

ALASKA LEGISLATURE SPECIAL COMMITTEE/SUBJECT FILE 8672
1907 SCOMM 75: MARICULTURE (FISH FARMING), 1987-1990

124

ALASKA BOARD OF FISHERIES & ALASKA BOARD OF GAME REGULATION PROPOSAL FORM

Box 3-2000, Juneau, Alaska 99802-2000

BOARD OF FISHERIES REGULATIONS

☒ Fishing Area Statewide

☐ Subsistence

☐ Personal Use

☐ Sport

☒ Commercial

JOINT BOARD REGULATIONS

☐ Advisory Committee

☐ Regional Council

☐ Rural

BOARD OF GAME REGULATIONS

Game Management Unit (GMU) _____

☐ Hunting

☐ Trapping

☐ Subsistence

☐ Other _____

☐ Resident

☐ Nonresident

Please answer all questions to the best of your ability. All the answers will be printed in the proposal packets along with the proposer's name (addresses and phone nos. will not be published). Use separate forms for each proposal.

1. Alaska Administrative Code Number 5 AAC

5 AAC 41.001

Regulation Book Page No. _____

2. What is the problem you would like the Board to address? When the Legislature addressed finfish farming in 1988, they said in a letter of intent, "for the period of the moratorium on finfish farming, the farming of finfish in a privately owned freshwater body with no outlet to state water should proceed." The letter of intent directs the Commissioner of Fish and Game to "work with prospective farmers and the Board of Fisheries to develop appropriate proposals to meet the goals of this legislation."

This proposal would address the subject.

3. What will happen if this problem is not solved? If the issue is not addressed, any individual currently farming in freshwater will be required to conclude their efforts. When the Legislature placed the moratorium on finfish farming, freshwater finfish farming was allowable at the discretion of the Board. Regulations regarding the transportation, possession and release of live fish have previously been adopted by the Board, and last year the regulations were amended by the department (under a delegation from the Board) to allow for shellfish farming.

4. What solution do you prefer? In other words, if the Board adopted your solution, what would the new regulation say? We propose that the Board amend regulation 5 AAC 41.001, sentence one to include "in conjunction with a commercial finfish farming operation in a privately owned freshwater body that has no outlet to state water." Furthermore, we propose that the Board then delegate to the department the authority to adopt appropriate regulations. Unless the Board directs otherwise, the following restrictions would be included in the regulations. A. Fish can only be held in a freshwater body that has no outlet to state water. B. No import of fish for these purposes will be allowed, including Atlantic salmon. C. Permits will be restricted (allowable species) to trout, sheefish, and arctic char. D. No finfish farming of Pacific or Atlantic salmon is allowed.

5. Solutions to difficult problems benefit some people and hurt others:

A. Who is likely to benefit if your solution is adopted? Those people interested in freshwater finfish farming.

B. Who is likely to suffer if your solution is adopted? Given the restrictions proposed in the regulations, we anticipate no adverse comments.

6. List any other solutions you considered and why you rejected them. N/A

RECEIVED
SEP 01 1988
BOARDS

Submitted By: Name Alaska Department of Fish and Game, FRED Division

Individual or Group

Address Box 3-2000 Juneau, Alaska

Zip Code 99802-2000 Phone 465-4160

Register __, __ 1989

FISH AND GAME

5 AAC 41.001

TITLE 5.

FISH AND GAME

CHAPTER 41.

TRANSPORTATION, POSSESSION, AND RELEASE OF LIVE FISH

ARTICLE 1.

SCOPE OF REGULATIONS

5 AAC 41.001 is amended to read:

5 AAC 41.001. APPLICATION OF THIS CHAPTER. The provisions of this chapter govern the transportation, possession, or release of live fish transplanted for or cultivated for human consumption or sport fishing purposes, or as part of an aquaculture program for scientific, educational or propagative purposes, the transportation and possession of shellfish for commercial purposes in conjunction with a shellfish farming operation or in conjunction with a commercial finfish farming operation on private property in a freshwater body that has not outlet to state water. Unless specifically provided, the provisions of this chapter do not apply to the cultivation of ornamental fish. Additionally, the provisions of this chapter do not apply to the transportation, possession, or release of fish taken for commercial, sport, or subsistence purposes. (In effect before 1988; am 4/10/88, Register 106, am __/__/89, Register)

Authority: AS 16.05.251(a)

5 AAC 41 is amended by adding a new article:

ARTICLE 5.

FRESHWATER FINFISH FARMING

Section

500. Applicability of Regulations

510. Permit Required

- 520. Freshwater Finfish Farming Permit Application
- 530. Authorized Species
- 540. Additional Information
- 550. Review and Determination
- 560. Inspection
- 570. Annual Report
- 600. Definitions

5 AAC 41.500. APPLICABILITY OF REGULATIONS. The provisions of 5 AAC 41.500--5 AAC 41.600 govern the permit application process for freshwater finfish farm permits, and establish guidelines and procedures regarding the operation of permitted freshwater finfish farms. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.510. PERMIT REQUIRED. A freshwater finfish farm permit, issued by the Commissioner, is required for the operation of a freshwater finfish farm. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.520. FRESHWATER FINFISH FARM PERMIT APPLICATION. An applicant must submit a freshwater finfish farm permit application to the Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development on a form approved by the Commissioner for purposes of complying with the application review and approval process established in these regulations. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.530. AUTHORIZED SPECIES. Allowable species to be propagated under a freshwater finfish farm permit are restricted

to coho salmon, trout, sheefish, and Arctic char. No finfish farming of Atlantic salmon is allowed. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.540. ADDITIONAL INFORMATION. If, after an application has been distributed to the department, and the department determines that information in the application is insufficient for an adequate evaluation of the proposed freshwater finfish farm, the department will request additional information from the applicant. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.550. REVIEW AND DETERMINATION. (a) The commissioner will review the recommendations resulting from the department's review of the application before rendering a decision on an application.

(b) Permits will be issued for a period of three years.

(c) If a permit holder fails to comply with the conditions and terms of the permit within a reasonable period after notification of noncompliance, the permit may be suspended or revoked by the commissioner.

(d) A permit may be cancelled, in whole or in part, if the permittee obtained it improperly through misrepresentation or error with respect to material fact.

(e) If the commissioner finds that the operation of the farm is affecting fisheries, wildlife, or habitat in an adverse manner, and the adverse effects are irreversible and cannot be mitigated sufficiently, the permit may be revoked.

(f) Permits may be renewed by submitting a request in writing to the commissioner. Renewal will be approved after a determination is made by the department that the terms and conditions of the original farm permit were complied with by the permittee in a reasonable manner. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.560. INSPECTION OF A FARM. A permittee shall allow inspection of the freshwater finfish farm by department inspectors at any time the farm is operating. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.570. ANNUAL REPORT. A person who holds a permit for a freshwater finfish farm shall submit an annual report no later than December 15 to the department. The annual report form shall be distributed to permit holders by the department. (Eff. / / , Reg.)

Authority: AS 16.05.251

5 AAC 41.600. DEFINITIONS. In 5 AAC 41.500--5 AAC 41.600

(1) "commissioner" means the commissioner of the Department of Fish and Game or his designee;

(2) "department" means the Alaska Department of Fish and Game;

(3) "farm" means a specific location where finfish are raised in captivity or under positive control as in a gravel pit, raceway, pond, or lake on private property for the purposes listed in 5 AAC 41.500--5 AAC 41.600.

(4) "freshwater body with no outlet to state water" means gravel pits, raceways, ponds, or lakes on private property with no

Register __, __, 1989

FISH AND GAME

5 AAC 41.600

connection to or possible communication with other waters of the state for the purposes listed in 5 AAC 41.500--5 AAC 41.600. (Eff. / / , Reg.)

Authority: AS 16.05.251

(11) "salmon stock" means a population of salmon of a single species identified with a specific water system or portion of a water system, which share a common spawning period;

(12) "special harvest area" means an area designated by the commissioner or the Board of Fisheries where hatchery returns are to be harvested by the hatchery operators, and, in some situations by the common property fishery; and

(13) "terminal harvest area" means an area designated by the commissioner, Board of Fisheries regulation, or department emergency order where hatchery returns have achieved a reasonable degree of segregation from naturally occurring stocks and may be harvested by the common property fishery without adverse effects. (Eff. 3/31/85, Register 93)

Authority: AS 16.05.020
AS 16.05.092

AS 16.10.375
AS 16.10.475

CHAPTER 41. TRANSPORTATION, POSSESSION, AND RELEASE OF LIVE FISH

Article

1. Scope of Regulations (5 AAC 41.001)
2. Permit System Established (5 AAC 41.005 — 5 AAC 41.060)
3. General Provisions (5 AAC 41.070 — 5 AAC 41.100)
4. Shellfish Farming (5 AAC 41.200 — 5 AAC 41.400)

Article 1. Scope of Regulations

Section

1. Application of this chapter

5 AAC 41.001. APPLICATION OF THIS CHAPTER. The provisions of this chapter govern the transportation, possession, or release of live fish transplanted for or cultivated for human consumption or sport fishing purposes, or as part of an aquaculture program for scientific, educational or propagative purposes, and the transportation and possession of shellfish for commercial purposes in conjunction with a shellfish farming operation. Unless specifically provided, the provisions of this chapter do not apply to the cultivation of ornamental fish. Additionally, the provisions of this chapter do not apply to the transportation, possession, or release of fish taken for commercial, sport, or subsistence purposes. (In effect before 1988; am 4/10/88, Register 106)

Authority: AS 16.05.251(a)

tory is incomplete or unavailable a brood stock inspection and certification pursuant to 5 AAC 41.020;

(6) isolation measures planned to control disease during transport, including a description of containers, water source, depuration measures, and plans for disinfection;

(7) a description of proposed egg-take methods;

(8) the source of water for rearing and proposed effluent discharge location;

(9) identification and status of native stocks in the area of taking, retention and release site, including a statement of expected interactions with other stocks in these areas;

(10) the method of transport or release and the expected date of transport or release;

(11) the purpose and expected benefits of the transport or release; and

(12) evaluation plans.

(b) A completed application must be submitted to the department regional office in the region in which the proposed transport or release will occur.

(c) If the commissioner or his authorized designee determines that an application is incomplete and that further information is necessary, the department will return the application to the applicant with a description of the deficient information.

(d) The commissioner or his authorized representative will approve, condition, or deny a permit within 45 days after a completed application containing all of the applicable information listed in (a) of this section has been received in the appropriate regional office. (In effect before 1982; am 7/25/82, Register 83)

Authority: AS 16.05.251(a)

5 AAC 41.020. INSPECTION FOR DISEASE OF BROOD STOCK. If the disease history of the brood stock is unavailable or incomplete as required by 5 AAC 41.010(a)(5), an inspection of the brood stock to detect fish disease must be scheduled by the applicant and conducted by the fish pathology section of the department, or by a person designated by the fish pathology section. The applicant must submit samples of the brood stock as directed by the fish pathology section for the purpose of inspection. The applicant will receive a certification from the fish pathology section upon successful completion of the inspection. (In effect before 1988)

Authority: AS 16.05.251(a)
AS 16.05.868

5 AAC 41.030. PERMIT ISSUANCE OR DENIAL. (a) The commissioner or his authorized designee will issue a fish transport permit

and release locations, methods of transport or release, quarantine and depuration requirements and procedures, disease inspections, disposal of wastes and effluents, timing of transportation and release, reporting requirements, and other measures necessary to achieve the purposes of 5 AAC 41. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.060. RETENTION OF PERMIT FOR INSPECTION. (a) After issuance a copy of the permit including any amendments must be retained by the permittee, and be made available upon request for inspection by a representative of the department, or a law enforcement officer of the Department of Public Safety.

(b) For the purposes of inspecting and monitoring compliance with the terms of the permit or the requirements of this chapter for the continued health and perpetuation of native, wild, or hatchery stocks of fish, each permittee shall give authorized representatives of the department, and law enforcement officers of the Department of Public Safety, free and unobstructed access at all times to permit sites. Each permittee shall give such assistance and furnish information the representative or law enforcement officer may reasonably require for monitoring and inspection. (In effect before 1988)

Authority: AS 16.05.251(a)

Article 3. General Provisions

Section

70. Prohibitions on imports and release of live fish

80. Reporting and control of fish diseases at egg-take sites, hatcheries, and rearing facilities

Section

90. Delegation of authority

100. Definitions

5 AAC 41.070. PROHIBITIONS ON IMPORTS AND RELEASE OF LIVE FISH. (a) Except as provided in (b) and (c) of this section, no person may import any live fish into the state for purposes of stocking or rearing in the waters of the state.

(b) Live oysters originating from locations other than Korea, the Gulf of Mexico, and the Atlantic Coast of North America, may be imported for aquaculture purposes and may be released into the waters of the state only pursuant to a permit required by this chapter. Live oysters native to and originating from Korea, the Gulf of Mexico, or the Atlantic Coast of North America may be imported for aquaculture purposes pursuant to a permit required by this chapter and released into the waters of the state only if

Infectious Hematopoietic Necrosis Virus (IHNV) — sockeye or chinook salmon kidney virus;

Herpesvirus salmonis — low-temperature virus;

Viral Erythrocytic Necrosis (VEN) — intranuclear virus of marine fish;

Vibrio parahemolyticus — vibriosis in fish and shellfish;

Aeromonas salmonicida — furunculosis;

Yersinia ruckeri — enteric redmouth disease;

Renibacterium salmoninarum — bacterial kidney disease (BKD);

Flexibacter columnaris — columnaris disease;

Henneguya — spp. — myxosporidian disease of fish and shellfish;

Labyrinthomyxa marina — fungal or haplosporidian disease of shellfish;

Minchinia nelsoni — a haplosporidian disease of shellfish; and

Ocenebra japonica — an oyster drill;

(3) Class III — Diseases of Concern.

Vibrio alginolyticus — vibriosis in fish and shellfish;

Vibrio anguillarum — vibriosis in fish and shellfish;

Aeromonas hydrophila — aeromonad septicemia;

Ichthyobodo — spp. — costiasis in fish and shellfish;

Hexamita — protozoan disease of salmonids and shellfish;

Trichodina — spp. — external fish parasite;

Diplostomum — spp. — eye fluke disease of fishes; and

Mytilicola orientalis — an endoparasitic copepod of shellfish.

(e) Diseases reported under (d) of this section, or found by inspection under (c) of this section, must be treated by taking steps acknowledged by the fish pathology section to be effective in eliminating the disease. Containers or facilities must be disinfected by the permittee in a manner directed or approved by the commissioner or his authorized designee. Presence of any of these diseases, or any other disease not previously observed in Alaska, may be cause for the commissioner or his authorized designee to prohibit stocking of the fish in new areas, and to quarantine the permittee's facility until disinfected.

