced a phenomenally high rate of growth in salmon production in the last ten years, but unlike Norway, it is already running short of suitable salmon farming sites. Scottish producers have formed a Scottish Salmon Growers' Association which co-ordinates promotional and political activities but lacks the market strength of the Norwegian FFSSO. Even with government and EEC support, Scottish salmon farms have probably been less successful financially than their Norwegian counterparts, but have earned high rates of return nevertheless.

Irish salmon farming was established about 1977 with much help and influence from the Electricity Supply Board, whose job it was to re-stock salmon rivers after they had been used for electricity generation. Because of warm sea water around the Irish coast, wild caught Irish salmon have a high proportion of young (therefore small in weight) precocious salmon (grilse). Irish salmon farms are also characterised by a high proportion of grilse. Government support to the Irish industry, through An Bord Iascaigh Mhara (the BIM or Irish Sea Fisheries Board), and Udaras na Gaeltachta (agency for Irish speaking areas), is significant and includes financial support, research and promotional activities.

1.3 The market - present and future

Norway, Scotland and Ireland are the main producers of farmed Atlantic salmon; they accounted for 97% of total production in 1985. Other minor producers include Faroes, Iceland and North America. Because of the four year cycle from egg to parr to smolt to salmon, the probable scale of production for 1990 was, by 1986, already apparent. It is clear that producers intend to continue the exceptionally high rate of growth in salmon production which has been generally evident for the ten years to 1985. Farmed salmon supplies in that year were 37,599 tonnes. In 1986, the expectation for total farmed production is 51,000 tonnes. By 1990, this is expected to grow to 153,100 tonnes - an annual growth rate of over 30% from 1985. Norway alone is expected to produce 100,000 tonnes (65% of the total) by 1990, with Scotland producing about 25,000 tonnes and Ireland about 10,000 tonnes. The question which many producers are asking is can this volume of production be sold without seriously reducing selling prices and profit margins?

When considering the world market for salmon, three clear layman's distinctions can be made at the outset. The first is that the relatively inexpensive pink and red salmon produced for canning is perceived by consumers as a totally different product from the more prestigious fresh or processed forms of salmon. The second distinction is that consumers tend not to discriminate between the expensive kinds of salmon; to western consumers, Pacific chinook or coho, when smoked or marinated or cut into steaks, is much the same as Atlantic salmon prepared in the same way. Effectively, expensive Pacific or Atlantic salmon are almost mutual substitutes. Indeed, consumer awareness is such that in some countries, sea trout may also be a substitute for high quality salmon. The third layman's distinction about salmon is that there is a ritual quality about its consumption. Salmon is not eaten primarily to satisfy hunger; it is eaten, or presented for eating, to bestow prestige.

Predictably, the markets for smoked, fresh and frozen salmon are located in countries with high per capita incomes. Within those countries, those with the highest incomes are likely to be salmon consumers. Among the top producers of farmed Atlantic salmon, neither Norway nor Ireland is a large consumer. The USA is a major producer of Pacific salmon (33,000 tonnes of high value chinook and coho salmon in 1984) but is also a significant importer of Pacific and Atlantic salmon. In the European market, France and West Germany are the chief salmon consumers (and importers, as neither of these countries has any substantive indigenous production), with the United Kingdom and Sweden also prominent. Principal importers of salmon (Table 3) include Denmark which re-exports most of its imports (after processing) to West Germany and other European countries.

TABLE 3 PRINCIPAL IMPORTERS OF FRESH, FROZEN AND SMOKED SALMON - 1984

Country	Atlantic Salmon (tonnes)	Pacific Salmon (tonnes)
USA	5,700	6,400
France	8,200	16,400
West Germany	5,200	1,600
Denmark	3,700	2,700
United Kingdom	2,900	3,800
Sweden	900	5,500
Japan	300	82,200
Others	3,000	3,100
	-----	-----
	29,900	121,100

Source: Tables 4.2, 4.4 and 4.6 of main report.
Smoked salmon included above is not
adjusted to fresh weight.

In the five years to 1984, the countries listed in Table 3 increased their imports at a similar rate to the increase in world production of salmon. Of European imports, perhaps as much as 60% are eventually consumed as smoked salmon, which, of all the marketable high value salmon products (ie; salmon steaks, fillets, pate and marinated salmon), has probably the lowest price elasticity of demand - ie; a substantial price fall will not induce a large increase in demand. In most salmon consuming countries, sales of fresh and frozen salmon have increased at a faster rate than sales of smoked salmon, which is particularly heartening in view of the higher price elasticity of demand for those products - ie; a large increase in demand can be triggered by a small reduction in price. Falling real price trends for fresh and frozen salmon products are already evident in most European and North American countries which, if continued, will induce greater consumption. Growing awareness of salmon's health value (low in cholesterol and high in unsaturated fats) will add to its marketability. However, the total world demand for Atlantic salmon by 1990, after considering present trends in individual consumer-country markets (and particularly the possibility of displacing Pacific salmon), is likely to be only 130,000 tonnes, which is 23,000 tonnes less than forecast production in 1990.

1.4 Imbalance and implications

The implications of the imbalance of projected supply and demand by 1990 are that reductions in prices and margins will be greater than farmers and traders currently envisage. Lower margins particularly will mean that the least efficient producers will leave the industry and potential small-scale new entrants will be deterred. Because a growing proportion of Atlantic salmon is likely to be consumed fresh or frozen, as steaks, fillets, joints, etc., there could be advantages in producing smaller fish - say up to 3kg - which would allow more appropriately sized portions for sale to a wider market. Consequently, the present tendency to avoid production of grilse may be reversed, giving high grilse producers such as Ireland, a natural advantage.

Greater efficiency in production will demand high standards of technology and training, and a larger minimum-volume production unit. Salmon farms based on integrated smolt and sea cage production are unlikely to be less than 500 tonnes a year capacity. The investment needed for such a project, including working capital to finance recurrent and overhead costs in the opening years, is in the order of UK£2 million and is capable of earning 18% internal rate of return. The investment is risky; a mere 10% reduction in real revenues through excessively low prices would halve the rate of return, and a stock loss say every five years (through disease or unusual weather conditions) would reduce this return to zero.

Thus the European salmon farming industry will continue to experience high rates of growth up to 1990 but lower prices and lower margins are likely to take their toll of small-scale inefficient producers. At the right scale, individual operators will make profits but will also face growing risks arising from production problems as well as marketing problems. Those problems can be better understood by looking in a little more detail at salmon production and salmon marketing, which is done in the next two sections of this executive summary.

2. SALMON AND THE SALMON INDUSTRY

2.1 Atlantic and Pacific differences

Although the two salmon groups, Atlantic and Pacific, have similar life cycles involving birth and early life in fresh water, migration to oceanic feeding grounds at high latitudes, and subsequent returns to their fresh water origins to breed and eventually die, Pacific salmon have a fundamental difference when compared to their Atlantic counterparts. They consist of six species, whereas Atlantic salmon consist of only one. Pacific salmon form the basis of one of the world's more important fisheries. Three of the six Pacific salmon species (sockeye, pink and chum) are caught in relative abundance by fishermen from the USA, Canada, the USSR, Japan and Korea. Of comparatively low value, sockeye, pink and chum salmon are at the heart of the salmon canning industry. Chinook or king salmon, and coho or silver salmon are relatively rare species of Pacific salmon and consequently are of a higher value and compete directly with Atlantic salmon on world markets. The sixth species of Pacific salmon is cherry salmon, caught only in small quantities for a specialised market in Japan. The rare species of Pacific salmon (chinook and coho) and the single species of Atlantic salmon are the subject of fish farming in coastal waters of the North Pacific and the North Atlantic, and more recently in the South Pacific, for chinook and coho.

Traditionally, both Pacific and Atlantic salmon were caught as they returned up-river to breed. Capture techniques varied for each fishery, but usually involved gill nets, traps, trolls (baited hooks on lines), drift gill nets, and highly efficient monofilament nets. The effects of last two are accredited with recent recorded reductions in catches from English, Scottish and Irish fisheries. Wild salmon fisheries are seasonal fisheries by nature, but also by regulation. Atlantic salmon is scarce during the winter months. Landings increase during March and peak in July and August, when catches are swollen by the arrival of grilse (young precocious fish weighing less than 3kg).

By October, wild Atlantic salmon are again very scarce. The Pacific salmon season starts in May, with landings of chinook and sockeye, and continues until about September. The canning industry is a natural corollary to the bulk landings of Pacific sockeye, pink and chum salmon (a combined total of about 400,000 tonnes a year); fish caught over a three month period when canned, are marketed continuously over a twelve month period. The traditional seasonal shortage of high value fish was one factor which contributed to the establishment of salmon farming.

The other significant factor which ultimately led to salmon farming in the Pacific was the attempt, first for sporting or state-supported, and then for commercial reasons, to hatch, breed and release young salmon in order to increase natural stocks and, in time, harvestable returns. Fish stocks benefited from these releases and increments in commercial fish landings were recorded in due course. However, the necessary increment returns from this kind of 'ocean ranching' had to be between 2% and 6% of all smolt released if the operation was to break even. Most commercial producers found that their fish returns, and incremental catches, were only 1% or less of their releases. Consequently some ranchers left the industry while others attempted new developments aimed at augmenting fish returns. The one exception to the doubtful results of ocean ranching was the Japanese Fish Agency which claimed that salmon catches increased by 200% in 1983 (from 39,000 tonnes to 120,000 tonnes) following a five year salmon release programme.

In the Atlantic salmon fishery, only Iceland has operated an ocean ranching programme, experimentally from the late 1960s and commercially from 1981. Their experimental evidence appears to show that fish returns of between 5% and 10% are possible compared to commercial viability rates of between 3.5% and 7%. As yet, the Icelandic commercial ranching operations have not demonstrated viability, although they are continuing in conjunction with commercial salmon farming interests. Other Atlantic countries such as Norway, Scotland and Ireland operate salmon release programmes which are not commercial in nature. It is reasonably certain that neither Atlantic nor Pacific ocean ranching operations will result in large, commercially sustainable increases in wild salmon landings. It is clear however that spin-offs from ocean ranching provided the initial impetus for salmon farming.

Commencing on the west coast of North America in the 1960s, Pacific salmon farming followed as a natural development of hatchery stock release programmes. Coho was the species of greatest interest to salmon farmers, with chinook attracting less attention. Culture was cage or 'pen' based with most producers aiming at small 'pan size' fish of between 0.25kg and 0.4kg. Production flourished for a while in the USA, reputedly reaching 11,000 tonnes in the mid-1970s. Presumably increasing costs of farmed production and incessant competition from traditional fisheries contributed to reduced margins during the late 1970s which led to a significant fall in farmed salmon output. By the early 1980s, that output was only 2,000 tonnes. The USA's main producer was Domsea, a subsidiary of Campbell Soups, which operated sea cages in Puget Sound and other locations in Washington state. Nine other salmon farms operate in Washington state and one ocean ranching unit in Oregon recently started a land-based coho-producing unit. In

neighbouring British Columbia, 40 farms had commenced salmon production by 1984, some of which produced Atlantic salmon. Pacific salmon output in British Columbia is set to expand from 1986 with an expected production of 5 million chinook eggs to yield 5,000 tonnes of salmon.

From the north western coast of North America, Pacific salmon farming has spread to Chile, Japan and New Zealand. In Chile, disappointing results of ocean ranching led to the development of cage culture. By 1986, 15 companies were in operation there, and production was expected to be about 1,300 tonnes. By 1990 it is likely to exceed 3,000 tonnes, most of which will be directed to the North American market. Despite encouraging growth of the industry in Chile, Japan dominates Pacific salmon farming. In 1985 their production of coho salmon reached 6,800 tonnes after several years of 50% annual growth, and despite a difficult start because of problems involving the fresh water stage of culture. The three leading salmon farming companies in Japan are Nichiro (2,500 tonnes), Taiyo (1,000 tonnes) and Nichimo (500 tonnes). Even though the Japanese industry is denied government financial incentives of any kind, production is expected to increase to 8,000 tonnes by 1990, most of which will be absorbed by the Japanese market. In contrast to Japan, New Zealand was the smallest producer of farmed Pacific salmon in 1986. The government of New Zealand established a chinook hatchery programme in South Island in the 1960s to create wild salmon runs. The programme has been reasonably successful, but more importantly, three salmon farms use output from the hatchery to produce a combined total of 250 tonnes of exportable fish. Production is likely to grow; the market in North America is likely to be the target.

In the foreseeable future, although production from Pacific salmon farms will increase, there will continue to be substantial quantities of wild chinook and coho fish, which will clearly influence prices and production of farmed fish. Different conditions prevail, however, in the case of Atlantic salmon. The average commercial catch of Atlantic salmon in the 29 years to 1984 was about 12,000 tonnes a year - that is about one fifth of the commercial catch of the high value Pacific species (chinook and coho). The fear of reduced commercial catches of Atlantic salmon, through improper fishing or pollution of estuaries, stimulated interest in hatcheries and fish release programmes. Stable low-volume commercial catches of Atlantic salmon also presented a golden opportunity to Atlantic salmon farming. In the ten years between 1976 and 1985, production of farmed Atlantic salmon rose from 1,571 tonnes to 37,549 tonnes. In 1986, production is expected to exceed 51,000 tonnes, with Norway producing 74% of output, Scotland 19% and Ireland 3%.

2.2 Evolution of technology

Although salmon farming technology is still developing and improving, the physical requirements for salmon culture are well established. They are:

- i) a well protected (ideally fjordic) coastline, with (for cage culture) areas of water of at least 10m depth and no more than a 3km to 5km fetch;
- ii) clean, unpolluted, cool sea water, which is not subject to extreme

variations in salinity and not liable to be invaded by ice;

iii) access to essential support infrastructure (power, feed supplies, expertise, communications, etc);

iv) reasonable proximity to a suitable fresh water smolt site.

Atlantic salmon farming in Europe is limited by these physical requirements to certain parts of the Norwegian west coast, the west coast of Scotland, the west coast of Ireland and possibly the coast of north west Spain, where there is a limited area of cold sea water currents. In North America, Atlantic salmon farming is feasible on the seaboard of New Brunswick and Maine. The 1970s saw the introduction of Atlantic salmon farming to Pacific coast areas in Washington, Alaska and British Columbia. It may also be possible in Japan, Tasmania and the Falkland Islands.

The technology which has evolved in Atlantic salmon farming falls into two stages; namely smolt production in fresh water and on-growing of maturing fish in sea water. Smolt are young river salmon, about 14 months old, and about to change to a salt water environment. A smolt unit generally aims at producing about 200,000 smolt a year, although smaller units exist, where integrated with salmon on-growing units. A smolt unit consists of a hatchery to rear fry, and parr tanks or cages, to rear smolt. A hatchery requires brood stock, ie; sexually mature male and female salmon, which are kept in sea cages and from which eggs and milt (sperm) are stripped in the autumn of each year. The eggs and milt are mixed and hatching occurs after about three months, depending on water temperature. The fry which hatch can then be reared in relatively cool water (as practised in Scotland and Ireland) or warmed water (as practised in Norway), with commensurate differences in rate of growth. When fry are 3cm to 3.5cm long (parr), they are placed in outdoor tanks (or cages) until their second spring, one set of tanks (or cages) accommodating small parr and another larger set accommodating large parr. By about May of their second year, smolting occurs and the young salmon enter sea cages and their salt water environment. Mortality between the egg and the smolting stage is between 30% and 40%. Food conversion ratios in smolt units are usually about 1:1 with average smolt size varying between 35gm and 50gm, depending on site. A convenient batch size for smolt production is about 20,000 fish; smolt tanks or cages are tailored accordingly.

