



Etolin Island Area Mariculture Pilot Project

Public Review Draft

May 1988

Alaska Dept of Natural Resources

COASTAL ZONE
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1988



Alaska Department of
**NATURAL
RESOURCES**

ERRATA:

The headings of Chapter 2 and Chapter 3 were inadvertently reversed. Chapter 2 should be Capability and Chapter 3 should be Suitability. Chapter tables of content are correct.

Rural Resources
or Management
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PUBLIC REVIEW DRAFT

Greetings:

We are pleased to present your copy of the Public Review Draft of the Etolin Island Area Mariculture Pilot Project.

This draft represents combined efforts of six state and three federal agencies. Agencies contributed information in their area of expertise with regards to mariculture development.

Aquatic farming is a relatively new and expanding use of tidelands in Alaska. This document examines major issues important for industry development and resource protection. Both prospective sea farmer and resource managers should find information and guidelines presented here useful in siting and operating mariculture facilities.

Time available for the Etolin Island Project is limited for a project of this size and scope. This draft contains written contributions from over a dozen writers. At this draft stage, subject matter and content have taken priority over style and editing. We expect the final document to be correctly edited and presented.

This is an opportunity for you to comment on any aspect of this project. Public meetings will be held in Petersburg and Wrangell in June. You may comment on the draft at these meetings or by writing or calling us. After the public comment period, the project will be revised.

All comments are due by June 30, 1988.

Project Team Leader Terry Rader and Team Assistant Fran Roche are available to answer questions or provide clarification on any issues of the project. Please feel free to contact either if you have any questions.

Sincerely,

Andrew W. Pekovich, Acting Regional Manager

By: *Terry W. Rader*
Terry W. Rader
Team Leader

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Financial assistance for this report was provided by the Alaska Coastal Management Program and the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration.

Alaska Department of Natural Resources
Division of Land and Water Management
Southeast Regional Office

Alaska Department of Natural Resources
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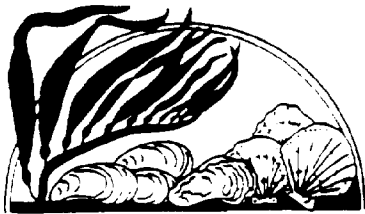
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Etolin Island Area Mariculture Pilot Project

CHAPTER 1

Introduction

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Chapter 1

INTRODUCTION

PROJECT DESCRIPTION

Etolin Island Area Mariculture Pilot Project is a multi-agency study of shellfish and sea vegetable mariculture development in the Etolin Island area near Wrangell. The project is being conducted under special federal funding from the Office of Ocean and Coastal Resource Management to address rapidly growing interest in aquatic farming and related land use and regulatory issues this new industry raises. Interest in mariculture is reflected by legislative proposals which include bills for shellfish, sea vegetable and finfish.

This study has been initiated to examine major elements common to mariculture development in a defined area: biological needs of mariculture species commonly cultivated, their effects on the native environment, and use conflicts caused by siting mariculture facilities in some areas. Guidelines will be developed that apply to siting and development issues of mariculture sites.

Existing permit systems set up by state and federal agencies to permit and monitor mariculture developments will also be examined. Permitting actions provide a vehicle to incorporate guidelines into siting mariculture activities, and will be useful to state and federal agencies involved in the issue or review of permits for mariculture development. Municipalities may find this study useful when evaluating land and resource management issues in other similar areas. It should also be useful to individuals interested in getting started in a mariculture venture.

To ensure that study content maintains the discipline and practicality of site specific application, the area under discussion is limited geographically to Etolin Island, and Blashke and related island complex in Southeast Alaska. The study area was selected because of high industry interest.

This study is organized into five chapters:

Chapter 1 is a brief introduction to the project and provides an historic overview of development history of Alaskan mariculture. It also describes this projects relationship to federal, state and local planning processes.

Chapter 2 discusses site capabilities. This section explores biological and environmental needs of the cultured organism and various cultivation techniques. It also provides a discussion of paralytic shellfish poisoning.

Chapter 3 examines site suitability parameters. This is a detailed discussion of major issues involved in site selection to avoid environmental and impacts with other coastal users.

Chapter 4 explains various permits required and systems set up for application and review. The Alaska Coastal Management Program is explained in this section.

Chapter 5 provides a summary of siting guidelines, implementation options and recommendations. Public comments are also summarized in this chapter.

Cooperating Agencies

Alaska Department of Natural Resources coordinated the project. Following is a list of cooperating and contributing agencies and a brief description of their primary areas of responsibilities:

State Agencies:

Department of Environmental Conservation (DEC) is responsible for water quality issues and administration of the National Shellfish Sanitation Program.

Department of Fish and Game (ADF&G) contributed information on site capability, cultivation, and potential environmental impacts on habitat. ADF&G also provided information for the resource and use inventory.

Department of Commerce and Economic Development (DCED) provided industry viewpoints on development issues.

Office of Management and Budget, Division of Governmental Coordination (DGC) is responsible for the Alaska Coastal Management Program. DGC also contributed information on various aspects of permits and permit review systems.

Department of Natural Resources (DNR) is responsible for land use issues as well as overall project coordination.

Marine Advisory Program, University of Alaska contributed information on their Remote Sensing Project.

Federal Agencies:

U.S. Army Corps of Engineers (COE) provided information on Department of the Army permits and their review system.

U.S. Forest Service (USFS) provided information on their Special Use Permits and review processes. USFS also contributed to the resource and use inventory.

U.S. Fish and Wildlife Service

Two federal agencies reviewed material used in the project and contributed comments and suggestions. These agencies are:

National Marine Fisheries Service
U.S. Environmental Protection Agency

In addition to offering expertise in their primary area of responsibility, all agencies provided clarifying comments and information throughout the study.

Project Features

Species studied in the project are:

- Oysters - Pacific Oyster
(Crassostrea gigas)
- Scallops - Weathervane Scallop
(Patinopecten caurinus)
 - Purple Hinged Rock Scallop
(Crassadoma gigantea)
- Mussels - Blue Mussels (Mytilus edulis)
- Kelp - Giant Kelp
(Macrocystis integrifolia)
 - Kombu (Laminaria ssp)
 - Nori (Porphyra ssp)

No attempt is made to address projects which are not within the scope of state law as of January 1, 1988. As such, finfish mariculture is not considered within this pilot project.

Although Department of Natural Resources is the agency responsible for producing land use plans for Alaska state lands, there are several legally mandated steps that must be completed before a project can be adopted as a DNR Area and Management Plan. State adopted plans must address all resources and uses. As this study focuses only on mariculture, it will not be adopted as an area or management plan.

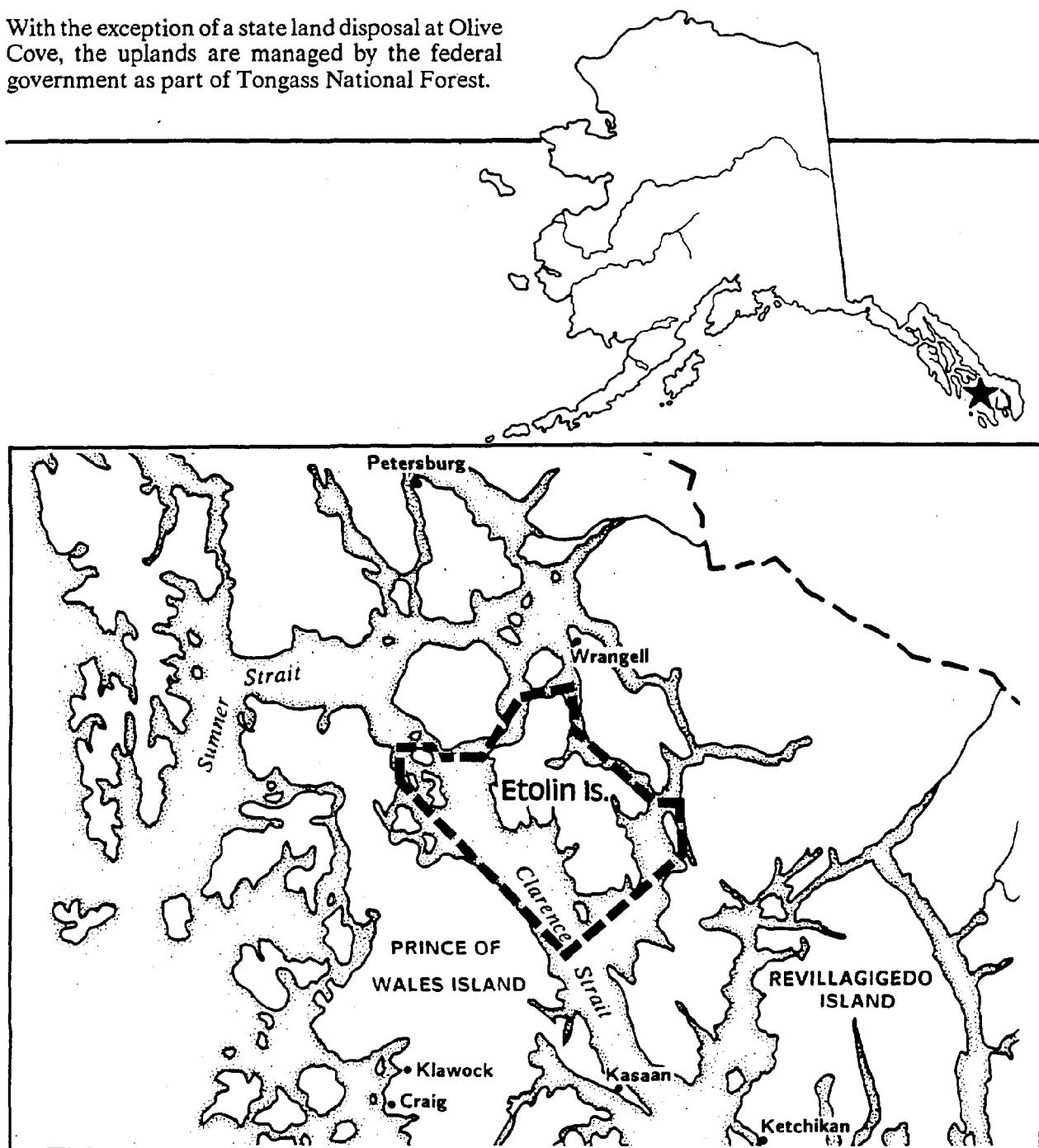
Public workshops were held in Petersburg and Wrangell in late February. A 30 day public review period will extend from approximately June 1 through June 30, 1988. Additional workshops are scheduled in both communities during the public review period. Written comments will be accepted on the project during this period.

Study Area

All of Etolin, Deer, Onslow, Eagle, Stone, Brownson and Kashevarof Islands and the adjacent smaller islands are included in the project area. The state manages approximately 60,000 acres of tide and submerged lands adjacent to the island seaward from mean high water seaward to three miles offshore.

This island group is located southwest of Wrangell and is remote from any major population center. These islands can be characterized as containing mountainous forested uplands, extended inlets, and multiple island groups, surrounded by estuarine coastal waters.

With the exception of a state land disposal at Olive Cove, the uplands are managed by the federal government as part of Tongass National Forest.



HISTORY

History of Shellfish and Sea Vegetable Mariculture in Alaska

Mariculture efforts in the Pacific Northwest have focused on Crassostrea gigas, the Pacific oyster. It was brought to Washington State in the late 19th century from Japan and subsequently transplanted to British Columbia (B.C.). By the 1920's significant shipments of seed were coming into B.C. from Japan, and intertidal culture techniques were being developed.

Nearly eighty years ago seed oysters from Japan were first planted in areas extending from southeastern Alaska to Kachemak Bay on Cook Inlet. From 1910 to 1961 Pacific oyster seed was planted with little success except in the areas of George and Carroll Inlets near Ketchikan. This area proved moderately productive for oyster culture and was used for 50 years. Tidelands were leased from the federal government under the Oyster Bottom Leasing Act from 1937 until 1960 when State of Alaska assumed responsibility for tideland leases.

Alaska Oyster Company leased about 300 acres of Coon Cove and Shoal Cove, both located in Carroll Inlet, in 1938 for culturing purposes. A minimal amount of oysters were marketed from this venture before it went out of business in 1953. North Gem Oyster Company of Ketchikan leased 10 acres on the east shore of George Inlet in 1955 and added to their holdings each year until they held 247 acres by 1957. The company planted its acreage with 7,000 spat per acre in 1955, 5,500 per acre in 1956, and 28,600 per acre in 1957. In April of 1955 North Gem Oyster Company began an experiment with raft culture on the east shore of George Inlet opposite Beaver Falls. This was the only known trial of raft culture in Alaska during that period.

Newly reorganized, Alaska Oyster Company took over North Gem holdings in 1960. During the winter of 1960-61 200 gallons of shucked oysters were sold locally. This company planted 700,000 spat in 1960 and 2 million spat on 227 acres in 1961.

Robin Larsson brought spat into the Etolin Island area in June of 1978. Mr. Larsson built large rafts, which were then experimental, so the oysters could take advantage of the warmest water and

reduced natural enemies. He eventually formed a new Alaska Oyster Company and was issued a shellfish handler's permit. The first sale of oysters from this company occurred in August, 1983.

In summary, oyster culture industry in Alaska was in progress in the early 1900's and has continued sporadically until now. Past attempts at oyster culture have been undertaken by undercapitalized inexperienced companies. From 1983-1988 a renewed interest in culturing oysters has brought about a significant fledgling industry spread among remote islands in predominantly southern southeast Alaska. Alaska specific information about oyster culture has been compiled in the Alaska Oyster Grower's Manual funded by Alaska Department of Commerce and Economic Development and the Alaska Marine Advisory Program.

Blue Mussels Mytilus edulis grow naturally throughout most Alaskan coastal waters. Enormous amounts of seed settle out each summer in most locations. Present culturing efforts are located in Kachemak Bay near Homer. To date, 10 mussel farm project reviews have been initiated for this area. Long line culture has proved unsuccessful in Kachemak Bay, and a type of raft culture has now been enlisted.

In Alaska there has been a growing interest in scallop culture. Major efforts have been underway to locate scallop larvae off Kodiak Island. Scallop culture has been researched in British Columbia where various projects and commercial attempts have focused on collecting wild seed and devising cost effective ways of growing it to market size.

Commercial culturing of sea vegetables has not been researched or tried in Southeast Alaska to any extent. Sheldon Jackson College in Sitka has active laboratory research on Macrocystis, in fall of 1988 a major project involving ocean growing of Macrocystis will be initiated.

Economic success of shellfish or sea vegetable farming is unpredictable. Technology for culturing these species is developing rapidly. Very little actual culturing has occurred in Alaska to date with the exception of oysters. Interest in the aquatic farming industry has remained high despite the unknown nature of the business.

Legislative/Administrative History of Mariculture in Alaska

During the 1980's considerable interest has been expressed in an expanded mariculture industry in Alaska. Analysis of policy issues and development of measures to encourage and accommodate mariculture has been progressing. The following chronology describes significant administrative and legislative actions since 1985:

Chronology of significant administrative or legislative actions regarding mariculture in Alaska

January 1985: Attorney General's opinion issued that fish farming is neither unconstitutional in Alaska nor is specifically authorized by state statutes.

July 1985: Governor Sheffield appointed an ad hoc Mariculture Advisory Committee and charged them with formulation of a workable and effective mariculture policy to guide development of the industry in Alaska.

January 1986: Ad hoc Mariculture Advisory Committee issued "A philosophy for Aquaculture Development in Alaska" which addressed culture of aquatic plants and animals in fresh and salt water environments.

Late 1986: Concurrent bills (SB 106, HB 108) were introduced into the legislature that would allow mariculture in Alaska.

December 1986: Report "Mariculture in Alaska" issued by inter-agency Alaska Mariculture Technical Work Group summarized current regulatory framework for mariculture in Alaska and identified policy issues.

June 1987: A compromise bill passed the legislature which:

- 1) placed a moratorium on finfish mariculture until July, 1988;
- 2) legalized shellfish mariculture by authorizing spat (juvenile shellfish) collection and use of spat in commercial aquatic farms.

Interagency Mariculture Workgroup was formed to work on specific tasks to implement the legislation.

July 1987: Attorney General's opinion issued that confirmed ADFG did not have statutory authority to issue permits for holding live fish for commercial fish farming.

Summer 1987: ADFG developed a permit system for commercial collection of shellfish spat for mariculture and revised the Fish Transport Permit to be appropriate for the shellfish program.

Late 1987: ADFG adopted new regulations governing shellfish farm permits. Several bills were introduced in the legislature to either allow aquatic farming under different types of regulatory frameworks, allowing finfish mariculture, or extending the finfish mariculture moratorium.

January 1988: Report of Interagency Mariculture Workgroup provided to the Fisheries Cabinet included eight issue papers on biological, land-use water quality, and product quality issues; a matrix of how four other areas had addressed the issues and a description of present socioeconomic studies.

March 1988: Consolidated Shellfish Farm permitting system adopted with:

- 1) a consolidated application form for most DFG, DEC, and DNR permits and coastal zone consistency determination, and
- 2) coordinated permit processing.

May 1988: A bill (CSSB 514) passed the legislature which;

- 1) extended the finfish mariculture moratorium until 1990
- 2) legalized sea vegetable farming;
- 3) established additional regulation of shellfish and sea vegetable farming; and
- 4) established an Alaska Finfish Farming Task Force.

CSSB 514 passed in the waning hours of the 15th legislature. State agencies are impacted by this legislation and policies and regulations have not been developed at this printing.

PLANNING AND CLASSIFICATION

No state land use plan currently encompasses the study area. Prince of Wales Island Area Plan includes areas to the southwest of the study area. The uplands of the study area are within the Tongass Land Management Plan boundaries. There are no organized local governments within the study area. A coastal resource service area for local coastal management planning purposes has not been formed for any part of the study area.

Etolin Island Area Mariculture Pilot Project will not be adopted as a DNR plan because of its limited scope and completion time frame. This pilot project will compare to a DNR management plan through its thorough inventory information and initial attempt at developing management guidelines for one tidelands use. Information presented and guidelines developed as a result of this project will be incorporated when an area plan is prepared. Information and guidelines may, as an alternative, be developed into a site specific plan and used as the basis for classification within the project area.

Aquatic farming development in areas covered by land use plans receive direction from the guidelines presented in plans. Although this project will not be adopted as a plan, the following discussions are presented to develop background information helpful in understanding how mariculture is currently viewed in the planning processes.

State Planning Process

Department of Natural Resources (DNR) performs four levels of land use planning which are: Statewide Resources Plans, Area Plans, Management Plans and Site Specific Plans. State law requires these plans be consistent with local government land use plans to the maximum extent without undermining state interests.

All resource decisions made by DNR occur within the Statewide Resources Plan. Development and management of each resource under the department's jurisdiction are described in the Statewide Resources Plan.

Area plans implement the Statewide Resources Plan on a regional basis. They examine statewide

allocations made by the statewide plan, provide guidelines for making management decisions by delineating primary and secondary uses, and desired results to be achieved through management. Area plans result in classification of state land based on allocation decisions of the plan.