(f) Stocks of fish in hatcheries or rearing facilities in which a Class I disease has been detected must be immediately destroyed by the permittee if the commissioner or his authorized designee determines that the disease is new to the area, the disease is a different strain of a disease than occurs locally, or if the disease poses a threat to the health and perpetuation of native, wild, or hatchery stocks of fish in the hatchery effluent watershed or the intended release location. In limited circumstances, the commissioner or his authorized designee may allow retention or transportation of these diseased fish under controlled conditions that pose no threat to native, wild, or hatchery stocks of fish (e.g. movement to a disease laboratory).

commissioner's designee, which has not been suspended, terminated, or expired;

(6) "permittee" means the holder of a permit and includes anyone employed, contracted, or assigned by the person to whom the permit was issued. (In effect before 1988)

Authority: AS 16.05.251(a)

Article 4. Shellfish Farming

Section	Section
200. Applicability of regulations	250. Permit conditions
210. Permit required	260. Inspection of a farm
220. Shellfish farm permit application	270. Annual report
230. Additional information	400. Definitions
240. Review and determination	

5 AAC 41.200. APPLICABILITY OF REGULATIONS. The provisions of 5 AAC 41.200 — 5 AAC 41.400 govern the permit application process for shellfish farm permits, and establish guidelines and procedures regarding the operation of permitted shellfish farms. (Eff. 4/10/88, Register 106)

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

5 AAC 41.210. PERMIT REQUIRED. A shellfish farm permit, issued by the commissioner, is required for the operation of a shellfish farm. (Eff. 4/10/88, Register 106)

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

5 AAC 41.220. SHELLFISH FARM PERMIT APPLICATION. An applicant must submit a consolidated shellfish farm permit application and coastal project questionnaire to the nearest office of the office of management and budget, division of governmental coordination for purpose of complying with the project consistency review of the Alaska Coastal Management Program as identified in 6 AAC 05.010 — 6 AAC 50.190. (Eff. 4/10/88, Register 106)

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

5 AAC 41.230. ADDITIONAL INFORMATION. If, after an application has been distributed to the department under 6 AAC 50, the department determines that information in the application is insufficient for an adequate evaluation of the proposed shellfish farm, the

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

5 AAC 41.270. ANNUAL REPORT. A person who holds a permit for a shellfish farm shall submit an annual report, no later than December 15, to the department. The annual report form must be distributed to permit holders by the department. (Eff. 4/10/88, Register 106)

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

5 AAC 41.400. DEFINITIONS. In 5 AAC 41.200 — 5 AAC 41.400

(1) "commissioner" means the commissioner of the Department of Fish and Game or the commissioner's designee;

(2) "department" means the Alaska Department of Fish and Game;

(3) "farm" means a specific location where shellfish are raised in captivity or under positive control, as in a pen, pond, raft, bottom culture, or an area of water completely enclosed by a generally escape-proof barrier;

(4) "shellfish" means any species of crustacean, mollusk, or other invertebrate, in any stage of its life cycle, found in or introduced into the state. (Eff. 4/10/88, Register 106)

Authority: AS 16.05.020 AS 16.05.251
AS 16.05.092 AS 16.05.340(b)

PART 2. SPORT FISHING AND PERSONAL USE FISHERY

Chapter

- 42. (Repealed)
- 45. (Repealed)
- 46. Southeast Alaska Area (5 AAC 46.001 — 5 AAC 46.060)
- 48. (Repealed)
- 49. Yakutat Area (5 AAC 49.001 — 5 AAC 49.060)
- 51. (Repealed)
- 52. Upper Copper River and Upper Susitna River Area (5 AAC 52.001 — 5 AAC 52.060)
- 54. (Repealed)
- 55. Prince William Sound Area (5 AAC 55.001 — 5 AAC 55.050)
- 56. Kenai Peninsula Area (5 AAC 56.001 — 5 AAC 56.060)
- 57. (Repealed)
- 58. Cook Inlet — Resurrection Bay Saltwater Area (5 AAC 58.001 — 5 AAC 58.050)
- 60. (Repealed)
- 61. Susitna-West Cook Inlet Area (5 AAC 61.001 — 5 AAC 61.050)
- 63. (Repealed)
- 64. Kodiak Area (5 AAC 64.001 — 5 AAC 64.050)
- 65. Alaska Peninsula and Aleutian Islands Area (5 AAC 65.001 — 5 AAC 65.050)
- 66. (Repealed)
- 67. Bristol Bay Area (5 AAC 67.001 — 5 AAC 67.055)



Senate Rules Committee

Senator Richard L. (Dick) Ellison, Chairman

3/1/88

Thorne Ferguson stopped
by re-raising coho/chinook
in salt water ponds on
private land. Evidently
Thorne travelled with you
to Washington with SEALASKA
They have property near
Hydaburg + appear to have
things really thought
through. Evidently the City



Senate Rules Committee

Senator Richard L. (Dick) Eliason, Chairman

(for its cannery)

of Hyda burg_n is interested
in purchasing excess
electricity that Thorne will
produce. They would like
to raise paw size coho.

349-6485- wk

243-6923- hm



Senate Rules Committee

Senator Richard I. (Dick) Eliason, Chairman

Dick

Thorne Ferguson received a corp of engineer permit, a DEC permit in May '86 for a lodge, barge, & dock facility. He has not applied for any permits for raising fish. When he made his original request, he was planning on building a resort & hatchery. Later



Senate Rules Committee

Senator Richard I. (Dick) Eliason, Chairman

Thorne Ferguson purchased a fish farm license from the Dept of Revenue 12/86 which expires 12/88 for \$200. This license is more like a business license + all ~~app~~ applicants receive license - no regulations of farm or activities.

Permits from DEC, DNR, + F+G would still be necessary

CORRECTION

**THIS DOCUMENT
HAS BEEN REPHOTOGRAPHED
TO ASSURE LEGIBILITY**



Senate Rules Committee

Senator Richard I. (Dick) Eliason, Chairman

Dick

Thorne Ferguson received a corp of engineer permit, a DEC permit in May '86 for a lodge, barge, & dock facility. He has not applied for any permits for raising fish. When he made his original request, he was planning on building a resort & hatchery. Later

the resort + hatchery
idea was dropped + the
application for lodge, barge,
+ dock proceeded.

If allowed to raise fish
he would need a corps permit
waste, H_2O discharge, water
rights, etc.



Senate Rules Committee

Senator Richard I. (Dick) Eliason, Chairman

Thorne Ferguson purchased
a fish farm license from
the Dept of Revenue 12/86 ✓
which expires 12/88 for \$200.

This license is more like
a business license + all ~~out~~
applicants receive license -
no regulations of farm
or activities.

Permits from DEC, DNR,
+ F+G would still be necessary

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

SOUTHEAST REGIONAL OFFICE DIVISION OF LAND AND WATER MANAGEMENT

STEVE COWPER, GOVERNOR

400 WILLOUGHBY AVENUE
SUITE 400
JUNEAU, ALASKA 99801-1000
PHONE: (907) 465-3400

March 23, 1990

Re: Thorne Ferguson

Honorable Richard I. Eliason
c/o Pouch V
Juneau, Alaska 99811

Dear Senator Eliason:

Research of our records indicates that T. Ferguson Construction, Inc. did purchase U.S. Mineral Survey 419B, known as the Maine, Monterey and San Francisco claims from Georgia-Pacific Corporation, (Warranty Deed, 1984). The property is located at Copper Harbor, Hetta Inlet, on the west side of Prince of Wales Island. In 1985 In 1985 Mr. Ferguson submitted applications intended to obtain approval of what appeared to be a multi-stage development. According to one of the cover letters, the initial stage of construction (development of a seasonal resort for hunting as well as fresh and salt water fishing) was intended to support the second stage (the development of a hatchery and fish farm); see ADL lease application 104488.

In September of 1987 the applicant indicated to DNR they had received a Army Corps of Engineers permit dated in June of 1986. Proposed construction under the Corps permit consisted of a lodge, barge ramp, and docks to be constructed in conjunction with the proposed private fish hatchery. The permit stated that the lodge and docks would supported by approximately 100 piles, and the barge ramp would consist of a timber crib bulkhead placed at M.L>L>W. and back-filled with approximately 1,800 cubic yards of shot rock fill (see Army Corps of Engineers Public Notice of Application for Permit Hetta Inlet 7, dated September 3, 1985).

However, contrary to the lease application and corps notices, a letter from the State Office of Management and Budget dated August 22, 1985 appears to indicate that the applicant dropped the hatchery portion of its proposal at that time. Mr. Menzies letter of June 2, 1986 appears to furnish the reason. The OMB consistency determination of May 9, 1986 purposely dropped consideration of the hatchery and hydroelectric plant.

A. Pekovich to Senator Eliason -2-

March 23, 1990

The 1986 Army Corps of Engineer Permit is the only document that appears to still imply a remaining interest in a hatchery. None of the State approvals, including Water Use Applications LAS 6089 and 6090 involve the hatchery proposal directly.

It appears clear from the file that the applicant was never assured of being able to develop a hatchery. That although it is something that he wanted to do, he decided to proceed with the lodge with no guarantees that he would be able to construct the hatchery. It is possible that the \$500,000 figure thrown around would include the \$370,000 initial purchase price.

Please let me know if there is anything else I can do.

Sincerely,



Andrew W. Pekovich
Regional Manager, SERO

CC: Larry Ostrovsky
Gary Gustafson
Janet Burleson

1-29-88 lag

FISH, GAME AND FUR FARM LICENSE CONTROL

LIC. NO.	DATE ISSUED	~~year~~	~~TYPE~~	LICENSEE NAME AND ADDRESS
166	11-30-84	1985-1986	Fish	Stephen E. Johnson 819 C St Juneau 99801
167	2-7-85	1985-86	Fish	Robt. m. me huck
168	void			
169	7-3-85	1985-86	Game	Kenneth K. - Wasilla
170	10-17-85	1985-86	Game	Robt. Iwait - Hope
171	12-19-85	1986-87	Fish	Dale Young - Juneau
1251	6-9-86	1986-87	Fish	Harry Nagamatsu - Anch
172	2-10-86	1986-87	Fish	Steve Ranney - Cordova
173	8/21/86	1986-87	Game	Jane Carter - Goldotna
174	12-22-86	1987-88	Fish	Thorne Ferguson - Anch.
175	1-30-87	1987-88	Fish	Robt Meyer Anch (meyers chuck)
176	1-30-87	1987-88	Game	Robt. Iwait - Hope
177	2-25-87	1987-88	Fish	Timothy Sirell - Anch.
178	void			
179	void			
180	5-21-87	1987-88	Fish	Stephen E Johnson - meyers chuck
181	7-13-87	87-88	Fish (*)	Andrew & Pamela Westcott - Hbx
182	11-5-87	1987-88	Game/Bird	Donald Mesimer - Sterling

(*) exempt from SB 297 per Mike Kaill - ADFG

No Fish Farm Licenses (Shell or finfish) have been applied for since 7-13-87.

L. Lockridge 4/29/88

Alaska Department of Revenue
Public Services Division
Fish & Game Licensing Section
1111 W. 5th St., Rm. # 108
Juneau, AK 99801

FISH OR GAME FARM
BIENNIAL LICENSE APPLICATION

For Department of Revenue Use Only
License #: _____
Issued by: _____
Place: _____
Date: _____, 19____

Fish or Game Farm Licenses are valid for two calendar years. The expiration date of each license is December 31 of the year following the year of issuance.

PLEASE MARK THE APPROPRIATE BOX BELOW:

FISH FARM LICENSE
\$ 200.00
Type of fish to be farmed: _____

GAME FARM LICENSE
Game Bird Farm \$ 20.00 ☐
Game Mammal or Reptile Farm \$200.00 ☐

Type of game to be farmed: _____

Applicants Name (First, Middle Initial, Last)		License Years		Applicant's Alaska Residency Status (Check One) (Please read definition of resident below.) ☐ Resident - 12 or more consecutive months of residency Alaska Resident Years Months ☐ Nonresident - Less than 12 consecutive months of residency.			
Mailing Address		Day time Telephone					
City, State, Zip Code		U.S. Citizen					
Physical Location of Residence (If same as mailing address, write "same".)		Birthdate (Month, Day, Year)					
Social Security Number	Weight (Lbs.)	Eye Color	Hair Color	Height FT. IN.	Sex	Physical Location of Farm:	

IMPORTANT: If you are applying for a license through the mail please allow 3 - 5 weeks for delivery.

I certify under penalty of perjury that to the best of my knowledge and belief the information on this application is true and correct.

X
Signature of Applicant _____ Date _____

Definition of Fish or Game Farming AS 16.05.940 (12) "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 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 which is completely enclosed by a generally escape-proof barrier.

Definition of Resident AS 16.05.940 (14) "resident" means a person who for 12 consecutive months has maintained a permanent place of abode in the state and who has continually maintained a voting residence in the state; and in the case of partnership, association, joint stock company, trust, or corporation, "resident" means one that has its main office or headquarters in the state; however, a member of the military service who has been stationed in the state for the preceding 12 consecutive months is a resident for the purposes of this chapter, and the dependent of a resident member of the military service, who has been living in the state for the preceding year is a resident for the purposes of this chapter, and a person who is an alien but who for one year has maintained a permanent place of abode in the state is a resident for the purposes of this chapter;

1200 E. 76th Ave. Suite 1222
Anchorage, Alaska 99518
(907) 349-6485

April 01, 1988

Senator Dick Eliason
P.O. Box V
Juneau, Alaska 99811

Dear Senator Eliason,

We were in support of Senator Eliason's 3/16/88 draft of Senate Bill 482 which would allow fish farming in upland salt water pens. We feel this is a fair compromise. Needless to say we are very disappointed in his 3/28/88 draft of this bill.

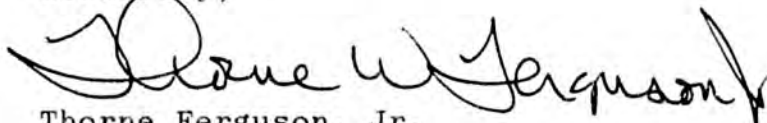
Salt water upland farms are economically and environmentally feasible. All of our upland fish farm discharge will meet or exceed Federal Clean Water Standards.

As we have previously stated, we have invested many years of time and effort in this project. The money invested is substantial and should this bill pass, as it is now written, we would suffer a substantial loss of both time and money.

We urge you to reconsider and include salt water upland fin fish farming in any bill dealing with mariculture.

If you would like additional information on our project please feel free to contact us.

Sincerely,


Thorne Ferguson, Jr.

1200 E 76th Ave. Suite 1222
Anchorage, AK 99518
(907) 349-6485

March 15, 1988

Senator Dick Eliason
Alaska State Senate
P.O. Box V
Juneau, AK 99811

Dear Senator Eliason:

We have been involved in the development of a fish farm since 1978. In 1982 we began the permitting process with the Alaska Department of Fish & Game and at their suggestion began a development of a land locked (upland) fish farm on private property. In December of 1986 we were issued a license. We have invested a significant amount of time and money in development of a viable commercial fish farm operation. If we were denied the opportunity to proceed with this venture now we would be more than disappointed.

In our first attempts to locate a suitable site we looked at an area in Washington Bay, which was owned by the U.S. Forest Service. As you can see from the enclosed letter, they were not at all encouraging.

It is our understanding that the only permit we need, once our tanks are installed, is a Fish Transport Permit.

We have reviewed proposed Senate Bill 482. If it is necessary for the bill to pass we would suggest the words "except for land locked saltwater pens" be added to the end of Sec. 16.40.100, paragraph (e).

Additional information regarding our efforts is enclosed for your use.

Thank you for your attention.

Sincerely yours,

Thorne W. Ferguson, Jr.
Thorne W. Ferguson, Jr. *by Jm*

Encl.

ALASKA STATE LEGISLATURE - SENATE

SENATOR RICHARD I. ELIASON

RULES COMMITTEE, CHAIRMAN
LABOR & COMMERCE COMMITTEE, VICE-CHAIRMAN
LEGISLATIVE COUNCIL
RESOURCES COMMITTEE
FISHERIES SUBCOMMITTEE, CHAIRMAN



P.O. BOX 143
SITKA, ALASKA 99835
P.O. BOX V
JUNEAU, ALASKA 99811
(907) 465-4916

MEMORANDUM

TO: Senator Dick Eliason

FROM: Sheila Peterson, staff
Senator Eliason's office *Sheila*

RE: Status of Permits

DATE: March 8, 1988

In response to your inquiry about whether or not Thorne Ferguson has obtain or has applied for the necessary permits to farm fish in saltwater tanks on Prince of Wales Island, I contacted Diane Mayer, Southeast Regional Office, Division of Governmental Coordination.

According to Diane's records, Thorne received permits from the Army Corps of Engineers and the Department of Environmental Conservation in May, 1986, for a lodge, barge, and dock facility. He has not applied for any permits necessary to begin raising fish in saltwater tanks.

When Thorne Ferguson made his original request, he was planning on building a resort and hatchery. During the permitting process, the resort and hatchery idea was dropped. The application for the lodge, barge and dock proceeded separately.

February 20, 1988

Our family began investigating the feasibility of fish farming in Southeast Alaska well over 10 years ago. All four family members are native Alaskans, born and raised in Southeast Alaska. We moved to the Anchorage area 12 years ago and soon after began a feasibility study. Three years ago we purchased a large parcel of land in Copper Harbor near Hydaburg on Prince of Wales Island specifically for developing a fish farm.