Smolt units are frequently located at a distance from the on-growing units. Transportation can be either by truck or boat. Oxygenated tanks containing 1.5cu m to 2.5cu m of water and 2,000 to 4,000 smolt per tank can be readily conveyed by truck for several hundred miles with only low mortalities. In Norway, 'well boats' with flooded sea water tanks in the hold (developed from traditional systems of transporting fish) typically transport 90,000 to 100,000 smolt per trip with even lower mortalities.

Smolt are delivered to on-growing units which mainly consist of sea cages, although some land-based sea water tanks are still in use. Sea cages vary widely in size, siting and design, but three properties are common to all: polypropylene or nylon net cages, which are now commonly rectangular; a frame for the nets which holds them in shape and provides floatation and access; and a mooring system with anchors, ropes and wave shock-absorbers. Elaborations on these basic requirements include a central walkway or raft to give working space

and access to groups of cages, a tender vessel, external protective netting or booms where cages are at risk either from seals or floating ice, automatic feeding and cage monitoring equipment, and shore-based facilities such as workshop, vehicles, laboratory, stores and offices.

Despite the variation in cage design and size, a new Norwegian standard design is emerging with 12m sides and 5m to 6m depth, enclosing about 750cu m of sea water. The allowable stock density in these cages is 25kg/cu m which gives a maximum of 20 tonnes of harvestable fish. The cage frame, or 'collar', consists of a floating walkway of expanded polystyrene enclosed within a box section of wood or metal beams on which are attached slatted planks. These collars are usually arranged to form common boundaries between adjacent cages. They are designed in sectional form to give them flexibility to ride out sea swells. Cage mooring systems also require flexibility to allow for wave height and tidal range. Wave shock-absorbers on the mooring system are needed in exposed conditions. The moorings themselves usually consist of concrete block weights to which the cage ropes are attached by chains. The walkways between cages, as well as the cages themselves, are moored, although in some cases, a centre pivot mooring is employed which permits cages to align themselves in response to wind or current and thus reduce stress on the structure.

Ideal sites for sea cage salmon culture are becoming scarce. Attempts are now being made to expand the range of salmon farming areas through the use of more robust sea cages. In Norway, the conventional rectangular design of cage was simply strengthened to withstand more exposed conditions. Elsewhere, particularly in Ireland, the Faroes and Iceland, salmon farms have adopted the Bridgestone cage for use in semi-exposed locations. Bridgestone, the Japanese tyre company, originally developed Bridgestone cages for use in aquaculture in Japan. The collar of the Bridgestone cage is constructed of heavy duty rubber tubing, joined by massive angled steel brackets, and fitted with expanded polythene sheaths at the joints to provide additional buoyancy. Hexagonal in shape, each collar section is 16m long. The complete collar encloses an area of about 750sq m. The net has an inverted conical shape with a depth of 10m at the edges and 14m at the centre. In all, the cage encloses 9,500cu m of water, enough for up to 100 tonnes of salmon. These large cage units clearly impose a high risk of loss should the unit fail for any reason, but experience in their use so far has been positive.

Shortage of ideal sea sites for salmon has instigated a re-examination of land-based salmon on-growing. A land-based unit must be near a reliable supply of clean sea water. The unit comprises circular tanks, pumps, drainage systems and back-up aeration systems. Initial capital requirements for land-based units are high compared to sea cage systems, but labour needs are reduced and better feed conversion ratios are often achieved. However, rapid improvement in sea cage techniques means that these advantages are being eroded.

As well as rapid improvement in sea cage design, Atlantic salmon farming has been greatly assisted by developments in feed compounding. Forty per cent of all costs in a fish farm consist of feed; it therefore lies at the centre of salmon farming economics. When salmon farming started in the early 1970s, in Norway, ground wet fish and

shrimp processing waste, enriched with key vitamins and minerals, were used as feed. Poor food conversion ratios of 6 or even 8 to 1 were common with such feed. High labour costs and high handling costs resulted in developments which reduced the water content of the feed, made it easier to deploy, easier to store and easier to handle. So-called 'moist' feeds were the first improvement, followed by 'dry' feeds. These are based on fish meal and soya bean meal with added fish oils, minerals and vitamins. One essential additive is the component which is responsible for Atlantic salmon's pink flesh. Wild salmon obtain this component - astaxanthin - from feeding on small crustacea, including shrimp. An artificial alternative to astaxanthin - canthaxanthin - is used in dry feed. Although canthaxanthin provides farmed salmon with pink flesh, the colour fades if the flesh is frozen for prolonged periods (three months or more). Variable doses of canthaxanthin (between 50ppm and 100ppm) produce varying degrees of pinkness in the flesh. To minimise feed-with-additive cost, canthaxanthin at the appropriate rate is included in feeds only during the last six months before slaughter.

Healthy competition between feed compounders such as Skretting (Norway), Ewos/Baker (Sweden and UK), Sjofoer (Norway), BP Nutrition (UK) and Fulmar (UK) has resulted in three recent major improvements in feed. First, high energy feeds using relatively cheap fats or oils allow farmed salmon to use the full protein content of the feed in production of flesh and tissue. Second, a meal dried at low temperatures (LT meal) compares with the nutritional value of dry feed but retains volatile taste attractants which make the feed more palatable which in turn leads to faster growth. Third, the development of lower density 'slow sinking' food pellets has meant greater utilisation of food. With improved dry foods, food conversion ratios in commercial farms vary between 1.8:1 and 2:1 but are expected to decline to about 1.5:1. Similarly, the time needed to produce a 3 kg salmon from smolt is likely to decline from its present 20 or 22 months (Scotland and Ireland) to about 16 months.

So far, disease has not been a major problem in Atlantic salmon farming. Atlantic salmon is prone to several viral, bacterial and fungal diseases and can also be troubled by endo and ectoparasites. Two bacterial diseases, furunculosis in smolt and vibrio diseases in young and mature salmon, are the most troublesome. Also sea lice ectoparasites need attention in some areas. Recent cold weather in Norwegian waters appears to have caused increased incidence of vibrio diseases, but losses of fish have yet to reach significant levels. In general, mortality rates for the complete growth cycle, which historically were about 30%, have declined in recent years to 20% or less. Two environmental problems have had an effect on salmon farmers in Norway and parts of Scotland and Ireland. Firstly, 'red tides' of toxic dinoflagellates, caused by a combination of strong winds (which mix the water column) and clear summer weather, have occurred in a few protected lochs where the geomorphological facilities for mixing fresh water with open sea water were restricted. Prevention of this problem will pre-empt the need for a cure; careful site selection of salmon farms may avoid the red tide threat. Secondly, acid rain, particularly in Norway, damages fish by restricting oxygen uptake and salt excretion.

Stock improvement programmes for Atlantic salmon have been underway for some time. The Norwegians particularly have tended to concentrate on conventional stock selection and breeding at the Agricultural Research Council's Sunndalsora research station. Selected best performers under this programme are tested in fully commercial conditions. The programme has achieved measurable success in improving growth rate performance by about 4% per annum over the four years to 1986. Researchers in Scotland, England and Ireland, as well as in Norway, have attempted to produce late maturing salmon. When salmon mature, their appearance and flesh quality worsens, food conversion ratio deteriorates and mortality increases. The prevention of maturity therefore would clearly improve salmon stock. Female salmon are known to mature later than males. Much of the research has consequently focused on hormonal or genetic elements which produce all-female stock or sterile stock. The experimental work completed so far, and commercial tests, show considerable promise.

Salmon are harvested between their first sea spring and the end of their second sea year (ie; between 9 months and 22 months). Traditional price premiums for large fish meant that light-weight early maturing fish or grilse, were generally regarded as a sub-optimal use of feed and other inputs. The proportion of fish which grilse therefore is a key variable in the profitability of salmon farms. Use of improved stock has limited grilising to about 15% in recent years, but with notable exceptions (eg; Ireland). Harvested fish are delivered live to packing stations where they are kept in pens until required. Prior to slaughter, the fish are starved to reduce gut content. Slaughtering may involve bleeding the fish to improve flesh quality (Norway), or use of a humane stunner (Scotland). After gutting (where necessary), the fish are iced and packed in styrofoam or polythene boxes of about 20kg for shipment to market. Special boxes have been developed to withstand prolonged air and surface freight.

There is a shortage of trained manpower in salmon farming. Experience in the United Kingdom and elsewhere points to a two year minimum training period for general farm hands, and longer for skilled personnel. Integrated salmon farm units in Norway achieve outputs of between 20 tonnes and 30 tonnes a year per man compared to the industry average of 14 tonnes a year per man. In Scotland, output from integrated farms is about 18 tonnes per man per year compared to the industry average of 11 tonnes per man per year. Irish productivity per man is below Scotland's, although both are thought to be improving with the advent of new technology.

Salmon farming by all the North Atlantic producers is commonly carried on in parallel with trout farming. Trout is frequently seen as a competitor to salmon, especially as it is often available when only small salmon are being harvested. European output of trout is about 150,000 tonnes a year. Japan and the USA produce a further 35,000 tonnes to 40,000 tonnes a year. European output has grown at a steady 10% a year whereas output in Japan and the USA has stagnated. Conventional trout products are firmly established in Europe with their own particular market niche, which does not overlap with salmon. Sea

trout however may genuinely compete with salmon. It offers a large (up to 4kg) fish with pink flesh for which both demand and supply appear to be growing. Current supply of large pink fleshed trout is between 30,000 tonnes and 40,000 tonnes a year which competes readily with small grilse salmon, especially when marketed during the second half of the year.

2.3 Main European Producers

The three principal producers of farmed Atlantic salmon are Norway, Scotland and Ireland, who all use a common technology similar to that described above. Their individual industries will bear further examination however, commencing with that of Norway.

i) Norway

Norway's progress from pioneer to dominant producer of farmed Atlantic salmon was engineered through major government intervention in the industry from 1973. A decline in traditional fisheries at that time created an imperative for rural development. Salmon farming became the vehicle for that rural development. The wide availability of good sites, good communications and the access to inexpensive fish as a basic source of salmon food were the foundations of the industry. Official regulations limiting farm sizes to 8,000cu m of water (originally enough to produce 60 tonnes of salmon a year) and smolt producers to one million smolt a year helped to determine the crofter pattern of the industry with its specialist services of feed compounding, harvesters, packers and transporters. The implementation of official policy has resulted in 603 salmonid farms (producing salmon and sea trout) and 327 hatcheries, most of whom rear parr through to smolt.

Areas less suited to salmon but socially disadvantaged have been favoured under these policies, they produced 25% of national salmon output in 1985. Ninety five per cent of Norway's farmed salmon is produced in sea cages; dammed enclosures and net impoundments account for the balance. The average sea cage farm uses 6,000cu m of water and produces between 50 tonnes and 60 tonnes of salmon a year. There are 3.4 million cu m of farms licensed. Improved technology has increased the potential for central and southern farms to about 200 tonnes per 8,000cu m, and to 150 tonnes per 8,000cu m in northern farms. Potential salmon production therefore currently stands at about 85,000 tonnes compared with present production estimates (1986) of 38,000 tonnes.

The potential productivity of crofter farms is reflected in their value. Sales of farms to small commercial enterprises are already occurring. Where possible, large-scale producers attempt to expand their Norwegian base by acquiring small units, despite their sometimes patchy profit performance. The largest salmon producers, with licences in excess of 8,000cu m granted before restrictions were imposed, have tended to become frustrated with Norwegian conditions and have sought expansion overseas. Two such operators are A/S Mowi and Sea Farm A/S.

A/S Mowi is a subsidiary of Norway's largest industrial concern, Norsk Hydro. They currently produce about 1,000 tonnes of salmon a year from two enclosures, and over one million smolt a year from three smolt units. They also conduct a certain amount of research on salmon and other fish species. Mowi has a majority shareholding in Fanad Fisheries in Ireland, Golden Sea Products in Scotland and a 45% holding in ISNO of Iceland. Their Irish and Scottish interests each produce about 600 tonnes of salmon a year with smolt production in Ireland, and the possibility of producing other fish in Scotland. Their Icelandic unit farms 100 tonnes to 200 tonnes of salmon a year and is experimenting with ocean ranching.

Sea Farm A/S is part of the Norwegian multinational I/S Sea Farm & Co. Sea Farm's primary Norwegian interests are in smolt production, for which they operate eight units. Current output is 2.9 million smolt a year, with an expectation of 6 million by 1989. Their single on-growing salmon farm is used to improve the performance of their stock and as a brood holding facility. Since 1982, Sea Farm have made substantial acquisitions overseas, including Sea Farm Polly and Sea Farm Kerry, both in Scotland, producing a combined total of 1.5 million smolt a year, Sea Farm New Brunswick, Canada (smolt producer), Sea Farm of Norway Inc., in Washington, USA (cage farm for Atlantic salmon), Sea Farm (Shearwater) in the UK (fish processing and marketing), Ferme Marine de Douhet, France (turbot farm), Tinamenor SA, Spain (fish and shellfish farm) and Seconda Aquaculture in Greece (fish farm).

Other investors in Norwegian salmon farming include British Petroleum (smolt production and a small salmon farm) whose salmon interests extend also to North America. Two Norwegian companies have emulated BP and have invested in British Columbia and in Scotland. Several others have gone further afield, to Chile, Australia and the USA with the aim of producing Atlantic salmon.

If Norwegian salmon farmers have been successful, it is in part because of their marketing organisation, the Fish Farmers' Sales Organisation (FFSO). With its origins in the protective joint sales arrangements established in the 1930s, the FFSSO co-ordinates production and maintains quality standards, regulates the first-hand sales of salmon and promotes salmon products, particularly in the export market. Acting almost as a cartel, the discipline and price arrangements of the FFSSO have gained persistently good margins for its farmer-members at the expense of wholesalers and traders. The organisation is funded by a levy of 2.5% on salmon turnover, paid equally by producers and traders. About 500 farmers were members in 1986 and about 80 traders, and it is from these that its governing body is drawn.

As well as its three tier salmon grading system and its co-ordination of supply, the FFSSO fixes minimum prices each year and helps to select and register buyers. Thus although domestic trade does not comprise an entirely free market, the FFSSO recognises the need to compete in the international market. Its promotional material has created a positive, healthy, desirable image for Norwegian salmon, virtually all of which is marketed under the same logo. The physical distribution of Norwegian salmon

continues the quasi-cartel theme in that only one company - Sties Termo Transport of Oslo - predominates. With a fleet of 70 large trucks (24 tonnes), Sties Termo delivers throughout Europe and by air freight, throughout the world. Deliveries to all major markets are made within approximately one day after packing. The existence of only one distributor would normally connote uncompetitive pricing. That situation may change in 1986/87 when the Norwegian company Gods-Trans commissions a new twin-hulled high speed cargo ship for transporting salmon to European destinations.