After an area plan is completed, a management plan may be prepared. Management plans define in more detail how allocation and guidelines of an area plan will be implemented. A management plan is usually written for one or a few management units of an area plan.

Site specific plans can be written for sites not covered by an area or management plan. They are usually prepared for actions on state lands requiring classification.

State law requires land or tideland be classified prior to action which results in assigning any land use rights. The classification process is based on land use planning. Area plans specify land use designations for land in the study area. These designations are an evaluation of existing and potential uses and resources. To ensure multiple use and avoid conflicts, the allocations are accompanied by management intent statements which give direction to land managers and guidelines for applying specific land classifications.

Alaska Administrative Code provides regulations which are the basis of the state land classification system. Land use designations are converted to appropriate classification by regulation. Several land use designations may convert to a single classification.

Alaska has adopted land and tideland classifications, including: settlement, wildlife habitat, reserved use, public recreation, resource management, and others. Mariculture is not currently a land use classification. Mariculture could occur under a variety of other classifications. Classifications are broader in scope than land use designations.

Mariculture in Area Plans

There are two area plans currently being developed for Alaska coastal areas that have mariculture potential, Prince of Wales Island Area Plan and Prince William Sound Area Plan. Other area plans will be developed in the future.

Guidelines for mariculture are being developed in various offices throughout state government. Guidelines and state policy for mariculture are evolving. Because of this evolution, area plans avoid rigid, inflexible guidelines. Instead they initially develop general guidelines and indicate several issues guidelines should address.

Alaska has declared a moratorium on finfish development to extend through June, 1990. Guidelines of plans are not sufficient to address complex issues related to these types of mariculture. Should these activities become legal, plans recommend the department develop policy for these activities before authorizing them. Policy development could take the form of a plan, study, or recommendations of a working group. Plans identify some issues for policy development.

Mariculture discussion occurs for two levels of management in both Area Plans: 1) area wide guidelines give general management direction and limited siting criteria for mariculture and; 2) site specific management direction is provided to give guidance in response to potential competing uses.

Clarification of management intent, accomplished by both plans, reflect department policy requiring other activities to be compatible with designated primary uses. Mariculture sites have not been designated due to lack of sufficient data to identify appropriate sites.

In general, mariculture activities may encounter the following situations under area plans.

1. Areas which have not been designated for other specific uses (Resource Management) or have been designated for other uses and resources which do not present apparent conflicts. It is reasonable to expect that these areas will be easiest for obtaining authorization for mariculture activities.

2. Areas have been designated for other uses and resources which may present significant conflicts. Areas designated for log transfer or storage,

mineral access, crucial fish and wildlife habitat, intensive harvest areas, developed recreation, anchorages, or adjacent to existing or proposed land sale areas may have significant conflicts. Siting mariculture activities in these areas may be more difficult; Mariculture can be authorized if the conflicts can be adequately addressed and if mariculture operations can meet the management intent and guidelines for the area.

3. Areas where specific requirements may be attached to mariculture locations or operations. For example, mariculture will **not** be sited within 300' of the mouth of an anadromous fish stream without the approval of ADF&G.

Offshore of Wilderness Areas or Wildlife Refuges, only mariculture growing facilities that are submerged and do not impact the visual characteristics of the wilderness or refuge may be considered for authorization. Mariculture support or caretaker facilities will not be authorized in these areas.

4. Performance standards will be attached to a permit or lease to ensure the area is used for appropriate activity, use is economically viable, and the permit is **not** used for speculation. Similarly, development plans will be required before approval of a permit or lease. Stipulations will be determined during permit adjudication.

Area plans also provide guidance for mariculture in specific areas. This is to clarify policy implementation or to note specific circumstances that affect mariculture development.

Examples from the plans include:

1. Where there is an existing community or state subdivision, mariculture may be allowed if it is consistent with land sale design and will not 1) block access; 2) Detract from the view of waterfront lots; or 3) require upland owners to meet higher sewage treatment costs

2. Near proposed state land sales, mariculture may be permitted if adjacent uplands are 1) unlikely to be used for residential settlement; 2) unlikely to be reserved for public use; or 3) where mariculture can accept short term permit or lease.

3. Mariculture will not preclude floathomes in six limited area designations for floathomes in Prince of Wales Island planning area.

4. Areas known for high recreation or fish and wildlife harvest values are discouraged from mariculture if there are feasible and prudent alternatives.

5. In areas that have a high potential for mariculture development such as Sea Otter Sound in the Prince of Wales Island planning area, cumulative impacts of mariculture will be periodically assessed.

Alaska Coastal Management Program Planning

With passage of the Alaska Coastal Management Act in 1977, local governments, rural regions, and the state began to cooperatively manage use and protection of Alaska's coastal resources. Thirty-two coastal communities and regions work closely with the state to prepare plans that guide development in their respective areas and to take part in decisions on permitting of proposed development projects.

These communities and regions, known as coastal districts, prepare management programs that include an inventory and analysis of their natural resources and policies to manage coastal development. Mariculture is a good example of coastal activity that can be effectively managed through a district coastal management plan. City and Borough of Sitka and Kenai Peninsula Borough are currently preparing innovative policies to address mariculture development through their coastal management plans.

In addition to district coastal management plans, mariculture activities could be addressed through preparation of coastal management planning documents such as this report, which was funded by the Alaska Coastal Management Program. Areas Meriting Special Attention (AMSA) plans, described in Chapter 5, could also be used to manage mariculture development.

U.S. Forest Service Planning Process

All uplands of the study area (with the exceptions of a state subdivision in Olive Cove) are part of Tongass National Forest and managed by the U.S. Forest Service. Management of the national forest is guided by the Tongass Land Management Plan.

Tongass National Forest is presently revising its land management plan for National Forest lands including the Etolin Island area. The revised plan will provide specific direction on how the resources on Etolin Island will be managed. Recommendations in this study regarding the capability and suitability of the shorelines in the study area for mariculture development could be incorporated into the revision of the plan. An Environmental Impact Statement for the plan is required. When it is completed and the Record of Decision is signed, direction for management of mariculture facilities on uplands under Forest Service jurisdiction should be consistent with recommendations made in this study.

Although the goals for the Tongass Land Management Plan are not mandated for waters below mean high tide, the USFS expects compatibility between management direction for their uplands and permitted activities on adjacent waters.

Until such time as the Revised Tongass Land Management Plan is completed, current Tongass Land Management Plan direction and guidelines will apply to mariculture. Depending upon public and U.S. Forest Service concern when USFS lands are involved and/or adjacent for individual mariculture proposals, further project specific environmental analysis and public disclosure through appropriate National Environmental Policy Act documents may be required.

Local Planning Process

Local governments have the authority to prepare and enforce comprehensive plans and land use regulations to guide development within their municipal boundaries. Mariculture development within cities and boroughs could be regulated through implementation of local authorities.

OTHER STUDIES

Kodiak Scallop Spat Collection Project

Fisheries Rehabilitation and Enhancement Division is involved in research to collect scallop spat in Alaska. Summer 1988 will be the second season for joint ADFG/OFCF scallop spat collection efforts centered in waters off Kodiak island. OFCF is Overseas Fisheries Cooperation Foundation a quasi governmental Japanese foundation that funds projects that will promote international good will.

These experiments represent first phase of an Alaska Japan project designed to test the feasibility of farming weathervane scallops on Kodiak Island. Goal of the 1987 season was to determine whether wild weathervane spat can be caught in quantities sufficient for commercial farming application. If sufficient quantities of spat are collected, the tiny animals will be moved into grow out cages where growth rates will be closely monitored. Efforts in 1987 took place in Kalsin Bay just outside the city of Kodiak and six other cooperator sites utilizing collectors developed by Japanese scallop farmers. During 1988 the project will expand to more sites in the Kodiak area and to sites in Southeast Alaska.

In addition to setting collection gear, project personnel which includes Japanese experts are tracking environmental factors (water, temperature, salinity, and wind) and taking plankton counts which can be used to determine where and when to set collection gear in future years. A "how to" field manual on scallop spat collection is currently being prepared (Blackett and Kaill, in prep.)

Macrocystis Research

Commercial culturing of sea vegetables has not been tried in Alaska to any extent. Initial research at Sheldon Jackson College in Sitka has been the focus of efforts to collect sporophylls of Macrocystis for release of gametophytes in a hatchery set

ting. Results from 1986 and 1987 experiments were successful laboratory propagation of Macrocystis fronds and subsequent attempts at a grow out phase in waters near Sitka. Disturbance of grow out plantings occurred in these urban sites so complete data on this venture has not been available.

Continuing research into Macrocystis propagation and out planting is planned for fall of 1988 at Sheldon Jackson College in a joint FRED/OFCF project. Goal of this expanded effort is once again to produce Macrocystis fronds through hatchery procedures and monitor out planting growth on an extensive number of plantings in waters off Sitka.

Southeast Alaska Subsistence Survey

Tongass National Forest, ADFG and University of Alaska are cooperating in a study of personal use (i.e., noncommercial harvest) of fish, wildlife, and plants in Southeast Alaska. Data is being collected in form of maps and narratives through interviews with community residents. Data collection will systematically identify where people collect what resources (eg., deer, bear, salmon, plants, berries, etc.) for personal use, how much they use, and areas of highest productivity.

Several communities which use the study area are included in the survey. Interviews were conducted in winter, 1988 but only preliminary mapped data for Petersburg and Wrangell residents was available for review during preparation of this report. More detailed information on use of specific areas and relative intensity of use by residents of these and other communities will be available in late summer, 1988, and should provide an important data base for use in state and federal decision making about prospective mariculture sites.

Marine Advisory Program Remote Sensing Study

Feasibility of using remote sensing to identify the aquaculture potential of coastal waters.

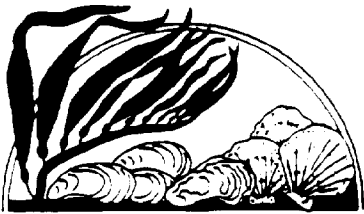
This project involves the collection, interpretation, and practical application of remotely sensed environmental data. Study during this project will be restricted to a site in central Southeast Alaska with the same boundaries as the Etolin Island Area Mariculture Pilot Project. A primary objective of this study is to compare the environmental requirements of oysters with the analyzed data charts. The expected outcome will be the delineation of estuarine areas with a significant potential for oyster culture. This procedure will assist in the rational of coastal development, developmental strategies, and if adopted throughout this region, will serve as a tool for establishment of unified coastal zone policies. Identification of potential areas of conflict between coastal zone users will be assisted by procedures formulated in this research. It is hoped that this means of data analysis will suggest additional avenues for conflict resolution.

The main objectives of this project are;

- 1) Application for remote sensing to the compilation and maintenance of coastal resource catalogs
- 2) Development of mapping technique
- 3) Establishment of a table of oyster growth requirements
- 4) Delineation of potential oyster culture areas
- 5) Technology transfer/contribution to managers capabilities to use this type of technology
- 6) Cataloging the waters/an interpretive process to aid resource managers in delineating areas capable of supporting productive operations
- 7) Multiple use system/the project will suggest location of other economic activities
- 8) Rational use of estuarine resources
- 9) Improved access to strategic resource information

Marine Advisory Programs global objective in this project is to develop a practical means of identifying wetlands capable of supporting productive oyster aquaculture in Southeast Alaska. An inquiry of this type would normally involve traditional oceanographic ("direct sampling") techniques. Although a conventional study of this sort would provide analysis with high levels of precision, costs would be extreme and the surveyed area would be limited. Such studies remain essential in the second stage identification and verification of specific microenvironments determined to be suitable for aquaculture. Proposed strategies of applied remote sensing has been only infrequently used in the northeastern Pacific. This project plans to make a strategic compromise, sacrificing some of the precision associated with conventional studies, but gaining in terms of extent of area examined and speed of analysis.

The approximate conclusion of the MAP Remote Sensing study is November 1988. Any finalized data generated prior to the conclusion of the Etolin Island Area Mariculture Pilot Project will be available for inclusion in the final report.



Etolin Island Area

Mariculture Pilot Project

CHAPTER 2

Site Suitability

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Chapter 2

SITE ANALYSIS/ISSUES

CAPABILITY

Site capability is defined for the purpose of this project as: "Environmental and biological ability inherent in a site to produce a marketable product, in a reasonable amount of time, safe for human consumption." This section will examine site capability for select species of shellfish and kelp.

Inventory and Evaluation of Site Capability Criteria for Selected Shellfish and Kelp

Potential of a particular site for farming of shellfish and/or sea vegetables is limited by a range of environmental and biological parameters. For purposes of Etolin Island Mariculture Pilot Project, this potential is a component of the **site's capability**. Mariculture site capability parameters include:

- Temperature
- PSP
- Salinity
- Dissolved Oxygen
- PH Level
- Estuarine Flushing Rates
- Zones of Upwelling & Mixing
- Substrate Composition
- Stratification of Water Column
- Phytoplankton Production
- Fresh Water Discharge
- Anoxic Conditions
- Competitors
- Predators
- Parasites and Disease
- Indicator Organisms
- Waste Deposits
- Turbidity
- Water Depth
- Tides
- Current Velocity
- Carrying Capacity of Estuary
- Growth
- Sewage and Industrial Pollutants
- Wave Action

Relative criterion importance depends on species and culture technique being considered. Shellfish species considered for this project include Pacific oyster (Crassostrea gigas), blue mussel (Mytilus edulis), weathervane scallop (Patinopecten caurinus), and purple hinged rock scallop (Crassostoma gigantea). Sea vegetables considered the most likely candidates for culture in the Etolin Island area are algal genera Macrocystis, Laminaria, and Porphyra. Of the above species Pacific Oyster is the only one being successfully farmed in the study area. Culture techniques developed at other locations for different species would have to be used or adapted for use on indigenous species in the project area. Options to import species other than Pacific Oyster do not currently exist.

Pacific Oyster

Strategies and site selection criteria for establishing oyster farms in Southeast Alaska have been thoroughly examined by Brian Paust and Page Else in Alaska Oyster Grower's Manual (Else, 1987). Most of the following material was obtained from this source. Growth of oysters in southeast Alaska is variable, as evidenced by the fact that it may take from two to four years to produce a marketable product. Rate of growth depends on such things as water temperature, salinity, current velocity, and concentration of phytoplankton available for food.

Although oysters will grow subtidally to a depth of at least 50 feet, successful commercial culture in

Alaska will probably be limited to a relatively narrow depth range. For various forms of suspended oyster culture, including raft and long line farming, maximum depth required will be approximately 15 to 20 feet of water at low tide. Generally, warmest water, and therefore best growth, will be obtained nearest the water surface.

Water temperatures of 0-30 C can be tolerated by oysters. However, feeding ceases below 5 C. Good growth occurs at temperatures greater than 10 C, but optimal growth occurs at greater than 15 C. Oysters cultivated in the study area will be subjected to suboptimal temperatures for most of the year. One of the advantages of oyster farms in Alaska is water temperatures are rarely high enough to precipitate spawning. As a consequence, high meat quality is maintained throughout the summer.

Salinities of 5 to 37 parts per thousand (ppt) can be tolerated by oysters. Optimal growth occurs between 15 and 30 ppt. Lower salinities result in more water being absorbed by the oyster which imparts a bland flavor to the meat. At some locations, influence of a fresh water lens created by runoff will impact salinity in only the top 1 to 3 meters of the water column. For this reason, salinity should be measured at several depths and at various times of year to obtain a true salinity profile of the site.

Oysters are capable of withstanding levels of dissolved oxygen down to 2 mg/l. It is unlikely low dissolved oxygen will be encountered at prospective sites in the study area, since expected values in the water column in marine environments are between 6 and 9 mg/l. In areas of poor water circulation, decomposition of accumulated fecal material from an oyster farm may contribute to production of ammonia or hydrogen sulfide under anaerobic conditions, both of which are toxic to oysters, even at low concentrations. If bottom culture is planned, consideration should be given to measurement of dissolved oxygen.

Tidal flushing of the farm area must be sufficient to provide adequate salinity, dissolved oxygen, and nutrients. To accomplish this, current velocity in excess of 2 cm/sec is required; best growth is obtained at flushing rates of at least one exchange per day (Brown, 1979). Currents of 9 to 75 cm/sec (moderate to fast current) provide highest feeding rates. Saline surface water should remain at the culture site during slack tide long enough to achieve some temperature elevation

for increased oyster metabolism. Most phytoplankton available to oysters is produced elsewhere and carried to the site by currents.

Acceptable pH values of 7.9 to 9.0 should not be a problem at most sites. Normal pH range of seawater is 7.5 to 8.4, and seawater provides natural buffering.

Oysters are capable of tolerating turbid water conditions but feeding efficiency may be impaired by ingestion of indigestible material. Sites that are chronically influenced by suspended sediment may not be suitable for farms. With bottom culture of oysters, accumulation of silt is unacceptable.

Sites considered for shellfish farms must not be located near sources of industrial, municipal, or sewage pollution. Industrial pollutants such as sulfite waste from pulp mills adversely affect oysters. Heavy metals such as zinc, copper, and cadmium, as well as other organic and inorganic poisons often present in municipal wastewater can accumulate in oyster tissues in amounts exceeding federal standards. Fecal coliform bacteria will result in contamination of oyster products that are often eaten raw.

Growth of oysters is largely a function of water temperatures and concentration of food particles in the water column. An oyster farm should be established at a site capable of sufficient production of phytoplankton. Such sites usually exhibit some surface stratification of the water column. Nutrient input from upwelling and surface runoff, in combination with surface warming, results in necessary primary productivity. Sites with suitable productivity for oyster culture are usually favorable for growth of potential competitors, including fouling organisms such as mussels, barnacles, algae, sponges, tubeworms, and bryozoans. Although fouling is unlikely to be fatal to oysters, reduced growth may result. Probably the most important impact from fouling is the increased cost associated with control. Biological control mechanisms described by Matt Dick (Else, 1987) should be employed wherever possible.

Predation on juveniles and adult oysters by sea stars, carnivorous snails, various crabs, some mammals, and aquatic birds is not likely to be an insurmountable problem in Alaska. Use of suspended culture will minimize predation by bottom dwelling animals. Physical barriers, such as nets to protect raft culture, may add to farm costs.

Prospective shellfish farmers will want to avoid sites identified as having high concentrations of encysted forms of the dinoflagellates responsible for paralytic shellfish poisoning (PSP). Abundance of encysted PSP organisms in bottom sediments can be used as an indicator of the potential for future PSP outbreaks in the site vicinity.

A shellfish farm should be relatively free from wind, wave action, and ice formation during winter. Problems associated with these phenomena arise mainly from safety and structural damage rather than the oyster's inability to withstand disruption. However, damage to new shell growth caused by such disruption could result in lower growth rates. Oysters may stop feeding during disruption (Church, 1988).

Blue Mussels

Many biological and environmental parameters important for the culture of oysters also apply to blue mussel farming. Perhaps the most notable difference is the fact that, unlike oysters, mussels occur naturally throughout the study area and are well adapted to environmental conditions there.