In 1986 we obtained a Corps of Engineer's permit for the waterfront construction and a Fish Farm License from the Department of Fish and Game, which expires at the end of 1988.

A good deal of the property was cleared in 1986 and 1987. We have invested well over \$500,000 in this venture.

Our operating plan is to raise salmon, and other fish, in upland tanks. Salt water will be withdrawn from the inlet as needed and all discharge water will be filtered and treated prior to discharge. The market for pen raised fresh salmon is largely in the off season when fresh caught natural salmon are not available in sufficient quantity.

Because we will have an upland farm, we believe that our operation does not present any threat to the salmon fishing industry. We urge you in this session of the legislature to either not extend the moratorium on fin fish farm permits or make a provision for several demonstration projects that are upland such as ours. Even though we have a fish farming license, we cannot commence operations without the other permits which are required such as a permit to appropriate water.

Our economic studies indicate that the development of a fish farm such as ours will actually bring economic benefit to the commercial fisherman through market development and broadening the amortization of the fresh fish handling and marketing infrastructure

Thank you.

Thorne W. Ferguson, Jr.
3321 Seppala Drive
Anchorage, Alaska 99517

STATE OF ALASKA
DEPARTMENT OF REVENUE - JUNEAU
FISH, GAME AND FUR-FARM LICENSE

No. 174 FISH FARM
EXPIRES DEC. 31, 1988

Thorne Ovi Ferguson, SR.
(NAME)

2455 Cratogeomys Ave.
(ADDRESS)

Anchorage, Alaska 99508
(CITY AND ZIP CODE)

Location of farm is licensed to possess, to capture, fish, game and fur-bearing animals legally acquired and to buy, sell and transport such animals during the year ending December 31, 1988, subject to the regulations of the Alaska Department of Fish and Game.

Issued at JUNEAU, Alaska 12/22/86

John H. Hedges
(ISSUING OFFICER)

[Signature]
(INVALID WITHOUT SIGNATURE OF LICENSEE)

NOTE

THIS LICENSE IS VALID ONLY IN ACCORDANCE WITH A PERMIT TO HOLD LIVE FISH OR GAME ISSUED TO THE LICENSEE BY THE COMMISSIONER OF THE DEPARTMENT OF FISH AND GAME.

Alaska Department of Revenue
Public Services Division
Fish & Game Licensing Section

1111 W. 8th. St., Rm. # 108
Juneau, AK 99801
Phone # (907) 465-2376

Dear Licensee:

Enclosed you will find your 1987 Fish and Game License. Please check the license to see that all of the information is correct. If not, please return it to our office so that we may make the necessary changes. Also, in order for this license to be valid it must be signed by you. If you have any further questions please contact us at the office shown above. Thank you. We hope you enjoy your visit to Alaska.

3430F

Chronology of Fish Farm Development Ferguson Family

T. Ferguson Construction is a small family owned and operated firm. All four family members are Alaskan Natives and were born and raised in Southeast Alaska.

1978 - 1979 Ferguson's interest in fish farming began in the summer of 1978 with the contraction of a fish weir at Auke Creek, Juneau, Alaska for the NOAA. We started to study the feasibility of raising salmon in upland ponds with help from the Northwest and Alaska Fisheries Center and study programs from the University of Washington.

1980 - 1981 A search for a site with the ideal condition to raise salmon was initiated. Several private individuals and public agencies were contacted to investigate the possibilities of leasing or purchasing their land holdings.

1982 - 1983 Family members visited and studied sites in Washington State, British Columbia, Canada, and Maui, Hawaii. In addition visits were made to government facilities in Washington State and British Columbia. Contacts were made with Jon Lindberg a noted consultant in the industry.

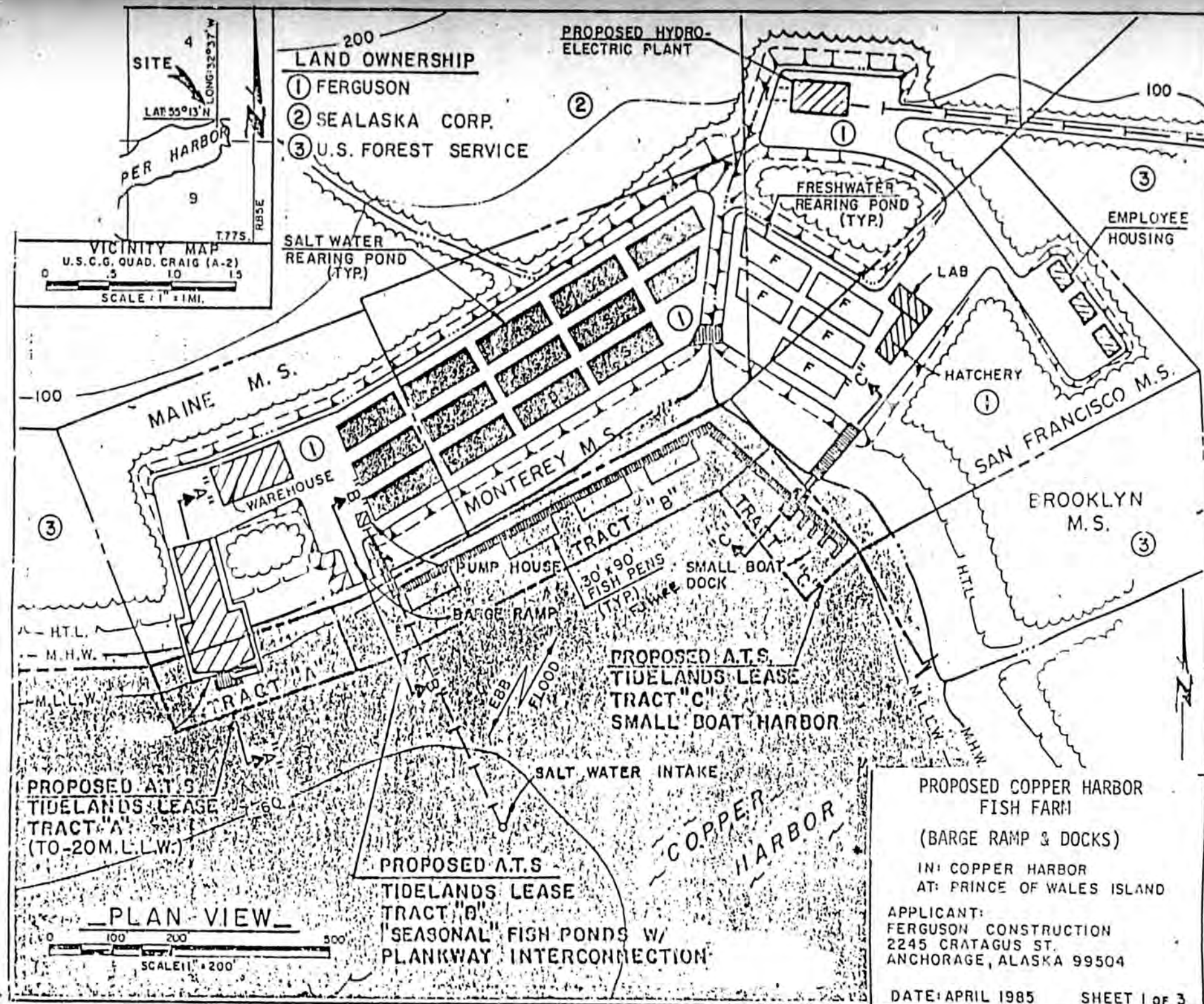
1984 Land was located for the proposed site on the west coast of Prince of Wales Island, in Copper Harbor. In December the land was secured with the help of the Farmers Home Administration under their Agriculture Loan Program.

1985 In the spring of this year surveying was begun and permits were applied for from the state and federal agencies as applicable. In addition clearing and leveling were begun. Visits to several sites in Washington State both private and public were conducted.

1986 Clearing and leveling was continued through the year and planning for the purchase of materials and equipment was begun. Permits applied for in previous years were granted and plans for docks and other tidelands activities were started. Attended a seminar in Seattle on fish farming put on by the Trade Commission of Norway.

1987 A Fish Farm License was acquired and plans to begin construction were made for the Spring of the following year. Negotiations for the acquisition of brood stock began. Attended a seminar in Juneau on fish farming hosted by the Trade Commission of Norway.

To date the Ferguson Family has invested 10 years and approximately \$500,000 in personal capital into this project in addition to the long term debt on the property. If the present legislation is passed without some provision for upland farming of salmon in salt water ponds on private land it will strike a crippling if not fatal blow to the family business and negate all the work and capital invested in the project.



JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME
OFFICE OF THE COMMISSIONER

P.O. BOX 3-2000
JUNEAU, ALASKA 99802
PHONE: (907) 465-4100

November 12, 1982

Mr. James L. McCormack
Project Manager, Ice Palace Farms
3321 Seppala Drive
Anchorage, Alaska 99503

Dear Mr. McCormack:

This letter is in response to yours of October 12, 1982, to Commissioner Skoog, regarding your interest in a commercial marine net-pen farm for coho salmon in Southeast Alaska. We are enclosing the \$100.00 check you submitted since we will be unable to issue a permit for your proposed operation.

In explanation, as stated in your letter, it is correct that State of Alaska law does not allow conduct of salmon ranching for a profit, only on a nonprofit basis. From the text of your letter, you appear to have received insufficient information about the legality of hatching and rearing stock coho for commercial purposes. The Alaska Department of Revenue does have available a Fish Farming License, which allows for the rearing of fingerlings, fry, or smolt to commercial marketing size, but this license does not allow the operator to incubate and hatch eggs. That can only be done in the private sector under a Private Nonprofit (PNP) Hatchery Permit, which cannot be secured for profit-making purposes. It would be for such a permit that a \$100.00 fee would be appropriate.

Functions under the fish farming license may only be conducted in a land-locked situation, so that would rule out net-pen rearing of coho in a bay, as is indicated in your proposal.

If you can define a land-locked location for fish farming and can determine a source of coho fry or smolt, it would be necessary for you to secure a Fish Transport Permit from Dave Daisy at the Anchorage Office, in order to assure that the source of stock is disease-free before you would be allowed to transport fish.

Finally, it would be necessary that you secure information on health inspection requirements for preparing for market and actual marketing of any fish produced. For information in that regard, please contact the following:

Alaska Department of Environmental Conservation
Anchorage Regional Office
P.O. Box 1328

Mr. McCormack

-2-

November 12, 1982

Anchorage Alaska 99510
Attn: George Hart
Telephone: 907-745-3236

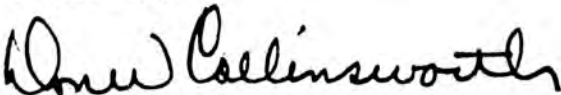
Also, I am enclosing for your use copies of application forms and background information for fish, game and/or fur farm licenses. The above references and enclosed information should give you the materials necessary to pursue a fish farm license, if you desire.

Should you have further questions, please contact me or Jerry L. Madden at the following address:

Alaska Department of Fish and Game
P.O. Box 3-2000
Juneau, Alaska 99802

Thank you for your interest in the Alaska salmon industry.

Sincerely,



Don W. Collinsworth
Deputy Commissioner
Resource Management

Enclosures

cc: Dave Daisy



United States
Department of
Agriculture

Forest
Service

Stikine Area, Tongass National Forest
Box 309, Petersburg, Alaska 99833

Reply to: 2720

Date: August 6, 1982

Mr. James L. McCormack
Project Manager
T. Ferguson Construction, Inc.
3321 Seppala Drive
Anchorage, AK 99503

Dear Mr. McCormack:

I have read your proposal for a net pen farm to be located in Washington Bay.

I will try to assist you by listing some of the things that must happen before your project can proceed as you have described it.

You must obtain approval from the Alaska Department of Fish and Game. We would follow their lead in this matter; therefore, this is the first step you must take. You need to obtain a State tidelands permit, a Corps of Engineer's permit, and a license or waiver from the Federal Energy Regulatory Commission; to mail application to the Forest Service for a special land use permit; and to prepare (or have prepared) an environmental assessment document to be approved by the Forest Service before a permit can be issued. Detailed engineering plans and drawings are also required by us and others. Unless you are one and the same, another party from Kake was also interested in developing a fish farm in Washington Bay. If this is the case, agreement between the parties would have to be reached before we could consider a permit application.

Twenty percent of the total project cost is not an unreasonable estimate of dollars needed to be spent just to get to the construction stage for a project of this type.

A fee is charged for the special use permit, payable each year. A decision would have to be made on whether or not to require a performance bond. Land on the National Forest is not available for sale.

You also must show that the National Forest is the only land suitable for your use. State and private land is available throughout southeast Alaska.

I am not trying to discourage you; I am simply trying to point out what we all must live with these days. Good luck.

Sincerely,



JOHN M. HUGHES
Forest Supervisor



**Alaska
Trollers
Association**

130 Seward St., No. 213
Juneau, Alaska 99801
(907) 586-9400

April 12, 1988

Members of the Senate Resources Committee:

During the April 7th meeting the committee discussed the possibility of separating the issues of finfish culture from that of vegetable and shellfish farming. Those of us in the audience also felt the frustration which Senator Fischer remarked upon when dealing with the present mariculture draft legislation and its many proposed amendments. The suggestion by both Senator Eliason and Senator Fischer that the two issues be separated, we feel, represents the best avenue for the formation of legislation which will adequately address the concerns of the fishing industry and the well-being of our state.

We find ourselves in the midst of a very complex issue with the potential for an even more complex piece of legislation. Due to the complexity of the current draft legislation there is great potential that seemingly small changes to the bill will inadvertently disrupt our existing seafood industry and the existing uses of our state lands.

An illustration of the complexities of the legislation is the single proposed amendment which would allow tank farms. As you will see, this issue further "muddies the waters" and makes it even more critical that legislation is drafted in as concise a manner as possible which will allow shellfish and vegetable culture the opportunity to develop in a manner which will benefit the state's citizens.

The following is a synopsis of our concerns regarding tank farms:

- 1) Allowing upland tank farms for salmon in salt water will not protect wild stocks from disease. Extremely expensive treatment facilities will be needed for the waste water to render it disease free. A 100 ton farm creates wastes equal to a city of 2,000 people, which is approximately the size of Homer or Kotzebue.
- 2) These operations are extremely capital intensive and to keep operating costs down employ few people (4-6 usually). These will not be small operations and this approach would definitely rule out mom and pop operations. For instance the Nanaimo tank farm in B.C., with projections of producing 1000 metric tons annually, and capital costs of \$7 million, will merely employ 5 people. Simply stated there are few Alaskan residents that can afford the capital required to buy the computers and machinery required to make these types of operations profitable. We also need to be aware that few U.S. banks loan money to fish farming operations so there is also the danger of foreign domination with relation to tank farms on our uplands.

- 3) Because of the high cost of these farms there will be greater pressures to import Atlantic salmon or to relax other biological protections once the capital investment is made and Pacific salmon fail (as projected) to develop adequately for economies of this scale. This is especially true if the price decline occurs with a glutted market as every forecast thus far has concluded.
- 4) Without statutorily established requirements for setbacks (1 mile?) from the shoreline, human error or mechanical failure, such as pump failure, will result in salmon escapement from these facilities into the marine environment or salmon spawning streams. These facilities will also cause major land use problems as they must consume acres of land for tanks and support facilities.
- 5) There will be large amounts of solid waste to be disposed of after water treatment which could lead to water quality problems. Siting will be a major concern to ensure that there is a way to dispose of the effluent. If sited in a municipality this could severely tax existing waste water treatment systems and/or increase costs to local governments. Outside municipalities these costs will also be substantial and there will be pressures to relax effluent treatment standards.
- 6) These facilities will use enormous amounts of water, both fresh and saltwater. A 200 ton production capacity farm requires 50 cubic feet of water per second, an amount equal to the amount of water the city of Eugene, Oregon uses. Water appropriations will be a big issue.
- 7) Also it may be possible, although unlikely, that under current regulatory structures (Section 1315 (b) of ANILCA which allows enhancement in wilderness) these types of smolt production facilities could be allowed in public wilderness areas.

It is our feeling that allowing upland tank farms will result in major problems for the protection of fish habitat, wild fish stocks, and the fishing industry.