Speed of delivery of Norwegian salmon exports is essential as they are nearly all fresh or chilled. Little smoked or processed salmon is exported because of generally high tariffs against such products. Most Norwegian farmers produce the largest fish possible because of price premiums in their favour. Over production of such fish is already evident, which may swing production towards small fish (3kg to 5kg) for smoking by importers. About half of all Norwegian salmon is eventually smoked, while half is consumed as fresh salmon. Future output may favour fish of 2kg to 3kg for the fresh market and 3kg to 4kg for the smokers' market.

Helped, no doubt, by favourable producer prices secured by the FFSO, nearly all Norwegian salmon farms were profitable in 1985. Average overall production costs were about UK£3.20/kg - about 75% of the producer price. Increasing capital costs for an 8,000cu m unit (which at 1985 prices was about UK£150,000 to UK£200,000) are partially alleviated by generous depreciation allowances and capital grants of between 10% and 35%. Capital costs are particularly high for smolt production units (between UK£1 and UK£2 per smolt produced) but a general shortage of smolt has kept prices and profits high. By 1989/90, smolt producer affluence may change for the worse when smolt availability is expected to match demand.

Profits earned by Norwegian salmon farmers also owe something to substantial government support. No less than three government institutions (encapsulating three non-research departments and two research institutes), and seven universities or colleges consume a research and development budget of UK£6.3 million. The technical, veterinary and breeding research, and training and extension services which result from this expenditure, contributed to an industry with a total value of about UK£130 million in 1985.

ii) Scotland

Limited numbers of sites, and the absence of large quantities of inexpensive fish as a food base, created conditions for Scottish salmon farming which were quite different to those prevailing in Norway. As a result, the limited sites have been subject to large-scale development by big corporations, with crofter participation occurring late in the development cycle and only in certain areas. Operating on the west coast, and in the western and northern isles, large corporation fish farm development has created integrated units of smolt production and on-growing farms, although some specialist smolt producers exist. Over 16 million

ova were laid down in 1985. About one third of these will be raised to smolt in fresh water cages moored in fresh water lochs, while the rest will be reared in fresh water land-based tanks. The majority of on-growing units employed sea cages, including Bridgestone cages, which have a capacity of 100 to 300 tonnes of salmon a year. The 128 on-growing units employed about 550 full and part-time staff while the 66 smolt units employed a further 171 full and part-time workers.

In 1985, Scottish salmon production amounted to 6,921 tonnes of which 2,659 tonnes were two-year-old salmon and 4,262 tonnes were one-year-old grilse. As with Norwegian production, about half of Scottish production is sold to smokers at first sale; the balance is sold fresh or frozen. Norwegian influence and investment is growing in the Scottish industry. The Scottish Salmon Growers' Association is concerned that Norwegian producers are privy to the Association's strategy for competing with Norwegian salmon. Currently, Scottish production is doubling every two years despite a shortage of smolt. The 6,900 tonnes of 1985 was worth about UK£30 millions. Continuation of the present growth rate will result in 25,000 tonnes production by the end of the decade.

The top ten salmon farmers in Scotland are responsible for most of the production. The largest producer is the Unilever-owned Marine Harvest Ltd, based in Edinburgh, with 13 sea cage units and six smolt production units. The company is also involved in salmon processing, which it is about to expand, and conducts its own salmon marketing and promotional schemes. Output in 1986 is expected to be in the region of 2,500 to 3,000 tonnes. McConnell Salmon Ltd, a subsidiary of Hooker McConnell, operates six sea sites and two hatcheries in the Outer Hebrides, as well as a recently acquired sea cage unit on the Scottish mainland coast. Total production in 1986 is expected to be about 1,100 tonnes. The Norwegian-owned Golden Sea Produce Ltd of Oban has other fish interests besides salmon. However, its salmon output in 1986 is expected to be about 700 tonnes, most of which will be marketed through its holding company. Wester Ross Salmon Ltd of Ullapool produces about 600 tonnes of salmon a year but currently faces smolt problems which it has tried to solve by developing facilities in Dorset, England. Gilbert Johnson Ltd of Shetland, a relative newcomer to the salmon business, has expanded rapidly, producing 500 tonnes from three owned or partly-owned cage sites. The company possesses no hatcheries. Rostad Salmon Ltd, Shetland Salmon Producers Ltd and Shetland Norse Fish Farm Ltd are companies with substantial Norwegian interests producing respectively about 500, 400 and 400 tonnes a year. Highland Fish Farmers Ltd, owned by the Wood Group of Aberdeen, and Joseph Johnstone & Sons Ltd of Montrose, are each projected to produce about 300 tonnes of salmon in 1986 from marine sites and hatcheries. A further six smaller companies complete the roll-call of Scottish salmon on-growers.

Complimenting these on-growers are several specialist smolt producers such as Marine Harvest Ltd (already mentioned), Sea Farm (Polly) Ltd and Sea Farm (Kerry) Ltd - both with strong Norwegian interests - producing about 600,000 smolt in 1985 and the potential to double that in 1986. Landcatch of Argyll is jointly owned by a Scottish and Norwegian company and has, under Norwegian

influence, switched its substantial land-tank facilities from salmon on-growing to smolt production only. Output of one million smolt is expected in 1986. Lovat Estates Hatchery of Inverness is also expected to produce 0.5 million smolt a year for sale to on-growing farmers.

The limited number of good mainland sea sites for Scottish salmon production influenced past development. Land-based operations for on-growing salmon were tried by Fisons Ltd in the early days. The project failed, and salmon investors have been cautious ever since, although at least one on-grower in Argyll (Otter Ferry Salmon Ltd) continues to produce salmon successfully from land-tanks. Increasing interest is also being shown in potential salmon production in the outer islands. In the western isles, an Integrated Development Programme has assisted crofters to take up salmon farming, and in Shetland, Norwegian interests have co-operated with small-scale local interests to develop hatcheries and on-growing farms.

According to the cautious analysis of the Highlands and Islands Development Board (HIDB), production costs of Scottish farms in 1985 were about UK£3.20 to UK£3.40 per kg, and provided between UK£0.27 and UK£0.48 per kg profit. Scottish profit margins would appear to be considerably below Norwegian margins, which is hardly surprising given that many Scottish sites are less than ideal. However, the HIDB analysis is probably over-cautious, and deliberately under-states revenue and over-states costs. More efficient producers, operating fully integrated smolt and on-growing units, are capable of double the HIDB profit per kg.

Quality standards and promotional campaigns are conducted on behalf of Scottish mainland and western isle salmon farmers by the Scottish Salmon Growers' Association (SSGA). Farmers in the Shetland Isles have their own marketing organisation. The SSGA is funded by an annual levy on surviving smolt on each of its 70 members' farms. The Association also lays down a code of fish handling, covering harvest, slaughter, packing etc. Regular inspection ensures that standards are maintained. Fish meeting the standards can be sold under the Association's seal of approval. Its promotional campaigns cover advertising and education in the use and preparation of salmon. The Shetland Salmon Producers' Association performs similar functions. Physical distribution of Scottish salmon, in contrast to Norway, is mainly performed by a multitude of contract hauliers or farms' own transport.

Government support and regulation of the salmon industry takes the form of technical assistance, financial assistance and statutory obligations. The technical assistance is channelled through the Department of Agriculture and Fisheries for Scotland and a number of Scottish universities and marine research stations. The Department administers the Diseases of Fish Act and heads research into the main diseases and breed improvement. The University of Stirling and Heriot Watt University in Edinburgh offer veterinary support and engineering design support for fish farmers. There are three sources of financial assistance to the salmon industry. The first is through the HIDB which offers grants

and loans to individuals or companies concerned with salmon development. In 1985, 150 applications totalling UK£8 million were received, against the HIDE's budget of only UK£2.8 million. Preference is usually given to smolt producers rather than on-growers, and small crofters rather than large companies. The EEC offer a second source of financial assistance to salmon farmers in Scotland under the European Guidance and Guarantee Fund (FEOGA). Support from FEOGA has been conditional on at least 5% government support for a project, but is presently under review. The demand for FEOGA funds greatly exceeds supply. Recent experience indicates that grants are being reduced. Consequently, delays in servicing applications are increasing. Also available through the EEC is a third form of financial assistance, namely grants to salmon farmers in the western isles under the Integrated Development Programme. Although the programme is due to end in 1987, all its funds were committed by 1986. Other minor sources of financial assistance include the Scottish Development Agency and the Orkney and Shetland Islands Council.

The statutory obligations of potential salmon farmers are designed to satisfy, among others, the environmental lobby. To set up a sea cage unit, obligatory applications must be made to as many as five separate bodies (Crown Estates, Department of Trade, landlords, Regional Councils and local harbour authority). To set up a land-based hatchery, four obligatory applications are required; for fresh water cages, three obligatory applications. In addition, once established, all Scottish salmon farms must register with the Department of Agriculture and submit annual returns of fish movements.

iii) Ireland

Even more than Scotland, Ireland's salmon farming industry is limited by the availability of suitable sites. The establishment of large integrated smolt and on-growing farms has characterised the industry to date, making optimal use of the few good sites. Irish salmon producers are already seeking ways of overcoming site limitations. Bridgestone cages have been used in exposed sea conditions, with encouraging results, but inevitably with increased risk. Circumstances in Ireland contrived to involve government in smolt and salmon production at a very early stage of the industry's development. The main government agencies involved in pioneering salmon culture were BIM, the Electricity Supply Board (ESB) and Udaras na Gaeltachta. The ESB was required to re-stock waterways which were used in generating hydro-electricity, and ESB created four hatcheries as a result. In addition, the Salmon Research Trust, jointly funded by the Guinness Foundation and the Irish government, established a hatchery in County Mayo with the initial intention of restocking rivers, but in more recent years supplying smolt to salmon farmers, including a few small-scale producers. Those small-scale producers have grown with the industry and have attracted attention and capital from external investors.

There are 12 major on-growing salmon farms in Ireland, using conventional cage culture, with two or three sites per farm. Many of these farms are in the process of establishing smolt units;

some trout farms are even converting trout units to salmon smolt production. Seven hatcheries currently are in operation; the largest established being those of the ESB, the Salmon Research Trust and Fanad, with other hatcheries being at various stages of development. Supporting industry is also gaining confidence in salmon production. Irish producers of cages, netting, floating collars and feed are already orientating their businesses towards the salmon industry. Fish processing companies have made investments based on an anticipated rapid increase in salmon production over the next five years. In 1985, production doubled from the previous year to 722 tonnes. In 1986, it will almost double again to 1,300 tonnes. By 1990, production of 10,000 tonnes is expected.

Genetic characteristics and Ireland's warm coastal waters can combine to produce a high proportion of grilse in Irish farmed salmon (20%-30% on average but occasionally up to 80%). Although grilse are smaller in size than older salmon, emergent producers have accepted grilse readily in the knowledge that their early sale improves cash flow and business returns. Norwegian developments in Irish salmon farms have shown that low grilising rates can be achieved with proper stock selection. Whether grilse or salmon however, Ireland's sea conditions should promote rapid growth to between 2kg and 3kg in the fish's first sea year.

Marketing of Irish salmon is still largely an individualistic, entrepreneurial activity, with each company making its own arrangements. Two of the larger companies (ESB and Fanad) market their fish individually while six of the mainly smaller producers opt to sell their salmon through the newly formed Irish Salmon producers' Group (ISPG). Promotion of Irish salmon on home and export markets is in the hands of BIM, in conjunction with the industry.

Government intervention in the Irish farmed salmon industry involves research and advisory services, veterinary services, licensing and provision of financial assistance. Research is carried out in the Fisheries Research Centre near Dublin, and the Salmon Research Trust. Veterinary support is provided by the Disease Diagnostic Service (DDS) jointly funded by government development agencies, and located in University College, Galway. Government licences or permits are required for fresh water hatchery units (one licence and one planning permit) and for marine on-growing units (two licences and one planning permit is required). Additional legal permits involving water rights may also be required. The licensing and legal routines are protracted. Once licences are obtained however, government grant aid can be generous, at up to 65% of capital costs. There are three sources of financial aid: BIM (which offers aid on a national basis, excluding the Irish speaking areas), Udaras na Gaeltachta (which offers aid to Irish-speaking areas), and EEC (through its FEOGA arm). BIM offers funding in three ways; as capital grants (up to 50% with a maximum of IRE20,000); grants of 10% of eligible fixed assets to commercial projects which will qualify a project for a further 40% grant from the EEC; and bridging loans while awaiting EEC funding (up to 20% of eligible fixed assets). Thus, immediate funding of 30% (ie loan of 20% and

grant of 10%) is available for salmon projects. BIM's maximum grant per project is IR£175,000. In addition, BIM provides a range of promotional and market information services. Udaras na Gaeltachta offers grants of up to 65% of capital costs for salmon projects in specified areas of Ireland, which are normally funded 25% by Udaras and 40% from FEOGA. In addition to the government grant agencies, the National Development Corporation has invested venture capital in projects ranging from hatcheries through grow-out to marketing. Training programmes are devised and funded by BIM and other government agencies.

The Irish farmed salmon industry appears to be set for a period of rapid growth which may require further government support in the form of a stock improvement programme and increased resources for export promotion. The development of a specifically Irish salmon stock capable of fast growth in the first sea year may ultimately allow Ireland to specialise in low-cost large grilse.

2.4 Projected Output 1990

This discussion of salmon and salmon producers can conclude with a forecast of production trends. Several factors make short-term forecasting reasonably accurate. The four year cycle of production, the lengthy process of obtaining licences and permits and the shortage of smolt means that present-day events will have a significant effect on output in 1990. Not only that, but a new type of investor is now interested in the farmed salmon industry; the conventional investor who looks for past performance as a guide to future prospects rather than the risk-taking pioneer investor. Salmon farming companies make their own forecasts with such an investor in mind.

Wild Atlantic salmon supplies are unlikely to increase beyond the consistent and stable 10,000 tonnes a year. Future farmed supplies however will be influenced by world salmon farming developments for both the Atlantic and Pacific types. Developments in Norway are particularly important for Atlantic salmon. Norway's industry currently produces at well below its licensed capacity and pressure is being applied to increase that capacity. Thus Norway could increase output at relatively low capital cost to on-growers, provided smolt shortages could be overcome and possible disease problems were solved. If increased output over the next few years had the effect of lowering producer prices, the reaction of large entrepreneurial producers in Norway would probably be to cut-back production. The crofter sector of the industry however may react differently in the short-term, choosing to increase production if price falls in order to meet target family incomes.

The world market for salmon will ultimately determine the limits to output, but the application of the latest technology suggests that Norway alone can produce up to 200,000 tonnes of salmon a year, the Faroes up to 10,000 tonnes a year (even when limited by smolt shortages), Scotland up to 30,000 tonnes and Ireland up to 15,000 tonnes. Consequently, Europe's technical maximum of farmed salmon output is in the order of 250,000 tonnes to 300,000 tonnes. Added to that would be the output from North America and the South Pacific, giving a very large figure for world output.