Sites for mussel culture have similar basic requirements to those of oyster culture: a reasonable amount of shelter, good water quality and a fair amount of phytoplankton for food (Korringa, 1977). Jenkins (1985) lists the most important environmental parameters as: oxygen, salinity, temperature, food availability, depth, exposure, and pollution. As with oysters, various species of mussels are widely cultured throughout the world. In Alaska, commercial farming of mussels has been established in Kachemak Bay (Hemming and Hemming, 1984). Mussel growth in Kachemak Bay is reported comparable to that achieved in Puget Sound with harvestable mussels produced within one year.

Water temperatures in which mussels are capable of growth range from -1 C to 25 C. Optimal growth occurs from 10 to 20 C. (Magoon and Vining, 1981). Hemming and Hemming (1984) reported average summer water temperatures of 11.6 C at 10 feet. Highest temperature in their study was 12.5 C.

As with temperature, mussels can survive in a wide variety of salinities ranging from 5 to 35 ppt. Hemming and Hemming (1984) reports good success culturing mussels in salinities of 24.5 ppt.

Herriott (1984) states mussels would grow in salinities down to 17 ppt, but sites near rivers should be avoided because low salinity will interfere with feeding and clumping.

Dissolved oxygen concentrations will not be of major concern to potential mussel farmers as mussels can withstand anoxic conditions for up to several days (Hemming and Hemming, 1984). However, conditions that could lead to low oxygen, such as poor circulation of water, may make sites unsuitable for other reasons.

Considerations for water depth at prospective sites are similar to those for oyster culture: depth must be adequate for the method of culture chosen. Herriott (1984) suggests a minimum depth of 6 fathoms for raft culture with 10 meter ropes. According to Magoon and Vining (1981), bottom culture appears to be impractical in most of Washington State because of heavy predation by bottom dwellers. Herriott (1984) lists one stake culture disadvantage as lack of extensive intertidal flats with suitable tidal ranges and severe predation gull predation. Suspended culture minimizes parasite infection and avoids production of gritty particles in tissues. Similar problems probably would exist in Southeast Alaska, relegating mussel farming to suspended types of culture apparatus (e.g., rafts, racks, or longlines). Loo and Rosenberg (1983) report best results from longline gear at 0 to 2 meters below the surface.

Predation by fish, gulls, and sea ducks could still result (Glude and Chew, 1982, Magoon and Vining, 1981). However, Hemming and Hemming (1984) report no overt signs of predation even though numerous scoters were sighted in the area. If predation becomes a problem, the only practical solution would be to place netting around the culture (Magoon and Vining, 1981). Sound devices have been used to scare away ducks but none proves successful (Glude and Chew, 1982).

Fouling by organisms such as sponges, bryozoans, barnacles, and algae may restrict water flow nutrients (Magoon and Vining, 1981). Problem solutions are labor intensive (Herriott, 1984). Hemming and Hemming (1984) indicate barnacles were difficult to remove and left a white marked mussel shell that reduced quality. They suggest postponing installation of tube or longline gear until after barnacles have settled. Hemming and Hemming report growth of bryozoans and a heavy coating of silt on tube culture mussels. Tur-

bidity is reported to influence growth of mussels (Herriott, 1984; Verica, 1982 in Hemming and Hemming, 1984); however, widespread existence of natural populations in areas of relatively high turbidity indicate it would not preclude mussel culture. Suspended solids have been measured as high as 1,200 mg/l near mussel beds in France where growth was comparable to areas with suspended solids between 10 and 50 mg/l (Hemming and Hemming, 1984).

Experiments by Rodhouse et al. (1985) indicate mussels are efficient filter feeders capable of removing more than half of available chlorophyll and carotenoids from the water column over a partial tidal cycle. In order to achieve maximum growth rates, sites chosen for intensive culture should have high phytoplankton abundance and sufficient water exchange rates to maintain abundance (Herriott, 1984).

Annual reproductive cycles will influence mussel quality and time of sale. Mortalities have been observed just after spawning, especially on warm days (Magoon and Vining, 1981). Mussels grown in raft culture may need to be conditioned to keep their valves tightly closed when removed from water for PSP testing and sale.

As with all filter feeding shellfish considered for culture in the study area, incidence of encysted forms of organisms responsible for PSP should be determined. Mussels become poisonous rapidly, but usually lose toxin faster than other clams (Magoon and Vining, 1981). In some areas, PSP may limit harvesting to periods of winter time (Glude and Chew, 1982). Mussel farm sites in proximity to sources of industrial, municipal, and sewage pollution should be avoided. It may be impossible to predict potential problems with disease organisms and parasites in intensive culture situations (Jenkins, 1985).

Scallops

Initial attempts to begin capture and cultivation of scallops are underway in Alaska. Techniques developed and in use by Japan are being tried in the Kodiak area and to a lesser extent in Southeast Alaska. Although technically and biologically feasible, Japanese techniques for use of cages to culture scallop need to be modified for economic viability (Cropp, 1983). Commercial scallop culture is probably still 10 to 15 years away from development in North America (Talley, 1985).

Virtually all attempts at scallop culture have been initiated at sites adjacent to natural populations of scallops (Aiken, 1987).

Two species, weathervane scallop (*Patinopecten caurinus*) and purple hinged rock scallop (*Crasadoma gigantea*), show some promise as candidates for farming. However, distribution of weathervane scallops in Alaska is different from that of related species being cultured in Japan and New Zealand (Blackett, 1987). Alaskan scallops tend to be confined to distinct beds of high density offshore, with numerous scattered pockets of low density nearshore; in Japan and New Zealand scallops are concentrated in more accessible near-shore areas. This distribution may have considerable implication procedure development to capture and harvest natural spat needed to initiate weathervane scallop culture. Techniques of releasing large numbers of juveniles to repopulate natural scallop beds may not be practical in Alaska.

In general, literature on scallop culture indicates scallops do not respond well to large fluctuations in water temperature and salinity, particularly when they are small in size. However, natural distribution of rock scallops suggests this species is flexible in temperature and salinity requirements (Leighton and Phleger, 1981). Low salinity may not be a problem for some species of scallops as evidenced by their occurrence in brackish water lagoons along the Sea of Okhotsk (Motoda, 1973). Scallop larvae subjected to salinities as low as 11 ppt and 17-30 ppt swam normally (MacKenzie, 1979). However, Olsen (1983) reports salinities less than 23 ppt were detrimental to normal rock scallop growth. More research will be needed on temperature and salinity tolerances of Alaska rock and weathervane scallops to define capability parameters needed for culture sites.

Rock scallop larval development is reported to be optimal at 12 to 18 C (Leighton and Phleger, 1981). Temperatures in excess of 21 C may be fatal, especially at relatively shallow depths of less than 20 meters (Mottet, 1979; Motoda, 1973). Scallops may be acclimated to varying temperatures, especially to rising temperatures, and temperatures as low as -0.7 C can be tolerated (Aiken, 1987; Mottet, 1979). Since temperature is likely to be inversely related to water depth, culture near the surface may produce best results.

Wallace and Reinsnes (1985) consider temperature and food quantity to be the most important

factors in Iceland scallop growth. Salinity and current speed were secondary factors. Mottet (1979) also considers growth rates to be proportional to temperature and phytoplankton concentration. Growth slows or stops during spawning. Adductor muscle condition is highest following spawning when scallops resume growth.

Culture growth appears dependent on density factors. Scallops of less than 2 cm are particularly susceptible to low oxygen concentrations because oxygen consumption is approximately three times greater than that of adults (Mottet, 1979). Growth of scallops in Japan has been shown to decrease as culture density increases (Ventilla, 1982; Ito, et al., 1975). Motoda (1973) states high density should be avoided as accumulation of feces may result in anaerobic conditions with toxic production of hydrogen sulfide. This situation is likely to result only from extremely intensive culture situations.

Siltation has been shown to be detrimental to scallops as concentrations of .05% can stop movement of cilia (Mottet, 1979). Spat in size ranges of 17 to 19 mm are intolerant of siltation (Motoda, 1973).

Scallops have been shown to be intolerant of rocking motion caused by wave action on suspended culture gear (Magoon and Vining, 1981; Mottet, 1979; Motoda, 1973). If suspended types of culture are used, structures will have to be located far enough below the surface to avoid wave action. Shock absorbing structures may have to be incorporated into gear in some locations. Raft culture may not be appropriate for scallops because of wave action (Motoda, 1973). Culture at depths of 3 to 8 meters under the surface may be necessary (Motoda, 1973). Traditional cage culture may be inappropriate for rock scallops because of the animals' need to cement to substrate (Leighton, 1985). Church (1988) relates that rock scallops grown in plastic cages eventually stop attaching to the cages. He suggests, however, that cage growth was extremely slow, perhaps requiring years.

Fouling of culture gear and the scallops themselves is a problem in some areas (Mason, 1983). Fouling by tunicates and mussels is a problem during culturing of rock scallops in oyster trays and required weekly cleaning of the trays (Leighton and Phleger, 1981). Motoda (1973) considers fouling a problem in cage culture because organisms cover the cage surface, thereby reducing nutrient and oxygen exchange. Gear

fouling may be a problem because it increases buoyancy requirements for gear and adds to maintenance cost (Aiken, 1987). Blackett (1987) indicates scallop hanging culture has been unsuccessful in New Zealand largely because of mussels and other organism fouling. Growth rates were not appreciably better on hanging culture than for scallops grown directly on sea bottom. Mottet (1979) suggests some fouling may be beneficial in protecting scallops from predation by sea stars; however, it usually results in competition for food, hampers mobility, may prevent complete valve closure or, conversely, may hold valves closed. Boring sponges and polychaete worms, perhaps more appropriately classified as parasites, may weaken valves and cause scallops to waste energy on shell maintenance that could be directed at growth (Ventilla, 1982).

Sea stars generate the most important predator problems for a scallop farmer (Ventilla, 1982). However, except for bottom culture and spat collector bags, predation by sea stars should not be a major problem. Carnivorous snails, crabs, fish, gulls, sea ducks and other water birds are potential predators of scallops. Suspended culture should avoid all but piscine, avian, and mammalian predators. As with other shellfish farms, installation of nets may be necessary if predation becomes a problem.

Paralytic shellfish poisoning is not generally considered to be a problem with scallops because only the adductor muscle is consumed and it does not accumulate the toxin (Mottet, 1979). However, if North American markets are developed for whole scallops, the same concerns expressed previously for oysters and mussels would apply. Scallops concentrate high levels of heavy metals such as cadmium, mercury, silver, and arsenic and should not be cultured in polluted areas (Mottet, 1979).

Sea Vegetables

Sea vegetables are cultivated for different purposes including: human food; food for livestock; agricultural fertilizer; industrial paste for use in textile and plaster manufacturing; alginic acid, components glue, food stabilizers, viscosity reinforcing agents, a water softener, and dental molding material; and medical products, including anthelmintic drugs and agar. Production of sea vegetables for industrial purposes is probably not viable in Alaska (Kaill, 1988). Ninety percent of

the harvest in Japan is used for human food. Potential is extremely limited in Southeast Alaska for establishment of a Japanese style sea vegetable industry (Olson, 1987). Stekoll (1987) suggests that a commercial kelp mariculture operation could be feasible in Southeast Alaska if it were closely linked to the herring roe-on-kelp fishery in Prince William Sound or if a roe-on-kelp fishery were reopened in Southeast. Church (1988) suggests algae settling naturally on shellfish culture gear could be harvested and sold as a byproduct to supplement shellfish farm income.

Algae growth is primarily controlled by available light. Green algae grow in shallow water; brown algae at intermediate depths; and red algae in the deepest water. Sea vegetables generally grow at depths less than 50 meters; most at less than 20 meters. Macrocystis and Laminaria are classified as brown algae; Porphyra (Nori) is a red algae. Contributing factors to successful culture sites in Japan are:

1. Relatively calm water, protected from severe storms that could tear seaweed loose.
2. Good growing conditions as evidenced target species in the area. Light, currents, nutrients, and temperatures are conducive to plant growth and no industrial or sewage related pollution is present.
3. Culture site use is restricted by excluding any form of conflicting use (Olson, 1987).

Macrocystis does not occur in the Etolin Island area (Frye, 1915), but both Laminaria and Porphyra do. Research and development work would have to be done with the resident species to determine cultural parameters for farming. According to Lindstrom (1987) local species of Porphyra probably are not suitable for Nori production. Another potential option is to import Asian species already under cultivation. Concerns regarding importation of disease organisms need to be addressed.

For algae considered in this report, water temperature requirements are similar to those discussed previously for shellfish. Upper temperature limit for culture of Macrocystis pyrifera in China is 23 C. Frye (1915) finds naturally occurring kelp (M. integrifolia) at temperatures ranging from 8 to 14 C manifests acceptable growth; from 5 to 15 C were optimal for

increase in dry weight. Washington Department of Natural Resources 1984 guidelines for Nori culture lists a temperature range of 6 to 18 C (Freeman, 1985). Actual growth rates show site variance depending on various conditions. Some species thrive only in small, narrowly defined areas.

Sea vegetable culture salinity requirements are species specific. Kelp generally require water of high salinity. Porphyra prefer water slightly less saline than open ocean (Freeman, 1985). Washington Department of Natural Resources suggests a range in salinity of 24 to 32 ppt for Porphyra culture.

Macrocystis and Laminaria require wave action for proper growth. Currents of 20 cm/sec or more are desired. However, when currents exceed 80 cm/sec (1.5 knots), problems with anchoring culture apparatus arise (Mumford and Melvin, 1983). For small scale operations, it is advantageous to choose a protected site; for large scale farms of 500 to 1,000 hectares, open ocean conditions are best where stronger waves, wind, and currents provide better growth. For Porphyra, Washington Department of Natural Resources guideline (1984) lists current requirements of less than 2 knots and less than one foot waves to allow work. Current requirements should allow high level maintenance. Nitrogen optimal levels for Laminaria culture are 7 to 14 $\mu\text{m/l}$. At 3.5 $\mu\text{m/l}$ or less, artificial fertilization is necessary (Mumford and Melvin, 1983).

Washington Department of Natural Resources guidelines (1984) require no nutrient drop be detectable at the culture site.

Water depth requirements for Laminaria farming are 3 to 30 meters. Five to fifteen meters facilitate construction (Mumford and Melvin, 1983). Depths from 18 to 60 feet are recommended for Nori farms by Washington Department of Natural Resources (1984).

Substrate requirements of relatively smooth bottoms, mud to gravel with no cobble, are recommended to facilitate anchoring culture apparatus.

Pests and disease organisms cause major concern in algae culture. Fungal, viral, and bacterial diseases have been discovered in Laminaria and Porphyra culture and epiphytic growth of various organisms is a problem (Neish, 1979). Guidelines established by Washington Department of

Natural Resources (1984) spell out standard procedures for combating these problems in Nori culture. Grazing by gastropods on cultured seaweed may be a problem (Saito, 1979). Offering alternate food sources or enclosure in synthetic cages have been tried for protection.

Sea vegetables are similar to shellfish as they should be grown only in pollution free areas. Kelp concentrate heavy metals such as copper, zinc, arsenic, and mercury (Druehl, 1987).

PARALYTIC SHELLFISH POISONING

Alaskan waters are periodically subject to natural dinoflagellate plankton blooms which may result in toxin concentration in bivalve shellfish tissue. Involved species include clams, oysters, geoducks, mussels, scallops and relatives. These toxins are known as paralytic shellfish poisoning (PSP), and human consumption of bivalve shellfish containing significant levels of PSP toxin can result in potentially serious illness.

All outbreaks of PSP in the North Pacific, are caused by the organism belonging to the dinoflagellate genus *Gonyaulax* (Nishitani and Chew, 1984). *Gonyaulax* species are common members of the marine phytoplankton community. Under normal conditions, their abundance is usually insufficiently high to create a problem with PSP; however, when favorable conditions arise (recent fresh water runoff, water column stability, increased water temperature, low winds, and sunlight) these dinoflagellates can divide very rapidly and cause a bloom, fostering PSP toxin concentration in shellfish.

Saxitoxin was the first toxin identified from PSP outbreaks, named after the Alaskan butter clam (*Saxidomus giganteus*) from which it was isolated. Since then about 15 different toxins have been identified as causing PSP. PSP toxins affect humans and other animals by paralyzing their nervous system when consumed, causing loss of critical body functions. Human illness is characterized by mild to severe symptoms occurring a few minutes to several hours after consumption of contaminated shellfish. Most commonly, nausea, vomiting, and numbness or tingling around lips and tongue will develop. If a significant amount of toxins are ingested, and prompt medical attention is not received, death may result from respiratory failure.

PSP toxin presence in shellfish cannot be detected by any simple method because these toxins do not alter appearance, smell, or taste of contaminated

shellfish. Since PSP toxins are not affected by heat, cooking shellfish will only slightly reduce toxins present. Freezing also has no significant effect on toxin levels.

PSP dangers in Alaskan waters have been known to local Alaskan Natives for centuries. Earliest recorded PSP episodes in Alaska date back to 1799, when four of Capital George Vancouver's men consumed contaminated mussels, resulting in three intoxications and one death. A short time later, Baranof lost 100 men after they ate a meal of mussels harvested in Peril Straits. From 1799 through 1982, 160 cases of PSP have been reported in Alaska resulting in 103 deaths. Today, PSP intoxications continue to occur sporadically throughout Alaska.

Dinoflagellate plankton blooms which contain PSP toxins are not uniformly distributed in marine waters. Effects of tides, currents, water temperature, winds and chemical factors tend to concentrate organisms in relatively restricted areas, but this cannot be predicted. Although certain environmental factors such as water temperature, salinity, sunlight, nutrient concentration, and stability of the water column are known to stimulate growth of dinoflagellates. Particular combinations of factors resulting in a bloom are not completely understood. Consequently, all beaches are at risk and no simple test can determine safety of a harvest area.

Inshore protected waters and open coastal locales demonstrate different patterns in their rate of PSP incidence. Open coastal waters less frequently are associated with high levels of PSP, but when they do occur they are very widespread. These events suggest correlation with El Nino, an offshore wind present for several days and weeks, and accompanied by an influx of warm stratified waters frequently stretching from California to Alaska. (Nishitani, personal communication to Guy Oliver 2/26/88). Research conducted by

Nishitani and Chew shows one Gonyaulax species exhibits signs of vertical migration which varies with the degree of vertical stability of water. When water is thermally stratified, they are concentrated during the day from 0.5 to 3 meters and at night from 4-7 meters. When water is mixed by wind driven turbulence, or by strong tidal currents vertical spread and depth of migration are more variable.

Although bivalve shellfish such as clams, oysters, geoducks, and mussels are not physically affected by ingestion of the plankton, PSP toxins are retained in shellfish tissues. Eventually, the bivalve is able to purge toxins through elimination. Different species of shellfish concentrate PSP in different parts of their bodies and retain it within their tissues for differing periods. Mussels accumulate PSP rapidly and after the bloom subsides naturally cleanse their tissue of toxin in a few days to a few weeks. In contrast, butter clams are reputed to retain toxins at high levels for up to 3 years. Clam siphons contain the highest values (as high as 22,000 units) while adductor muscles collected from Kodiak scallops have never been higher than 80 units even when other parts of the animal show high levels.