Whew - that is complex! Don't you think that separation of salmon farming from vegetable and shellfish culture represents the best way to achieve consensus? If such separation occurs, fishermen would advocate the development of a reporting schedule by affected state agencies and resumed public debate regarding finfish farming in 4-6 years. In this way the legislature would be assured of not wasting taxpayers' dollars by rehashing presently existing data again within 3 months as proposed by one amendment, but would wait for new developments in the field which will only occur over a longer period of time. Furthermore, this would assure proponents of salmon farming we would revisit the issue.

We hope that you will take the above concerns into consideration in your deliberation on mariculture legislation.

KETCHIKAN DAILY NEWS * PIONEER PRINTING * MEMO

.....from the desk of Lew Williams, Jr.

3 July '80

Dick:

Happy Independence Day,
Don't you think you
should reverse your fish
ban a little for
people like Thorne
Ferguson and Bethie
Falconberg's Sonbom
trout farmer?

Lew

high in 1988. Now that prices are back down again, Pacifics may gain some of that market back. But I don't think anyone expects that wild Pacifics will ever regain the dominance they had before."

Japan is the top world market for salmon, though, and here Pacifics are king. Though 3,000-4,000 tons of farmed salmon were imported into Japan last year, they went to a specialty market that didn't compete with wild salmon.

Says Talley, "No matter how you inflate or deflate the numbers, wild still is the predominant category of salmon.

The problem is that farmed salmon compete directly against chinook and cohos, most of the pinks are canned, and in that segment there's probably more farmed salmon than wild. The competition is real. Even in the frozen markets, fresh farmed Atlantics still affect the prices just because they put parameters on prices in every market."

To gain an edge, fish farmers in Norway are developing value-added products that they will introduce to the U.S. market this fall. At recent food shows, several producers introduced skinless/boneless salmon fillets, ready-to-cook items, and other further-pro-

cessed salmon. But if producers of Alaskan wild salmon can keep up in the value-added market, they may have an advantage.

Atlantic salmon are fatter, have a shorter shelf-life and are likely to go bad quicker than Pacific salmon. That's an important market advantage for the wily wild salmon.

With prices down around producers' ankles, fish farms in British Columbia have proven to be less profitable than they'd hoped; several are on the verge of bankruptcy. "For right now, I don't think it makes any difference whether Alaska bans salmon farming or not. Anybody

Ban Leaves One Hopeful High & Dry

WHEN THE LEGISLATORS banned fish farming in Alaska, they didn't just close the door on an idea. They closed the door on 10 years of sweat and investment that Anchorage resident Thorne Ferguson spent following the state's instructions for setting up a fish farm.

"We're finished," he says. "We'll probably lose everything we own."

Ferguson and his wife, Carol, have invested \$800,000, including a Farmers Home Administration-backed loan, in an upland tank farm site on Prince of Wales Island in Southeast Alaska. On a spring morning five days after the fish farm ban was passed, the Ferguson's living room floor was awash with notebooks and file folders full of permits, letters, surveys and reports representing 10 years of effort.

They started looking in 1979 for the perfect fish farming site, a deep-water bay, a relatively remote site within easy transporting distance from a processing plant, hopefully with hydropower possibilities so power costs could be kept to a minimum. They found the spot in 1982, a turn-of-the-century copper mine near a deep harbor and good water. They purchased 340 acres.

Recalls Ferguson, "We applied for our first aquaculture license from the Department of Fish and Game in 1982. It was turned down because at the time we were asking for a net-pen permit. They recommended we go



Thorne and Carol Ferguson

can include ponds and runways with an impermeable liner to isolate the water supply.

The Fergusons cleared 15 acres and consulted with world experts on tank farms. Although they first planned to raise coho salmon, they switched to Arctic char when it became apparent that salmon farming probably would not be allowed.

"We've got a letter here from Don Collinsworth (the commissioner of Alaska Department of Fish and Game) when he was deputy commissioner, telling us how to go about getting a permit for what we tried to do," Ferguson said. "Fish and Game told us two \$200 permits that allowed us to raise the fish. But we never could get a transport license so we could get smolt to the site."

Ferguson's tanks would have been set 100 feet inland and 10 feet above the saltwater shoreline. His water system included five filtering stages that would have prevented his char from escaping into the sea.

Even through the difficulties of

water Arctic char. "It's been a long, hard struggle to end up with nothing," he said.

"Now that fish farming is banned altogether, our financing has pulled out. The bank has given us three months to sell the property."

The Fergusons held out hopes that the legislature might meet in special session in June, and would have time to consider upland tank farming as an exception to the fish farming ban. If tank farming was legalized this summer, Ferguson believed he could get his financing back.

"I can't understand the legislature doing this to us after all this hard work," he said. "They make exceptions for themselves, for the state to run hatchery programs, and then they shut us down. Salmon ranching is lots more potentially dangerous than tank farming, and yet they let it go." He believes the ban is a "political nature."

According to Thorne and Carol Ferguson, their char farm could have employed 30 to 40 people year-round if they packed their own product. If they'd shipped their fish to Hydaburg for processing, it could have kept one local processing plant busy all winter. Most salmon canneries now shut down in winter and only operate during salmon season.

"We've been working hard on this for a long time," Ferguson said. "I wish there was something we

Alaska State Legislature

PRESIDENT
907-465-3755

JAN FAIKS
POST OFFICE BOX V
JUNEAU, ALASKA 99811

Senate

March 9, 1988

MEMORANDUM

TO: Senator Dick Eliason, Chairman
Senate Rules Committee

FROM: Senator Jan Faiks
President of the Senate

SUBJECT: Senate Bill 482, Relating to Aquatic Farming

Recently I became aware the project which the Ferguson family is attempting to undertake on Prince of Wales Island near Hydaburg.

Specifically, the Ferguson family would like to construct a fish farm which would consist of upland tanks on private property. Because the tanks would need saltwater, the current wording of Senate Bill 482 would stop the project.

Many of the concerns which have been raised about finfish farming center around the issues of disease and escapement from floating pens. However, a fish farm such as this which would use upland tanks would avoid both of these problems by having all of the discharge water go through an extensive filtration system.

I will certainly continue to follow your lead on this issue. As the Senate Resources Committee works on SB 482, I would hope that you would consider amending the bill to allow for saltwater ponds on privately owned uplands.

Thank you for your consideration of this request. If I can provide you with any further information, please let me know.

OUT OF SESSION

6060 YUKON DRIVE ANCHORAGE ALASKA 99516 907-274-6611

ALLOWED

1. Farms
 - ° All shellfish
 - ° All finfish except Pacific salmon in saltwater
 - Cod
 - Halibut
 - Steelhead
 - Arctic char
 - Sheefish
 - Trout
 - Coho (freshwater)
 - Chinook (freshwater)
 - ° Sea vegetables
2. Hatcheries
 - ° Shellfish
 - ° Finfish

NOT ALLOWED

- ° Pacific salmon in saltwater
- ° Atlantic salmon

ALLOWED

1. Farms
 - ° Shellfish
 - ° Freshwater finfish in private ponds
 - Trout
 - Char
 - Sheefish
 - Coho
 - Chinook

NOT ALLOWED

1. Farms¹
 - ° Pacific salmon in saltwater
 - ° All other saltwater
 - Cod
 - Halibut
 - Char
 - Steelhead
 - ° Sea vegetables
2. Hatcheries (for-profit)
 - ° Shellfish
 - ° Finfish

¹Farms for some or all may be legal, subject to approval by Board of Fisheries
Court action could be expected depending on board action.

Questions for Dick Eliason to ask Brian Allee

- 1) Do you wish to comment on the Young brothers testimony that ocean ranching holds a greater threat than salmon farming to the wild stocks.
- 2) From your experience can you speculate on the size, needs, biological risks, and economics of a large tank farm verses an existing state hatchery to produce market size pacific salmon.
- 3) Do you see any danger to the protection of wild stocks if a tank farm industry is developed in the State, given the size and economics required to make such an operation profitable.

GENETICS:

We know fish escape from net pens: Geoff Meggs testified (and Bill Heard of NMFS backed this up) that one of the major farms in B.C. put a large number of fish in their farm - but when they went to harvest them, only 1/2 of them were left. Further, Norway has reported large numbers of farmed fish have been found in Norwegian streams mixed with wild fish, 26% in some cases. It needs to be pointed out that as the number of pens increase, a small percentage of escapements equals a lot of fish.

Genetic stocks chosen for ocean ranching have good wild stock survival traits - whereas, genetic stocks chosen for pen salmon farming are those good for animal husbandry - not wild survival; this is why Atlantic salmon are good in farms.

Private for Profit - When millions of dollars are invested it may well mean a loss of those strict regulations on genetics and disease. Rodger did not answer Senator Fischer's question on this issue.

(Question) If there is an erosion of the disease and genetics policy to accommodate salmon farmers who can't reach profitability under current strict regulations can you speculate on the dangers that such policy changes would have on Alaska's wild stocks.

Commercial fishermen

And why not raise salmon on a farm?

By CHRISTOPHER BATIN
Correspondent

Andy Wescott was ice fishing with his father-in-law at Quartz Lake last year for no special reason. The two frequently fished at Quartz, and would sit, fish and talk about a variety of subjects for hours. This particular day, talk turned toward catfish farming, and a documentary Wescott had seen earlier on the pen rearing of salmon.

During their discussions, they had caught several coho. Soon, talk turned toward the fish, which were chunky and full of spunk.

"We wondered over how a fish could stay in such good shape for so long under the ice," Wescott said. "Then the idea hit. Why couldn't I raise coho in a controlled environment, and sell them?"

Unlike other ideas, this one took hold. "For two weeks I couldn't sleep at night, the idea had me so excited," he said.

He started to investigate the possibility of starting his own salmon farm.

"Salmon farming deals with a high volume product with good profit potential," he said. "The Norwegians are selling fish all over the world, and lots of it. And during the winter months, Alaska spends millions of dollars in purchasing salmon from overseas farms. I figured, why spend it over there, when we can spend it here?"

But there was more to it than just salmon farming. Wescott also owns and operates Little Eldorado Gold Camp on the Elliott Highway, in addition to serving as vice president of the local chapter of the Alaska Visitors Association and board member of the Fairbanks Chamber of Commerce. Naturally he was curious if a coho farm would interest tourists, and help bolster the Fairbanks economy. He questioned tourists at his gold camp last summer.

"A coho farm was on the top of their list of things they'd want to see," he said.

According to Wescott, he has the first permit issued for a salmon farm in the state of Alaska. Since his is a pilot project, the recent moratorium on salmon farming doesn't affect him. "They were pretty much concerned with fish grown in ocean pens," he said.

"I had to wade through a lot of politics. Southeast fishermen were dead set against issuing me a permit whatsoever. Legislators argued that I'd be taking away from the fishermen's market. I agreed not to sell during their main harvest month, to calm their fears."

Officials with the Fish and Game Fisheries Rehabilitation and Enhancement Division (FRED) said they would provide a permit if the fish were raised in a closed system away from navigable streams or waters.

"They didn't want my fish to mix with wild stocks," Wescott said. "There's always the chance for transmission of disease."

He received his permit about a year ago and dove into the project immediately. The first step was to obtain stock. Yet, Wescott had no pens, no waterways, no hatchery. What he did have were ideas.

"I went down to the hatchery at Clear and spent three weeks helping them harvest eggs from salmon entering Wood Creek," he said. "The 655,000 eggs I harvested saved the hatchery considerable time and effort. I personally received hands-on knowledge in hatchery operation and procedures."

In exchange, Clear hatchery personnel offered to incubate the eggs and raise them. When hatchery trucks pull out this June to stock Tanana Valley lakes, they'll deliver to Wescott's Lakeview Terrace home 1,000 coho, about 2½ inches long, depositing them into two, 4,000-gallon tanks.

"The number of fish is small because this is a pilot project," he said. "If it's successful, I'm going to request one million fish next year."

At 44-cents a pound for fish food, feeding times could get mighty expensive. Wescott figured another way to cut the costs of feeding the fish, at least during the summer.

"If the operation gets large enough, we'll move either to my gold camp or another piece of property," he said. "Once there, I'm going to sell fish food to the tourists who visit, and they can pay to feed the fish. I'm excited about the possibilities. The state will also protect my project for two years by not issuing similar permits. It gives me a jump on the competition."

He said that in 14 to 16 months, the fish will weigh 3 to 5 pounds, and sell for \$1.50 more a pound than those from ocean-raised pens. Why the higher price?

"What I'm guaranteeing are pure salmon," he said. "There will be no antibiotics used, or fast-grow additives. Plus, I've eliminated the costs of air freight, and the fish are fresher."

He said there's a high demand for his product.

"I receive quite a few inquiries from local restaurants wanting to put live fish in glass tanks for their customers to see,



ANDY WESCOTT
A lot of politics

and to have the option of offering fresh fish. The same fish from overseas retail for about \$5 to \$9 a pound."

A Japanese firm has already approached him with buying the eyes for \$90 a pound. There's a good market for the salmon caviar also. He plans to sell fish that don't grow to expectations to a businessman who wants to start a pay-to-fish recreational fishing project.

He said he intends to make a profit from the fishes' waste products, too.

"The urea can be easily turned into good fertilizer," he said, "and the waste makes good plant food. It currently sells for about \$4.25 a pint."

Eventually, Wescott hopes to manufacture his own fish food from the waste the fish generate, mixing it with grain grown in the Delta area.

He said that once his operation is going full bore, he'll be employing 40 to 45 people, and that the farm will draw more tourists to the Fairbanks area.

"Tourists don't visit state-owned hatcheries because most of them are too much out of the way," he said.

Wescott doesn't believe fish farming is harming the commercial fishermen or hamstringing the economy. His operation is evidence that if his farm will do anything, it will enhance the economy.

"The Chamber of Commerce, Fairbanks Convention and Visitors Bureau, and Alaska Visitors Association have all helped me tremendously. They've provided an awful lot of good information," he said. "If it works out, we all stand to benefit."

He's looking forward to the June delivery of fish.

"The Chamber is planning a 'baby shower' to celebrate the 'delivery' of the little fish," he said. "We're excited."

much like farming in at

Tourism, fishing grounds may be affected.

Aquaculture, the cultivation of seafood, is a controversial concept in fisheries that could change the way Alaskan fishermen make their livings. This is the third part of a four-part series on the subject.

By CHRISTOPHER BATIN
Correspondent

Alaska is a state divided over the issue of fish farming: the raising of fish in made-made pens for sale to domestic and world markets.

According to commercial fisheries officials, Alaska boasts 90 percent of the U.S. salmon production and 43 percent of the world salmon production, excluding pen-reared salmon. Yet, farmed salmon is one of the most rapidly growing segments of the U.S. fish market. Pen-raised Atlantic salmon have increased dramatically, growing to more than 16 million pounds in just three years, at a net value of \$50 million.

But, commercial fishermen claim a fish-farming industry will cripple them, cause a glut of fish on world markets and provide an inferior product to the consumer.

"We've seen our market share for trolled fish from Alaska get smaller over the last seven years," said Barry Lester with the Alaska Troll Salmon Processors Association. "The foreign fish farmers are definitely making inroads."

Fishermen say pen-reared salmon will either be a "Mom and Pop" industry, with farms scattered up and down the coast, or the state will use its resources to develop a market for foreign investors to exploit and take some the profits.

Lester said the problem facing commercial fishermen is not just the loss of market and improving the quality and grading system of salmon.

"We don't want to tell people that farmed salmon swim in their own waste and are filled with chemicals against disease. We just want people to know the virtues of wild salmon," he said.

Kate Graham, executive director of United Fishermen of Alaska, said Alaska commercial fishermen strongly support the moratorium imposed on salmon farming in Alaska. "We're reaping the benefits of our non-profit hatchery system. It would be a real mistake to bring fish farms in here."

UFA represents 19 organizational members and about 12,000 commercial fishermen. The 22-member board of directors is concerned that when the moratorium prohibiting finfish farming expires in July, regulations won't be in place.

"If the moratorium expires, without clarification, farmers and entrepreneurs will automatically come in and start an

industry that has virtually no regulation. We want to make it (fish farming) illegal," Graham said. "The state would need to make a tremendous investment, in addition to what it's already made, if it hopes to see fish farming take off."