Competing with that world output of Atlantic salmon would be high value Pacific salmon, which with improved marketing, lower transport costs and a lower valued US dollar, could be highly competitive. Production from Japanese cage culture could also complicate the equation, although the results of Pacific salmon ranching and release programmes are unlikely to add large volumes of fish to the salmon market.

Various methods of forecasting future output of Atlantic salmon can be applied. As a result, the total farmed supplies of Atlantic salmon in 1990 are estimated here at 153,000 tonnes (Table 4). In contrast to this projection, the Norwegian Council for Scientific Research has forecast much less output by 1990, at 120,000 tonnes, because of 'market effects'. It is those market effects and the total market for salmon, which must now be examined.

TABLE 4 ATLANTIC FARMED SALMON PRODUCTION AND PRODUCTION FORECASTS

Country	Forecast Production			
	1985 (tonnes)	1986 (tonnes)	1990 This report (tonnes)	1990 Norwegian CSR* (tonnes)
Norway	28,656	38,000	100,000	80,000
Scotland	6,921	9,700	25,000	13,000
Ireland	722	1,300	10,100	2,000
Faroes	600	1,200	6,000	10,000
Iceland	100	200	2,000	10,000
N America	100	500	7,000	2,000
Others	500	100	3,000	3,000
TOTAL	37,599	51,000	153,100	120,000

*Norwegian Council for Scientific Research

Source: Tables 3.20 and 3.21 of main report.

3. TRADE, MARKETS AND PROFITS

3.1 The Salmon Export Trade

Atlantic salmon are mostly sold fresh at the farm gate, weight graded in steps of 1kg, according to potential use. Grilse under 2kg are eventually sold as fresh, frozen or smoked salmon. Fish from 2kg to 3kg are sold fresh as salmon steaks or cutlets, or eventually smoked. Salmon between 3kg and 5kg are usually for the exclusive use of smokers whereas fish of 5kg or more are destined for caterers' displays. Fresh salmon has a shelf life of only 3 to 5 days at 1 deg C., whereas if it is subject to controlled atmospheric packaging (CAP), shelf-life is extended by up to two weeks. The product known as smoked salmon requires boned salmon to be smoked over burning hardwood chips. The end result is sold as sides, sides pre-sliced, or vacuum packed sliced pieces. Other ways of processing include marinating (gravad laks) and as recipe packs such as salmon and prawn crepe.

Five species of Pacific salmon are marketed in Europe and North America (the sixth, cherry salmon, is marketed only in Japan). Chinook or king

salmon, graded in 2kg steps, is ideally suited for smoking and is bought whole, dressed and frozen by the French, and headless by the Italians. Coho is graded to slightly smaller sizes (up to 6kg) and is highly prized either as a smoking fish or as a table fish. Troll caught chinook and coho usually realise the highest prices. Chum salmon (or keta, fall or dog salmon) is smaller on average than either chinook or coho (ie; up to 5kg) and much of it is canned. However, there is a fresh or frozen market for it in Sweden, France, West Germany and the UK. The remaining species, sockeye and pink salmon, are generally smaller fish than the other species and are the mainstay of the salmon canning industry.

No Atlantic salmon is canned, which means that international trade in the commodity is in the fresh, frozen or smoked forms. Trade in smoked salmon has grown slowly over the last few years compared to the substantial growth in trade in fresh and frozen salmon. Indigenous, under-utilised industries and tariffs against smoked salmon imports partially account for this. Of the seven principal exporters of Atlantic salmon, Norway is the chief, while Denmark (a non-producer) exports over 3,000 tonnes of fresh or frozen salmon and over 2,000 tonnes of smoked salmon. Denmark, of course, engages in entrepot trade, importing substantial quantities of Atlantic salmon from Norway and Pacific salmon from North America, and re-exporting processed produce. Denmark's classificatory labels of Atlantic and Pacific salmon may become a little blurred as a consequence. In all, over 31,000 tonnes of Atlantic salmon were exported in 1984 compared to only 11,000 tonnes in 1980 (Table 5).

Of the four nations which participate in the Pacific salmon fishery, only one (the USSR) does not engage substantially in international trade of that fish. Of the others, only the USA and Canada are exporters while Japan is a prominent importer. Exports of canned salmon have declined during recent years, partly due to an outbreak of botulism poisoning in 1981 which was traced to canned salmon. Fresh and frozen Pacific salmon exports however have grown at about 15% a year during the four years to 1984 (Table 5).

3.2 Imports, Present and Future

Atlantic salmon importers in 1984 were led by France (Table 6), but by 1985 they had been overtaken by the USA which imported 6,700 tonnes of Norwegian Atlantic salmon in that year. Fresh Atlantic salmon imports in all countries shown in Table 6 grew at a faster rate than either frozen or smoked imports. Pacific salmon imports are dominated by Japan whose purchases of frozen salmon grew by 23% a year in the four years to 1984. The remaining importers of frozen Pacific salmon appear to have stabilised their purchases during the four years to 1984 whereas imports of canned salmon appear to have declined during that period (Table 6). Japan mainly imports frozen sockeye and chum Pacific salmon while in Europe, France and Italy import coho and large chinook. Sweden, Denmark, Germany and the UK on the other hand favour lower-value species such as chum. Thus approximately half of Europe's imports of Pacific salmon are of high value species.

It is clear from Table 6 that the main growth in salmon imports is in Atlantic fresh and frozen, which when combined, have shown an average 33% increase in the four years to 1984. Pacific salmon imports in Europe, on the other hand, have languished. Although there is little probability that imported Atlantic salmon could make significant inroads into the

TABLE 5 MAIN EXPORTERS OF ATLANTIC AND PACIFIC SALMON
(in 000 tonnes)

Country	Product	Atlantic		Pacific	
		1980	1984	1980	1984
Norway	Fresh	3.0	17.5		
	Frozen	1.2	2.6		
	Smoked	0.1	0.3		
Denmark	Fresh	0.7	1.8		
	Frozen	1.2	1.3		
	Smoked	1.5	2.3		
Scotland	Fresh	0.3	1.8		
	Frozen	0.5	0.5		
	Smoked	0.3	0.6		
Ireland	Fresh	0.3	0.5		
	Frozen	0.4	0.1		
	Smoked	0.1	0.2		
France	Fresh	-	0.1		
	Frozen	0.2	0.4		
	Smoked	0.4	0.6		
Canada	Fresh	0.1	0.1		
	Frozen	0.5	0.3	17.8	25.0(e)
	Smoked	0.2	0.2		
	Canned	-	-	10.8	-
Netherlands	Fresh	-	0.1		
	Frozen	0.1	0.1		
	Smoked	0.2	0.1		
USA	Frozen	-	-	57.0	104.1
	Canned	-	-	33.6	22.3
TOTAL		11.4	31.7	119.2	151.4
	Fresh	4.5	22.0		
	Frozen	4.1	5.5	74.8	129.1
	Smoked	2.7	4.2		
	Canned	-	-	44.4	22.3

Note: Totals may not add exactly because of rounding.
e = estimated

Source : Tables 4.1 and 4.3 in main report

TABLE 6 MAIN IMPORTERS OF ATLANTIC AND PACIFIC SALMON
(in 000 tonnes)

Country	Product	Atlantic		Pacific	
		1980	1984	1980	1984
France	Fresh	1.5	5.4		
	Frozen	1.0	2.1	13.5	16.0
	Smoked	0.5	0.7		
	Canned	-	-	6.0	3.1
USA	Fresh	-	4.3		
	Frozen	-	1.1	2.6	6.4
	Smoked	-	0.3		
West Germany	Fresh	1.1	3.3		
	Frozen	0.7	0.6	2.6	1.6
	Smoked	0.9	1.3		
Denmark	Fresh	0.8	2.5		
	Frozen	1.7	1.2	2.6	2.7
	Smoked	-	-		
UK	Fresh	0.3	1.5		
	Frozen	0.9	1.3	4.0	3.8
	Smoked	-	0.1		
	Canned	-	-	25.9	22.2
Spain	Fresh	-	1.4		
Belgium/Lux	Fresh	0.3	1.1	17.8	25.0(e)
	Frozen	0.3	0.4	1.6	1.5
	Smoked	-	0.3	-	-
	Canned	-	-	-	3.6
Italy	Frozen	-	0.1	1.3	0.8
	Smoked	0.5	0.5		
Sweden	Frozen	-	-	4.6	5.5
Ireland	Canned	-	-	1.2	1.1
Japan	Frozen	-	-	35.6	82.2
TOTAL		10.5	29.9	114.7	157.8
	Fresh	4.0	19.9		
	Frozen	4.6	6.9	69.3	121.3
	Smoked	1.9	3.2		
	Canned	-	-	45.4	36.5

Note: Totals may not add exactly because of rounding.

Source : Tables 4.2, 4.4 and 4.5 of main report

Japanese market (where taste and cost factors appear to give the advantage to Pacific species) there is a strong possibility that Atlantic salmon could displace Pacific imports into Europe, especially into France. A simple forecast of imports is made here on the basis of extrapolating recent growth rates, but also assuming that Pacific salmon imports into France are displaced by Atlantic salmon to the extent of 50% and, as an alternative, 100%. Where direct extrapolation results are at odds with the known characteristics of the market, then adjustments are made; for example in the case of Japan and the USA. By 1990 therefore, total imports by the major consumers of Atlantic salmon will be between 150,000 and 180,000 tonnes, reflecting an overall annual growth rate of 30% (157,000 tonnes if Pacific salmon imports into Europe are not replaced by Atlantic salmon, 169,000 tonnes if 50% of French imports of Pacific salmon are replaced by Atlantic salmon, and 181,000 if 100% of French Pacific salmon imports are replaced by Atlantic salmon).

3.3 Consumption

In Europe as a whole, 1984 consumption of Atlantic salmon was 100gm per head; it was 90gm per head for Pacific salmon, including only high value species but excluding canned salmon. Highest consumer nation in that year was Sweden which averaged 110gm of Atlantic salmon per head and 660gm of Pacific salmon. In North America, USA consumed 20gm of Atlantic salmon per head but 360gm of Pacific salmon per head. Japan consumed 1.83kg of Pacific salmon per head in 1984.

In Europe at least, probably as much as 60% of all salmon (other than canned) is consumed as smoked salmon while 40% is retailed or consumed through the catering trade as fresh or frozen salmon. Salmon is 'cold smoked' (ie; at temperatures not sufficiently high to cook it) in smoke from burning hardwood chips. Texture and flavour are changed but shelf-life is still limited, ie; up to 21 days at 1 deg C. Although, traditionally, a high proportion of smoked salmon has been sold as whole sides, an increasing proportion is now sold in sliced or pre-sliced form; the latter being re-assembled into a whole side. Poor quality smoked salmon is frozen, so greatly enhancing its shelf-life. Peaks in the European smoked salmon market occur around Christmas and Easter, which implies processing peaks several weeks earlier. As a general rule, a gutted whole salmon yields only 65% of smoked product. Consequently, smoked salmon costs are very sensitive to the cost of whole salmon, which forms 75% of smoker's total costs. Most smokers in Europe appear to add a mark-up of 20% of sales price as their profit, provided they are selling a quality product. The high price of smoked Atlantic salmon (up to UK£13.00/kg ex factory in 1986) endows the product with prestige characteristics, although the price (which can vary substantially according to quality and presentation) must also create some consumer resistance.

Other fresh or frozen salmon products such as steaks, cutlets or joints, are currently benefiting from salmon's healthy image in the USA and Europe. The consuming public however has yet to discover that the meat yield from salmon is high compared to say chicken, which in effect means that salmon compares favourably in price with even the cheapest animal protein.

The generalised consumer response to price changes in fresh salmon is thought to be greater than their response to price changes in smoked salmon. Whereas smoked salmon demand is somewhat insensitive to price changes, fresh salmon demand appears to respond very positively to price changes. A Canadian study based on 1955-81 data for Atlantic salmon showed that a 1% fall in salmon price would lead to a 10% to 12% increase in demand - a price elasticity of demand of 10 or more. There is also a similar relationship to income and salmon consumption; a 1% rise in income will lead to a 3% - 6% rise in salmon demand. Salmon producers should be encouraged by these findings as they show that fresh salmon consumption will rise with income and that greatly increased quantities can be absorbed by the market with relatively small price declines.

3.4 National markets

Having considered the form in which salmon is sold and consumed, and the favourable relationship between price and consumption, and income and consumption, for fresh and frozen salmon, a brief survey of the principal national markets will prepare the way for a forecast of consumption in those markets.

i) United Kingdom

About 10,000 tonnes of fresh, frozen or smoked salmon and about 22,000 tonnes of canned salmon were consumed in the UK in 1984. Imports of fresh and frozen Atlantic and Pacific salmon exceeded exports of farmed Scottish salmon. In relative terms, smoked salmon accounts for a declining share of the market which, by 1985, was about 50% smoked and 50% fresh or frozen. Both Pacific salmon and farmed Atlantic salmon were favoured by smokers, which suggests that there is scope for replacing smokers' Pacific salmon with Atlantic farmed salmon. Production costs of smoked salmon varied between UK£8 and UK£13 per kg and high profit mark-ups were the rule. Smoked salmon retail prices were twice its cost price, depending on quality. The product appears to be price inelastic. The fresh and frozen sector of the market is growing, characterised by new retail outlets in supermarkets as well as traditional, but increasingly less important, fishmongers. In the catering sector, there appears to be growing demand for salmon in the pub food market, but a less buoyant demand in the up-market restaurants, where traditionally large fish are required. On balance, it seems reasonable to assume future growth in demand of 5% for smoked salmon, (with 75% of all Pacific salmon replaced by Atlantic salmon by 1990), 25% for retail sales (assuming a 5% price decline) and 25% for catering sales. By 1990, expected demand would be about 20,000 tonnes, of which 18,000 tonnes would be Atlantic salmon.

ii) France

Pacific salmon constitutes the bulk of French salmon consumption of about 30,000 tonnes a year, although Atlantic salmon accounts for an increasing proportion. About 70% of salmon is consumed as smoked salmon with particular areas preferring darker or lighter smoked colour. The major salmon smokers use 30% Atlantic and 70% Pacific salmon but the year-round availability of Atlantic salmon is leading to its increasing use by smokers. Although the highest grades of Pacific salmon will retain their market share, Atlantic salmon is likely to displace much of the lower value Pacific salmon. The best sliced smoked salmon retails for FFr450/kg (Scotch or Red King) whereas lower grade produce (smoked sliced coho or farmed Atlantic) sells for FFr220/kg to FFr260/kg. Price inelasticities are thought to exist for smoked salmon. Fresh salmon sales are almost exclusively Atlantic salmon; frozen salmon on the other hand tends to be low quality chum and pink salmon. The fresh market prefers fish under 3kg, for which there appears to be a somewhat price inelastic demand when sold through the traditional fishmongers. However, chain stores and hypermarkets are encroaching on traditional outlets and it is in this sector of the market where most growth is likely to occur. In the catering market, potential growth lies in the medium quality restaurants rather than the up-market or fast food establishments. Sold in steak form, cheap frozen Pacific salmon is generally perceived by the consumer to be inferior quality. Reasonably priced Atlantic salmon therefore could conceivably make inroads into the low price Pacific salmon market. Based on these observations, a forecast of future demand for Atlantic salmon can reasonably assume growth rates of 25% a year in sales of fresh Atlantic salmon, a maximum of 50% of the smokers market being captured by Atlantic salmon, growth of 2.5% a year for Atlantic smoked salmon in the medium price range and displacement of frozen Pacific salmon by competitively priced Atlantic salmon. Forecast demand by 1990 therefore is 46,000 tonnes, 35,000 tonnes of which will be Atlantic salmon.

iii) United States

As both producer and consumer of salmon, the USA ranks first in the world. From a total annual catch of over 300,000 tonnes, nearly 200,000 tonnes are consumed domestically, principally as canned salmon (116,000 tonnes). Exports of salmon, at about 130,000 tonnes annually, consist of frozen salmon (109,000 tonnes, 70% of which goes to Japan) and canned salmon (22,000 tonnes, 50% of which goes to UK). Domestic consumption of fresh or frozen salmon is about 70,000 tonnes while smoked or salted salmon consumption is only 6,000 tonnes. In 1985, the USA imported 14,200 tonnes of salmon, most of which was fresh, chilled or frozen (13,000 tonnes) with relatively small amounts of filleted (800 tonnes), smoked (320 tonnes) and preserved salmon (850 tonnes). The main foreign supplier was Norway (7,000 tonnes) followed by Canada. Salmon importers are concentrated in the Boston area from whence they supply wholesalers, distributors, hotels and restaurants. Several supermarket chains are investing in full seafood service sections in a bid to expand sales, but regularity and quality of supply are still of major concern to store buyers.