Different PSP toxins have differing toxicity and some shellfish have evolved physiological mechanisms to minimize toxic effect upon themselves. Littleneck clams appear to utilize an enzymatic process to change higher level toxins to lower level toxins. Butter clams may be doing the reverse. Preliminary work by John Sullivan suggests they convert lower level toxins into saxitoxin, which has greater toxicity, and then shunt this to the tip of the siphon. In doing so, the clam may be using PSP toxins as an anti-predator device.

Physiological and behavioral mechanism of various shellfish species determine how toxic they may become. When oysters encounter Gonyaulax concentrations of about 20 cells per ml. they decrease their pumping rate. If concentration continues to increase they will stop pumping and feeding entirely. If the level of Gonyaulax remains high the oysters will remain anaerobic for up to 7-10 days, after which they are forced to start feeding again. In contrast, mussels continue to feed regardless of Gonyaulax population level. This behavioral mechanism explains why during a Gonyaulax bloom oysters initially show an increase to levels of several hundred units and then plateau for 7-10 days after which PSP units rapidly increase into thousands. Mussels comparative-

ly show no such tendency to plateau, so that PSP levels continue to rise to a peak.

Predicting PSP potential for a particular site is difficult. Three measures which are useful are: 1) monitor PSP levels in mussels on a weekly or semi weekly basis; 2) quantify the number of cysts in upper sediments; and 3) obtain and review 3-5 years of oceanographic data on the site to determine frequency of conditions conducive to Gonyaulax blooms. Even if all three of these methods are utilized, this does not guarantee that PSP problems will not occur. Nishitani is not certain that quantifying cyst numbers in upper sediments will accurately predict potential for PSP outbreaks in a given area, and consequently may not be a reliable method for determining a potential shellfish growing site.

Some concern exists shellfish mariculture operations may actually contribute to blooms of PSP producing organisms, especially in a bay with limited circulation and slow nutrient replenishment. In this situation, rafts used for culturing could further reduce circulation, resulting in a stratified water column, and shellfish feces and pseudofeces could act as a source of nutrients.

PSP awareness has spread throughout the world because it is a world wide phenomenon. Increased awareness has resulted in increased numbers of reported cases worldwide. There are indications blooms of PSP causing organisms are occurring more frequently. This pattern is repeated in El Nino events. Since 1972, El Nino events have been occurring at a faster rate than from the 1930s to the 1970s. Whether this is a cyclic phenomenon or a result of the greenhouse effect remains open to further study.

Concerns for consuming shellfish containing PSP toxins are critical because of: inaccurate predictability of occurrence of plankton blooms within a given area, 2) inability to detect presence of PSP toxins in shellfish without laboratory testing, and 3) potency of the toxins, which directly affect human nervous systems and can be life threatening without medical attention. Therefore, strict measures must be observed to assure that only bivalve shellfish with minimal levels of toxins are marketed.

Monitoring programs are necessary to protect public health from possible rapid proliferation of dinoflagellates, and to promote and protect the shellfish industry. U.S. Food and Drug Ad-

ministration has established a maximum level of 80 micrograms of PSP per 100 grams of shellfish meat as the allowable limit for shellfish marketed for human consumption. Currently, all PSP testing of Alaskan shellfish is done by ADEC Environmental Health lab in Palmer.

In most places, PSP is regarded as a seasonal environmental problem. Washington and British Columbia state and province governments routinely monitor shellfish sites for PSP levels, and have been able to adequately characterize seasonality of potential outbreaks. This allows commercial producers to ship their product without sampling their lots from late fall through early spring, and implement a progressively more stringent testing regime as potential for PSP increase occurs.

Currently ADEC requires every lot of shellfish to be tested for PSP prior to being released for distribution or sale. Preliminary data taken in Alaska suggests high PSP levels from April through late July or early August. However, ADEC feels that without a more substantial data base on PSP, it is not yet possible to declare any periods of the year safe. As PSP history of each site is extended, periods of open season may be applied to Alaskan sites, and winter clearances may be obtained as already exist in British Columbia, Washington, Oregon, and California.

To date, no shellfish farms in Alaska have provided enough PSP samples over a given period of time to develop a reliable data base. Because of this, and the fact that dinoflagellate blooms can develop rapidly, dry storage or quarantine of shellfish is required prior to marketing, while PSP levels can be tested at the ADEC Palmer Lab.

Preliminary discussion concerning dry storage location is a part of the permit review process.

A dry storage facility must protect the shellfish from all forms of contamination, including saltwater, while the farmer awaits PSP test results. Refrigerated storage or the equivalent is required for holding during the waiting period.

Before gaining approval as a shellstock shipper, a PSP sampling plan is developed for the operation by DEC. Plans require the shellstock shipper notify local ADEC personnel at least two weeks in advance of any sale to give the Palmer lab ample time to prepare for tests. Prior to sale, ADEC personnel or the farmer obtain official samples of mature shellfish which are then sent to the Palmer lab. Shellfish held in dry storage are not released for sale until the PSP sampling procedure is completed and satisfactory results are obtained. The farmer is responsible for all costs involved in transporting the samples to Palmer. At the present time, PSP test results of shellfish lots are available within 24 hours of sampling.

PSP test results contained in the following information were taken from 5 farms in the study area. As previously mentioned, number of results are not enough to develop a reliable data base. However, it does show variability can result from farms in the same general geographic area.

Numbers given are in micrograms per 100 grams of shellfish meat. Keep in mind maximum allowable level of PSP intended for human consumption is 80 micrograms per 100 grams of meat. (Note: numbers from actual samples were rounded off to the nearest whole number for easier reading.)

Farm site #1 (on map)

<u>Month/Year</u>	<u>Shellfish type</u>	<u>PSP levels</u>
8/82	Mussels	less than 40
	Bent Nose Clams	61
	Little Neck Clams	less than 40
5/83 - 10/83	Mussels	47 - 60
	Butter Clams	less than 32
	Oysters	32 - 39
4/84 - 7/84	Mussels	39 - 111
	Butter Clams	33 - 63
	Oysters	30 - 67
4/85	Oysters	30 - 33
6/86	Oysters	31
6/87 - 12/87	Oysters	30 - 59
	Butter Clams	121 - 279
1/88	Oysters	less than 34

Farm Site #2 (on map)

<u>Month/Year</u>	<u>Shellfish type</u>	<u>PSP levels</u>
6/82 - 7/82	Mussels	125 - 268
	Butter Clams	56 - 292
	Oysters	40 - 52
4/83 - 11/83	Mussels	32 - 1989
	Butter Clams	32 - 670
	Oysters	32 - 546
11/84	Oysters	32 - 35
10/85 - 12/85	Oysters	30 - 33
	Clams	36 - 48
1/86 - 10/86	Oysters	30 - 33

Farm Site #3 (on map)

<u>Month/Year</u>	<u>Shellfish type</u>	<u>PSP levels</u>
5/83	Mussels	61 - 133
	Little Neck Clams	152
	Butter Clams	32
10/86	Oysters	less than 30

Farm Site #9 (on map)

<u>Month/Year</u>	<u>Shellfish type</u>	<u>PSP levels</u>
2/86	Mussels	32
	Butter Clams	169
	Little Neck Clams	less than 32
7/87 - 8/87	Mussels	32 - 67
2/88	Mussels	less than 30
	Butter Clams	97

Farm Site #11 (on map)

<u>Month/Year</u>	<u>Shellfish type</u>	<u>PSP levels</u>
7/87 - 8/87	Mussels	32 - 88
	Butter Clams	33 - 49
	Little Neck Clams	less than 32

CULTIVATION

Choice of Technique in Relation to Site Characteristics

Stages of culture and appropriate techniques, by species

Organisms types currently being considered likely candidates for mariculture in Alaska include the Pacific oyster, blue mussel, weathervane scallop, and various seaweed species. Culture of purple hinged rock scallop, geoduck (*Panope generosa*), and pinto abalone (*Haliotis kamshatkana*) may eventually be feasible.

Kinne (1970, in Mason, 1983) classifies shellfish culture into four classes: 1) maintenance (keeping animals alive without significant growth), 2) raising (fattening young adults), 3) rearing (bringing up early stages, e.g., fertilized eggs and larvae), and 4) breeding (production and raising offspring). Alaska oyster and mussel culture currently consists of the raising stage. Scallop culture is in the experimental collecting larvae for raising stage.

Mumford and Melvin (1983) classify seaweed culture into three stages: 1) enhancement (spread of desirable species in natural beds), 2) semi-artificial culture (control over primary stages of plant development but not of seedstocks), and 3) artificial culture (provision of artificial substrates with seedstocks and all stages of plant development under control). Seaweed culture is in the experimental stage. Semi-artificial culture of *M. integrifolia* and *L. groenlandica* with maintenance activities is occurring in the herring roe-on-kelp fisheries.

Techniques are discussed below. Additional description of successful techniques is necessarily based on activities occurring in other states or countries, which may or may not prove to be suitable in Alaska. Those discussed below have been selected because they appear likely to be adaptable to Alaskan conditions.

Some culture stages are carried out successfully only in the laboratory or greenhouse hatchery. Early stage seaweed culture occurs in laboratory or greenhouse operation. Use of laboratories

or greenhouses for early stage culture of oysters and mussels ensures a stable supply of seed or spat. Where natural sets are predictable, devices are used in water to collect floating shellfish seed or spat. In Alaska, experimentation is proceeding with in water collection for scallops and mussels; oyster spat is necessarily imported because water temperatures are too low for local spawning by the Japanese oyster. Laboratory experimentation is also proceeding for *Macrocystis* culture.

Shellfish larvae may be cultured via one technique to a certain stage, then transferred to another area or structure for intermediate culture or full growth to harvest. Scallops and oysters may be cultured via hanging culture to a certain size then placed on the bottom for later growth. They may be moved at various stages of growth from bottom areas to different tidal ranges or predator situations to maximize growth and survival. Scallops and oysters are often transferred to structures where they are separated as individuals (e.g., lantern nets or cages) for specialized markets.

Techniques and Facilities for Shellfish Culture

Scallop spat collection is being pursued experimentally near Kodiak Island (Kaill, in prep.) and experimentation in the Yakutat, Ketchikan, and Tenakee Springs areas are planned. Shellfish culture can be described in five stages: 1) seed collection, 2) rearing of early developmental stages, 3) intermediate culture, 4) rearing to marketable size, and 5) harvest and handling.

Various techniques have been developed to successfully culture three shellfish species with highest potential for Alaska. The following description is generalized, but innovation of new techniques may occur under specific site conditions. Floating structures, intertidal zone structures, or natural or modified sea bottom are used for the first four stages of culture. Floating structures are used to collect spat or seed in the water column. Seed can be harvested after it has settled by using rakes, shovels, or dredges. Early developmental stages are reared on various structures including trays, nets, or ropes suspended from

floating rafts or longlines; racks or poles in intertidal zones, submerged racks or trays, or without structures by placing seed directly on suitable bottom substrates at suitable tidal levels. Transferring animals of a certain size to different structures for intermediate stages of growth is a fairly standard technique in scallop culture in other areas. This technique may be used in oyster culture to grow individual oysters for the oyster on the half shell market. Similar floating structures (rafts or longlines) are generally used for intermediate culture, but animals are placed in baskets or containerized nets (i.e., pearl nets or lantern nets) rather than on lines, or collectively in nets, so they don't attach to one another or bite each other with their shells. All three species are also sown on the bottom when they reach sufficient size. Rearing to marketable size occurs either in the same location as early rearing or where intermediate culture occurs. Types of structures used for each culture stage and potential impacts of structures and culture techniques are described below.

Shellfish are generally harvested by boat in floating culture situations. Harvest from intertidal structures, such as poles or racks, may require truck or tractor access, and harvest from subtidal beds may occur by dredging or by use of divers. The three species can have specialized requirements for immediate handling after harvest that also requires intertidal zone use. Oysters grown in suspended culture develop brittle shells and also have adductor muscles too weak to keep the shell closed during storage and transport. They are often laid in intertidal zones for several days to harden. Mussels grown in suspended culture also need to be conditioned to keep their shells closed by storage in the intertidal zone if a longer shelf life is desired. All shellfish are able to clean themselves of impurities if they are provided with a clean water source for an extended time period. To accomplish this in some areas, harvest is followed by moving the animals to a clean water container for washing with a continuous flow of water for several days. In areas where water is polluted by sewage, a different process of depuration is required. Shellfish are held in disinfected water or placed under ultra violet light before being certified as fit for human consumption.

Requirements for upland support facilities vary, depending on operation size and type of facilities used for various culture stages. Storage sheds and caretaker residence facilities have often been included in proposed oyster farms in Etolin Island

Study Area. It can be anticipated that upland facilities will generally be required as full scale production and future expansion occurs in successful sites.

Culture Techniques and Facilities for Seaweed Culture

Seaweed culture has only recently been legalized in Alaska so no sea vegetable mariculture operations exist in the study area. Locations within the study area may have considerable potential for this activity. Seaweed culture reduces impact on native stocks if it should become desirable to harvest them commercially. Seaweed culture is extensive in some countries, most notably Japan, and experimentation and pilot projects have been carried out in California, Washington, and British Columbia. These efforts have been directed at enhancing native seaweed stocks (North, 1973) or at creating new stands (Bourne, 1987; Washington DNR, 1987) to sustain commercial harvests for a variety of purposes. Seaweed culture consists of three stages: 1) seed or spore collection 2) cultivation of early developmental stages and 3) growth to harvestable size or maturity.

Specific techniques have been developed to enhance natural stocks or to enhance habitat for natural stocks, but none have been tried on a large scale in Alaska. In the first stage of culture, reproductive portions of mature plants are gathered from either natural or cultured stock by divers or from boats. Induction of spore release and culture of early developmental stages occurs in the laboratory for the three species which are most likely candidates for mariculture in Alaska. Techniques for culture of both *Macrocystis integrifolia* and *Laminaria groenlandica* have been successful in both Alaska and British Columbia. Experimental growth of *Laminaria* occurred in Auke Bay (Calvin and Ellis, 1976) and experimental maturation of *Macrocystis* is being attempted in the Sitka area during 1988 and 1989 (Steckoll, 1987). Immediate application of *Macrocystis* culture is probably creation of stocks in Prince William Sound (outside the natural range of the species) in close proximity to existing herring roe-on-kelp fishery.

No Nori culture has been attempted in Alaska, but culture techniques for species of Nori similar to those growing in Alaska have been standardized in Japan (Lindstrom, 1987). Importation of Nori on nets from Japan and maturation or harvest has

been successful in Washington (Washington DNR, 1987). Nori seed growth occurs in a greenhouse or hatchery, but nets can be seeded either indoors or outdoors.

Because early stages of seaweed cultivation generally occur in the laboratory, requirement for structures is limited to the grow out phase. Seaweeds are generally grown on nets or ropes attached to floating frames, rafts or longlines. Nori is cultured intertidally in Japan with nets or ropes suspended from poles sunk into substrate. Enhancement techniques have included: 1) placement of artificial substrates on the bottom, 2) transplanting mother plants, 3) sowing seed from boats in areas of suitable habitat, 4) weeding undesirable species, and 5) blasting reefs to create suitable substrates.

To rehabilitate former kelp stands off the California coast, plant transplantation attached to plastic rings and glued to rocky substrates with epoxy, and sowing young plants by pouring concentrated solutions down a hose from a boat have been very successful techniques (North, 1973). Japan has an extensive program of marine habitat enhance-

ment, which includes placement of rocks or substrate blocks with large, relatively horizontal surfaces for attachment. Holdfast supports, seeded with spores, are used in conjunction with structures in areas with high energy waves. Blasting has been employed in Japan following a phenomenon termed isoyake which results in large areas of rocky bottom converted from productive seaweed to calcareous algae. Blasting provides new surface areas which permit successful sowing or transplantation of *Laminaria* (Saito, 1979). Substrate blocks and rocks are also cleaned periodically by blasting, air drying or coating concrete blocks with a new layer, or by use of high pressure hoses (Mottet, 1981).

Harvest of seaweed is accomplished by divers or manually from boats. In California, harvest has been mechanized using a boat with a cutting edge held a fixed distance below the surface, and a conveyor belt transfer mechanism. Beach areas are sometimes used for seaweed drying, but in Southeast Alaska, drying sheds may be required if on site drying is to occur.



Etolin Island Area

Mariculture Pilot Project

CHAPTER 3

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Chapter 3

SITE SUITABILITY

CHARACTERISTICS OF THE STUDY AREA

Several islands and island groups in Alexander Archipelago, Southeast Alaska, comprise the study area. An irregular shoreline produces many marine areas enclosed or semi enclosed by land which may be suitable for mariculture. Terrestrial and marine factors influence area mariculture capability.

Topography

Topography can greatly influence local weather patterns by intercepting and channelling winds, influencing amount and form of precipitation (freshwater run off, and creating micro climates. Topography can influence pattern and amount of solar radiation striking the ocean surface. These effects have important implications for mariculture.

Islands were formed by uplift adjacent to north south trending faults, one of which extends up Clarence Strait. Topography of both areas has been shaped by glaciers which, at their greatest extent covered nearly all of the Alexander Archipelago and extended into the ocean as a huge ice shelf. Coastal Foothills are a westward extension of the precipitous Boundary Ranges of mainland to the east. Blocks of mountains are separated by flat floored valleys and straits. Mountain tops have been rounded as a result of being overridden by glaciers and lower portion of stream valleys were drowned as glaciers melted and receded and inlets and harbors were formed. Streams are generally less than 10 miles long, with sedimentary deltas formed at stream mouths. Lakes are abundant on Etolin Island.

Islands are interspersed along a broad, shallow ocean trough extending from mainland coastline to continental shelf edge. Sedimentary deposits resulted from glacial advance and retreat, often in the forms of incomplete shallow sills across

mouths of inlets and riverine deposits. Stikine River delta to the northeast of the study area has extensive river deltas. Clarence Strait, Stikine Strait, and Ernest Sound are deep channels, while shallow, rocky areas are characteristic around Blashke and Kashevarof Islands and areas offshore southeastern and southwestern Etolin Island. Snow Passage, Kashevarof Passage, and Zimovia Straits are relatively narrow waterways with shoals and shallow rocks.

Climate

Climate of Alexander Archipelago is primarily maritime. However, continental climatic conditions may influence areas in close proximity to large mainland river drainages, such as Stikine River, which extend into the interior. Northeastern and eastern portions of Etolin Island area likely receive some influence from Stikine River and mainland weather patterns. Maritime climatic conditions result in a relatively narrow range of cool daily air temperatures and low variability between summer and winter. On a regional basis, temperatures from 40's to mid 60's can be expected in summer, and temperatures in high teens to low 40's can be expected in winter. However, it must be emphasized that due to considerable topographic regional variation, temperatures vary widely, depending on local influences. No weather stations exist within the study area. Rainfall at nearby Coffman Cove averages 81" per year, which includes 56" of snow. Further description is necessarily generalized to provide information on type of considerations which may determine weather patterns at a specific site.

Although temperature and precipitation patterns are difficult to summarize and predict for any given site in Southeast Alaska, global weather patterns which determine them can be described.