Alaska commercial fishermen list several reasons for being against fish farming. One is the disruption of traditional fishing grounds and anchorages. Depending on the location of the farms, waterfront properties could diminish.

It also could affect tourism, they say.

Also, opponents of fish farming claim fish feed and feces can collect on the ocean bottom under pens in layers a foot deep. Biologists say that a salmon farm of a few acres could generate as much feces and urine as a city of 4,000 people.

They also cite toxics. Last year, British Columbia's Ministry of the Environment discovered a substance called tributyltin, or TBT, in pen-reared salmon sold in U.S. seafood markets. TBT, with toxicity levels reached in as little as five parts per trillion, is commonly used in anti-fouling paint for boat bottoms, and is sometimes used to treat netting in salmon pens. European countries have banned the substance because of the damage it inflicts on the environment. Researchers have concluded that exposure to low doses of TBT may increase susceptibility of disease among salmon and other fish.

Among penned fish, the spread of bacterial disease is a gray area that needs more study. The use of antibiotics, especially oxytetracycline, would help control disease. Yet opponents to farming claim bacteria could develop a resistance to the antibiotic, and be harder to treat, especially if spread among wild fish stocks.

Also, after several cycles of pen rearing, they claim genetic alterations could occur and domestic pen-raised salmon could affect the gene pool of wild salmon stocks.

As for costs, "Fish farming is touted as an activity for small, coastal villages," Graham said. "The trouble is, the costs of operation are so high, that it'll be extremely difficult for a small family or village to meet everyday costs, let alone the cost of services offered by FRED (Fish and Game's Fisheries Rehabilitation Enhancement Division). Farmers want the state to wait until after they've made a profit to collect fees. That's two to three years after the start-up, and that's if they survive that long. Commercial fishermen have always had to take their costs and expenses right off the top. The state doesn't say we



don't have to pay our enhancement tax until we make a profit.

"The state should meet its current needs before creating a new industry," Graham said.

House Research Agency analyst Brad Pierce indicated that Alaska fishermen will face competition from farmed salmon whether or not fish come from Alaska farms.

"At the rate that worldwide production of farmed salmon is growing, domestic markets can be expected to become saturated in the intermediate (next five to 10 years) future. This means that there is a limited 'window of opportunity' for Alaska to enter salmon farming and gain a market share. If traditional fishermen in Alaska can learn from their counterparts in other countries and adopt some of the cooperative methods that have made others more competitive, then the greatest loss they suffer from farmed salmon may be some of their sense of autonomy and individual freedom."

"Fish farmers would have the public believe that they're not competition for us," Graham said. "You bet they'll be competition. But that's not the main reason we're fighting it. There are serious problems that need to be addressed that concern everyone, from the sport fisherman to the subsistence user to the man on the street."

"Alaska has the last great runs of wild salmon in the world. With the proper marketing, and additional help from the state, we need to continue extolling the wonders and virtues of Alaska wild salmon. We already have the resource. Let's use it."

In Alaska, commercial fishermen claim in-state salmon farming will seriously hurt Alaska's salmon market.

Salmon farmers disagree, saying the state's commercial salmon fishery supplies fish predominantly during the summer months. Fish farmers also claim that profits, timing of the salmon run and competition from other boats often are reasons why seine fishermen don't treat their fish with the care that premium salmon buyers require, which gives Alaska salmon a bad name.

(The exception is troll fishermen who fish year-round for kings and cohos and handle and process their fish individually. Both farmers and troll fishermen sell premium salmon to the same markets.)

Fish farmers say they produce carefully handled fish without bruises or blemishes, that are uniform in size, and that are fresh, not frozen, every day of the year.

Proponents of Alaska salmon farming say the state should cash in on the market before other nations take control. They claim the benefits to Alaska's economy are many and include market penetration and continuity of product during the winter when commercial salmon fishing is at a standstill.

Also, fish wastes and entrails can be remanufactured into fish food and fertilizers.

A variety of species are available in-state to reduce the risk of disease, they add. Prospective species for Alaska fish farmers are coho, chinook and steelhead. Arctic char might also be a possibility because of its red-orange flesh and high prices in the European market.

FRED's Mike Kaill said most fish farmers he's talked to are in favor of an industry that is self-supportive.

In regard to fears stressed by the commercial fishermen and environmental groups, he referred to Gov. Steve Cowper's eight-point policy on mariculture released in 1987. That paper stresses that mariculture must benefit Alaskans; must pay for itself and the state must get a fair return for its resources; must be done in an orderly fashion to develop a stable industry; must meet all federal and state requirements for health and sanitation; must be managed to protect plant and animal stocks; must be managed to ensure adequate environmental safeguards and habitat protection; must minimize land use conflicts; must allow for navigation and ensure access to upland areas; and stipulate that brood stock be carefully regulated when taken from limited entry fisheries.

Kaill said despite the restrictions, there's much interest in salmon farming from in-state and Outside investors.

"The type of farm will determine the type of investor you'll attract," he said. "Large farms will probably attract large, firms, perhaps from Outside. If the state wants to keep ownership in Alaska, with local people, the farms will probably be small."

Christopher Batin is an award-winning outdoor photojournalist and frequent contributor to the News-Miner's Outdoor Page.



Senate Rules Committee

Senator Richard L. (Dick) Eliason, Chairman

Tank farm -

- need massive \$
(not mom + pops)
- not really labor
intensive
- applies only to one
or two people in state
- BC allows tanks - but
they are big business -
probably not Canadians

Kodiak Mariculture Association

by Matt Dick

A little known fact is that Alaska has a fairly long history of mariculture, the art of farming organisms in the sea. Imported Japanese oysters were first planted in Alaska in 1910. The most successful area was near Ketchikan, where farming continued sporadically for 50 years, with annual harvests of up to 550 gallons of shucked meat in the mid 1940's. As late as 1961, the Alaska Oyster Company planted two million spat, or juvenile oysters, on 227 acres of tideland. Soon thereafter, effort and production of the few Alaskan oyster farms declined. The late 1970's and early 1980's saw a renewal of interest in oyster farming in South-eastern Alaska. Pioneered by John Church, Robin Larsson, Don Nicholson and others, the recent burst of activity has employed the more effective floating-tray method rather than bottom culture. In the early 1980's, the Alaskan Shellfish Grower's Association was formed in Wrangell, and it is currently active in promoting sea farming in the state. There are at least 20 oyster farms in various stages of development in Alaska, and several mussel farms. The renaissance of mariculture in Alaska has paralleled a worldwide trend of increased activity in the field.

By 1984, interest in mariculture had percolated to Kodiak. A number of individuals began, more or less independently, considering the potential for culturing oysters, mussels, scallops and seaweed in the Kodiak archipelago. In April 1986, a group of these people met to discuss formation of a Kodiak Chapter of the Alaska Shellfish Grower's Association. A second meeting was held in November of the same year. At that time, it was decided that an independent organization, the Kodiak Mariculture Association (KMA), would be formed. A President and Secretary-Treasurer were elected, and annual dues of \$20.00 per member were set.

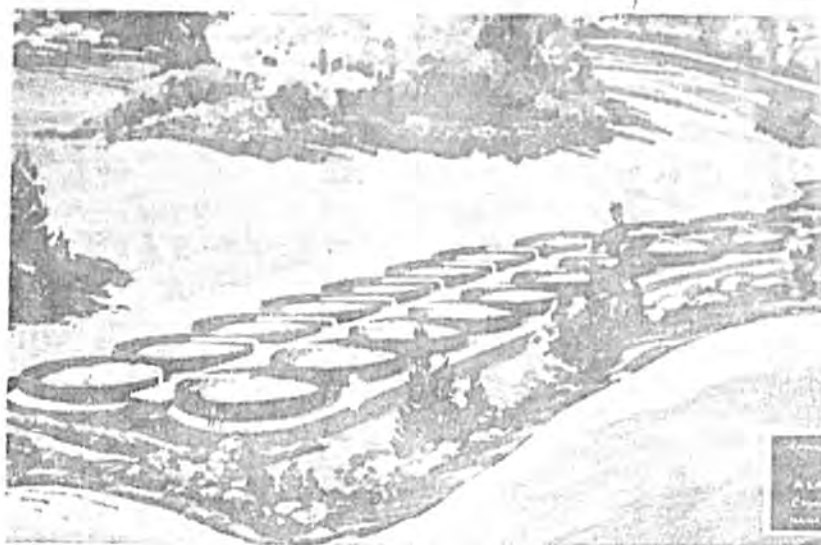
KMA holds four or five meetings a year, schedule so as to minimize conflicts with fishing seasons and community activities. The organization has several functions. Perhaps the main function is to make information on mariculture available to members and to the public. Every

meeting a presentation (approximately one hour in length) is given on some aspect of mariculture. Meetings are open to the public; however, only dues-paying members can vote in the business sessions.

A second function of KMA is to stimulate local mariculture development. One of the main activities in this regard has been an effort to establish a temporary "Aquaculture Park" in Trident Basin, near Kodiak. The Association has been negotiating with the City for access to about 7 acres of the basin. It will also obtain the necessary State and Corps of Engineers permits for use of a "tidelands" site. The park will be managed by the Association, and will provide the opportunity for local individuals interested in mariculture to experiment with farming various organisms, using various culture methods. Individuals can thus learn the techniques of mariculture in a suitable area close to town without having themselves to establish a site and go through the lengthy permitting process. People can conduct pilot studies before establishing their own commercial sites elsewhere. Several KMA members are presently rearing oysters and mussels on a pilot scale, prior to establishing commercial farms.

A third function of the Association is to keep track of legislation on the statewide level which pertains to mariculture. The group actively supported Senator Zharoff's Mariculture Bill during the last legislative session, and its members figured prominently in local debates on the bill. Although KMA is loosely affiliated with the Alaska Mariculture Association, the two are different organizations. For example, in December the Kodiak group sent a resolution to the Alaska Mariculture Association urging that any future mariculture legislation separate the issue of pen-rearing salmon, which is extremely controversial, from that of shellfish mariculture, which has been established in Alaska for nearly 80 years.

The Kodiak Mariculture Association presently has about 25 members. Officers are Bill Osborne (President) and Barbara Rudio (Secretary-Treasurer). For further information, contact Bill (486-5726), Barbara (486-8369) or Matt Dick (486-4161).



May 22 1977

Since land based salmon farming will now be allowed, should the size of the farm be restricted? Suggested 70 mt.

• Norwegian firm plans to produce 1,000 tons of salmon annually from a new land-based tank farm near Nanaimo. The project would not be permitted in Norway.

Nanaimo salmon tank farm would be illegal in Norway

Premier Bill Vander Zalm and Norwegian investors linked arms April 23 in Vancouver to announce the building of a massive fish tank farm near Nanaimo.

Using new technologies, Hagensborg Resources Ltd. will build a \$7 million land-based facility aimed at producing 1,000 tons of fish annually.

Ironically, the mere size of the farm would make it illegal in Norway where the government keeps farm sizes down to prevent corporate concentration.

"I have no knowledge about anything like this in Norway," said Norwegian Consul General Odvar Mosnesset. "This is a little surprising, it's so large."

Mosnesset also said the Norwegian government has placed restrictions on investment in farms because it wants "to have small firms instead of large companies coming in."

Unlike B.C., where farms are controlled more and more by large companies, Norway has seen many commercial fishermen get into fish farming because the commercial fishery was destroyed.

Hagensborg president Carsten Hagen said the government supported Norwegian fishermen getting into fish farming.

"You have a more socialistic government (in Norway) so they support fishermen," he said.

Hagen said the project would



• Premier Bill Vander Zalm was on hand to welcome Norwegian entrepreneur Carsten Hagen to B.C.

farm could not be built in Norway under the present laws.

The new mega-farm will rely on the public hatchery system to guarantee enough eggs to make the farm viable.

UFAWU secretary treasurer Bill Procopation said the new farm will dump 1.5 tons of waste into the ocean every day.

"This farm will cost \$7 million, create only 12 jobs and potentially pollute the ocean," Proco-

pation told the press conference the government supports the development of a strong aquaculture industry.

He described the aquaculture boom as a "super new industry" for B.C.

Procopation refuted Vander Zalm's claims, pointing out that the industry remains out of control and a potential threat to wild stocks.

He predicted the next step would be ocean ranching, where farmers release their fish to the ocean and harvest them when they return to spawn.

"That would be the final blow to a common property resource and result in the loss of millions of dollars annually to B.C. communities," he said.

Controversy surrounded the development of the farm when local residents opposed it because of the intrusion into a rural residential area.

The residents are also opposing the dumping of the sewage in Dods Narrows.

Questioned at the press conference, Hagens denied there was any pollution problem at all.

At the local Nanaimo Regional District director of planning John Magor said the company did not need local approval before proceeding. He said the area is zoned for fish farming, but cautioned no one imagined



• A former employee of a fish farm says his boss dumped thousands of pounds of diseased fish into the ocean. The DFO says there are no regulations that can stop a fish farmer from doing this. Above, a farmer has dumped his fish in the local dump.

DFO says no restrictions on dumping diseased fish

A former employee of a fish farm says his boss dumped 20,000 pounds of diseased fish into the ocean, a move DFO officials say is perfectly legal at this time.

The allegation is contained in a Dec. 10 letter from Serge Cote of Tofino to the DFO, and also alleges fish with disease and antibiotics were processed and sold to the public.

It's a charge Ron Ginetz, head of DFO's aquaculture department, says is probably true, but the department can't do anything about it at this time.

"The procedure is not something we condone, but there are no regulations in place to control that activity," he said. "We are in the process of developing regulations to prevent this."

Ginetz also revealed that no regulations exist at the present time to prevent the sale of farmed fish with antibiotics or other kinds of drugs in them to the public.

And the jurisdictional problems between the federal government and the

provincial government in Tofino to request the farmer stop the practice of disposing of dead fish in this manner.

In his letter Cote alleged on July 25 that Belcher Point Fish Farm processed 430 farmed salmon that were "showing high evidence of B.K.D. and Vibriosis infection."

"That fish coincidentally was under antibiotic treatment and with full knowledge of this, was sent onto the consumer market," he alleged.

Ginetz said the farming industry has asked members to hold fish for 40 days in a drug free state before sending them to market.

But he agreed the fish could go right onto the market without any check on the amount of antibiotics or other drugs contained in the fish.

"We're trying to create a standard but there hasn't been sufficient time to do this," he said. "We're all waiting for regulations and standards."

of inspection of domestic fish sales.

But Ginetz said the provincial government does not do much inspection since most fish is bound for foreign markets.

Safe levels of drugs in farmed fish must be set by the Health and Welfare department and then DFO would be in charge of enforcing them.

While Ginetz estimates the DFO is spending between \$2.5 million and \$3 million on aquaculture now, more will be needed to properly police the regulations.

"For the sake of the industry itself, in order to survive, it better clean up its act," he said.

The B.C. Salmon Farmers Association has sent out a bulletin advising farmers not to dump diseased fish into the ocean, Ginetz said.

New regulations to control dumping and the level of drugs are expected no sooner than May of '88. At that time



IS YOL
AR.

WE CAN SAVE
FUEL
WITHOUT DRAINING
WASTING CASH

(E.O.P.C.) THE FUEL

ROULSTON
Chartered Accountant

Offering personalized financial

- Unaudited and
- Fisheries tax
- Personal and
- Tax and estate
- Personal financial
- Financing programs
- Advisory services
- Venture Capital
- Aquaculture

Peter C. Roulston, B.A., C.A.
(604) 692-2239



SUZIE 1

Generators —

YOUR BEST ENGINE
SERVICE & PARTS

Phone us first for ALL your
and Transmissions

Repairs and exchange units on fuel
starters, injectors and alternators.
Choose reliable, fuel efficient Isuzu
power for your present and future.
Ask about the marine accessories
exchangers, mufflers, etc.

KLASSEN DIESEL

5660 Cedarbridge Way, Richmond

(604) 271-0777



North Pacific Fisheries Association, Inc.

HEADQUARTERS:

BOX 796 • HOMER ALASKA 99603

March 4, 1988

Senator Richard Eliason
Alaska State Legislature
Pouch V (MS311)
Juneau, AK 99811

Dear Senator Eliason:

This letter addresses Senate Bill No. 482.