Importers responded to that concern with an 83% growth in 1984 and a 28% growth in 1985. Fresh salmon imports currently exceed frozen salmon imports and most of the increase is attributable to farmed Atlantic salmon from Norway. Smoked salmon imports, although of minute proportions, also increased between 1980 and 1985, Norway overtaking the UK as the largest import source followed by Canada and Ireland. The total smoked salmon market remains sluggish however, at only 8,000 tonnes and without special promotional effort may not be a future growth market. The quality and continuity of supply of farmed Atlantic salmon appeals to the USA market, particularly on the east coast where Atlantic salmon outsells the less expensive Pacific varieties and where the old seasonality of the market has almost disappeared. On the west coast, farmed Atlantic salmon is in demand during the Pacific salmon off-season (December to March). It is estimated that about 75% of farmed Atlantic salmon imports are sold through hotel and restaurant outlets and 25% through retail outlets. Generally, the US market seeks head-on gutted fish in grade sizes 2-3kg, 3-4kg and 5-6kg. Head-on fish exports to the USA are expensive in air freight, but the market judges the freshness of the fish by the gills. Imported fish, which is free of duty if fresh (5% ad valorem if smoked and 3.6% if prepared/preserved), requires a certificate that it is free of 'whirling disease'. Against a background of growing per capita fish consumption in the USA, the retail price of Atlantic salmon, sold as steaks or fillets, is between US\$12.65 and US\$16.20 per kg. This price is thought to be a factor limiting large increases in sales volume. Factors such as exchange rates and air freight costs may keep prices of imported salmon high, although Irish salmon air freighted to the USA by Aer Lingus pays a substantially lower freight charge than a similar product air freighted by SAS from Norway. These factors, and any others, such as increased competition from Pacific salmon producers, establishment of new Atlantic salmon farms on the east and west coasts, Chilean competition, the perceived ill-effects of the Chernobyl disaster on Norwegian salmon and the use of artificial colouring additives to salmon feeds, all subscribe to a less than optimistic prognosis for the US salmon market. Assuming demand for fresh imported salmon grows at 30% a year, that Chilean and New Zealand imports account for 6% of the market and that indigenous production of Atlantic salmon reaches 7,000 tonnes by 1990, then imports of farmed Atlantic salmon could be expected to rise to 21,000 tonnes by that year.

iv) West Germany

Over 77% of West Germany's 7,700 tonnes of imported salmon in 1985 was in fresh, chilled or frozen form, with the balance mainly in smoked form. With overall salmon imports (and therefore salmon demand) increasing at 14% a year, fresh salmon is gaining over frozen, and smoked salmon imports account for an increasing share of the total. As with the USA, Norway is Germany's main supplier of farmed Atlantic salmon, delivering to specialist importers in north German ports on a regular and reliable basis. Salmon smokers are normally responsible for their own imports which are either Atlantic salmon (mainly from Norway) or Pacific salmon (from North America). Smoked salmon accounts for 70% of salmon consumption, which helps to explain the doubling of smoked salmon

imports in the five years to 1985. Denmark has been the primary supplier of these increased imports, and is itself a large importer (and re-exporter) of Norwegian salmon. Fresh salmon is distributed throughout Germany by up to 200 fish wholesalers, supplying the retail and catering trades. The real price of all grades and types of salmon has fallen in the five years to 1985, perhaps reflecting partly the strength of the Deutsche mark in the foreign exchange market. Apart from a short-lived price surge in the early part of 1986, prices have recently fallen in line with trends in other countries. Seasonality accounts for some price variation over the year, with Christmas being the main consumption period. Fresh Atlantic salmon is not a strong retail product because of its high price. Its main outlet therefore is through up-market restaurants. What little retail fresh salmon demand there is appears to want a red coloured salmon rather than pink. Fish is supplied to the German market gutted with head-on, in sizes up to 3kg or 4kg for retail sale, and up to 7kg or 8kg for smokers. New suppliers to the West German market (such as potential Irish suppliers) must be able to match Norwegian reliability and cost of delivery if they are to compete successfully. Given the expected 2% or 3% growth in German per capita incomes up to 1990, demand for fresh salmon should grow by about 15% per year, and for smoked by about 8% per year. Atlantic salmon demand therefore by 1990 should be of the order of 7,200 tonnes.

iv) Denmark

Although a relatively insignificant consumer of salmon, Denmark has importance because of its entrepot trading and processing activities. Denmark's combined total of production and imports of salmon in 1985 amounted to 9,600 tonnes. Imported frozen Pacific salmon accounted for over 4,000 tonnes of this total. Traditional fish suppliers to northern Europe and expert fish processors, Danish smokers supply a competitively priced smoked salmon based on chum Pacific salmon, imports of which increased markedly between 1984 and 1985. However, many Danish smokers are switching to farmed Atlantic salmon because of its regular availability, its quality and the decreasing price differential between it and the Pacific salmon. As Denmark's main market for smoked salmon (ie; West Germany) is very price-conscious, Danish smokers are also using an increasing amount of sea-trout, which is considerably cheaper than Pacific or Atlantic salmon, and which has been marketed as salmon (a practice which is now receiving the attention of West German authorities). The market for Danish smoked and other salmon is expanding while raw material costs are generally in decline. Producers however are less than ebullient at future prospects largely because their principal market in West Germany cannot be expanded indefinitely without serious deleterious effects, such as low-price supermarket chains threatening to dominate the market and demand substantial price cuts from suppliers. In effect, the Danes sense significant price inelasticities of demand in their main markets which makes them cautious, if not pessimistic, about the future.

iv) Spain

As one of the largest sea-food markets in western Europe, Spain is only just beginning to consume salmon in any significant quantity. Up to 1981, imports were largely frozen salmon from North America or Denmark, totalling about 400 tonnes a year. In 1981, Norway began supplying fresh farmed Atlantic salmon. By 1985, Norwegian and Danish exports to Spain for this product exceeded 1,400 tonnes, while frozen salmon imports (mainly North American) remained steady at about 400 tonnes. Three specialist importers, based in Barcelona and Madrid, organise the Spanish salmon trade and pay particular attention to the early summer and Christmas peak periods. Only about 10% of salmon imports are retailed; the remaining 90% are divided equally between caterers and smokers of whom there are six firms using fish sizes of 4kg or more. Caterers prefer smaller fish sizes (up to 4kg) and, because they tend to purchase smaller quantities, usually pay high prices for fresh salmon. Retail demand, such as it is, looks for fish in the 2kg to 4kg range with most fish being sold whole or steaked. The structure of retailing in Spain is generally less developed which means that retail fish sales rely on traditional fish shops and market stalls. The increased imports of (and presumably demand for) farmed Atlantic salmon have been earned at the expense of dramatic price falls. For example, Spanish wholesale prices fell by up to 40% between January and August 1986, mainly through intense competition between several Norwegian exporters. The Norwegian FFSO recently opened an office in Madrid which may result in a better co-ordination of exports in the future. Small amounts of Scottish salmon have been imported into Spain and salmon farming in a selected coastal area has commenced. Future growth in the Spanish salmon market will be assisted by the reduction of import duties on fresh salmon under the terms of Spain's EEC entry conditions. As members of the EEC, Scottish and Irish salmon farmers will benefit more than Norwegian salmon farmers, who must still face 2.5% duty on their salmon when EEC members' salmon will be duty free. The main future demand will be for fish of over 3kg, although there may be a growing retail market for smaller fish. An annual growth rate in the overall market of 35% is forecast here, making anticipated demand for Atlantic salmon about 7,000 tonnes by 1990.

3.5 Supply/demand imbalance and price effects

The country demand forecasts for Atlantic salmon up to 1990 suggest that world demand (including countries other than those summarised above, for whom a 20% per annum market growth is assumed) will be about 120,000 tonnes by that year, which is lower than the forecast made earlier by extrapolating import trends (150,000 to 180,000 tonnes). A qualified synthesis of both these forecasts would suggest that world demand for Atlantic salmon by 1990 is likely to be between 130,000 and 140,000 tonnes. The forecast of production given earlier (Table 4) suggests that nearly 160,000 tonnes will be supplied by 1990. Thus supply is likely to exceed demand by as much as 20,000 to 30,000 tonnes by the decade's end. The effects of such an excess of supply over demand could be felt by producers before 1990. In the short-term, it appears inevitable that there will be salmon business failures in all producer countries.

An apparent imbalance in projected demand and supply implies downward pressure on prices which in turn may mean reduced profitability for salmon farming enterprises. Future prices now need examination in the light of the market analysis.

Real prices for Atlantic salmon, based on CIF prices at Boulogne, have declined by an average of 3% a year for the last five years to 1985. The real price decline during 1986 is likely to be at least 15%. Part of this price decline can be attributed to a change in the price differentials between salmon grades, where recently the demand for very large fish (over 4kg) has slumped in the face of increasing supply. In Europe at least, over-valuation of the US dollar has reduced the price differential between Atlantic salmon and the most common Pacific salmon species (ie; coho and chum). Whereas coho (headed and gutted) once cost only 80% of Atlantic salmon sold round (ie; not headed and gutted), and chum only 50-60% of Atlantic salmon price, coho and chum since mid-1984 cost 95% and 75% respectively of Atlantic salmon prices. This movement in Pacific salmon prices has helped to expand the market for Atlantic salmon in Europe and could be an indication of the possible European floor price for Atlantic salmon. Norwegian and other exporters' experience in the USA suggests that if the dollar is over-valued (ie; worth more than US\$1/UK£0.57 or UK£1/US\$1.75), then exports to the USA will be encouraged. Conversely, if the US dollar is under-valued, exports to the USA will be jeopardised. Whether sold in Europe or North America, the lowest floor price of farmed Atlantic salmon cannot be less than the ex-farm production costs, including capital costs and adequate rewards for proprietors. Based on Norwegian and Scottish data, average ex-farm production costs are presently between UK£3.0 and UK£3.8 per kg. By the 1990s, new technology and the disappearance of less efficient producers is likely to bring down ex-farm production costs to about UK£3.0 to UK£3.12 per kg, in real terms.

Bearing in mind the estimates of total production of Atlantic salmon bearing up to 1990, the weakness in total demand and the probable price elasticities which apply, the real price forecast made in this report for the ten years to 1995 predicts substantial price falls up to 1989 (at least 25% in real terms), followed by a stabilisation of price reductions thereafter (about 1% a year - see Table 7). By 1990, the European wholesale price for Atlantic salmon is forecast at UK£3,496 per tonne (round) and by 1995, UK£3,324 per tonne (all in 1985 UK£s). These prices will be less than ex-farm cost prices for many smaller, less efficient farms, which means a contraction of the number of salmon producers, especially where they lack government support.

The effect of hardening real prices and narrowing margins over the next ten years will have profound effects on the attractiveness or otherwise of investment in salmon farms. In order to explore this effect, four 500 tonne/year salmon farm models were simulated on a computer, the first

TABLE 7 TEN YEAR PRODUCER PRICE FORECAST FOR ATLANTIC SALMON
(Fish delivered Boulogne)

Year	Assumed Annual Price Fall %	Salmon Price UK£/tonne	Grilse Price UK£/tonne
1985		4,600*	3,750*
1986	15.0	3,910	3,188
1987	5.0	3,715	3,028
1988	2.5	3,622	2,952
1989	2.5	3,531	2,879
1990	1.0	3,496	2,850
1991	1.0	3,461	2,821
1991	1.0	3,426	2,793
1993	1.0	3,392	2,765
1994	1.0	3,358	2,738
1995	1.0	3,324	2,710

* Base year historical price. For 1986 onwards, prices are in real terms, expressed in 1985 UK£s.

In late 1985, the exchange rate was about UK£1/US\$1.40 (average for year UK£1/US\$1.30). Up to October 1986, the observed real price fall was greater than the 15% shown above. Some of this was attributable to fluctuations in the values of European currencies.

Seasonal factors such as the Christmas demand were expected to lift the October 1986 price and reduce the extent of the annual fall for 1986.

Source : Table 5.3 in main report

three being integrated smolt and on-growing units employing different technologies, and the fourth being an on-growing unit only. The different integrated farm technologies were sea cages, Bridgestone cages and a land-based tank farm. The capital cost of the first model (sea cages) was UK£0.967 million, the second UK£1.279 million, the third UK£2.039 million and the fourth UK£0.804 million. The financial rates of return on each model were 18.8%, 14.9%, 3.6% and 16.2% respectively, with a fairly high risk factor in each case. For example, in the first model, the rate of return is halved if revenue falls by 10% (through a reduction in selling prices even greater than the 25% anticipated). In addition, should disease or unfavourable weather cause total stock losses periodically - say every five years - the rate of return becomes negative and the project loses all feasibility. Potential new entrants should therefore view the prospect of salmon farming with considerable caution; the days

of fast fortunes are over. The balance of advantage appears to lie with established efficient farms, which possess the resources needed for expansion, rather than with inexperienced new entrants with inferior sites and untrained personnel.

4. IMPLICATIONS FOR THE INDUSTRY

Because of rising output and generally falling real prices over the next five years, the established large producers of farmed salmon will be best able to reduce their operating costs in line with falling prices, and thus maintain to some extent, margins and profitability. In contrast, new entrants will experience high capital costs (as government grants become less generous), high operating costs (because of less favourable siting of farms and untrained personnel) and reduced margins as prices fall. There are several implications therefore for those concerned with running or encouraging the expansion of the salmon industry.