Hydrology

Freshwater drainage dynamics are important because variations in freshwater inputs to marine systems can modify salinity and temperature of seawater, introduce sediment, pollutants, and nutrients, and drive circulation patterns under some conditions. Amount of freshwater input depends on size of stream drainage area feeding into an embayment, and seasonal climatic patterns, particularly precipitation patterns. If wind and current patterns carry fresh or brackish water plumes into adjacent basins, freshwater flows may influence several water bodies.

In general, non glaciated watersheds on Alexander Archipelago Islands exhibit a small peak flow period in late spring or early summer following snowmelt and a large peak flow in fall during the stormy, rainiest period.

Low flow conditions occur during summer following snowmelt and in winter as precipitation accumulates in the form of snow at higher elevations. Higher elevation drainages accumulate more snow which melts over a longer period, extending periods of higher summer flows. If lakes are present in a watershed, they act as a buffer, delaying and moderating both peak and low flows (Wallen and Hood, 1971). James (1956) further characterized Southeast Alaska watersheds as having a combination of steep slopes, heavy precipitation, and limited water holding capacity. Resulted can be unstable flow characteristics due to rapid discharge from rainfall intensity and rapid fluctuations between minimum and maximum flows.

Hydrology of Stikine River drainage, one of the largest drainages in the region and one which includes several glaciers at headwaters of tributary streams, influence the study area. Glacial melt moderates effect of summer low flows from snow melt and maintains stable flows throughout the season, prolonging periods of large volume discharges from Stikine river systems. Stikine River is a considerable source of suspended sediment, an effect observed by changes in water color some distance beyond the river delta to the south and west. Stikine River flow influences oceanic current and tidal flows as well.

Oceanography and Estuarine Processes

Physical oceanographic parameters of mariculture importance are those related to bottom sediments, on going sedimentary processes, currents, wave action, estuarine circulation patterns, water temperature and salinity patterns, and tidal flushing capacity. Biological parameters are related to patterns of phytoplankton productivity, seasonal nutrient dynamics, and biological carrying capacity.

Bottom Sediments and Sedimentary Processes

Bottom substrate composition will determine feasibility of bottom culture and of anchoring culture facilities. It is one factor which will determine type of benthic community. Waterway bottom composition within the study area varies considerably with local sediment sources. In general, sediments in Inside Passage are dominated by silt and clay, with variable amounts of sand and gravel near localized sediment sources.

Suspended sediment loads are of interest to mariculturists because sediment filtered by shellfish can reduce feeding efficiency and sediment suspended in the water can reduce light penetration, and consequently depth at which phytoplankton can photosynthesize. Glaciers are the major source of inorganic sediments in Southeast Alaska. This could be a factor in the area influenced by run off from Stikine River drainage. In the rest of the study area, a major process of ongoing sedimentation is the delta building process of streams. Suspended load reaching estuaries is proportional to stream discharge size which, in turn, depends primarily on amount of precipitation. Sediment remains suspended in a surface plume of low salinity water until mixing with sea water occurs. During dry periods, suspended sediments may still occur due to resuspension of sediments over tidal flats resulting from tidal action (Sharma, 1979).

In areas of steep topography, runoff may carry sediment directly from landslides and submarine slides may occur, changing sediment distribution.

Currents and Tides

Northward flowing Alaska current is the major oceanic current in Southeast Region. Coriolis effect is very pronounced in northern latitudes, causing a deflection of Alaska current to the east. During flood tides, regional currents generally flow eastward, northeastward, or northward, while during ebb tides, flow in opposite directions (Selkregg, 1975).

Tides throughout Southeast Alaska are mixed, semi diurnal tides of unequal height. Tidal range is large, so strong tidal currents are generated during ebb and flow (Selkregg, 1975). Areas with large tidal prisms (basin cross section) can generate currents of substantial velocities.

Currents in the study are a result of interactions between Alaska current and tidal currents as modified by shoreline topography, bathymetry, freshwater flows, and winds. Unique and dynamic localized current patterns result. Shore line protuberances and islands deflect currents, resulting in areas of back eddies, while narrow passages constrict flows, resulting in falls or rapids at certain tidal stages.

Wave Action

Wave action is an important variable for mariculture, from the standpoint of operation practicality as well as food supply for filter feeders and rocking effects on cultured shellfish. Protection from wind driven waves and turbulence afforded by shoreline topography is site specific. Wave or swell conditions depend largely on weather in Gulf of Alaska, which from autumn through spring can generate very rough seas.

Circulation Patterns

Bays and coves with freshwater inputs exhibit estuarine circulation. Estuarine circulation refers to distribution of a brackish surface layer resulting from freshwater flows into seawater. Rain and rainfall runoff can form a shallow brackish layer over a large water body. Wherever freshwater enters seawater it tends to remain as a top layer because it is less dense than underlying, denser sea water. Water column stratification is quite stable in absence of mixing events. Extent and depth of brackish layers vary with stream seasonal discharge patterns, amount of freshwater discharge,

tide, current, and wind events that act to mix freshwater into seawater.

A rapid increase in size of a freshwater plume can occur following rapid, heavy rain run off because the ground has low capacity for absorbing precipitation (e.g., frozen ground, impermeable soils).

Enclosed areas with little freshwater inflow exist in areas of low relief, for example Blaske Islands. Nutrient conditions within water columns depend on replenishment from oceanic sources through tidal mixing. Blashkes and Kashevarof Island areas exhibit considerable turbulence as Sumner Strait flows meet Stikine River outflows and are deflected southward, mixing with northward flowing Clarence Strait waters. Offshore upwelling areas have been reported in this area. (B. Paust, per. comm.)

Temperature, Salinity and Oxygen Patterns

Temperature and salinity profile of the water column is an end result of estuarine and marine processes under a particular incident light regime. Freshwater inputs alter salinity profiles of upper water columns; incidental solar energy striking a water surface warms the upper layer. At some depths, water mass temperature and salinity is stable because it is below these influences. Below 100-125 meters in Inside Passage, conditions of the water mass are a result of oceanic conditions of waters of Gulf of Alaska which enter through Cape Ommaney.

During spring, sunlight and long day lengths increase surface water temperatures and melt snow, increasing freshwater runoff, which is colder than surface saltwater. Waterbodies stratify under these conditions unless winds of sufficient strength and duration cause enough turbulence to mix layers. Periods of stratification may be interspersed with well mixed conditions throughout summer and on into fall (depending on fall cloud cover). Typical fall pattern of storms again mixes water columns.

Stratification of water columns can result in anoxic bottom conditions where oceanic flows are restricted and oxygen is eventually depleted by biological activity. Deep, silled glacial fjords or other waterbodies with restricted circulation may exhibit extremely stable stratification. However,

according to Wallen and Hood (op. cit.), few estuaries in Alaska are believed to have conditions sufficient to develop anoxic sediments. Conditions of Gulf of Alaska oceanic waters, which have highest bottom salinities and lowest surface salinities during late summer to early fall, are considered sufficient to displace estuarine bottom waters in Southeast Alaska in absence of sill restrictions. Even waters of silled basins may overturn eventually during winter.

Tidal Flushing

Tidal flushing regime is also important in terms of residence time of nutrients and relatively warm surface water conditions. In some bays, circulation patterns forms gyres. Water entrained in a gyre may warm at the surface and concentrate nutrients. Tidal flushing is extremely difficult to measure or predict and must be evaluated on a site specific basis.

Patterns of Phytoplankton Productivity and Nutrient Dynamics

Bivalves such as oysters, mussels, and scallops are filter feeders feeding on plankton, and in some cases, on organic detritus. Phytoplankton are major producers in open ocean and many estuaries. In absence of extensive eelgrass or seaweed beds, they are a major producer group. Their abundance and productivity are key indicators of food availability for mariculture (Else, 1985).

Few studies of primary production patterns have occurred in Southeast Alaska. A major study (Mathieson et al., 1986; 1987) is now under way in Auke Bay. Study is focussing on phytoplankton spring bloom. During three years of study, patterns of blooms have varied. Some Southeast Alaska bays may have patterns of continuous pulses of phytoplankton production rather than distinct blooms (B. Paust, pers. comm.). Patterns of blooms may determine growth patterns and cultured bivalve productivity.

Extended sampling is important to determine feasibility of mariculture because of inherent variability of phytoplankton blooms.

Results of Auke Bay study (Mathieson et al., 1987) indicate that factors limiting phytoplankton blooms in subarctic estuaries are light levels

during spring and fall and nitrogen availability during summer. A period of 3-5 days of exceptionally clear weather in mid April when day lengths are sufficient, was required to initiate spring bloom. Once nitrogen was depleted by phytoplankton, bloom ceased and was only reinitiated if a wind event of sufficient strength and duration mixed into a highly stratified water column, entraining nutrients which had sedimented to the bottom, bringing nitrogen back up into the photic zone.

Although estuaries in the study area cannot be expected to function exactly like Auke Bay, limiting factors are probably similar. These limiting factors have several key implications for culture productivity during spring, summer, and fall:

1. Factors influencing amount of solar radiation reaching the water column surface (i.e., basin orientation, topography which provides shading, cloud cover) will control initiation of spring phytoplankton blooms. Factors influencing the amount of solar radiation penetrating the water column (i.e., suspended sediment, density of phytoplankton during a bloom) will control depth of spring phytoplankton blooms, which in many cases is the major annual primary productivity event. These factors will similarly influence initiation and depth of photosynthesis by sea vegetables.

2. Factors which influence nitrogen availability in euphotic zone (i.e., wind mixing, tidal mixing, upwelling phenomena) will influence initiation of secondary blooms, their magnitude, and duration.

Conversely, processes which tend to stratify water columns and increase stability of stratification (e.g., freshwater inputs, protection from winds) will likely reduce nitrogen entrainment, and therefore reduce potential for secondary blooms and sea vegetable photosynthesis.

Detrital sources of nitrogen from land runoff may play a key role in overall nitrogen budget, particularly when decaying salmon carcasses provide a substantial seasonal input.

During late fall and winter, the water column is well mixed, but light levels are too low for phytoplankton blooms and nutrients may be largely bound in detritus. More research is needed on factors which determine food supply and productivity of candidate culture species during this period, particularly roles played by detritus

and phytoplankton during periods following the spring bloom. Nicholson, a permit holder in the study area, has observed good oyster growth during winter at his Blashke Island site when water temperatures rose above 45 degrees F.

Carrying Capacity

Every habitat area has a particular carrying capacity, expressed in terms of maximum organisms it can support. For cultured species, food supply is likely the limiting factor, which is, in turn, limited by factors described above. Habitat has a certain carrying capacity for naturally occurring organisms, before any culture is introduced. Typical features of marine and estuarine systems are dynamic food supply and animal adaptation to the moveable feast provided by currents and tides. Because of these features, carrying capacity is dynamic and very difficult to quantify.

Some attempts have been made to develop a method for estimating carrying capacity for mariculture, but none have taken into account effects on naturally occurring populations if carrying capacity for cultured animals is reached.

In some production areas in Japan, carrying capacity was determined when production levelled off despite increased stocking rates. Sutherland (1986) is attempting to model capacity of a bay in British Columbia to grow good quality oysters based on food supply, food usage, and bay flushing rate, but estimates are still tentative. Rosenberg and Loo (1983) model energy flow through a mussel long line culture in western Sweden. They conclude two main interrelated ecological factors limiting size of mussel cultures are food supply and current speed. Adapting these models to Southeast Alaska will require a consideration of tidal action effects.

RESOURCE USE/INVENTORY

Maps developed for this project are enclosed inside the back cover. Many resources and uses of the study have been placed on these maps.

Following are brief narratives describing major resources and uses of the study area.

Timber and Timber Harvest

Timber in the study area consists of Sitka spruce, western and mountain hemlock, western red cedar and Alaska yellow cedar. Etolin and Kashevarof islands have a logging history. Approximately 85 recorded sites near the beach have been logged by A-frame and tractor prior to 1966.

Recent upland logging began with the Olive Cove Sale which expired in 1981. Granite Timber Sale of 48 million board feet (MMBF) is being logged and transported to a terminal transfer facility (TTF) in Anita Bay. Quiet Timber Sale for 11 MMBF is available as of May 1987. Vestige Timber Sale in Southwest Cove for .8 MMBF will be offered in 1988. Bushy Island Sale for 15 MMBF will continue until 1990. A small sale on Middle Island was logged in 1986. 15 MMBF on Deer Island have been offered for contract but no operations have begun.

Mineral and Soils

Etolin study area is primarily composed of soils with low, moderate and high mass movement hazard ratings. Some relatively young alluvial soils are present in the area. Extensive wetland areas exist throughout Etolin/Kashevarof Island group.

Four mining claims exist and have been filed on Etolin Island, only one is currently active.

Private and State Lands

Private lands occur in the study area only in Olive Cove. Alaska selected 524 acres and in 1983 sold approximately 80 acres as a subdivision with 26 lots. Alaska retains ownership of the remainder. Five lots will be transferred from state ownership to the University of Alaska as part of a land settlement.

Two small parcels of private lands in Olive Cove were patented prior to state selection. Alaska has proposed a selection near Mosman on Etolin Island which could place additional land in state ownership.

Visual Resources

Etolin/Kashevarof islands can be viewed from Zimovia Strait, Clarence Strait (Alaska Marine Highway and cruise ship routes) and from numerous bays and anchorages used by recreationists.

Cultural, Historical and Archaeological Resources

A number of limited reconnaissance level archaeological surveys have been conducted in the study area. Sites identified and recorded have been added to the State of Alaska's Heritage Resource Survey.

Transportation Systems

Etolin, Bushy and Shrubby islands have road systems extending into various areas for logging purposes. Roads are constructed and maintained under Forest Service management practices.

Major portions of the road system on Etolin Island extend from Anita Bay. Anita Bay road system does not connect with the Olive Cove road system which is old and begins at a log transfer facility. Forest Service may examine the potential of connecting these two road systems. Anita Bay road system comes within one mile of Quiet Harbor and one half mile of Kindergarten Bay.

A road system exists on the western half of Bushy Island. Shrubby Island road system is very old and begins at an old log transfer facility. A transportation plan for Deer Island that will be implemented as part of the proposed timber sale.

Road systems will grow to support logging operations. Time frame for road expansion will depend on the economic viability of the timber industry.

Permitted oyster sites in the study area are not currently served by a road system. Expanding road systems could serve mariculture operations by simplifying and enhancing existing water routes.

Anchorage

Coves and protected waters in the study area are used extensively as small boat anchorages. Anchorages vary in size from one or two boats to

over 20. Fishing fleets are major users of these anchorages, but dispersed recreational boating and kayaking occur throughout the area.

Watersheds and Fisheries

Forty ADFG numbered streams exist in the study area, and approximately one hundred numbered fish streams. An aquaculture facility (hatchery) is located on Burnette Inlet. An Alaskan steep pass fishway was installed on Navy Creek during mid-1970's. Twelve mariculture permit sites for oyster farming are located in Whaletail Cove, Mosman/Threeway Passage, and Kashevarof Island group.

Waters of the study area are rich in both species and numbers of fish and shellfish. Salmon, herring, flounder, crab, shrimp are all harvested.

Kashevarof Island group waters are especially rich in nutrients. Nearby upwellings (B. Paust, per. comm.) and the currents of Clarence Strait provide a steady source of phytoplanktons, algae and other nutrients to this area. South and west Etolin Island benefits from the southwesterly winds and currents.

Extensive kelp beds exist in the study area, notably in the Kashevarof Island group. However, no *Macrocystis* is found in the study area.

North and east sides of Etolin Island are subject to influence of the Stikine River drainage which has significant levels of siltation and temperatures are thought to be lower than surrounding areas.

Wildlife

Various wildlife species are found within the study area including deer, black and brown bear, waterfowl, grouse, beaver, marten, mink, and river otter. Approximately 50 Roosevelt and Rocky Mountain elk were transplanted to Etolin Island in 1987. Deer populations are currently low on Etolin Island.

Approximately 243 bald eagle nests have been located in the study area. Waterfowl, seabirds, and shore birds concentrate seasonally in protected areas or in areas where food is abundant. Large concentrations of phalaropes have been observed in waters west of Kashevarof Islands during spring which may be an indication of food rich upwelling areas.

Sea lions and harbor seals are found in waters of the study area. Offshore rocks and rocky beaches are used as haul out areas. Various whale species are likely to be present in the area, at least occasionally. Sea otters are not present in the area, but are on the west side of Prince of Wales Island and may expand their range in the future.

Fish and Wildlife Harvest

Important commercial and non commercial fish and wildlife harvests occur in the area. Commercial fishing occurs for: 1) salmon by purse seine 2) troll and drift net gear 3) halibut and other bottom fish by longling 4) Dungeness and Tanner crab by pots and 5) shrimp by pots and trawl gear. Beaver, land otter, and wolves are trapped along the beach fringe of Etolin Island and other small islands.

Information about subsistence use by residents of all southeast Alaska has recently been gathered by the Subsistence Division of ADF&G. Preliminary information on harvests by Petersburg and Wrangell residents shows use of large areas of Etolin Island, including all of the shoreline for deer hunting, and most nearshore and estuarine areas for fishing and gathering invertebrates.

Wrangell residents report use of the area for harvest of shellfish, marine mammals (harbor seal), waterfowl, deer, salmon, and assorted finfish including species such as halibut and rockfish. Petersburg residents report using the area for deer and waterfowl hunting.

Additional information will be available in late 1988 on the relative intensity of specific areas use and on use patterns by residents of other communities such as Coffman Cove, Whale Pass, Point Baker, Port Protection, and Kassan. Maps can be produced that will show relative amounts of use (by numbers of households using an area) for Etolin Island Study Area or other areas in the region.

Subsistence salmon permits are issued for Thoms Place and Olive Cove. In 1986, Wrangell residents obtained 9 permits for Olive Cove and 44 for Thoms Place, and harvested 190 pink salmon and 277 sockeye salmon respectively.

Residents of nearby communities sport fish in the Etolin Island vicinity. A principal day use area by Wrangell residents is located in waters off the north end of Etolin Island. This vicinity is a major regional marine recreational fisheries, based on effort and harvest figures.

Recreation

Low level dispersed recreation occurs throughout the study area. Two sites have developed recreation facilities. Steamer Bay has a Public Use Cabin operated by the USFS and Kunk Lake has a trail and shelter. Access to recreation sites in the study area is primarily by water. Anchoring, sport hunting, sport fishing, and upland access to freshwater lakes and use of calmer water in extended inlets are the most common activities.

Table 1. Recreation sites and anchorages in Etolin Island Area.
Identified by the U.S. Forest Service and the Alaska Department of Fish and Game.