NPFA supports the idea of allowing shellfish and aquatic plant mariculture to go forward. We feel that a major concern, the siting process, needs to be strengthened in the present bill. We suggest that Senator Jones' Bill 425 addresses these problems and we would appreciate the "Identification of Sites for Aquataic Farms and Hatcheries" portion of Bill 425 be included in SB 482.

We can support fin-fishing farming only in completely enclosed fresh water systems. A further concern is due to the major problems and unanswered questions about genetic pollution and disease in pen-farmed salmon. We would like to allow fin-fish farming to take place only under the conditions that the present moratorium allows. Our intent is to allow no fin-fish farming in bodies of water that have outlets to either the ocean or other fresh water systems in the State.

We support laws that would require fish farmers to prove to the State that they have proper disposal methods and equipment available. We would like additional language dealing with the problem of dumping diseased fish. The hatchery system in Alaska has only dealt with diseased eggs and smolts. Finding ways to dispose of tons of diseased four to eight pound fish is another matter all together and has developed into a major problem in Canada. The experience in British Columbia has shown that the disposed diseased fish have occasionally been disposed of in the ocean, and on a regular basis have been thrown into open landfills. We would like ADF&G to address the proper disposal of large quantities of diseased fish and require the fish farmers to submit a contingency plan when they are issued permit.

We would support an amendment to this Bill that would limit the quantity of fin-fish that a single farm could

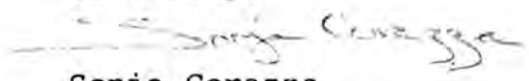
+ 50

large corporations. Individual businessmen and communities are then targeted to benefit by the industry. This is not government interference. Alaska has always restricted salmon entry permit holders to fish in only one area. A salmon boat may not fish in two areas. This law has kept the salmon fishery in the hands of the maximum number of individuals and has succeeded in allowing coastal communities to benefit from the resource.

You may be aware that the Kodiak Mariculture Association supports a split mariculture bill? I include for you their article from the latest edition of The Kodiak Fisherman. The last paragraph of the article addressed this bill. Also I include some articles that address problems of diseased drug-filled fish being put on the consumer market with photos of improperly disposed fish.

We appreciate your efforts to write legislation that will safeguard Alaska's wild salmon and ecosystem while also allowing mariculture to exist in Alaska. We recognize what a major step for our coastlines this legislation represents and if NPFA can be of any help to you in the future, please contact us.

Sincerely,



Sonja Corazza
NPFA UFA Delegate and Secretary

SCOMM

75:31

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

Cost of Production Model For Pen-Rearing of Salmon in Alaska and Currently Producing Regions

Final Report

**State of Alaska
Department of Commerce and Economic Development
Division of Business Development**

SCOMM

75.32

This is the EIS report
done by Washington.

One side says "fish-farming
OK"

Other side says report shows
"there are lots of concerns"

J

Draft Programmatic
Environmental Impact Statement

Fish Culture in Floating Net Pens

Washington Department of Fisheries

Technical Appendices

January 1989

Draft Programmatic
Environmental Impact Statement

Fish Culture in Floating Net Pens

Washington Department of Fisheries

Technical Appendices

January 1989

APPENDIX A

Assessment and Prediction of the Effects of Salmon Net-Pen Culture
on the Benthic Community

TABLE OF CONTENTS

- A. Assessment and Prediction of the Effects of Salmon Net-Pen Culture on the Benthic Community
- B. Modeling of Particulate Deposition Under Salmon Net-Pens
- C. Phytoplankton and Nutrient Studies Near Salmon Net-Pens at Squaxin Island, Washington
- D. Infectious Diseases of Salmon in the Pacific Northwest
- E. The Economics of Salmon Farming
- F. Permits That May Be Required for Aquaculture Projects

NOTE: Appendices A and E were completed under separate contracts with the Department of Fisheries.

CORRECTION

**THIS DOCUMENT
HAS BEEN REPHOTOGRAPHED
TO ASSURE LEGIBILITY**

CORRECTION

**THIS DOCUMENT
HAS BEEN REPHOTOGRAPHED
TO ASSURE LEGIBILITY**

APPENDIX A

**Assessment and Prediction of the Effects of Salmon Net-Pen Culture
on the Benthic Community**

TABLE OF CONTENTS

- A. Assessment and Prediction of the Effects of Salmon Net-Pen Culture on the Benthic Community
- B. Modeling of Particulate Deposition Under Salmon Net-Pens
- C. Phytoplankton and Nutrient Studies Near Salmon Net-Pens at Squaxin Island, Washington
- D. Infectious Diseases of Salmon in the Pacific Northwest
- E. The Economics of Salmon Farming
- F. Permits That May Be Required for Aquaculture Projects

NOTE: Appendices A and E were completed under separate contracts with the Department of Fisheries.

ASSESSMENT AND PREDICTION OF THE EFFECTS OF
SALMON NET-PEN CULTURE ON THE BENTHIC ENVIRONMENT

by

Donald P. Weston, Ph.D.

School of Oceanography, WB-10
University of Washington
Seattle, WA 98195

and

Richard J. Gowen, Ph.D.

Scottish Marine Biological Association
Dunstaffnage Marine Research Laboratory
PO Box 3
Oban, Argyll PA34 4AD
Scotland

Prepared for:

Washington Department of Fisheries

November, 1988

TABLE OF CONTENTS

Acknowledgements	iii
Abstract	iv
INTRODUCTION	2
MATERIALS AND METHODS.	4
RESULTS	
Clam Bay site	10
Squaxin Island site	27
DISCUSSION	
Clam Bay site	48
Squaxin Island site	49
Assessment techniques	50
Model evaluation.	51
LITERATURE CITED	60

ACKNOWLEDGMENTS

The authors appreciate the assistance of many individuals and organizations for providing information or logistical support essential to completion of this project:

- o The farm operators provided feed rate and production information required for the analyses. The Squaxin Island Tribe was particularly helpful by providing boats and operators on several occasions. This work would not have been possible without the cooperation and assistance of tribal staff.
- o The National Marine Fisheries Service assisted these studies by providing boats for use in Clam Bay.
- o The collection of samples in Clam Bay was made possible by the help of Mr. Dwayne Karna, Mr. Dave Terpening and other members of the EPA Region 10 dive team.
- o The Washington Department of Fisheries provided patrol boats for deployment and recovery of current meters.
- o The prompt analytical services provided by Dr. Donald McLusky of the University of Stirling are much appreciated.
- o Finally, we are grateful to Mr. Ron Westley and Mr. Eric Hurlburt of the Washington Department of Fisheries for their support, patience and review of the draft report.

ABSTRACT

Sediment chemistry and macrofaunal communities were examined in the vicinity of two salmon mariculture facilities in Puget Sound. The Clam Bay farm is a relatively large operation containing 200 to 400 tons of salmon, and has been in operation for about 13 years. Deposition of feed and feces beneath the pens has created an area characterized by high levels of organic carbon and nitrogen and depressed sediment reduction-oxidation potentials. This area extends under the pens and out to a distance of 15 to 60 m from the farm perimeter. The macrofaunal community shows dramatic alterations in this area including the disappearance of most species characteristic of the natural community and high abundances of nematodes and an opportunistic polychaete. More moderate changes in the infaunal community extend at least 150 m from the farm.

The Squaxin Island farm is a comparatively small facility (20 to 40 tons of fish on site) and has been operating only since early 1987. Unlike the Clam Bay site, there was little effect of the farm on sediment chemistry, even directly under the pens. The infaunal community shows evidence of disturbance in an area extending from the pen perimeter out to a distance of 6 m. Within this zone the community appears to have been undergoing gradual change over the 18 months of farm operation.

On the basis of these investigations, macrofaunal community composition appears to be a more sensitive indicator of benthic impacts than measurement of sediment chemical parameters alone. Among the sediment parameters evaluated, redox potential appears to be a valuable tool for rapid and cost-effective impact assessment, at least in coarse-grained sediments.

A model which predicts dispersion of feed and feces from a farm site was tested for agreement with actual conditions at the Clam Bay and Squaxin sites. The model was found to be reliable to within a factor of two or less in predicting the magnitude of organic loading to the seafloor. At the Clam Bay site and, to a lesser extent, at Squaxin Island the areas which the model predicted to receive the greatest input of feed and feces were the same areas showing the highest degree of sediment enrichment. On a broader scale, the model appeared reliable in identifying the areal extent of impact from net-pen culture. After tests at eight farms the model has predicted enhanced carbon fluxes up to 70 m (and usually less than 30 m) from the pen perimeter. These predictions are consistent with the results from this study and other investigations. The model is useful in identifying sites that would be clearly unsuitable for culture or others where environmental impacts are likely to be negligible. There are, however both inherent unknowns and oversimplifying assumptions in the model, which should be recognized to avoid indiscriminant application of the

model and misinterpretation of the results. The data base of current velocity and direction on which model predictions are based is rarely, if ever, available for siting decisions, but would be valuable both to environmental managers and farm operators.

**ASSESSMENT AND PREDICTION OF THE EFFECTS OF
SALMON NET-PEN CULTURE ON THE BENTHIC ENVIRONMENT**

INTRODUCTION

Cultivation of salmon in estuaries and coastal embayments generates substantial quantities of particulate organic wastes consisting principally of feces and uningested feed. It has been estimated that the production of 1 kg of salmon generates 0.5 to 0.7 kg of particulate waste (Weston, 1986; Gowen and Bradbury, 1987). For large farms, which produce several hundred tons of salmon annually, the quantity of particulate waste settling to the seafloor is considerable. Accumulation of organic waste on the sea bed has been found to alter some aspects of sediment chemistry and benthic macrofaunal community composition in the vicinity of salmonid culture operations. The changes in sediment chemistry include increases in carbon, nitrogen and phosphate content (Hall and Holby, 1986), depression in sediment reduction-oxidation potentials (Brown *et al.*, 1987), and changes in the rates of nutrient cycling (Kaspar *et al.*, 1988). Shifts in the species composition and relative abundances of benthic macrofauna have been reported, occasionally with an azoic zone directly beneath the farm (Pease, 1977; Brown *et al.*, 1987). Waste accumulation on the seafloor can have implications for the viability of the farm itself. The release of hydrogen sulfide from anoxic sediments and/or related changes in water quality can adversely effect the health of the cultured fish (Arizono, 1979) and has been the reason for the closure of some operations (Braaten *et al.*, 1983).

At the present time there is a rapid growth in the farming of salmon. The results of this growth will be the expansion of existing farms, some to an annual production of 2,000 to 3,000 tons, and the establishment of multiple farms in individual embayments. As development proceeds potential pollution problems require careful scrutiny, and it has recently been stated that there is a need for models which can

be used to predict ecological impact before establishment of a farm (Rosenthal et al., 1987). The development of such models, together with an understanding of the effects of organic wastes on the benthos, is essential to ensure that this form of mariculture does not cause broad ecological change. An additional application of such model would be in resource management, to ensure that farming is not conducted in areas which, through ecological change, can not sustain the long-term use of the site.

This paper describes an assessment of the intensity and spatial extent of impact on the benthos of two farm sites in Puget Sound, Washington. The sites chosen for study differ greatly in physical conditions, farm size and duration of operation, and potentially offer a broad range in the scale of impact. The study was also intended to further test a sedimentation model designed to predict the dispersal of solid wastes from fish farms (Gowen et al., in press). A preliminary test of the model (Gowen et al., 1988), using sediment redox potentials as an indicator of organic pollution, suggested that the model could be used to predict the spatial extent and severity of ecological disturbance of the benthos and in the selection of suitable sites.

MATERIALS AND METHODS

Field sampling and model verification was performed at two salmon net-pen operations in Puget Sound. The Clam Bay farm is a large operation with an annual production of 617 tons and containing 200 to 400 metric tons of salmon at any given time. The farm has been in operation at the same site continuously since the early 1970's. The Squaxin Island farm holds 20 to 30 tons of salmon and has only been in operation since 1987. There are 53 additional pens located 250-500 m south of the Squaxin Island farm. These pens are used to hold juvenile salmon on a seasonal basis, and were largely unused during the period of investigation. Physical characteristics of each site and details of the Clam Bay and Squaxin farms are given in Table 1.

Sampling stations were established at each farm at predetermined distances along 3 transect lines extending out from the pens, varying in length from 30 to 165 m (Figure 1). Field activities included deployment of current meters and sediment traps, collection of sediments for chemistry and grain size analysis, measurement of dissolved oxygen in near-bottom waters, and sampling of benthic macrofauna.

Current measurements - Two Aanderaa current meters were deployed at each of the farm sites, and set to record at 15 minute intervals for a period of 60 days. The meters were placed 2.5 and 5.5 m above the seafloor at the Squaxin Island and Clam Bay sites, respectively.

Sediment traps - Sediment traps were constructed of PVC piping, 15 cm in diameter and 45 cm in length. An array of three traps were placed under the pens and at each station along transects CB1 and SQ1. The distances between the sea bed and the mouths of the traps were 0.5 and 5.5 m at the Squaxin and Clam Bay sites, respectively. Prior to deployment 250 g

Table 1
Physical characteristics of the farms
and surrounding environments

<u>PARAMETER</u>	<u>CLAM BAY</u>	<u>SQUAXIN ISLAND</u>
Depth of water (m at mean lower low water)	10 - 26	4.7 - 5.0
Distance between bottom of pens and sea bed (m at mean lower low water)	6 - 22	1.7 - 2.0
Area of cages (m ²)	14,560	1,184
Duration of operation (years)	13	1.5
Biomass held on farm (metric tons)	200 - 400	20 - 30
Feed provided (kg·day ⁻¹)	2200 - 5900	400 - 600

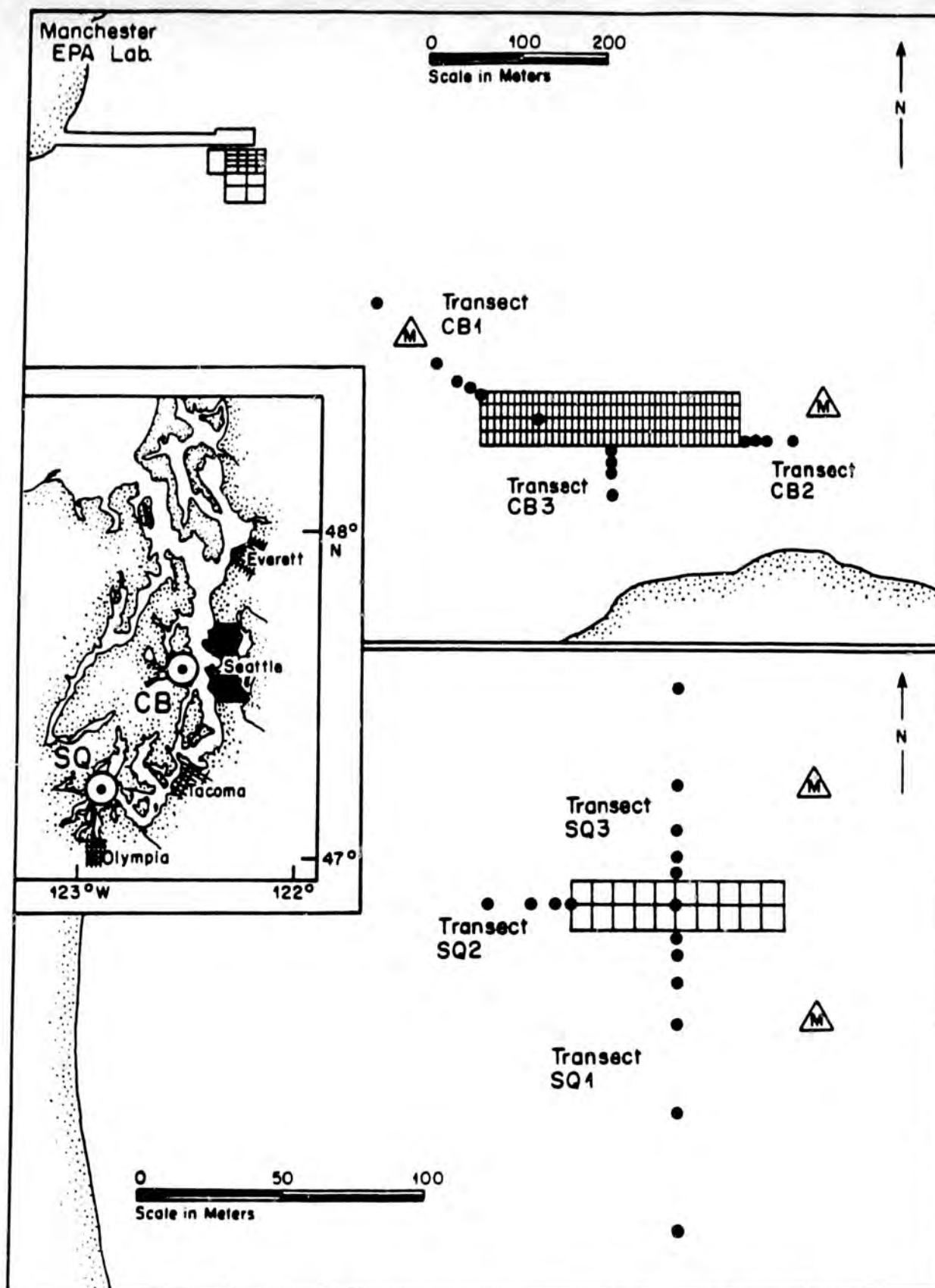


Figure 1. Locations of the two Puget Sound farm sites investigated. Sampling stations are indicated by dots under the pens and along three transects at each site. Locations of the Aanderaa current meters indicated by M symbol.

of reagent grade salt was added to each trap to retard microbial activity and reduce loss of material by resuspension. The traps were deployed for 9 days at the Clam Bay site and 15 days at Squaxin Island. Mercuric chloride was added to the traps at the time of recovery to inhibit microbial activity prior to analysis. The total amount of particulate material retained in the traps was estimated by filtering duplicate aliquots of the homogenized trap contents on to combusted and preweighed 45 um silver filters. The material retained on the filters was analyzed for carbon and nitrogen in a Carlo Erba Model 1106 CHN microanalyzer following vapor phase acidification to remove inorganic carbon (Hedges and Stern, 1984).