The price differential between salmon grades is shrinking, and smaller sizes of fish are likely to be in demand. The most cheaply produced small salmon is grilse whose production is favoured under Irish conditions. Therefore production policy needs to switch from trying to produce the largest possible fish per smolt, to producing the largest possible first sea year fish. Additional smolt production will be needed for this policy which may mean directing official support towards smolt producers. At the same time, salmon farmers using favourable sites should be encouraged to expand and gain maximum economies of scale from their existing work force and shore facilities.

The salmon market is rapidly becoming a buyers' market. Attention to every detail in selling the product will become crucial to success. The requirement is for carefully graded and handled fish, well iced, and moved rapidly to market with promptness and reliability. Quality standards must be maintained and consumer confidence in the product must be gained. To that end, an appropriate logo for a particular country's salmon acts as a focal point for promotional campaigns. The market holding the greatest scope for Irish sales expansion is that of the USA. However, the eventual value of this market will be dependent on the fate of the dollar and the degree of export co-ordination and market promotion directed to it.

Government support needs to concentrate on three areas; firstly the development of group marketing, secondly, state support for market promotion and development, and, thirdly, research into improved breeds of salmon, to select primarily for fast growing grilse which attain, say 3-4kg in their first sea year and which are tolerant of, or resistant, to the main diseases.

The
Fisherman (B.C.)
6-23-89

LETTERS

The Fisherman welcomes letters to the editor. Letters must be signed and should be brief, if possible.

UFAWU stand on fish farms needs to be toughened

In a recent editorial entitled "Can the UFAWU represent salmon farm workers?" (April 21, 1989) union policy was outlined with respect to aquaculture — no ban on fish farming but strict regulations. Your position is reasonable and takes into consideration that workers in this industry require safe working conditions and decent wages.

However, it has now become apparent that salmon farming has become an even bigger problem than most had predicted in terms of mort disposal, industrial plastic garbage, destruction of marine wildlife, water pollution, antibiotics, price wars, fish escapement and numerous other problems.

The union's decision to embrace a "regulated" aquaculture industry does not take into account the burden that must be shouldered by the residents of the many communities that have to live with and pay for (through taxation) this new industry.

Our communities have lost funding in other areas, such as recycling, parks development and education as public money and expertise are poured into this industry.

We then must live with the mess created by people who don't care about local concerns and values and think that all you have to do is wave money in people's faces and they will swallow anything.

Both levels of government seem completely disinterested in regulating this industry. The new waste management laws for fish farms are not even worth the paper they are printed on. This industry is, and will continue to be, "self-regulating."

This industry has little respect for existing laws like the Fish and Wildlife Act or the Pest Control Products Act, so there is every possibility that new laws will be ignored as well.

In the wake of falling farm fish prices, many people are asking questions concerning the viability of fish farming. But regardless whether or not fish farming is sustainable or must continue to be subsidized by the public, there is no question the industry will continue to impact negatively on coastal communities.

The use of the biocide Nuvan 500 in Scotland to control sea lice is just one indication of what we can expect to see here if it hasn't already been used.

It is becoming more and more obvious that the economic benefits are confined to the fish farming industry while we must pay the social/economic and environmental costs borne out over the long term. Under these circumstances, phasing out fish farming during the next five years is become a more appealing and realistic alternative. Then we can get on with the real job at hand — rehabilitation and conservation of wild salmon stocks.

We would be pleased to present a slide show documenting industry abuses.

Claire Heffernan,

Citizens for Aquaculture Regulations,
POWELL RIVER

Puget Sound Fish Farms Challenged

By KEITH SCHNEIDER

Special to The New York Times

PORT ANGELES, Wash. — Salmon farmers in the Puget Sound region are encountering resistance this summer as they and a group of scientific critics clash over the safety of production practices, including the use of antibiotics.

The dispute, waged in public hearings around the sound, comes as the state's salmon farming industry is emerging from legal and legislative battles that have delayed its growth for two years. Local and state licensing panels are considering proposals that would expand the number of Puget Sound salmon farms to 20 from 13 in the next year.

The expansion here, however, and the prospects for the rest of the United States aquatic farm industry could turn on the ability to answer the critics and satisfy consumers that fish are safe to eat.

In 1969, when the first experiment in salmon farming was started in Puget Sound, aquaculture was seen as an intelligent, ecologically responsible way to raise food. The three million acres of Puget Sound offered deep clean water and many protected coves for raising fish in floating enclosures.

Aquatic farms produced 790 million pounds of fish and other seafood last year, or nearly 10 percent of the 8.1 billion pounds of fish and seafood consumed in the United States, the Federal Department of Agriculture says. But the growth in the \$600 million aquaculture industry is slowing as Americans take a second look at the health attributes of fish.

Consumption Fell in '88

Last year, consumption of fish fell to about 15 pounds a person from 15.4 in 1987, the first decline since 1982. Experts attributed the drop largely to unease about ocean pollution.

But farmers and the South's catfish producers depend more than fish farmers here do on synthetic substances to control disease. Fungus, aquatic weeds and other threats to farm-raised fish thrive more readily in fresh water than in salt water, aquaculture specialists say. But the production practices in the other parts of the industry have not yet come under scrutiny as intense as salmon farmers now face in the well-populated Puget Sound area.

Though evidence is far from being clearly established, some biologists say antibiotics could be absorbed into shellfish and other organisms and make some bacteria resistant to the drugs.

Earlier this year, after a series of hearings by a House Merchant Marine and Fisheries subcommittee, the National Marine Fisheries Service began a study to develop new inspection procedures that would be modeled after existing systems that monitor for antibiotics in poultry, pork and beef. The study is scheduled to be completed in 1990.

of salmon, about equal to Washington's salmon harvest.

Maine's aquatic farms have also not been hampered by the intensity of the political conflicts of the industry in the Pacific Northwest. The northern Maine coast is less developed than the Puget Sound region, and many who live along the Maine coast make their living from the ocean.

"There is a highly vocal group of opponents who have argued for years that Puget Sound should not be developed for aquaculture," said Dr. Forster. "Now they are using the food safety issue as a point of argument."

The use of antibiotics worries some critics.

The real issue has always been aesthetic concerns about what should be the proper use of public waters.

Assurances From State

Since 1986, the State of Washington has set guidelines for establishing and managing fish farms and published a series of reports intended to answer questions and reduce anxieties. The reports provide evidence that fish farms properly situated in deep water with strong currents will not pose an environmental problem and have the potential to generate thousands of new jobs. The state's assurances have begun to persuade more counties and review panels to approve new fish farms.

Yet as the number of approvals increase, the dissent has also grown louder. And now critics are raising the safety of production practices to consumers as an important issue. The critics, led by Dr. Arthur H. Whiteley, a retired marine biologist from the University of Washington, assert that feed medicated with antibiotics is widely used on Washington State's 13 salmon farms to treat bacterial diseases.

Dr. Whiteley said that in some cases meat from fish treated with antibiotics may contain residues of the drugs, an assertion strenuously denied by salmon producers. In other cases, he said, antibiotics may be changing the genetic structure of aquatic bacteria infectious to other fish and to humans.

Critics Are Still Uneasy

It is well established scientifically that antibiotics fed to livestock and poultry cause bacteria to develop resistance to the drugs. The Federal Centers for Disease Control in Atlanta has traced some outbreaks of salmonella food poisoning in the Midwest to medicated cattle.

Three antibiotics are approved by the Food and Drug Administration for use on fish farms. The most commonly used is oxytetracycline. Fish farmers are required to stop using medicated feed weeks before salmon are sent to market, and residues are not present in the meat, said Dr. Forster and other industry executives.

But studies have shown that 90 percent of the antibiotics fed to fish are excreted in the feces. Last year researchers in Norway, the world's largest producer of farmed salmon, found that oxytetracycline persisted in the sediments below fish farms for months. Other studies have determined that aquatic bacteria developed resistance to the drugs.

Of particular concern to health specialists is the possibility that resistance to antibiotics could be transferred from bacteria that cause fish diseases to bacteria that cause illnesses in people. The most important of these is *Vibrio parahaemolyticus*, a bacterial strain known to cause severe digestive discomfort in people who have eaten infected shellfish.

In 1982, Japanese scientists showed that antibiotic resistance could be transferred to *Vibrio parahaemolyticus*, but the experiments were performed in very warm water. Kevin H. Amos, chief fish pathologist with the Washington State Department of Fisheries, said in an interview that *Vibrio parahaemolyticus* does not survive well in the cold waters of Puget Sound.

One of the most prolific of the Puget Sound area aquaculture farms is just outside of Port Angeles harbor where Sea Farm Washington built a four-acre salmon farm, one of the country's largest. Two 900-foot-long floating steel platforms are divided into 50-foot squares from which nylon nets are suspended to form pens 20 feet deep. Thousands of Atlantic salmon, a species more docile than the aggressive Pacific species, gleam in the clear, cold water like polished stones. This year, Sea Farm may sell more than 1 million pounds of salmon.

Dr. John Forster, who directs the Sea Farm operation here and is president of the Washington Fish Growers Association, a Seattle-based trade group, has worked for years to ease both technical and political problems. The Atlantic salmon, he said, has proved a delicate species in Pacific waters. Farms lose 40 percent of their fish, most of them when 15-month-old smolts, or young salmon, are transferred from freshwater hatcheries and put into saltwater net pens.

Washington's production problems are enabling Maine's aquatic farms to challenge Washington's for dominance in the domestic industry. The 7-year-old industry in Maine now numbers 18 to 20 farms, executives say. This year, Maine could produce 5 million pounds

New York Times

Alaska State Legislature



SENATOR
ARLISS STURGULEWSKI
Senate President Pro Tempore
Chairman, Senate Rules Committee

2957 SHELDON JACKSON STREET
ANCHORAGE, ALASKA 99508

While in Juneau
P.O. BOX V
JUNEAU, ALASKA 99811
(907) 465-3818

Senate

MEMORANDUM

March 14, 1989

TO: All Legislators

FROM: Senator Arliss Sturgulewski, Chairman
Senate Rules Committee

RE: Mariculture

Attached are two very informative articles on the issue of salmon farming. The first provides an overview of the Washington state experience written by Per O. Heggelund and published in the University of Washington Graduate School of Business magazine "Executive."

The second is a U.S. Department of State current status report regarding salmon aquaculture in Chile.

Attachments

Salmon Farming In Washington: The Issues and the Potential

by Per O. Heggelund



A marine salmon farm, simply stated, is a floating structure of from one to 20 individual netpens (cages) that is anchored relatively close to shore. Salmon farmers can control the freshness, size, flesh color, fat content, and market availability of their products. During the off-season of commercially harvested Pacific species, for example, Washington's salmon farmers continue to supply consumers with fresh fish.

The saltwater farming operation actually begins in freshwater. Farmers strip ready-to-spawn broodstock salmon of eggs and sperm in the fall and winter months. Once fertilized, the eggs are stored in trays, boxes, or baskets fitted with mesh and are constantly flushed with water as they develop. The time from fertilization to hatching takes roughly 60 days, although the process varies with each species and is particularly sensitive to water temperature. When fry, or fingerlings, reach the feeding stage, they are moved to troughs or starting tanks.

Rearing fry to the smolt stage, at which time the fish are capable of adapting to a marine environment, takes from four to 15 months. Smoltification changes a fish's body shape and physical coloration. Once salmon reach this stage, the two- to three-ounce fish are transported to saltwater netpens to begin the grow-out phase, during which time they are given a commercial diet for from nine months (for coho) to two years (for Atlantic salmon). The fish are typically fed 2 percent of their body weight per day; between one and a half and two pounds of

feed produce one pound of salmon.

Washington salmon farmers lose 50 percent, on average, of their salmon between the fertilization stage and the time when they can market fully developed fish. The common causes of loss are disease, predation, physiological maladjustment to seawater, escape from the netpens, stress, poor environmental conditions, and naturally occurring floating plants.

The Washington salmon farming industry is now at a crucial point in its development: the novelty of the process has worn off, farmers have been challenged by commercial fishermen and confronted by neighboring landowners, and the state's government has yet to commit itself to the support and promotion of the fledgling industry. At the same time, the demand for seafood continues to climb—both in the United States and the rest of the world.

Global Expansion

Salmon farming has experienced a remarkable global expansion in the last decade. The world production of salmon in netpens has increased more than tenfold, from 16 million pounds in 1980 to 215 million pounds in 1987. Industry projections for the next three years estimate that the amount of salmon raised in enclosures will burgeon to 490 million pounds. By 1990 the world production of farmed salmon will represent almost 25 percent of the total salmon harvest.

This increase in the production of farmed salmon has occurred during a period when traditional salmon fisheries hit an all-time



high. This worldwide peak in the wild catch was recorded in 1985, when 1.8 billion pounds of salmon were taken. Since that time, the harvest has dropped to 1.5 million pounds, and most experts predict further declines by the beginning of the next decade.

The increase in aquaculture has been attributed to a jump in the production of Atlantic salmon—152 million pounds of Atlantics were farmed in 1986, compared to 26 million pounds of Pacific salmon. By 1990, if current trends continue, it is possible that the world farmed production of Atlantic salmon will exceed 320 million pounds and that the Pacific salmon total will hit the 140-million-pound mark.

The Scope of the Industry in Washington

The state of Washington's environmental assets and existing infrastructure make it an ideal area in which to establish a salmon farming industry for both Pacific and Atlantic species. The environment's physical and climactic characteristics are similar to such successful salmon growing areas as Norway and Chile. Numerous coastal inlets, fjords, and embayments provide sheltered areas for floating salmon farms. Ocean temperatures, which vary from 43 degrees to 61 degrees Fahrenheit, are within the optimal temperature range for salmon culture, and Atlantic salmon, for example, can grow to more than 80 percent of their annual maximum attainable weight. The Washington Salmon Growers Association estimates that the Puget Sound's 870,000 surface acres are

© Per O. Heggelund

capable of supporting at least 300 acres of farms, which could generate \$225 million in revenue annually.

In addition to the state's geographical features, Washington's Department of Fisheries is noted for its salmon enhancement programs, and the region has well-developed academic, commercial, and scientific communities to support the salmon farming industry.

Atlantic salmon, Pacific salmon (chinook and coho), and Donaldson steelhead are grown in farms throughout the Puget Sound region. Pan-sized coho salmon weighing from one-half to three-quarters of a pound are produced in floating marine netpens or in freshwater ponds and raceways. Atlantic salmon, which were introduced from Eastern North America and Western Europe, are grown in netpens in the Puget Sound and are usually marketed in size lots of four to six pounds, six to nine pounds, and nine to 11 pounds per fish.

The largest producer of farmed salmon in the United States—and, perhaps, the world's most extensive salmon farm—is Domsea Farms, Inc., which operates at Clam Bay near Bremerton. Domsea, a subsidiary of Campbell Soup, produced 5.4 million pounds—58 percent of the state's salmon total—in 1987. There are 11 other commercial farms, which produced 4 million pounds of fish, in the Puget Sound, and applications for approximately 20 additional commercial farms are pending.