<u>RECREATION AREA</u>	<u>USE</u>
1. King George Bay	Anchorage, used for black bear, deer and furbearers hunting and trapping
2. Kunk Lake	Recreational trail and shelter, anchorage for deer hunting
3. Dog Salmon Creek	Anchorage, used for waterfowl hunting
4. Anita Bay	Anchorage, used for black bear, deer, and furbearers hunting and trapping
5. Starfish Cove	Anchorage
6. Between Olive & Whale T. Cove	Waterfowl hunting
7. Olive Cove	Anchorage, used for black bear, deer and furbearers hunting and trapping.
8. Whale Tail Cove	Wildlife harvest area, anchorage
9. North of Southwest Cove	Anchorage, dispersed recreation
10. Southwest Cove	Anchorage
11. Menefee Inlet	Anchorage, used for deer, black bear, and waterfowl harvest, access to lakes
12. Fishermen's Chuck	Anchorage
13. Canoe Pass	Anchorage, small watercraft use
14. South Brownson Island	Anchorage
15. Stone Harbor	Anchorage

RECREATION AREA**USE**

- | | |
|--------------------------------|---|
| 16. Stone Island | Hunting, beachcombing |
| 17. Eagle Island | Anchorage, hunting, beachcombing |
| 18. Onslow Island | Hunting, beachcombing |
| 19. McHenry Anchorage | Anchorage |
| 20. McHenry Inlet | Anchorage, used for black bear, deer and furbearers hunting and trapping, access to McHenry Lake |
| 21. Navy Creek | Access to Navy Lake |
| 22. Cannery Pt.
Anchorage | Anchorage |
| 23. Burnett Hatchery | Sightseeing |
| 24. Head of Burnett
Inlet | Hunting |
| 25. Head of Mosman
Inlet | Hunting |
| 26. Mosman Island | Anchorage |
| 27. Three Way Pass | Anchorage, used for black bear, deer, and furbearers hunting and trapping, beachcombing |
| 28. Johnson Cove | Anchorage, access to Streets Lake, (trout/char concentrations), recreation |
| 29. Steamer Bay | Remote USFS cabin & concentrated fish harvest area, anchorages used for black bear, deer, and furbearers hunting and trapping, recreation |
| 30. Kindergarten Bay | Anchorage, used for black bear, deer, and furbearers hunting and trapping, recreation |
| 31. Quiet Harbor | Anchorage, used for black bear, deer, and furbearers hunting and trapping, recreation |
| 32. Cove east of Quiet | Anchorage |
| 33. Bushy Island | Limited anchorage, deer hunting |
| 34. Between Bushy
& Shrubby | Anchorage, used for deer hunting, furbearer trapping and upland bird hunting |

<u>RECREATION AREA</u>	<u>USE</u>
35. Ossipee Channel	Limited anchorage
36. W. Shrubby Island	Anchorage
37. Middle & Blashke Island Group	Anchorage
38. Niblack Island	Limited anchorage
39. S. Deer Island	Anchorage
40. Middle Deer Island	Anchorage
41. N. Deer Island	Limited anchorage

ENVIRONMENTAL IMPACTS

Information concerning potential environmental impacts of various mariculture operations likely to occur in the study area is summarized and cross referenced to guidelines for siting and mitigating impacts. Many potential impacts have been noted as concerns. Proper site selection, stringent controls over importation of exotic animals and disease organisms, prohibition of harmful techniques, and the use of appropriate mitigative measures will help the sea farmer avoiding significant adverse impacts that have occurred in areas other than Alaska.

Two types of areas which should be avoided during the siting of floating shellfish mariculture facilities are: 1) areas where accumulation of organic sediment on productive benthic communities can be expected and 2) areas where predator or wildlife disturbance are problems. Site selection should include areas with suitable upland areas for support facilities and suitable intertidal areas for beaching gear, hardening shellfish, and holding shellfish for PSP testing where impacts to habitat values are minimized. If other aspects of site selection override environmental concerns, a variety of mitigative measures have been developed which may minimize potential impacts.

From the standpoint of potential environmental impacts, a good mariculture site for **shellfish** culture will have the following characteristics: 1) a flushing capacity which will exceed organic sedimentation rates at maximum production, 2) circulation unrestricted by sills or topography/bathymetry, 3) upland and intertidal areas of relatively low biological productivity that can be used for support operations, 4) sufficient separation from sensitive or crucial fish and wildlife habitats (e.g., mouths of anadromous fish streams, eelgrass beds, herring spawning areas, shellfish beds), 5) sufficient separation from predator concentration areas, and 6) sufficient separation from concentration areas of wildlife species sensitive to human disturbance (e.g., seabird nesting colonies, marine mammal pupping areas).

Environmental impact of mariculture development is examined in this section in two parts: 1) impacts on water quality and 2) impacts on fish and wildlife. This section is followed by a section on siting guidelines and mitigating measures.

ENVIRONMENTAL IMPACTS, WATER QUALITY

Potential Water Quality Impacts

Mariculture requires clean water. Water quality surrounding culture facilities, however, can be affected by both mariculture activity or other nearby uses or activities. Two key water quality issues associated with mariculture are: 1) changes in water quality caused by mariculture operations, and 2) potential siting conflicts with other uses or activities.

One major concern with mariculture operations is unfavorable changes in water quality and environmental conditions that may develop during normal facility operations. Specific changes may occur including increases in sedimentation under culture rafts, changes in water circulation patterns and changes in water chemistry.

Sedimentation can result as organic matter deposits from wastes, shell fragments, etc. build up on the bottom below culture rafts. Amount of organic matter produced is dependent upon several factors; size of facility, production level, and environmental factors such as water depth, current velocity, flushing, and bottom topography. Accumulation of wastes and sediments can induce chemical and biological changes in bottom habitat and water column. Another possible problem resulting from sedimentation is a change in benthic macroinvertebrate community. Species unable to tolerate organic enrichment may disappear, and other more tolerant species become dominant.

Sediment accumulation is site specific. Location of the culturing facility in areas with adequate depth and tidal flushing will greatly reduce chan-

ces of sedimentation. A study of mariculture environmental effects in Puget Sound (Weston 1986) concludes a high probability of solid waste accumulation if less than 15 meters of water was maintained below a mariculture facility. He found most mariculture facilities were sited in waters less than 20 meters deep in Washington State.

In the study area, divers observed only a minimal dusting of sediment under rafts in Canoe Lagoon (A. Grossman, pers. comm.). This site has been used for oyster production since 1983. Water sampling in this area indicated a good tidal exchange even though the lagoon is isolated at low to medium tides. Divers at a proposed oyster farm in Mosman Inlet observed natural sedimentation in the area possibly due to a sill restricting tidal exchange (T. Farris, per. comm.). Sedimentation may be a problem in areas like this if stocking densities exceed flushing capability.

Mariculture facilities may reduce water circulation in the immediate area. A number of variables can affect this flow reduction including flow rate, density of water, enclosure size and type, stocking density, and degree of fouling. Reduced water circulation may result in decreased food availability to parts of the culture structure and increases in sedimentation rate under rafts.

Weston (1986) cites one study which measures a reduction in current velocity amidst culture strings of Pacific oyster in Japan. Velocities were reduced within the raft by 12 to 14% compared to those outside the raft, but 1 meter below the lower end of oyster strings, no consistent effect on current velocity was found (Arakawa et al., 1971). In Hiroshima Bay in 1968, 6000 oyster rafts (9 meters x 18 meters each) acted as a floating breakwater to damp waves and reduce water circulation so the current speed on the shoreward side was only one-seventh or one-eighth of speed on the seaward side. A drop in productivity is attributed to a decline in water quality from changes in water and sediment chemistry (Mottet, 1981). These problems occur in areas of inadequate flushing or intensive culturing activity.

Water chemistry changes may occur from mariculture facilities. Information on mussel culture indicates the possibility of a net reduction in nutrients (nitrogen and phosphorus) around a culture facility. Studies show 40% of nutrients are put back into the water column in form of waste products, 30% are concentrated in growth

removed during harvest, and 30% is excreted as feces or pseudofeces. (Ackefors and Grip, 1985; Ackefors and Soedergren, 1985; in Weston, 1986) Weston (1986) reviews potential impacts of waste products on water quality and concludes ammonia is the only water quality parameter of any concern from mussel culture. Concentrations downcurrent from farms would be well below toxic levels for other organisms. In situations of extremely dense and large scale culture, production of nitrogenous wastes are potentially significant.

A majority of unfavorable changes in water quality and environmental conditions can be avoided by properly siting mariculture facilities. Water quality problems would be anticipated only in areas of limited flushing or intensive culturing activity. Field studies rarely have shown organic deposition or any other culture induced water quality change to be a problem at facilities located in well flushed areas.

Potential Water Quality Conflicts With Other Users

Mariculture facilities can conflict with other users or activities. It is widely recognized most suitable mariculture sites are also suitable sites for other water dependent and water related activities. Because mariculture facilities need pristine water to operate, water quality in surrounding areas, facility location and monitoring vicinity activities are critical. A mariculture facility proposal can be submitted for an area which has historically been used for other activities. For example, some existing activities could have an associated discharge detrimental to cultured organisms.

Sewage discharge from upland development, caretaker facilities associated with a mariculture project, boat traffic, or any other pollution source is a conflict. Shellfish are filter feeders and concentrate fecal coliforms and heavy metals in their bodies. Alaska Water Quality Standards vary levels of allowable fecal coliforms by designated water user. For example, in waters designated for industrial use allowable level of fecal coliforms is not to exceed 200 FC/100ml based on a minimum of five samples taken over a period of 30 days. Allowable level of fecal coliforms for harvesting and consumption of raw mollusks or other aquatic life is 14 FC/100 m. Conflicts arise when an area has historically been used for something other than mariculture, and the approved level of fecal coliforms has exceeded the mariculture allowance.

ENVIRONMENTAL IMPACTS, FISH AND WILDLIFE

Potential Environmental Impacts On Fish and Wildlife

Environmental Aspects Of Siting

Recently passed legislation requires proposed farms or hatcheries will not be permitted to significantly affect fisheries, wildlife, or their habitats in an adverse manner. Adverse environmental impacts have occurred in some areas of the world when mariculture was poorly sited or permitted to exceed carrying capacity.

Careful selection of mariculture sites can avoid or minimize these adverse impacts. Degradation of habitat quality, particularly water quality, can reduce culture productivity, and in extreme cases, result in massive shellfish culture deaths. Although a variety of mitigative measures can be employed to minimize environmental impacts of a site chosen for overriding logistical or economic reasons, such measures usually add to the cost of operation. Environmental protection goals of regulatory agencies largely overlap economic interests of mariculturists. Clean water, preventing creation of anaerobic sediments below rafts and resulting production of toxic substances, and a lack of predator, disease, and parasite problems can ensure sustained productivity. Both regulatory agencies and mariculturists have a vested interest in good site selection for immediate benefit and avoidance of future problems.

Subsequent sections describe environmental impacts which have occurred as a result of shellfish mariculture in areas other than Alaska. This discussion provides a basis for developing siting guidelines and recommended mitigative measures for use in Alaska. Such impacts need not occur in Alaska, but they are described to demonstrate potential impacts considered as possible concerns.

Guidelines

Since environmental considerations are just one part of the equation in terms of final site selection and permitting, mitigation may be necessary if impacts cannot be avoided. Both guidelines for avoidance and mitigation are included in the Site Guidelines and Mitigation Measures section of

this chapter and cross referenced to each impact discussion.

Factors Influencing Magnitude Of Impact

A number of factors determine whether environmental impacts will occur, whether these impacts will be beneficial or adverse, and whether impacts will be significant.

Because mariculture involves an attempt to maximize productivity of a single species in midst of an existing complex and diverse marine ecosystem, some alteration of natural regimes can be expected. As examples, waste products are produced and food that would enter the natural food chain goes into culture production. High productivity may involve elimination of species that compete with or prey upon cultured species.

Factors which determine extent of impact to natural regime include species cultured (e.g. seaweeds as primary producers vs. bivalve shellfish as filter feeding consumers), size of operation (area occupied and stocking densities), culture techniques, need for upland facilities, and physical and biological characteristics of the waterbody such as: 1) currents and flushing rates (hydrography and hydrology), 2) nutrient dynamics, 3) baseline water quality, 4) existing benthic, pelagic, and terrestrial communities; 5) composition of bottom sediments, and 6) distance from facilities to sensitive habitats.

Size Of Operation

Culture operations in Alaska are small scale. However, further projections anticipate successful operations will expand at existing sites and into suitable new areas. Larger operations may be necessary to achieve an economy of scale ensuring long term profitability.

Based on review of 12 permit applications, range in areal extent of proposed farms employing floating oyster culture facilities in Etolin Island Study Area has been from less than 1 acre to 25 acres. Table 1 lists the proposed structures and overall structure size. Review of approximately 40 other permit applications suggests size of facilities proposed for other sites in Southeast Alaska, for mussel culture in Kachemak Bay, and for shellfish

mariculture in other regions of Alaska are comparable. Areal extent of proposed facilities range from 60 sq. ft. for an experimental raft with lantern nets to 100,000 sq. ft for a log boom enclosing 144 5' x 20' pens. Area requested ranges from 2 acres to 10 acres, with multiple sites proposed in some cases more than one bay. One proposal was modified from a request for a 1200 acre lease to 8 acres for floating rafts. Longline rearing facilities have also been proposed, with longlines ranging from 15 to 200 feet long, and from 75 to 1600 feet in lineal distance. For comparison purposes, Table 2 summarizes reported extent of mariculture operations in other areas of the world.

High stocking rates can intensify the magnitude of localized environmental impacts where flushing capacity is inadequate. Culture operations could exceed carrying capacity of a given area, in terms of both food available and localized flushing capacity. Carrying capacity is site specific and varies on a seasonal basis.

No specific information is available on stocking rates of oyster farms in Etolin Island Study Area because this information has never been requested by permitting agencies. Stocking rates reported from other areas are shown in Table 2.

Many significant adverse impacts summarized below occur in areas where large scale intensive mariculture has been operating for several years. Such impacts can be avoided in Alaska with proper siting and monitoring of culture intensity with respect to carrying capacity and flushing regimes.

Need For Upland Facilities

Development of upland facilities adjacent to floating structures results in impacts to terrestrial ecosystems. Upland areas are generally cleared. In areas where a gravel source exists, fill may be required for building pads, access roads, or to provide dock or loading facilities. Timber harvest may occur to provide a source of materials for log raft mariculture facilities or for buildings.

Proposals for upland facilities were included in 4 of 25 oyster culture operations in the study area, in addition, floathomes were proposed on two applications. One proposal included an oyster larva stage setting facility. Lack of similar requests for other proposed farms can be attributed to currently small scale experimental projects. Shellfish and seaweed mariculture throughout the world is commonly associated with areas where uplands are already developed. This is particularly true adjacent to small communities, where mariculture work is accomplished cooperatively. It appears reasonable to assume, with the exception of unique circumstances, most mariculturists will eventually require availability of suitable uplands adjacent to their floating facilities for processing, storage, residence, and caretaking. Nature and areal extent of upland facilities will be a major factor in determining magnitude of impact.

Table 1. Size of oyster farms proposed in Etolin Island Study Area

<u>Structures</u>	<u>Minimum Area Extent of Structures</u>	<u>Acres</u>	<u>Area Requested</u>
4-200' long rafts	800'x ?	?	-
V-shaped log boom enclosing rafts	570'x870'x?	?	-
20 20'x35' rafts	14,000	.3	-
24 20'x60' rafts in 300'x900' log-boom/pole raft	27,000	.6	-
8 sites: 10 111'x50' rafts	55,500	1.3	20 acres
10 60'x16' rafts in 200'x425' log-boom raft	85,000	1.95	-
20 13'x4' rafts in 425'x200' log-boom raft	85,000	1.95	-
100 5'x20' rafts in 295'x295' log-boom raft	87,025	2	-
72 20'x60' rafts in 200'x436' log-boom raft	87,200	2	2 acres
48 5'x11' rafts in 200'x550' log-boom raft	111,000	2.5	2 acres
variety of structures within 1,000'x550' log-boom raft plus 250'x250' beach storage area	500,000	11.5	-
3200 4'x10' rafts	128,000	2.9	25 acres

Table 2. Summary of reported areal extent and stocking rates of various mariculture operations

	AREA	Culture Method	Areal Extent	Stocking Density	Source
<u>SEAWEED</u> <u>Porphyra spp.</u>	Washington	Nori Net Culture	300-600 net farm to cover 25-40 acres; nets cover 2.5-4.8 acres	-	Washington, DNR, 1987
<u>SCALLOPS</u> <u>Patinopecten</u> <u>yessoensis</u>	Mutsu Bay, Japan	Bottom Culture	Total area: 2 14% of 665 mi. ² (1660 km. ²) bay	Av. 24,000- 40,000/acre at max. density	Ventilla, 1982
				24,300/acre recommended density	Ventilla, 1982
	Mutsu Bay Japan	Hanging Culture	Total area: 2 31% of 665-mi. ² (1660 km. ²) bay	40,000/acre at max. density;	Ventilla, 1982
				12,000-14,500/acre recommended	
Japan		Longline	50-60 m. long in shallow, inshore waters	10,000 shells/ longline	Ventilla, 1982
			100-120 m. long in off-shore waters	20,000 shells/ longline	Ventilla, 1982

Table 2. (Cont'd)

	AREA	Culture Method	Areal Extent	Stocking Density	Source
<u>SCALLOPS</u> <u>Patino pecten</u> <u>yessoensis</u>	Japan	Longline, lantern nets	"Jumbo" system examples: 1) 480 m. long lines, 22.3 acres	-	Ventilla, 1982
			2) 5.6-7.4 acres	40,500-50,500/acre	
			3) 48 100-200 m. lines, 44.5 acres	100 lanterns/line, 16,200/acre; 250 lanterns/line, 405,000/acre	
	Japan Fuka Bay	Longline	23 1200 m. lines, 222 acres	56,200/acre	Ventilla, 1982
	Japan	Longline, ear- hanging	100 m. longline	450/m.	Ventilla, 1982
		Longline, lantern nets	100 m. longline	150/m.	Ventilla, 1982
	Tasmania (feasibility study projections)	Longline	8.4 acre lease	225,000/acre seeded	Cropp, 1983
				190,500/acre harvested	
<u>Patinopecten</u> <u>caurinus</u>	Washington	Longline	50-100 m.	-	Magoon and Vining, 1982
<u>Hinnites</u> <u>multirugosus</u>	Hawaii	?		Approx. 200,000 400,000/acre recommended (5-10 m. ²)	Monical, 1979

Table 2. (Cont'd)

	AREA	Culture Method	Areal Extent	Stocking Density	Source
<u>OYSTERS</u>					
<u>Crassostrea</u> <u>gigas</u>	Trevanen Bay, Vancouver Island, B.C.	Hanging Culture	60% of bay leased, 154 acres total	"minimum diligent usage"=12,000/acre Intense culture = 150,000/acre	Sutherland, 1986
	S.E. Alaska, 1938-60	Bottom Culture	110-227 acres leased	-	Else, 1985
	Japan	Raft	Standard size 120 m. x 10 m.	-	Glude, 1979
		Longline	70-75 m. long		
	Germany	Submerged cage array	Bottom area=2 approx. 3 m.	20,000,000 seed/ acre 2,500,000 harvest- table oysters/acre	Meixner, 1979
<u>MUSSELS</u>					
<u>Mytilus</u> <u>edulis</u>	Riade Arousa, Spain	Raft	10% of surface area used, .07 acres/raft; 2,040 rafts, 143 acres (total)	-	Marino et. al., 1982
	Rhode Island	Raft	60 acres (total)	-	Glude and Chew, 1982
	Maine	Raft	14 acres (total)	-	Glude and Chew, 1982
	Washington	Raft	5 acres (total)	-	Glude and Chew, 1982

AREA	Culture Method	Areal Extent	Stocking Density	Source
China	Raft	50-60 m. long rafts	-	Zhang, 1984
Prince Edward Island, Nova Scotia	Longline	330' longlines	-	Anonymous, 1986
Ireland	Longline	40 m. longlines, 5 acre leases	-	Herriott, 1984
Sweden	Longline	.2 acre farm (4500 m. ²)	-	Rosenberg and Loo, 1983
<u>MUSSELS</u>				
<u>Mytilus</u>				
<u>edulis</u>				
Sweden	Longline	.06 acre farm ² (1500-2000 m. ²)	-	Swedish Council for Planning and Coord. of Res., 1985
Italy	Intertidal Racks	.25 acre plots	-	Korringa, 1979
Netherlands	Bottom Culture	11-25 acres plots	-	Korringa, 1979

Potential Environmental Impacts Of Specific Techniques And Facilities

Anchored Floating Facilities (Rafts And Longlines)

Anchored floating facilities are the only facility types currently in use or proposed for use for shellfish or seaweed culture in Alaska. In the study area and in other areas of Alaska, oyster farms consist of arrays of trays or nets suspended from rigid raft structures, usually composed of logs, boomsticks, poles, or plastic pipe. Some farms have a log float corral of boomsticks surrounding raft or tray array. One mussel culture operation is being carried out on similar raft structures in Kachemak Bay. Longline systems, similar to those in use in Japan and other countries, are being used for oyster and scallop spat collection and rearing experiments and have been proposed for mussel and oyster culture.