Sediment sampling - The upper 1 cm sediment stratum was collected by SCUBA diver (Clam Bay) or Van Veen grab (Squaxin Island). The sediment was analyzed for carbon and nitrogen content in the same manner as the sediment trap material, except that a Perkin Elmer 240 elemental analyzer was used. Sediment redox potentials were measured in diver-collected cores following the method of Pearson and Stanley (1979). Grain size analysis was performed by dry sieving followed by pipette analysis of the silt and clay fraction.

Dissolved oxygen - Near-bottom water samples were collected 5 to 10 cm above the sediment-water interface by SCUBA divers, and analyzed by the Winkler titration method (Strickland and Parsons, 1972).

Benthic macrofauna - Macrofauna samples were collected at each farm site in connection with independent investigations. The Squaxin samples were collected as part of the operator's routine monitoring program which was scheduled so as to sample concurrently with the present investigation. The Clam Bay samples were collected as part of an EPA-funded study by the University of Washington to examine the effects of organic enrichment on benthic communities (Weston, 1988).

At the Squaxin Island farm macrofaunal samples were collected at each station along transect SQ1. Three 0.008-m² cores were collected by diver at each station. The contents of two of the cores were washed on a 1.0-mm screen, while the third core was washed on stacked 0.5 and 1.0-mm screens. The Clam Bay macrofauna samples were collected one year prior to the present investigations at stations closely approximating those of transect CB1. Three samples were collected at each station using a 0.06-m² spade corer, and washed on a 0.5 mm screen sieve.

The predicted dispersal of feed and feces from the net-pens was determined using the sedimentation model of Gowen *et al.* (in press). The model uses a value of 4 cm·sec⁻¹ for the settling velocity of feces (Warrer-Hansen, 1982), and a settling velocity for uneaten feed that was determined in a settling column using feed from the specific farm. The area occupied by the farm was divided into a grid of 1 m squares, and waste production was assumed to be evenly distributed over the farm area. Solid waste production (in units of g organic carbon·m⁻²·hr⁻¹) was calculated as a proportion of the feed provided. The amount of waste feed was assumed to be 15%, although the actual wastage varies greatly among farms and is generally unquantified (see p. 54 for complete discussion). The fecal production was estimated to be 30% of the ingested feed (Penczak *et al.*, 1982). Hourly values of current velocity and direction were used to calculate the horizontal displacement of feed and feces in each array element using the equations:

$$I + \frac{(D) \times (V \cos \theta)}{U}$$

$$J + \frac{(D) \times (V \sin \emptyset)}{U}$$

where I and J are the co-ordinates of the waste within the array at the start of each hour. D (water depth under pens) divided by U (settling velocity of feed and feces) determines the time during which horizontal displacement takes place. $V \cos \emptyset$ and $V \sin \emptyset$ provide the components of the horizontal displacement of a particle. Thus, the above equations give the X and Y co-ordinates of a particle on the sea bed in relation to the position of the farm at the end of each hour. The model was run using current data over one or more spring-neap tidal cycles and integrated the dispersal and input of organic carbon waste over this time period.

RESULTS

CLAM BAY SITE

Fourteen stations were sampled in the vicinity of the Clam Bay farm site, ranging from directly under the net-pens to a distance of 165 m from the perimeter of the complex (Table 2). The bottom topography at the farm site was steeply sloped, with water depths increasing to the north and east. Water depths near the southwest corner of the cage complex were 10 m at MLLW in comparison to 26 m at the northeast corner. Sampling in the deeper areas was not possible by SCUBA diving, thus all samples were collected at depths of 19 m or less. Seawater temperature and salinity of near bottom waters were 13°C and 30 ppt, respectively.

Sediments were primarily medium sands (0.25 - 0.5 mm diameter) to the east and south of the pen complex with finer sands (0.125 - 0.25 mm) to the northwest. Silts and clays comprised less than 5% of the sediment throughout the study area. Shell and gravel comprised a large fraction of the sediment (19%) only at stations to the east of the farm site.

Water Currents

Two current meters were deployed near the Clam Bay farm site. The first was positioned 100 m east of the net-pen complex, 5.5 m above the seafloor and 23.5 to 27 m below the surface (depending on tidal stage). The second was located 100 m northwest of the farm, 5.5 m above the seafloor and 9.5 to 13 m below the surface. Data collected during the period July 6 through August 4, 1988 were analyzed and presented in Figure 2. The current regimes showed pronounced differences at the two sites as a result of either depth-related differences in current flow, or, more probably, local variations attributable to the close proximity and curvature of the shoreline.

Table 2
Clam Bay station summary

<u>Station or Transect</u>	<u>Distance from net-pens (m)</u>	<u>Water depth (m at MLLW)</u>	<u>Substrate</u>
A	0	15	
Transect CB1			
	0	16	
	15	16	
	30	16	
	60	15	
	165	15	0.3% shell/gravel 95.7% sand 4.0% silt and clay
Transect CB2			
	0	13	
	15	14	
	30	15	
	60	19	19.4% shell/gravel 77.1% sand 3.5% silt and clay
Transect CB3			
	0	13	
	15	12	
	30	11	1.8% shell/gravel 98.2% sand 0% silt and clay
	60	10	

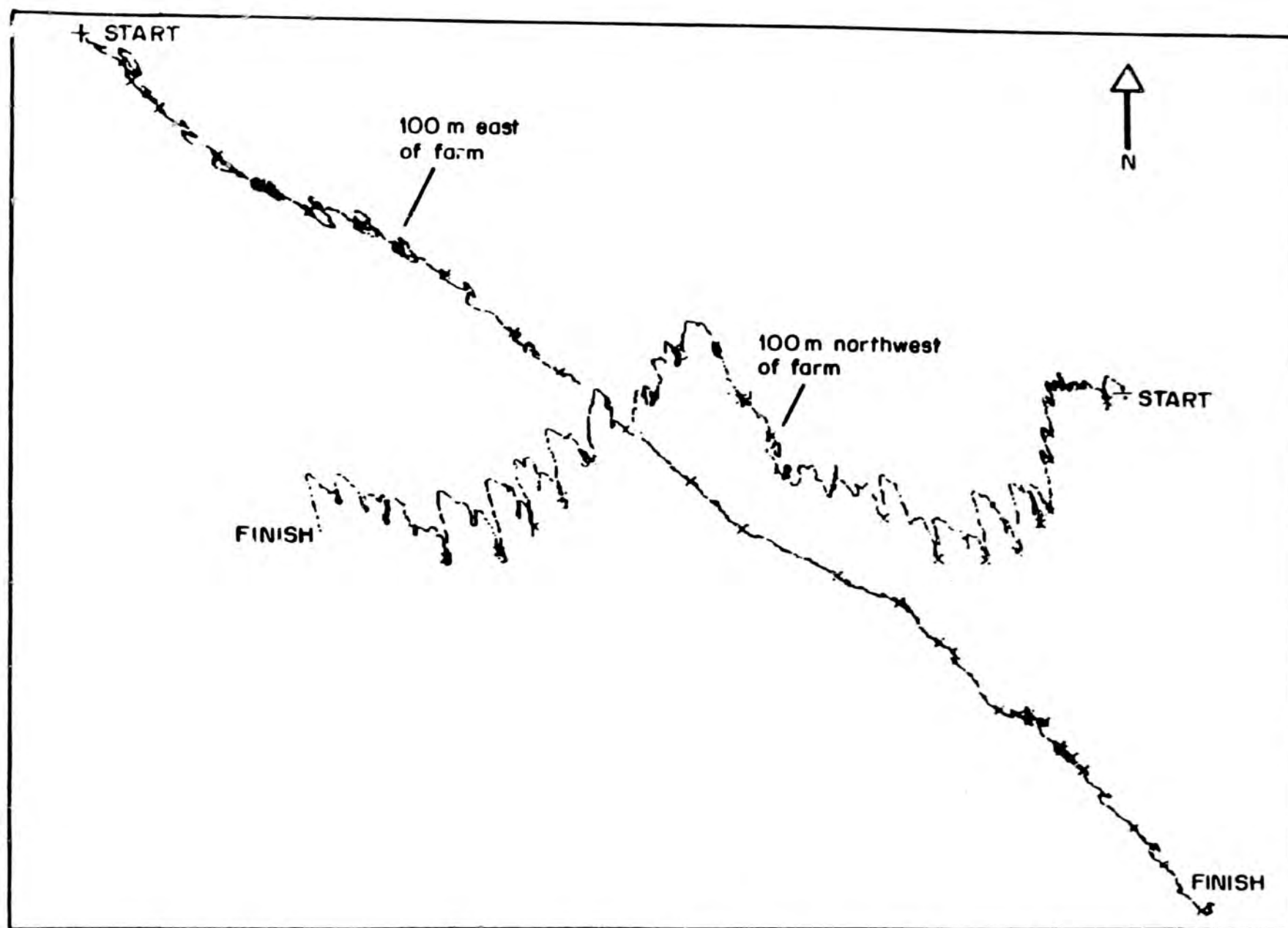


Figure 2. Progressive vector diagrams based on the two current meter records from the Clam Bay site. X symbols indicate 24-hour intervals.

CORRECTION

**THIS DOCUMENT
HAS BEEN REPHOTOGRAPHED
TO ASSURE LEGIBILITY**

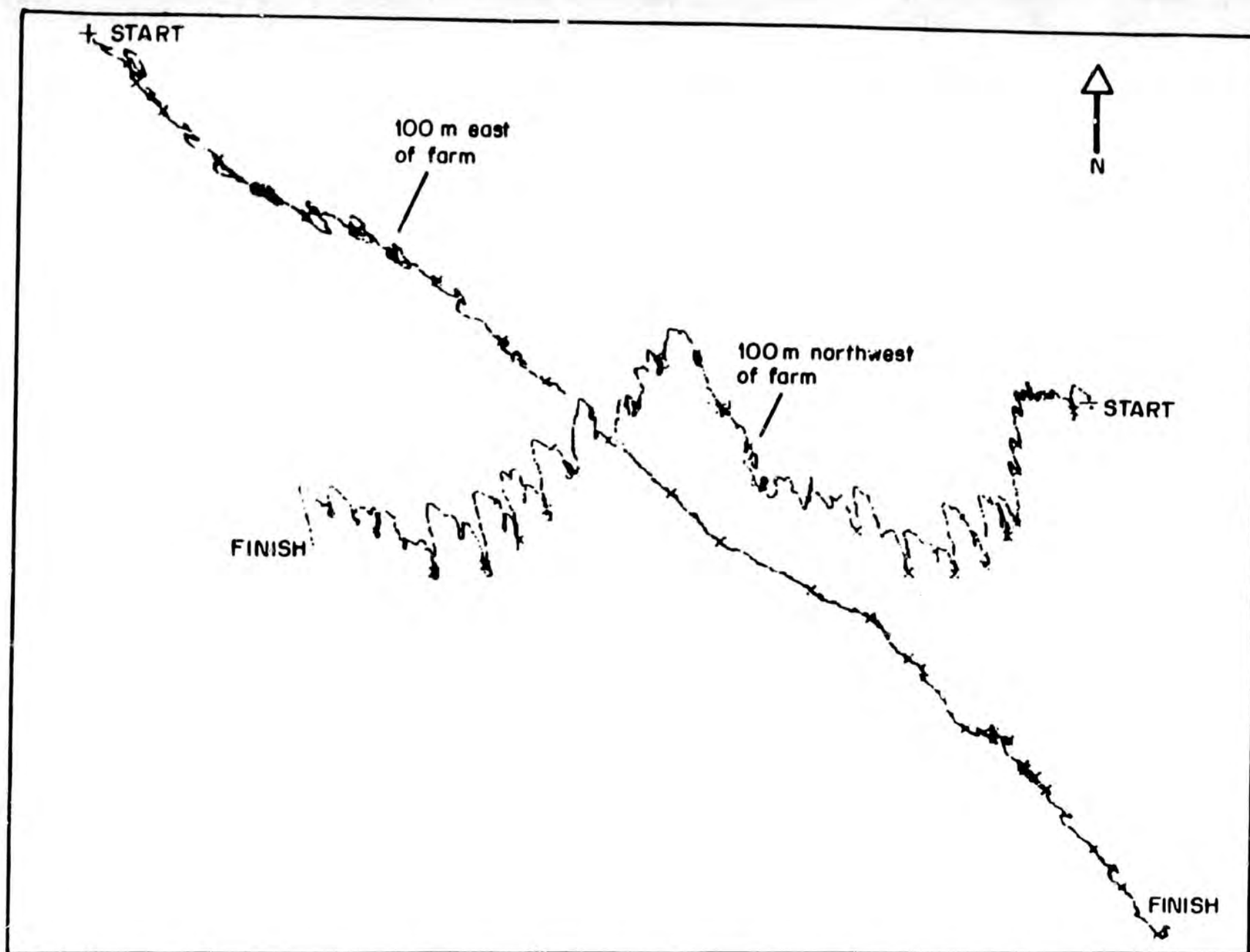


Figure 2. Progressive vector diagrams based on the two current meter records from the Clam Bay site. X symbols indicate 24-hour intervals.

The current data are presented in the form of progressive vector diagrams. These diagrams were created by drawing a vector for each of the 690 current observations such that the orientation of the vector corresponds to the direction of the current and the vector's length corresponds to current velocity. The vectors are then arranged in a head-to-tail fashion with "start" and "finish" indicating the first and last records, respectively. East of the farm site (Figure 2) most of the vectors were oriented to the southeast, indicating current flows primarily in this direction with little evidence of tidal oscillation. The constancy factor at this site was 94.7%. (A constancy factor of 100% would indicate currents consistently in one direction; a constancy factor of 0% would indicate that currents flowed in all directions with equal frequency). The mean current velocity over the period of observation was $9 \text{ cm}\cdot\text{sec}^{-1}$, although velocities as high as $36 \text{ cm}\cdot\text{sec}^{-1}$ were recorded. These current data were collected to model the dispersal of solid wastes sinking from the pens, so the measurements were taken at a depth of about 25 m. Current velocities at the depth of the net-pens (0-4 m) are likely to be somewhat different.