Looking for the Ideal Salmon

The ideal salmon probably doesn't exist, but researchers and growers have experimented with four different salmon species—coho, Atlantic, chinook, and Donaldson steelhead—to determine which is best suited for farming in the Puget Sound. The biology of salmon and trout is better understood than most other cultivated fish, and this

scientific and technical insight has been used to manipulate and advance the aquaculture of these species.

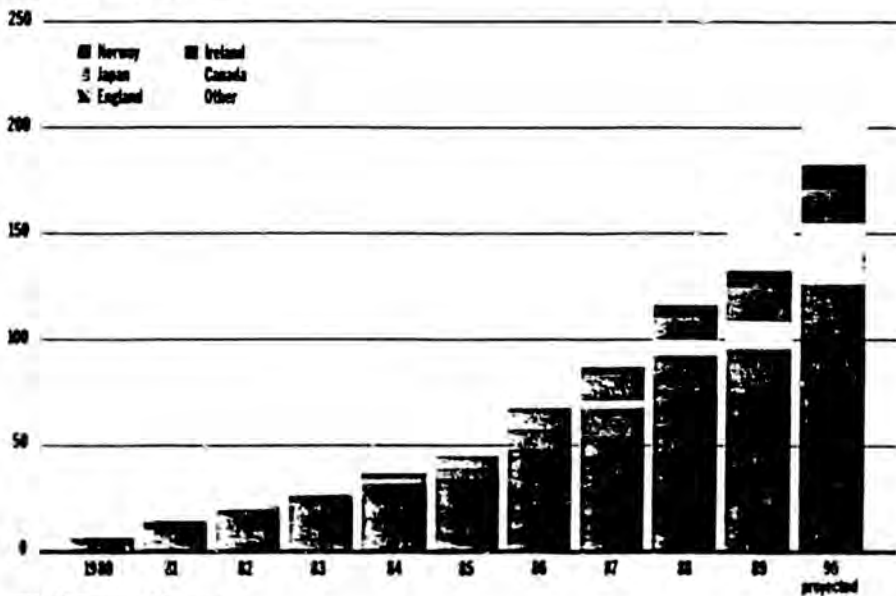
The prominent status of salmon farming in Washington, relative to other regions, is based on the state's long history of scientific research in this field. In 1960 the first salmon farming experiments occurred simultaneously at the Department of Commerce's National Marine Fisheries Services (NMFS) in Seattle and at the Bergen Aquarium in Norway. In fact, a strain of rainbow trout developed by Professor Lauren Donaldson of the University of Washington gave Norway's commercial salmon farming industry its start.

Coho Salmon. In the late 1960s, Domsea Farms, in conjunction with the National Marine Fisheries Services, conducted a feasibility study to investigate the production and marketing of pan-sized salmon that had been raised in saltwater netpens. By the

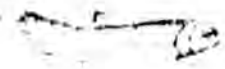
mid-1970s, Domsea Farms was joined by Pacific Ocean Farms, Mariculture N.W., and Aquasea. The Weyerhaeuser Corporation conducted its own feasibility study in Henderson Inlet near Olympia, and later purchased Oregon Aqua Foods, a large producer of pan-sized coho and a leader in the ocean ranching business. As the saltwater farming industry developed, the demand for coho smolt rose, and a number of small freshwater growers went into business.

Swecker Salmon Farm, located near Rochester, Washington, was one of the early leaders in freshwater smolt production; the operation began in 1974, with a contract to produce 200,000 half-ounce coho smolt. Today Dan and Debbie Swecker's annual production of coho totals 200,000 pounds of 7- to 12-ounce pan-sized salmon and 400,000 fingerlings and smolt. The Rochester area, known for its high-quality aquifer, is the site of three hatcheries, which produce smolt for

Farmed Salmon Production
in thousands metric tons



SOURCE: U.S. Department of Commerce



their own saltwater operations, and two other salmon farms that raise pan-sized salmon—Steelhammer Salmon Farms and Carlson Salmon Farms. The Rochester operations use circular ponds or tanks and pump ground water from local wells. Two other freshwater growers near Morton, Washington—Cascade Aqua Farms and Glenoma Trout Farms—divert stream water through manmade ponds to raise pan-sized salmon. Cascade, like most other salmon farms in Washington, has recently deemphasized its production of coho in favor of Atlantic salmon.

Atlantic Salmon. The National Marine Fisheries Service has selectively bred and domesticated Atlantic broodstock for more than 15 years. At the Manchester Research Station, which is headed by Conrad Mahnken, researchers have noted that Atlantics have a number of advantages over chinook and coho salmon. Mahnken reports that Atlantics grown in a netpen can weigh more than 20 pounds. Coho and chinook, however, are not likely to grow heavier than six pounds. Adult chinook can be afflicted by diseases that are foreign to Atlantics. The Atlantic salmon are tame, due to their long domesticated history, but the wilder chinook need deeper and wider netpens to mature. Both species are fed an identical diet, and they taste about the same. Given the Atlantic salmon's relative ease of farming and the similarity in taste, Mahnken comments, "Why farm peacocks, when you can farm chickens?" Most salmon farmers in the Puget Sound have taken that advice to heart.

The popularity of Atlantic salmon has a long legacy in the Pacific. Early in this century, biologists in British Columbia unsuccessfully introduced Atlantics in an effort to build additional wild salmon runs. Conrad Mahnken and his staff started farming Atlantic salmon in the Puget Sound in 1972, when the National Marine Fisheries Service began developing aquaculture. Mahnken ob-

tained his first Atlantic, a Canadian strain from the Gaspé Peninsula in the Gulf of St. Lawrence, from the Wizard Falls hatchery in Oregon. The Wizard Falls hatchery had been raising salmon in ponds since the 1950s and used them to improve sportfishing in the area.

Washington's salmon farms have obtained Atlantic eggs for their hatcheries from Mahnken's project and from other superior overseas broodstock. Scan Am, one of the first farms in the Puget Sound to emphasize Atlantic salmon, plans to produce 4.5 million pounds annually within the next two to three years, and Seafarms of Washington, located in the Port Angeles harbor, intends to harvest approximately 1.5 million pounds in the same time period. Global Aqua, the new owner of Domsea's netpens and a supplier of salmon smolt for local farms, has abandoned coho smolt production in favor of Atlantic salmon. Swecker Salmon Farm plans to increase its production of smolt to 800,000 by 1989.

Chinook Salmon. The popularity and success of Atlantic salmon farming in Washington has created a demand for Atlantic smolt that has, during the last few years, far surpassed the local supply. This scarcity has prompted Northwest farmers to experiment with raising local chinook stocks in netpens.

The initial reports from the Washington and British Columbia farms express cautious optimism. Canadian salmon farmers, who are restricted by federal and provincial regulations from importing Atlantic salmon seed stock, are particularly hopeful about the commercial applications of chinook. Washington farmers have found that chinook salmon are a better alternative than coho for aquaculture, especially if Atlantic smolt are in limited quantities and part of the farmer's grow-out facility is idle.

The chinook is far from domesticated, and these salmon must be raised in conditions that provide them with a greater volume of water per fish than the Atlantics require.

This drawback limits the number of chinook that can be raised per facility, because farms in Washington State are regulated as to the number of surface areas they can cover. In addition, salmon farmers typically sell chinook for 35 to 50 cents less per pound relative to Atlantics. Chinook are similarly priced with Donaldson steelhead.

Donaldson Steelhead. This steelhead is perhaps the first designer salmonid ever produced. The steelhead-rainbow trout hybrid has a genetic trail that leads back to Lauren Donaldson's superspawner, a fish named Susie, developed at the University of Washington. Donaldson produced his cross in the early 1960s, and fertilized eggs from the hybrid were exported to Scandinavia, where the steelhead has become an important contributor in the commercialization of the salmon farming industry, particularly in Finland.

Although the hybrid hasn't been fully commercialized in Washington, the Finns produced 30 million pounds of this species last year. In recent months, innovative Washington salmon farmers obtained permission to import Donaldson steelhead eggs from Finland. Dan Swecker of Swecker Salmon Farm has demonstrated that he can produce a Donaldson steelhead smolt in six months, which is less than half the time it takes to raise Atlantics to that same stage. In the Puget Sound, the steelhead has outperformed the predictions of the most optimistic experts, and the strain appears to be more disease resistant and faster growing than Atlantic salmon.

Markets and Competition

More than three decades ago, the oceans, we thought, contained an enormous untapped supply of seafood. Between 1950 and 1970, the world catch increased from 46 billion to 145 billion pounds, and per capita consumption grew from 19 to 39 pounds. The percentage of annual growth

in the total catch outpaced world population increases until 1970. From 1970 to 1985, the world's catch increased 29 percent, and population grew 33 percent. The Food and Agricultural Organization of the United Nations projects that global demand for aquatic species could reach 250 billion pounds by the end of the century, but production estimates for the same period total only 210 billion pounds. The seafood supply will need to grow at rates well above those of recent years to keep pace with anticipated increases in demand.

The global demand for seafood has important implications for U.S. markets. Consumer demand for seafood in the United States has grown steadily: between 1980 and 1986, per capita consumption rose from 13 to 15 pounds, an increase of almost 15 percent. The rise in consumption has been the result of increases in income, changing lifestyles, and a greater awareness of the health benefits of seafood.

America's growing appetite for seafood is satisfied by a combination of domestic sup-

plies and imports. As U.S. catches of groundfish, salmon, shrimp, lobster, and crab have approached or exceeded the species' maximum biological limits, seafood from foreign fisheries and aquaculture has been imported to meet the increase in consumption. The net result is a persistent seafood trade deficit that has grown from \$2.6 billion in 1980 to \$7.1 billion in 1987 and shows no sign of diminishing.

If the upward trend in seafood demand continues, the United States is going to need new sources for seafood in the 1990s. Based on recent projections by the Department of Agriculture, per capita seafood consumption will increase between 5 and 17 percent (above the 1986 base) by the century's end, boosting per capita consumption to between 16 and 18 pounds. In the last decade alone, U.S. imports of fresh farmed salmon rose from 1.6 million pounds (worth \$3.9 million) in 1980 to more than 28 million pounds (almost \$78 million) in 1986. The U.S. catch of salmon increased 60 percent between 1970 and 1986, but the quantity of salmon available for the domestic market actually declined. Salmon exports in those same 16 years jumped from 28 million pounds to 352 million pounds.

The world's leading salmon farming nations are Norway, the United Kingdom, and Japan. In 1986 these three countries produced approximately 90 percent of the world's farmed salmon. Norway's Atlantic salmon farms have shown the most dramatic growth—from 9 million pounds in 1980 to 100 million pounds in 1986—and that country's salmon farming industry accounts for 75 percent of the world's commercial production of Atlantic salmon.

The key to the short-term global production of salmon is Norway, which could farm as much as 220 million pounds of Atlantic salmon by 1990. The United Kingdom, too, has expanded its production and has superseded Japan as the second largest producer of farmed salmon. Other countries that are

rapidly expanding their pen-farmed salmon industries are Ireland, Iceland, the Faroe Islands, Canada, and Chile.

Chile and British Columbia, in the future, are most likely to become Washington's strongest competitors in the U.S. market. British Columbia's advantage lies in the province's positive investment climate for salmon farming, effective trade barriers that protect the fledgling industry, and the region's proximity to the U.S. market. Chile's competitive status is based on low operating costs and its location in the Southern Hemisphere, which adds six months to the fish's growth cycle before it matures. As a result, Chilean salmon can be harvested at an ideal time for a northern market.

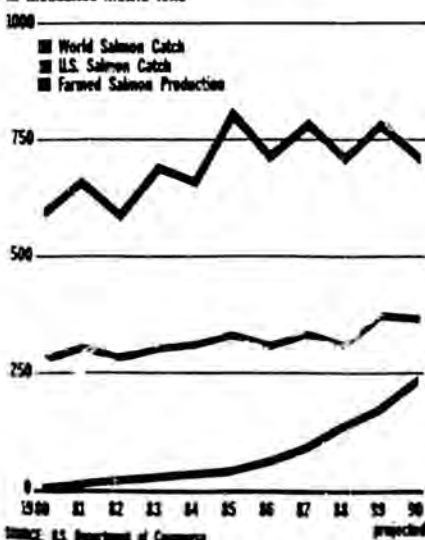
Chile's salmon farming industry has shown explosive growth in the 1980s: salmon farming was nonexistent five years ago, yet the industry will produce 18 million pounds in 1988-89. According to Chilean officials, the country now has 100 salmon farms and 25 hatcheries in operation, and these facilities represent an annual production capacity of 100 million pounds of salmon.

The country's geographic location makes it such a formidable competitor. Chile can produce a larger salmon in the off-season, and because of its proximity to the extensive anchovy resource off South America, local farmers have the advantage of low feed costs. In addition to these advantages and savings, Chilean labor costs are only 65 percent of those in North America and Europe.

Chile has the competitive advantage on the East Coast of the United States, and British Columbia holds the dominant position on the West Coast. In fact, when delivering to Western states, British Columbia can reduce its freight costs by 50 percent. These same delivery expenditures double for Chilean and European producers.

This competitive advantage has catalyzed the development of the British Columbia salmon farming industry, which parallels

Farmed salmon production, and U.S. and world salmon catch
in thousands metric tons





that of Chile in many respects. The Canadian industry was virtually unknown prior to the 1980s. Today, 125 farms and 30 hatcheries are operating commercially in the province, and these facilities have a projected capacity of 70 million pounds of salmon, which is destined in large part for the U.S. West Coast market. This market focus by the B.C. salmon farmers may eventually create conflict with Washington's developing industry.

Conflicts and Issues

In Washington, the salmon farming industry has been confronted by a number of conflicting interests and major issues. Pacific Coast salmon fishermen, for example, are deeply concerned about the effects of salmon farming on their industry. They see the continued development of netpen farms as a source of competition, both in domestic and foreign markets and in the state's waterways. In some instances, farms occupy the same physical space that fishermen once considered theirs. Fishermen have also criticized salmon farms for the environmental damage that results from the organic wastes produced by floating netpens, for the genetic deterioration of native fish that results from interaction with farmed salmon that have broken free of their netpens, and for the introduction of exotic diseases from nonnative species.

Neighboring landowners argue that the existence of floating salmon farms and their shoreline support structures reduce local property values. Netpens, the landowners maintain, increase the risk of environmental pollution and visually mar the pristine waterways of the Puget Sound. The upland owners, in coalition with local salmon fishermen, have effectively lobbied the Washington State Department of Natural Resources to delay or prevent the department from issuing salmon farm licenses. The lobbying effort, in some cases, has been so

thorough that local counties have issued moratoriums on salmon farms within their jurisdiction under the auspices of the Washington Shoreline Management Act.

In addition to these actions, salmon farmers in Washington face an increasing number of nontariff trade barriers. These restrictions stem from a multitude of inconsistent domestic and international regulations that govern the salmon industry. In general, the regulations have been created to protect and preserve the health and viability of marine species. Legislative inconsistencies, however, could pose a threat to the development of the state's salmon farming industry. The federal government, for example, lists salmon as the nation's principal commercial species, with a market value of \$600 million, yet, under the terms of the Lacey Act, defines the fish as an "injurious wildlife" species, a designation that typically restricts trade. State regulations make it particularly difficult to trade live salmon products between East Coast and West Coast states. In Canada, federal and provincial regulations prohibit the importation of live fry, smolt, and broodstock from Washington. British Columbia can, however, export these same products to Washington and does so on a regular basis.