An indepth literature search indicates potential environmental impacts associated with floating facilities common to all culture techniques. Weston's study of impacts focused primarily on salmon net pen rearing facilities as well as mussel rafts and longlines. He summarizes potential environmental impacts into categories. Categories of impacts relevant to suspended shellfish mariculture (rafts or longlines) are as follows: 1) changes in water circulation, 2) changes in water chemistry, 3) sedimentation beneath culture operations, 4) alteration of phytoplankton biomass and productivity, 5) effects on benthic (bottom dwellers) communities and more mobile invertebrates and fish, 6) introduction of exotic species, 7) disease transmission from cultured to wild animals, and 8) proliferation of bacteria pathogenic to humans. Introduction of exotics and disease transmission are of concern in all mariculture. Weston summarizes potential impacts of floating mariculture facilities for Puget Sound (1986). This study provides relevant information which can be applied when considering potential environmental impacts of anchored floating facilities.

Alteration Of Phytoplankton Biomass And Productivity

Potential contribution of shellfish culture to phytoplankton blooms (due to recycling of nutrients, particularly nitrogen) was investigated by Weston (op.cit.) as a possible concern. Blooms are important to other shellfish mariculturists if the organism responsible for paralytic shellfish poisoning (PSP) is involved. Harmful blooms have been linked to shellfish culture only in extremely intensive culture situations in Japan. In Hiroshima Bay, Japan, *Heterosigma* blooms occurred for the first time after oyster culture productivity began to decline, and it was shown blooms were accelerated by oxidation of partly decomposed substances from shellfish excrement. In Funka Bay, PSP outbreaks from a *Protogonyaulax* spp. may have been linked to transfer of infected seed scallops from other areas or to changes in nutrition levels at the bottom of the bay (Mottet, 1981). Siting to avoid sediment accumulation should minimize potential for this impact in Alaska.

Mollusc filter feeding could reduce phytoplankton standing stocks on a localized basis. Imai (1971) documented a reduction of particulate matter of a magnitude of 76-95% after passage through 11 rafts supporting 50,000 to 90,000 oysters each. Reduced phytoplankton stocks is a reason to locate large or intensive culture operations, or several culture operations in waterbodies with good circulation and productivity. Effects of tidal action need to be considered in determining carrying capacity of bays for culture operations and separation distances between farms.

Guideline 1b should address this concern.

Effects On Benthic Communities And More Mobile Invertebrates And Fish

Should organic sediment accumulate on the bottom below floating mariculture facilities, the major effects would be on benthic animals, those living in or on the sediments. Impact studies have been directed at larger invertebrate animals such as polychaete worms, molluscs, and crustaceans, all important components of prey for important commercial species of bottom feeding fish. Weston (op. cit.) investigated both impacts on benthic community, organisms living in close contact with

sediments (burrowers and sessile filter feeders) and more mobile animals such as crabs, starfish, and fish which are able to exploit food resource provided by organic sedimentation but are not as intimately tied to sediment chemistry effects.

He provides an excellent summary of changes in benthic communities expected if sedimentation occurs, from which the following description is taken. Addition of organic matter initially enhances a community; number of species, abundance, and overall biomass increases as a food source and nutrients attracts detritus and filter feeders. However, if additional organic matter is deposited, eventually species survival is very low. The few species present are very abundant and biomass is high at this stage of organic enrichment. At higher rates of organic input there is a complete absence of benthic macrofauna, due to absence of oxygen in bottom waters and sediments as water exchange of oxygen decreases and is eventually too low to support aerobic organisms. Release of hydrogen sulphide to the water column, toxic to shellfish, occurs as a by product of metabolism by anerobic organisms. Development of an anerobic sediment layer also affects organisms that live within sediments (i.e., burrowers) since they also cannot obtain oxygen and they are eventually excluded.

In mussel farm effects studies in Sweden, Mattson and Linden (1983, in Weston, op. cit.) observed this progression under a longline in Sweden and also observed recovery after mussel culture facility removal that had been in operation for three years. Benthic community reached stages of low species numbers within 6 months and original species dominant in the community disappeared after 15 months. Six months after removal the bottom was still covered by 20-40 cm of mussel shells and sediments rich in sulphides. Only limited macrobenthic recovery occurred within a year and half. The area of organic enrichment was limited to within 20 m. of the culture site. Dahlbaeck and Gunnarsson (1981) also observed a accumulation of sediments rich in sulphides, and a progression towards anerobic sediments.

Intensive raft culture studies have been conducted in the rias of Spain. Two studies (Tenore et. al., 1982; Lopez-Jamar, 1985 in Weston, 1986) documented a benthic community under raft culture dominated by polychaete worms, with species diversity, abundance, and biomass decreasing over time. Ria de Arousa supports an intensive

raft culture that covers 10% of surface area. However, it is very productive due to extensive nutrient rich upwelling and high phytoplankton production. It supports about 2000 rafts and has one of the highest protein yields per unit area on earth. A comparison study of Ria de Muros with less than 100 rafts documented a high diversity and equilibrium assembly on muddy sediments (Tenore et al., 1982).

A study in New Zealand documented decreased diversity in sediments under mussel culture and presence of polychaete worms in contrast to brittle stars, molluscs, and crustaceans in a reference area (Kaspar et al., 1985 in Weston, 1986). Golikov et al. (1979) reported increased biomass and total respiration under mussel culture in the White Sea. He did not provide information on species diversity. Abundance and noted decreased productivity in reference areas was affected by siltation and unfavorable anthropogenic factors.

Sedimentation and resultant chemical changes can affect organisms that burrow into sediments such as clams. They can continue to obtain oxygen through use of siphons from water overlaying sediments, but mortality is likely as more sediments accumulate.

Mobile benthic species appear to benefit from all but the last stage of organic enrichment. Romero et. al. (1982) documents a higher density (up to six fold) of crabs under rafts than areas without rafts in Ria de Arousa in northwest Spain. He attributes this to their opportunistic and mobile feeding habits. Other studies in the same area document increases in bottom fish that may benefit from cover provided by shell deposits (Chesney and Iglesias, 1979 in Romero et. al., 1982), higher density and biomass values and denser populations of echinoderms, especially seastars (Olaso, 1979 in Romero et. al., 1982) under rafts. Weston (1986) cites studies in Puget Sound (Pease and Goodwin, unpub.), in New Zealand (Kaspar et. al., 1985), additional studies on Ria de Arosa in Spain (Tenore et. al., 1982; Lopez-Jamar, 1984), and in Sweden (Mattsson and Linden, 1983) with similar findings. Mussels which fall from rafts provide for growth of organisms and attract predators. Epifauna from rafts provides a food source for fish and starfish. Conversely, he cites a study in Japan (Ito and Imai, 1955) which documents an elimination of starfish in Japan in an area of extreme organic enrichment under oyster cultures. Some areas of in-

tensive scallop culture in Japan appear to have reached a maximum capacity for production. Densely stocked areas, such as Lake Saroma and Mutsu Bay, have experienced massive mortality believed to be due, in part, to declining water quality and toxic hydrogen sulfide production from bottom sediments (Motoda, 1977). This form of intensive mariculture developed over many years and can be avoided in Alaska with careful siting and bottom condition monitoring as culture intensity increases.

In summary, organic matter accumulation and a typical sequence of benthic changes can be expected under suspended shellfish culture facilities, unless bottom currents are sufficient to disperse the sediment. If the accumulation is deep enough and an anerobic sediment layer forms, the benthic community closely tied to life in or on the sediments and oxygen presence will be eliminated. In addition to loss of habitat for particular species, a decrease in abundance of food items can affect the food chain. In extreme cases, mortalities or toxic affects may occur in more mobile species associated with sediments and overlying water column. Many site factors influence occurrence of adverse environmental impacts. Baseline sediment chemistry and water quality, depth of water beneath the culture, and currents and circulation patterns in the waterbody are key variables determining rate of accumulation of organic matter. Areal facility extent and stocking rate are also key determinants on impact magnitude.

Guidelines # 1a, 1b, 1c, 8a, 8b and 12c were developed to avoid or minimize adverse of impacts to benthic communities as a result of organic sedimentation.

Suspension from Poles (Nets, Bouchot Culture)

Use of poles or pilings set in intertidal area is a method of mariculture for mussels and oysters in France (Magoon and Vining, 1981) and in Japan for net culture of Nori. Similar techniques are being employed in Washington (Washington DNR, 1987). Use of intertidal area permits a period of drying which may kill fouling organisms on nets and rearing structures. Bouchot culture of oysters and mussels in France involves attachment of netting or strings directly onto wooden poles. Culture grounds are fairly extensive on a mudflat area and truck access is used to replace pilings or perform various culture techniques. Siltation problems have been encountered due to its

location at a river mouth and connection of an extensive pole gridwork with interwoven branches (Korringa, 1979). Other techniques using stakes set in intertidal zones extending 6-8" above the bottom and "umbrella" culture with radiating ropes attached to stakes are described by Magoon and Vining (1981) as suitable for use in Washington. They recommended use of cedar, redwood, creosoted fir, or plastic stakes and reported PVC structures worked well. Nori net poles are traditionally bamboo, but a recent use of fiberglass has been innovative.

Pole suspension or pilings impact on intertidal area where used. Driving of piles or stakes might require access by heavy equipment and maintenance might require vehicle access. These operations result in compaction of substrate and loss of benthic habitat. Similar effects on organic matter sedimentation could occur in absence of currents sufficient to disperse sediments.

Guidelines 1b, 1c and 12a were developed to avoid or minimize these impacts.

Washington DNR (1987) identified potential significant impacts from Nori farms to include shading of eelgrass or seaweed beds, disruption of salmon migration and herring or smelt spawning, restriction of travel by marine mammals, and disturbance of sensitive bird species in nesting areas and overwintering areas (bald eagles, osprey, herons, trumpeter swans, peregrine falcons, waterfowl.)

Nori is generally farmed where the bottom is covered with loose sediment for ease in anchoring structures. Eelgrass grows on similar bottom types and needs surface light. Nori nets or rafts sited over eelgrass beds could reduce available light for eelgrass, resulting in lower productivity, food chain effects on fish and birds, and loss of substrate stability. Other seaweeds, such as bull kelp (*Nereocystis luetkeana*) grow attached to rocky substrates and are less likely to be impacted. They would foul and damage Nori culture so the presence of kelp would make the site undesirable.

Structures could disrupt migration of salmon or act as hiding areas for predators on salmon. Herring could spawn on the Nori. Structures offshore of traditional beach spawning areas could alter wave action and change conditions for herring and smelt spawning. No data is available on the impacts of existing Nori farms on salmon because they have been sited in depths greater than 10 feet

which avoids areas used by outmigration of young salmonids, but potential for adverse impacts exists (Washington DNR, 1987).

Guidelines 1e, 12a, 12b and 13d were developed to avoid or minimize potential impacts of Nori farming.

Intertidal and Submerged Structures

Racks are used in intertidal area to keep oysters separated for half shell trade. In Washington, cut lumber or poles are driven into low intertidal areas as uprights to support shallow trays (Magoon and Vining, 1981). Shallow water racks are used for Japanese oyster culture or fixed to the bottom beyond intertidal range, and also intertidally in France (Glude, 1979). In British Columbia, racks built at different tidal levels are used to transplant oysters between intertidal and submerged conditions at different life stages (Gunn et. al., 1983). A new technique in British Columbia makes use of rebar supports for cedar frames and plastic "pillow" bags with mesh tubing for young oysters. Areas are chosen for exposure to air 1-2 times per month for fouling control (J. Hemming, pers. comm.). In Germany, a submerged tray array has been designed. Trays are perforated plastic in a steel framework which is maintained by use of a barge mounted crane (Glude, 1979; Meixner, 1979).

Guidelines 1b, 1c and 12a were developed to avoid or minimize these types of impacts.

Bottom Culture

Oyster bottom culture has occurred historically in Alaska (Else, 1985), but it is not currently practiced. Bottom culture may involve enhancing natural beds of scallops or mussels or in creation of beds of these species or of oysters in areas where they are not growing naturally. Enhancement or creation of sea vegetable beds by placement of artificial substrates could occur, but any advantage of localized change to substrate are generally surpassed by overall productivity of sea vegetable bed habitats. Conversely, the specific impact of bottom culturing shellfish on existing benthic communities depends on the following: 1) composition of communities, 2) outcome of competition between natural community residents and cultured species for space and nutrients, and 3) predation rates on cultured species. These

types of impacts are impossible to quantify or predict in general terms.

Certain measures used elsewhere could result in impacts if permitted in Alaska. Resulting bottom alteration to make it suitable for culture or eliminate competitors or predators offers advantages and disadvantages. Measures for shellfish growing in Puget Sound include placement of shell, gravel, veneer cuttings, thin plastic sheetings below crushed shell, or gravel to provide a firmer substrate in areas with soft bottoms; and ploughing sandy bottoms, destroying eelgrass beds by covering them with plastic or roofing, and altering tidal levels through fill (Quayle, 1969). Quayle further describes the problem of ghost shrimp which can burrow extensively and soften oyster grounds. Use of heavy equipment or plastic sheeting to crush or suffocate them is recommended. None of these techniques have been proposed in Alaska; they are provided as examples of what is described as acceptable techniques in other areas to illustrate potential impacts.

In areas other than Alaska where bottom culture is practiced, predators are eliminated by lethal means. In Japan, starfish and sea squirts are removed by either dredging or liming (Ventilla, 1982; Wakui, 1983), fishermen are required to catch and kill a quota of starfish (Mottet, 1979), and oyster drills are collected manually at low tide (Glude and Chew, 1982). Starfish were removed from seeded natural beds of scallops in England (Mason, 1983). Urchins can be a significant kelp predator and efforts for control have included use of quicklime and hammers (North, 1973). However, in Japan, where urchins are eaten, one experiment involved culturing seaweed to fatten urchins, then harvesting them, and eventually establishing a natural system producing both kelp and urchins (Mottet, 1981). Labor intensive means which are not lethal exist to control predators. Dredges have been used to collect seed (Wallace and Reisnes, 1985), transplant animals at certain growth stages to other bottom areas at a different tidal level or to floating culture or to harvest the animals. If practiced in Alaska, potential for significant adverse impacts is high. Impact of dredges on scallop beds has been a problem in regulating commercial harvests from natural beds, which eventually decline after repeated harvests. Selective harvest of larger scallops is difficult to achieve because selective gear is soon clogged with debris and large animals block escape of smaller animals. Caddy (1973, in Mac-

Kenzie, 1979) reports effects of scallop dredging in the Gulf of St. Lawrence include: 1) mortality of younger scallops from mechanical damage during dredging or return to beds, 2) sublethal damage to scallops left in dredge tracks, 3) disturbance and roughening of the bottom, 4) siltation and packing of young scallops with sand or silt, and 5) attraction of predatory fish and crabs to dredge tracks. He documents densities of 3 to 30 times greater inside tracks than outside after dredging. A study in New Zealand (cited in Blackett, 1987) also documents high mortalities of young scallops associated with dredging; beds seeded with scallops at densities of 10/square meter has a survival rate of 20% after 9 months while those which had been dredged has a survival rate of .8%.

Guidelines 1d, 1e and 1f were developed to avoid or minimize these types of impacts.

Intertidal Handling

Use of intertidal areas adjacent to floating facilities is often desirable to hold animals out of water or in conditions where they are exposed to air at least part of the day. Air drying of rafts or nets is also a recommended technique to control many forms of fouling (Else, 1985; Nicholson, 1987). In Alaska, it can be expected at a minimum, oysters and mussels will require a period of holding out of the water while awaiting the outcome of PSP tests.

Impacts on intertidal areas depend on the activity, particularly if equipment is used to transport or process shellfish or structures are constructed. Compaction of substrate, pollution, and disturbance and elimination of existing intertidal communities are potential adverse impacts.

To avoid impacts to important habitats, site selection should include gravel or sand beach locations.

Guidelines 1f and 1g were developed to minimize these types of impacts.

Fertilization

Fertilization is used to increase nutrient supplies to seaweed cultures (Saito, 1979). Report of Swedish Steering Council for Planning and Coordination of Research (1983) described addition of 90% nitrogen/ 10% potassium pellets to Nori farms in Japan and use of 1 kg of fertilizer to produce 3.75 kg of Laminaria. An experimental

trial in California, however, resulted in a finding of no significant differences in growth of either Macrocystis or Porphyra following fertilization (Fei, 1983).

Fertilization may be proposed in Alaska as a technique to increase the nutrient supply in a localized area. Nutrient addition could offset any localized effects of nutrient depletion resulting from culture. As an example, nitrogen, which is generally the limiting nutrient to production in marine systems, will be added. It is possible fertilization could lead to eutrophication, reduction in dissolved oxygen content, and changes in bottom sediment chemistry in areas of restricted water flows and poor circulation.

Guideline 1b should minimize this type of impact should fertilization ever be proposed.