Northwest of the farm site there was a strong tidal influence with currents flowing alternately to the northwest and to the south. The net current flow was to the west with a relatively low constancy factor of 65.6%. Current velocities were slightly lower than those recorded by the other meter. Mean velocity was $6 \text{ cm}\cdot\text{sec}^{-1}$ with a maximum of $31 \text{ cm}\cdot\text{sec}^{-1}$.

Sediment chemistry

Total organic carbon and total nitrogen in surficial sediments exhibited similar patterns of enrichment throughout the study area (Figures 3 and 4). The highest levels of enrichment were found under the southern perimeter of the farm site (CB3-0 m) and 15 m east of the site (CB2-15 m). To the east of the farm site (CB2) the area of enrichment extended to

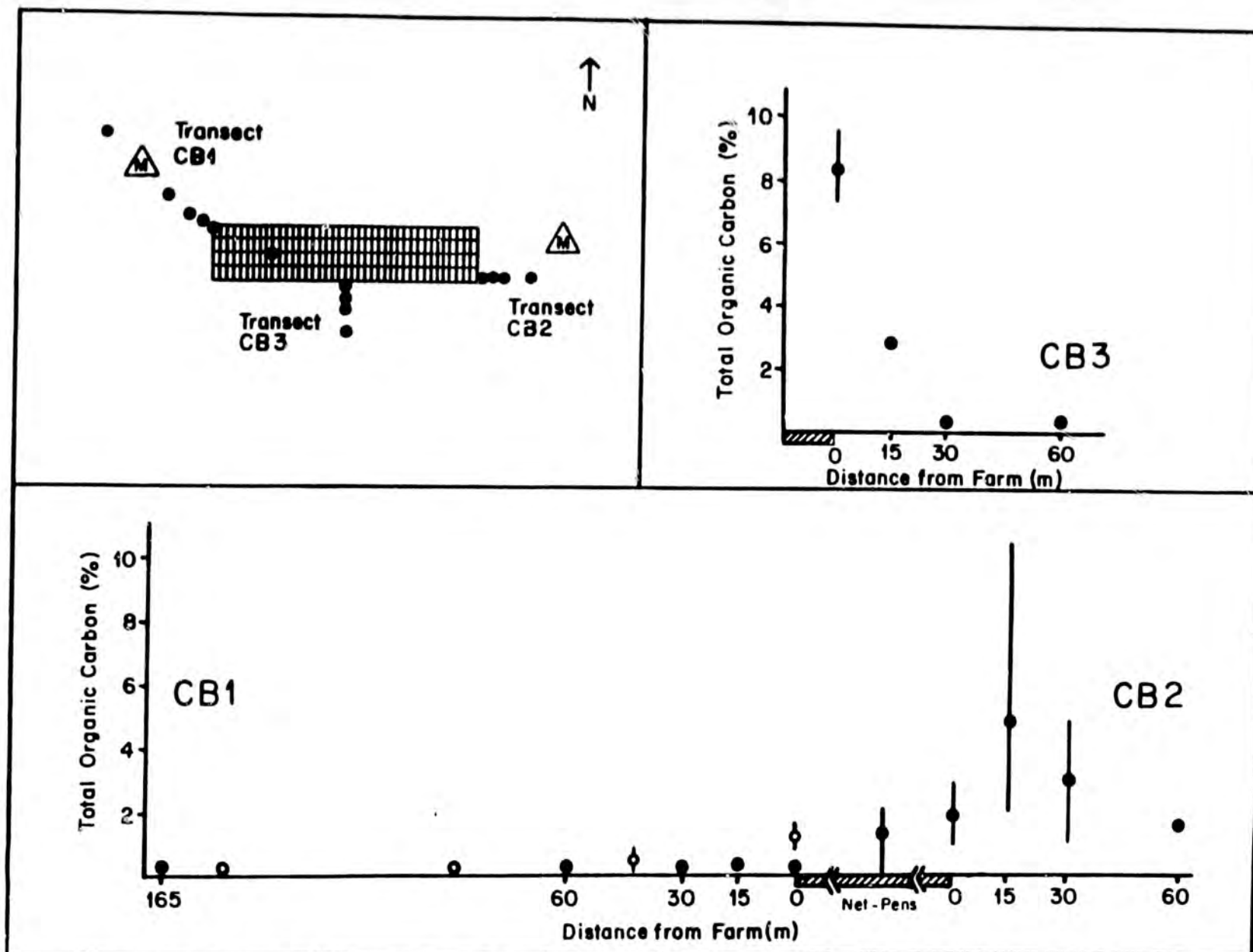


Figure 3. Total organic carbon concentrations in sediments surrounding the Clam Bay farm. Range bars are not shown if less than the size of the mean symbol. Open circles show data collected one year earlier as part of a separate investigation.

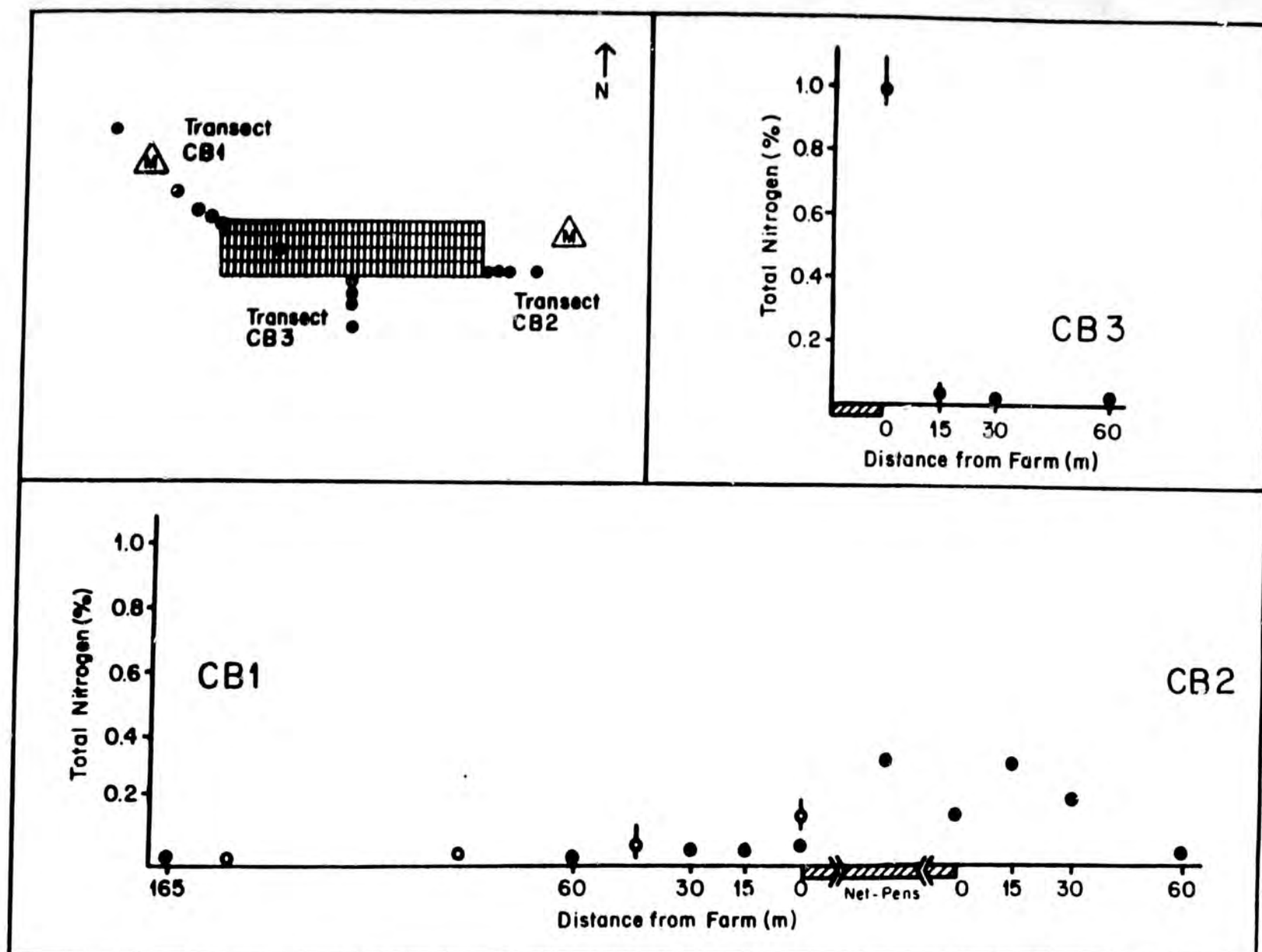


Figure 4. Total nitrogen concentrations in sediments surrounding the Clam Bay farm. Range bars are not shown if less than the size of the mean symbol. Open circles show data collected one year earlier as part of a separate investigation.

a distance of at least 30 m (nitrogen) to 60 m (carbon). To the south enrichment was limited to within 15 m of the net-pens. Northwest of the farm nitrogen showed a statistically significant enrichment to a distance of 30 m (Kolmogorov-Smirnov two-sample test among all possible sample pairs, $\alpha < 0.05$), but carbon levels remained uniformly low throughout the transect. The area northwest of the net-pens had also been sampled in July 1987 as part of an independent study (Weston, 1988). The results of the current sampling were generally similar to the results from the previous year except in close proximity to the net-pens. Within 45 m of the farm carbon and nitrogen concentrations were substantially reduced relative to their levels one year earlier. This reduction is not due to stocking density since the total biomass of fish in the farm was actually 20% greater during the present investigation than one year earlier, but other factors such as small differences in station location or sampling artifacts (diver vs. box corer) may explain this apparent decrease.

The reduction-oxidation potential (E_h) is a quantitative measure of the reducing or oxidizing intensity of sediments. Positive E_h values are generally characteristic of sediments which have a large grain size, are well oxygenated, and/or are poor in organic matter. Negative E_h values are measured in sediments which are rich in organic matter, consist largely of fine sediments, and/or are poorly oxygenated. Sediments receiving high inputs of feed and feces from an aquaculture facility would be expected to have more negative E_h values relative to background conditions assuming grain size is comparable.

At the Clam Bay farm site trends in E_h values closely mirrored gradients in total organic carbon and total nitrogen. Background values were generally about 350 mv at the sediment water interface and 250-300 mv at a depth of 4 cm in the sediment column (Figure 5). With increasing proximity to the pen site, E_h values were reduced throughout the sediment column. The area of depressed potentials extended from 30 m

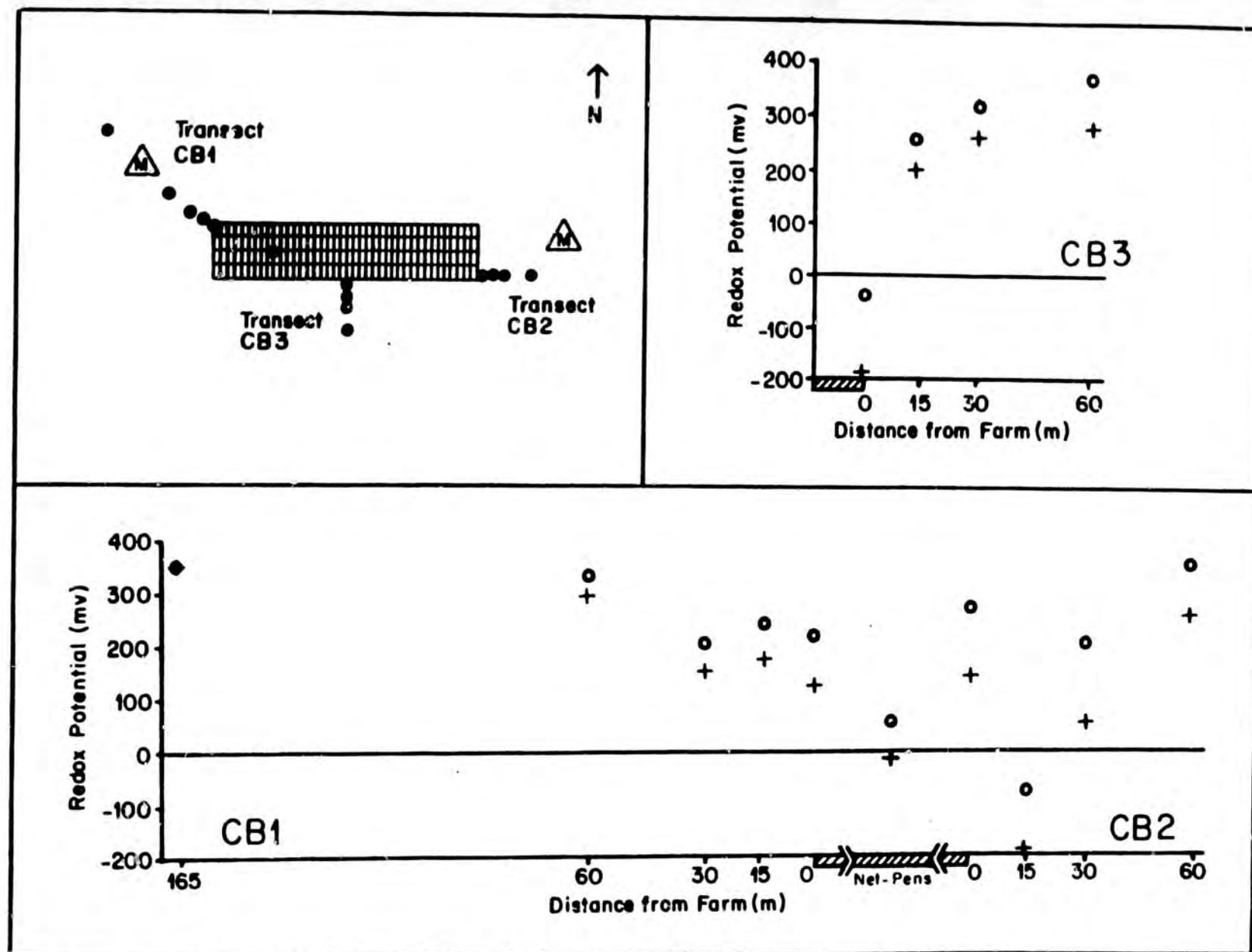


Figure 5. Reduction-oxidation potentials in sediments surrounding the Clam Bay farm. Open circles represent potentials at the sediment-water interface; cross symbols represent potentials at a depth of 4 cm in the sediment.

northwest of the net-pens, to 30 m east of the net-pens, to 15-30 m south. Reducing conditions at the sediment-water interface were evident only 15 m east of the net-cage complex and directly under the southern perimeter.

Dissolved oxygen

Dissolved oxygen concentrations at a height of 5 to 10 cm above the sediment-water interface were uniformly about $8 \text{ mg}\cdot\text{l}^{-1}$ throughout the study area (Figure 6). The dissolved oxygen sampling design was necessarily less than ideal, since the various stations were sampled over a 6 hr. period and it is not possible to differentiate between upcurrent and down-current sites. Nevertheless the data should show if the enriched sediments caused a dramatic depletion in dissolved oxygen of the overlying water as has been observed elsewhere (Brown *et al.*, 1987). No such depletion was evident, presumably because of the high current velocities of the site.

Sediment traps

Seven sediment trap arrays were deployed along transect CB1, but because of limitations in bottom time and air supply, the divers were only able to retrieve one array directly under the net-pens (Station A) and the array at the farm perimeter (CB1-0 m). Duplicate samples from the three traps within each array were analyzed, resulting in six estimates of deposition rates at each station.

Directly under the net-pens the estimated sedimentation rate was $52.1 \text{ kg dry wt.}\cdot\text{m}^{-2}\cdot\text{yr}^{-1}$ (range of six samples = $46.6 - 55.2$). At the pen perimeter the sedimentation rate was $29.7 \text{ kg}\cdot\text{m}^{-2}\cdot\text{yr}^{-1}$ (range $27.8 - 30.8$). The particulate material collected directly under the net-pens was approximately twice as enriched in organic carbon as that collected in the trap at the farm perimeter (25.9% and 12.0%, respectively). The