Future Prospects

Although these conflicts are troublesome and evoke strong emotions, it is unlikely that they will completely stall the growth of the state's salmon farming industry. To minimize the conflicts, Governor Gardner announced a policy in 1987 to promote aquaculture and, at the same time, maintain Washington's environmental safeguards. The governor also directed state agencies to develop a more coordinated siting process and to reduce current controversies.

While the governor's policy statement is being implemented, the state's salmon farming industry gradually expands. By 1990 the

existing farms and the newcomers will harvest 25 million pounds, with a sale value of \$75 million. If some of the proposed new technology for fish farming is implemented, this industry estimate may even prove conservative.

At Westport, for example, one company is proposing to establish a land-based salmon farm that will pump seawater into its facility. This venture will eliminate some of the environmental and esthetic objections. Another new high-tech project is proposed for the offshore waters of the Strait of Juan de Fuca. In this unprotected waterway, Sea-farms of Washington has been permitted to install ocean netpens for salmon. These enclosures would be located so far offshore that conflicts with landowners would be minimized. Recreational and commercial fishermen, too, should be appeased by this venture's less controversial site.

At some point, however, the introduction of sophisticated technology offers only a marginal return, and salmon farming becomes uneconomical relative to the less technical operations that are based in Chile and British Columbia. Before that happens, Washington's political leadership should assert itself and avoid the narrow focus or half-solutions that have in the past been promoted by the state's regulatory agencies. The salmon farming industry needs a serious aquaculture development strategy based on a positive investment climate. In other states and nations, salmon farming has been successfully promoted and developed by the combined efforts of political and financial leaders. Such leadership could secure Washington's future as the world's foremost supplier of salmon. ■

Per O. Heggelund is the president of Aqua-Seed Corporation, which supplies seedstock to the aquaculture industry, and publisher of a quarterly industry newsletter. He received an M.Sc. in fisheries and an MBA from the University of Washington.



Pacific Northwest Executive is a publication of the University of Washington made possible by a grant from Seafirst Bank.

Publisher
Graduate School of
Business Administration
University of Washington
Alfred N. Page, Acting Dean

Executive Editor
Jeremiah J. Sullivan
Associate Professor
Business Communications

Research Director
Michael Rahm, Ph.D.

Editor
Connie Bourassa-Shaw

Research Assistant
Mary Macfarlane

Editorial Assistant
Steven Bryan Bieler

Art Director
Jane Rady
Weekly Typography &
Graphic Design

Color Separation
Color Service, Inc.

Printing
Craftsman Press



©1989 Pacific Northwest Executive

Pacific Northwest Executive is published four times a year in January, April, July, and October by the Graduate School of Business Administration, University of Washington. Permission is granted to quote, with credit.

Correspondence related to subscription or other business matters should be addressed to the Executive Editor, 336 Lewis Hall, DJ-10, University of Washington, Seattle, WA 98195, (206) 543-1819. We welcome requests for inclusion on our mailing list.

The purpose of *Pacific Northwest Executive* is to inform managers about economic, business, and public policy issues in the Pacific Northwest. The analyses, conclusions, and opinions expressed are those of the writers and not necessarily those of the University of Washington. Neither the University nor the financial sponsor of the magazine assumes responsibility for the views expressed, and publication does not necessarily imply endorsement.

Any advertisements found in this publication are solely the responsibility of the advertiser and are not to be considered an endorsement of the publisher, writers, editors, or sponsors of the publication.

PACIFIC NORTHWEST Executive

A Regional Business Publication of the University of Washington Funded by Seafirst Bank

VOLUME 5, NUMBER 1

JANUARY 1989

Salmon Farming In Washington: The Issues and the Potential 2

BY PER O. HEGGELUND

REGIONWATCH

► Economic Developments in the Pacific Northwest 7

► The Pacific Northwest Executive Stock Index 8

► Industrial Restructuring and Changing Patterns of Employment and Earnings in the Pacific Northwest 9

► PACIFIC NORTHWEST PERSONAL INCOME INDICATORS 12

► Forecasting the Effects of Alternative Tax Reform Measures on Washington 14

BY DAVID C. CLARK AND KATHLEEN S. MORSE

The West, Garbage, and the American Dream 19

BY W. ED WHITELAW, ERNEST G. NIEMI, AND TERRY MOORE

Entrepreneurs and the Washington Wine Industry: The Influence of Social and Strategic Networks 22

BY JOHN E. BUTLER AND GARY S. HANSEN

Cover photo by Richard G. Shaw

UNCLASSIFIED Department of State

INCOMING
TELEGRAM

PAGE 01 OF 03 SANTIAGO 09694 00 OF 05 232227Z
ACTION 055-09

3987

SANTIAGO 09694 00 OF 05 232227Z

99

INFO LOG-00 ADS-00 INR-07 CIAE-00 ER-00 DODE-00 ARA-00
JSAE-00 COME-00 L-03 LAB-04 DOTE-00 STR-17 IPVF-00
CG-00 FMC-02 JUSE-00 /042 V

-----305131 232230Z /61 67

R 231913Z DEC 88
FM AMEMBASSY SANTIAGO
TO SECSTATE WASHDC 9511

UNCLAS SANTIAGO 09694

E.O. 12356: N/A
TAGS: EFIS, CI
SUBJ: CURRENT STATUS OF CHILEAN SALMON INDUSTRY

1. SUMMARY: SALMON AQUACULTURE IN CHILE SHOWS THE FASTEST GROWTH OF ALL ECONOMIC ACTIVITIES, AVERAGING 60 PERCENT GROWTH IN VOLUME, ANNUALLY. THE SALMON AQUACULTURE INDUSTRY IS STILL AT ITS EARLY STAGES OF DEVELOPMENT. NEVERTHELESS, LAST SEASON'S EXPORTS REACHED 3,500 MT WORTH US\$20 MILLION. EXPERTS FORESEE THAT SALMON AQUACULTURE COULD GROW TO 25,000 MT BY 1990, EQUATING AT CURRENT PRICES TO MORE THAN US\$100 MILLION. TWO THOUSAND WORKERS AND PROFESSIONALS ARE CURRENTLY INVOLVED IN AQUACULTURE ACTIVITIES. UNEMPLOYMENT DECLINES WHERE SALMON PRODUCING ACTIVITY STARTS. LABOR IS GETTING SOME OF THE WEALTH GENERATED BY THE SALMON INDUSTRY AND WORKERS ARE BEING PAID ABOVE THE AVERAGE SALARY IN THE FISHING INDUSTRY. THE TENTH AND ELEVENTH REGION LOCATED BETWEEN THE SAME LATITUDE AS PHILADELPHIA AND MAINE'S BORDER WITH CANADA ARE FACING AN UNPRECEDENTED ECONOMIC BOOM: SERVICES ARE DEVELOPING AT A FAST PACE TO COPE WITH THE DEMAND GENERATED BY THE SALMON AQUACULTURE INDUSTRY. BANKING, COMMUNICATION, TRANSPORTATION, HOUSING AND SCHOOL SERVICES ARE ALL GROWING. THE EXPECTED FINAL EFFECT OF THIS GROWTH WILL BE AN INCORPORATION OF THESE CURRENTLY ISOLATED AREAS INTO THE MAINSTREAM OF THE CHILEAN ECONOMY.

2. BACKGROUND

-A) SALMON AQUACULTURE ECONOMICS: CHILE'S ECONOMY

HAS BEEN GROWING AT A POSITIVE RATE FOR THE LAST THREE YEARS--BETWEEN 5 TO 6 PERCENT PER ANNUM--AND THE SALMON AQUACULTURE INDUSTRY IS CONTRIBUTING TO THIS GROWTH, AVERAGING 60 PERCENT PER ANNUM IN VOLUME, RESULTING IN ONE OF THE FASTEST GROWING AREAS OF THE CHILEAN ECONOMY. CHILE DOES NOT HAVE A NATIVE SALMON POPULATION, SO ALL PRODUCTION COMES FROM NET PEN RAISED SALMON. INDUSTRIAL SALMON AQUACULTURE BEGAN ONLY SOME EIGHT YEARS AGO, HOWEVER, LAST SEASON (DECEMBER 1987 TO APRIL 1988) THE TOTAL HARVEST WAS 3,500 MT--WORTH SOME 20 MILLION DOLLARS IN EXPORTS--AS COMPARED TO EIGHT YEARS AGO WHEN THERE WERE NO SALMON TO EXPORT. EXPERTS AGREE THAT CHILE WILL PRODUCE NEARLY 25,000 MT BY 1990--WORTH 100 MILLION DOLLARS IN EXPORTS.

-B) SALMON SPECIES AND ITS MARKETS: CHILE'S SALMON INDUSTRY CULTIVATES PACIFIC AND ATLANTIC SALMON, BOTH ARE INTRODUCED SPECIES SINCE THERE ARE NO NATIVE SALMON SPECIES IN CHILE. THE INDUSTRY PRODUCTION IS ALL FOCUSED ON EXTERNAL MARKETS, WHERE THE U.S. AND JAPAN ARE CHILE'S LEADING BUYERS, WITH 70.8 PERCENT OF ALL CHILE'S SALMON EXPORTS. THE U.S. ALONE BOUGHT 45.6 PERCENT OF CHILE'S SALMON IN THE 1987/1988

SEASON.

-C) AQUACULTURE INDUSTRY: THE INDUSTRY IS LOCATED IN CHILOE (TENTH REGION) AND AYSEN (ELEVENTH REGION)--BETWEEN LATITUDE 42 AND 47 SOUTH, CORRESPONDING TO THE SAME LATITUDE OF PHILADELPHIA AND MAINE'S BORDER WITH CANADA. THE INDUSTRY IS CHARACTERIZED BY LARGE FIRMS--33 PERCENT OF THE PRODUCERS HAVE AN INSTALLED CAPACITY BETWEEN 300 AND 1,200 MT/YEAR--AND IN THE 1987/88 SEASON ONE FIRM ALONE EXPORTED ONE THIRD OF TOTAL SALMON EXPORTS. NEW FIRMS ENTERING THE INDUSTRY RANGE FROM THE SMALL TO THE VERY LARGE--THE FIRST BEING MAINLY LOCAL INVESTORS WHILE THE LATTER MOSTLY LARGE INTERNATIONAL SALMON AQUACULTURING COMPANIES--BRITISH, SCOTTISH, DANISH, NORWEGIAN, JAPANESE, US AND CANADIANS. AS FAR AS THE INDUSTRY'S FISH EGG SUPPLY IS CONCERNED, THE U.S. HAS AN IMPORTANT SHARE OF THE SUPPLIES IMPORTED BY CHILE FROM ABROAD--40 PERCENT OF FERTILIZED EGGS COME FROM THE U.S.--WHILE CANADA IS ANOTHER KEY SUPPLIER. SPECIALIZED MACHINERY AND EQUIPMENT COME MOSTLY FROM THE US AND EUROPE. JAPAN HAS NOT GAINED YET A NAME FOR AQUACULTURE EQUIPMENT.

-D) COMPARATIVE ADVANTAGES: THIS INDUSTRY HAS GROWN IN CHILE AS A CONSEQUENCE OF A PROPITIOUS CONFLUENCE OF: NATURAL CONDITIONS, UNPOLLUTED WATER IN THE SOUTHERNMOST REGIONS, ABUNDANT RAW MATERIAL TO FEED SALMON--FISH MEAL (CHILE IS THE LARGEST WORLD EXPORTER OF THIS FOODSTUFF), A FAVORABLE INVESTMENT CLIMATE, AND WELL TRAINED MANPOWER. THIS GROWTH IS OPENING NEW OPPORTUNITIES FOR PEOPLE FORMERLY PART OF A SUBSISTENCE ECONOMY COMPRISED OF AGRICULTURE AND FISHING ACTIVITIES. IN THESE REMOTE REGIONS ISOLATION IS FADING AWAY AS THE AQUACULTURE INDUSTRY HELPS IMPROVE COMMUNICATIONS.

-E) AN EXAMPLE OF THE GROWING INTEREST OF LOCAL AND FOREIGN COMPANIES: FUNDACION CHILE--A CHILEAN PRIVATE FOUNDATION FUNDED BY THE GOC AND ITT--ESTABLISHED "SALMONES ANTARTICA" (SA) AS A PILOT PROJECT FIRM TO DEMONSTRATE THE VIABILITY OF A SALMON INDUSTRY. SA STARTED IN 1980 A SALMON HATCHERY BY IMPORTING FERTILIZED SALMON EGGS FROM THE U.S.A. AND USING THEM ALONG WITH EXTENSIVE SALMON AQUACULTURE TECHNIQUES, I.E., OCEAN RANCHING. BUT LOW SALMON RETURNS AND THE LACK OF CLEAR LEGAL PROPERTY RIGHT RULES APPLICABLE TO THE RETURNING SALMON, MADE THIS COMPANY SWITCH IN 1983 TO INTENSIVE AQUACULTURE TECHNIQUES, I.E., NET PEN RAISING. HAVING THESE TWO TECHNOLOGIES TO DO RESEARCH, SA KEPT ADDING NEW ELEMENTS TO THEIR SYSTEM, MAKING IT A WHOLLY VERTICALLY INTEGRATED OPERATION, FROM FERTILIZED EGG PRODUCTION TO SPECIALIZED SALMON FOOD FORMULATION, TO PRODUCTION AND MARKETING. AS SA ADDED NEW AQUACULTURING AREAS--CHILOE, THEN AYSEN AND FINALLY MAGALLANES--THEY BEGAN DOING MARKETING RESEARCH, AND DEVELOPED THEIR OWN BRAND--GOURMET'S CHOICE--TO SELL FRESH, FROZEN OR SMOKED SALMON PRODUCTS. ALONG THIS PROCESS SA BUILT A SALMON FOOD PROCESSING PLANT--EXPERIMENTING AND RESEARCHING SALMON PROCESSING TECHNOLOGY--AND INSTALLED A FISH PROCESSING PLANT TO PRODUCE FRESH DRESSED AND FROZEN SALMON FOR EXPORTS. A SMALL PILOT PLANT TO PRODUCE SMOKED PRODUCTS WAS ALSO INSTALLED. AFTER FOUR YEARS OF HAVING STARTED THE INTENSIVE AQUACULTURE PRACTICE IN CHILE, SA BECAME THE LARGEST SALMON PRODUCER WITH A POTENTIAL TOTAL OUTPUT OF 1,500 MT OF SALMON PER ANNUM (CURRENTLY SA'S OUTPUT IS 30 PERCENT OF ITS POTENTIAL TOTAL OUTPUT). IN 1988, FUNDACION CHILE DECIDED TO SELL THE SA SALMON AQUACULTURE FACILITIES TO MEET THEIR MANDATE OF TRANSFERRING TECHNOLOGY AND EXPERTISE TO PRIVATE INDUSTRY. SA CHOSE CALDERON TO