Potential Impacts Common to all Facilities

Introduction of Exotic Species and Importation of Seedstocks

Introduction of exotic species may compete with native species and the possibility of introducing associated organisms may have negative effects on native species. Alaska Department of Fish and Game has adopted a conservative policy toward introductions which should avoid these negative effects. Currently, the only species that can legally be imported into Alaska for use in mariculture is Japanese oyster (Crassostrea gigas) in spat form from approved sources. Due to lack of hatchery and laboratory facilities in Alaska for early stages of shellfish and seaweeds culture, it is likely that mariculturists will be interested in importing seedstocks of exotic species and of species native to Alaska. Nori in particular would have to be cultured as with an exotic species. Otherwise, development of techniques adapted to indigenous species would take at least 10 years. This situation has prompted a continuous effort to develop a plant mariculture policy for Alaska. A committee of pathologists, botanists, invertebrate zoologists, and prospective mariculturists is working to ensure a responsible approach. (M. Kaill, ADFG)

Under current policy, potential for spread of exotics is extremely low. Japanese oyster should not compete with native species if accidentally released into the wild, because it has never

reproduced under Alaskan conditions. However, Nicholson (1987) reports observing some gonadal development of cultured oysters within the study area after unusual conditions of high water temperatures reached 70 degrees for 3-5 days. Conditions were followed by a massive mortality. Importation of Japanese Nori strains appear to be of concern due to performance in Japan. One species, *Porphyra yezoensis*, has been cultured beyond its natural range and has almost entirely displaced *P. tenera* (Kafuku and Ikenoue, 1983). However, the two Japanese species have been introduced into Washington and have never been found growing wild there. Water temperatures are colder than those in Japan where reproduction occurs (Washington, DNR, 1987).

Stringent stock certification and inspection programs currently required in Alaska can avoid the accidental importation of exotic predators and disease organisms. It is desirable to avoid effects on native species, such as those created by Japanese oyster drill (*Ocenebra japonica*), introduced into Washington, and now a major predator on native oysters (Weston, 1986).

Guideline 14a currently established in law, is included to avoid these types of impacts.

Disease Transmission from Cultured to Wild Animals and Proliferation of Bacteria Pathogenic to Humans

Disease transmission from cultured to wild animals is a major concern related to importation of broodstocks and exotic species investigated by Weston (op.cit.). Conservative importation policies of ADFG minimize potential that diseased organisms would be introduced into Alaska. Cultured animals are at higher densities than under natural conditions, facilitating disease spread. Very dense stocking results in stress that makes organisms more susceptible to diseases and pathogens. Basis for human health concerns is food chain effects from bioconcentration occurring when pathogens accumulate in shellfish or fish subsequently harvested from cultures or from native populations, in close proximity to mariculture operations.

If bacteria of the genus *Vibrio* were to spread from cultured stocks to natural stocks, this organism would be of particular concern, because various species are pathogenic to shellfish, salmon, and humans and they are widespread in oc-

currence. Weston (1986) reviews available information about linkage between mariculture and increased incidence of *Vibrio*. He describes a possible route of increased human infection from sedimentation onto natural shellfish beds where bacteria would thrive under conditions of high organic input and where filter feeding molluscs would bioaccumulate pathogens. He describes several factors which he concludes contributes to a low incidence of infections in humans in general and could find little evidence mariculture contributes to proliferation of bacteria and strains pathogenic to humans. However, he did recommend floating facilities not be sited over harvestable shellfish beds to avoid sedimentation effects and noted this restriction would also minimize risk of pathogenic bacteria transmission to humans.

Adopting such a siting guideline 1e adds another safeguard to already stringent policy toward importation of exotics and certification of stocks as disease free.

Disease and Parasite Control

In the event disease or parasite infestations should occur, efforts to prevent or control disease and parasites and disposal of diseased animals could result in native stock impacts. Recommended methods of control vary based on cultured species and disease or parasite involved.

Three shellfish species likely to be cultured in Alaska have all experienced massive mortalities under some culture conditions in other areas of the world. Disease organisms have rarely been identified as causative factors; rather, death has generally been attributed to physiological changes resulting from stressful environmental conditions such as prolonged high water temperatures (Chew, 1987) or rough seas and wave rocking action (Motoda, 1977); improper handling of spat or seed (Ventilla, 1982; Wakui, 1983), and over stocking and resulting changes in water quality (i.e., self pollution) (Motoda, 1977; Koganezawa, 1979; Mottet, 1981; Ventilla, 1982; Wakui, 1983). Sinderman (1979) reviews many different and complex causes of oyster mortalities and identifies several oyster disease organisms.

Sinderman (1979) recommends methods for control of disease in oyster culture to include environmental manipulation through cleaning dead shell beds, selective use of chemicals, and removal of

intermediate or reservoir hosts; and of stock manipulation through moving oysters to less saline growing areas, planting at low densities, suspending at specific depths, moving oysters to low nutrient waters for part of the season, planting seed late, and harvesting early. He notes only one recommendation has been made for chemical control using organic mercury salts in early 1950's and this recommendation would not be made at the time the article was presented because of toxicity of these salts to other organisms. He also notes artificial propagation and development of disease resistant oyster stocks as a potential control technique.

Methods recommended for disease control do not appear to pose potential adverse environmental impacts. As described above, stringent control of exotic seedstock importation should minimize potential spread of exotic disease organisms.

In Scotland, mussels are parasitized by pea crabs (*Pinnotheres* spp.) and red worm (*Mytilicola intestinalis*) (Edwards, 1984). In Netherlands, parasites are a major mortality factor in culture of oyster species *Ostrea edulis* (Glude, 1979). Scallops also have naturally occurring parasites (Mottet, 1979; Ventilla, 1982). Suspended culture has been described as a technique which minimizes parasite problems (Herriott, 1984). Continued vigilance and stringent controls over importation of exotic seedstocks should minimize potential for exotic parasite introduction into Southeast Alaska ecosystems.

Fungal, viral, and bacterial diseases have been discovered in *Laminaria* and *Porphyra* culture and epiphytic growth of various organisms is a problem (Neish, 1979). Guidelines established by Washington Department of Natural Resources (1984) which spell out standard procedures for combatting these problems in Nori culture would not cause any adverse environmental impacts. Offering alternate food sources or enclosure in synthetic cages has been tried for protection.

Predator Control and Disturbance of Sensitive Species

As described above, mariculture involves maximizing single species productivity. Depending on natural populations present, eliminating competitors or predators may be desirable from the standpoint of the farmer. Mariculture can also involve considerable human activity resulting in

disturbance and displacement of species which cannot tolerate noise or pollution. Finally, species such as bears may become problems because of human confrontation and mariculturists may desire to eliminate them as well. Site selection can avoid impacts to species likely to become competitors or predators or which are sensitive to human disturbance by avoiding known concentration areas. Note that wildlife species which are of concern to the farmer because they are predators in one mariculture situation may be protected by regulatory agencies when in concentration areas where human activity disturbs the species.

Hanging culture eliminates the majority of predation problems from bottom dwelling predators such as sea stars, carnivorous snails, and various crabs. Efforts are generally undertaken to remove starfish and other invertebrate predators that attach to cultures or enter spat collecting devices and trays by hand, but there is generally no need to kill them. Starfish occasionally enter suspended trays as larvae and grow large enough to consume small oysters (Church, pers. comm.). Starfish reportedly require only a single removal from mussel culture (Herriott, 1984). Culture operations in areas other than Alaska have involved killing of invertebrate predators by use of quicklime (Magoon and Vining, 1981), but this practice can also kill many other animals as well. Some efforts may be made to trap crabs particularly in the vicinity of intertidal storage areas; crabs can be used for human food in accordance to sport fishery regulations. Predation problems can be minimized with other types of rearing structures by repeated checking and removal.

Marine mammals, some furbearer species, some invertebrate species, and a variety of bird species are attracted to mariculture facilities to prey on concentrated food source of their traditional food items. Predators on fish or shellfish cultures in Alaska are likely to include mink, land otters, harbor seals, sea lions, sea otters, bald eagles, herons, scoters and other diving ducks, and gulls. Sea lions, sea otters, scoters and diving ducks, and gulls are most likely to prey on shellfish cultures. Also, sea urchins, herbivorous fish, and some grazing snails may reduce productivity of seaweed culture through intensive grazing.

Steller sea lions prey on a wide variety of fishes and invertebrates, including bivalves such as clams and mussels. Based on review of food habit studies in Gulf of Alaska, researchers speculate importance of schooling fish species might indi-

cate a foraging strategy that minimizes effort and conserves energy (ADFG, 1985). While shellfish are often not the most important component of their diet when schooling fish are available, presence of concentrated bivalve cultures may be extremely attractive to this opportunistic predator.

Predator sea otters are most likely to result in conflicts with shellfish mariculture because of diet and expanding range in Alaska. Reduced to near extinction in the early 1900's, rehabilitation efforts have resulted in repopulation of historical habitat, with scattered groups occurring throughout southeastern Alaska. Sea otters have a highly variable and opportunistic diet which has included purple hinged scallops, mussels, and a variety of clams. They tend to concentrate on a single prey item, feeding on it until it is drastically reduced. They also have an important role influencing stability of nearshore communities. When introduced into an area with kelp beds, they can control macroinvertebrates feeding on kelp, such as sea urchins. This shifts kelp beds towards higher productivity which supports higher concentrations of small herbivores in turn supporting higher populations of fish that prey on small herbivores (ADFG, 1985). Sea otters are potentially serious predators on shellfish cultures while their presence may benefit seaweed cultures.

Based on a study of food habits in Cholmondeley Sound, land otters are primarily fish eaters in Southeastern Alaska, although identification of shelled molluscs in scats is difficult if they are able to remove shells (Larsen, 1983). A study in the same area on mink food habits concludes mink forage in lower intertidal zones, feeding primarily on crabs, nearshore fish, and isopods. Quantification of importance of bivalves in their diet appears as problematical (Johnson, 1985). Johnson (op. cit.) cites a study of mink trapped in the Petersburg, Wrangell area which documents a high percentage of clams in mink stomachs (Croxton, 1960 in Johnson, 1985). A shellfish culture could attract mink and otter and result in predation, although Church observes mink feed on crabs and other organisms in surface oyster trays but do not feed on oysters at a Blashke Islands culture site.

Several species of diving ducks feed heavily on bivalve molluscs. Scoters, goldeneyes, and harlequin ducks, in particular, feed heavily on mussels and may however, find oysters palatable. One oyster farmer in the Blashke Islands reports no

problems with bird predation on surface trays (John Church, pers. comm.) Gulls are opportunistic predators and may also prey on shellfish cultures; experimental *bouchot* culture of mussels was subject to severe gull predation in Ireland (Herriott, 1984).

Lethal methods of predator control offer the greatest impact mariculture could have on existing native wildlife. If facilities are not properly sited to avoid predation problems, killing predators cannot be assumed to be an acceptable means of control due to the current statutory and regulatory protection of most species. Alaska Department of Fish and Game considers mariculture facilities to be attractive nuisances to predators and does not favor destruction of predators under 5 AAC 92.410 (a)(2) which permits taking of animals in defense of life or property under some circumstances (Alaska Interagency Mariculture Workgroup, 1988). Other restrictions on harassment or killing of marine mammals, of migratory birds, or of bald eagles exist in federal law, in Marine Mammals Protection Act, Migratory Bird Treaty Act, and Bald Eagle Protection Act, respectively.

Jefferds (1987) reports on chronic problems with scoter predation of mussel rafts in Washington. A variety of techniques were tried, of which net enclosure of rafts was most successful. He notes a problem with gulls able to get between the logs of mussel rafts from above and unable to get out either through net or between logs. Several were drowned but predation on mussels did not appear to be significant. Line or string can also be strung as a web to minimize bird predation from the air (Herriott, 1984; M. King, pers. comm.). Canadian Department of Fisheries and Oceans (1986) recommends sheet metal collars on cables, boom sticks, and stiff legs which are attached to shore to prevent passage of furbearers onto floating structures. A French crab fence has been designed with plastic mesh walls supported by uprights with outslipping eaves dug into the beach to protect mussel rafts (Herriott, 1984). Finally, netting has been used successfully in beach culture of Manila clam to exclude moon snails and other predators (Chew 1987) and in culture of butter clams to reduce predation by crabs, sea stars, and scoters (Gunn et al., 1983).

Alaska Oystergrowers' Manual (Else, 1985) recommends use of mesh or plywood covers over oyster tray rafts to keep out birds and bears. Fencing has been recommended to keep crabs out

of intertidal storage areas (Glude, 1979) and cages have been used to protect seaweed seedlings from predation by grazing snails (Saito, 1979).

Placing crops which will not be harvested near the surface has been recommended for seaweed (Saito, 1979) and for mussels. Gunn et al. (1983) finds the provision of a sacrifice crop of mussels near the surface results in a productive crop 5-10 m below surface in an area with severe duck predation in British Columbia.

Whereas a variety of measures exist to minimize predation problems on hanging cultures, eliminating predators from bottom culture areas appears to be more difficult to accomplish in Alaska without resorting to lethal means used elsewhere. Starfish are frequent predators on shellfish. They are widespread and abundant in productive intertidal areas which are suitable for bottom culture. A variety of boring snails (whelks and drills) also occur; their potential as oyster predators is not known. In fact, many descriptions of bottom culture practices emphasize cost considerations of methods which are generally less expensive than floating culture and describe lower productivity due to predation as an accepted consequence of selecting this method.

Human activity associated with all mariculture can displace species from preferred habitats or important concentration areas. These species include harbor seals, whale species, bald eagles, and many species of waterfowl, waterbirds, shorebirds, and seabirds. Sensitive habitat areas include harbor seal haul outs and pupping areas, heron rookeries, bald eagle nest and perch trees, waterfowl concentration areas, and seabird nesting colonies.

Improper disposal of garbage and wastes from shore based facilities may attract brown or black bears. Church reports bears have destroyed beached oyster culture structures on some occasions, possibly because of its attractive smell as fouling organisms die and decay. Mariculturists create attractive nuisance in these situations. Human development, in general, results in negative impacts on bear populations through displacement and bear mortalities following bear and human confrontations.

Guidelines 2a, 2b, 2c, 2d, 3a, 3b, 3c, 3d, 10a, 10b, 10c, 10d, 10e, 10f, 13a, 13c, and 13d were developed to avoid or minimize these types of conflicts.

Fouling Control

Organisms which grow naturally on substrate of bivalve shells, on surface of seaweed, or on mariculture structures are considered to be fouling the culture. As described in Capability sections for each species, fouling organisms can reduce productivity through competition for nutrients or food items, parasitism, or restriction of water flow. Degree of fouling varies with site conditions; however sites with high phytoplankton productivity suitable for shellfish culture are ones most likely to have a high level of fouling organisms. Fouling has made culture of some species of seaweeds in Puget Sound (Mumford and Melvin, 1983) and of scallops in hanging culture in New Zealand (Blackett, 1987) economically unfeasible.

Major techniques for fouling control include: (1) air drying rearing structures and cultures to kill fouling organisms which cannot tolerate prolonged exposure (Korringa, 1979, Magoon and Vining, 1981; Kafuku and Ikenoue, 1983), (2) timing seed/spat collection or outplanting to avoid the settling of encrusting organisms (Ren-Zhi et al., 1984, Mumford and Melvin, 1983), (3) increasing stock density by reducing spacing on ropes and strings (Mumford and Melvin, 1983), (4) suspending cultures lower in the water column, (Motoda, 1977; Mottet, 1979) or lowering them only during time of settlement (Ventilla, 1982); and (5) manual scrubbing or cleaning with high pressure hoses (Magoon and Vining, 1981); and (6) biological control, using natural herbivores or predators (Else, 1985). Other recommended techniques for seaweed cultures include immersion of seaweed nets in citric acid and use of chafers, small discs on lines (Mumford and Melvin, 1983). Else (1985) recommends the following techniques for oyster culture in Alaska: (1) siting in areas with tidal action to discourage settling of fouling organisms, (2) deep suspension to discourage seaweed attachment and deter barnacle and mussel setting in the spring, (3) allowing rafts to dry out on a sunny, windy day, (4) cleaning gear by removing it from the water for at least one week then leaving it in half tide level for scavenging, (5) manual scrubbing, and (6) cleaning with pressure hoses. Else describes biological control of fouling organisms using their natural predators.

In some areas, antifouling chemicals have been used on structures but because these work by killing marine organisms, they may kill many or-

ganisms and may also bioaccumulate in cultured animals. One substance, tributyltin or TBT, has been prohibited for sale by statute in Alaska. With exception of the use of antifouling substances, recommended methods of fouling control should not result in adverse environmental impacts.

Guideline 9d and 13b were developed to minimize the impacts of fouling control.

Disposal of Wastes

Mariculture operations can generate a variety of potentially polluting wastes. These wastes include solid waste, sewage, waste oil, diseased or spoiled animals, etc. Improper disposal of garbage or organic wastes is of particular concern where it may become attractive to brown or black bears.

CONFLICTS WITH OTHER COASTAL USERS

Mariculture is a relatively new use of Alaska resources and has the potential to conflict with more established uses. Many existing uses are dispersed over large areas but other activities likely to produce pollution are often localized. These conditions provide opportunities to site mariculture facilities that avoid conflict with other users. Not all conflicts can be resolved, but most can.

Resource agencies in Alaska sometimes lack detailed information on all uses occurring in vast coastal areas. Use patterns can be dynamic, varying dramatically in response to changes in natural conditions and government regulations. Resource agencies conduct planning and permit review processes to provide opportunity for existing and potential resource users to identify their needs.

Stringent water quality standards for growth of marketable seafood products will limit the suitability of sites to those with physical locations separate from uses that produce pollution. Determining acceptable separation distances will guide any conflict resolution process and will determine areas where mariculture and other uses are incompatible.

This section will discuss major conflicts with other users of Alaska's coastal resources.

Land Management Issues

Resource agencies share responsibility for development of new industries that depend on public resources for development. Primary land use manager for the state is Department of Natural Resources (DNR). As state land and

water resources manager DNR is responsible for developing state land and water resources while at the same time providing for resource conservation and protection.

DNR historically has been the state agency facing new industry needing access and use of state land, such as prospective barley farms, coal mines, petrochemical plants, shore based seafood processing facilities, geothermal energy developments, and cattle ranching. Developers need assurance of long term property rights to secure financial backing and so they don't lose control of sites they have made significant capital investments. DNR's responsibility is to ensure commitment of state lands will be lawful, in the public's best interest and will produce viable new industries, useful products, stable jobs, and a hopefully a fair market value.

Other resource agencies such as ADF&G and DEC review development proposals and provide guidance for development and protection of resources in their areas of responsibility. These agencies and others share in Alaska Coastal Management Program (ACMP) which provides for a coordinated review of all coastal development in Alaska. (See Chapter 4 for discussion on ACMP)

Mariculture is a new and expanding industry in Alaska, and may become a significant long term use of state tide and submerged lands. Alaska must achieve balance in our regulatory programs which will allow industry to thrive, while at the same time protecting existing uses of land. These problems may occur if we do not achieve balance; displacement of public uses such as recreation and

fish and wildlife harvest; conflicts with other commercial uses of tide and submerged lands; land speculation; impacts on adjacent land holders; and stifling of an emerging industry.

Mariculture Development Land Use Needs

Successful mariculture developments share a number of basic requirements. Foremost among these is a need to secure appropriate sites. Desirable features of a mariculture site are also desirable for other uses, such as anchorages. Even in rural Alaska, it is a rare mariculture site that does not also attract other users.

Resolution of use conflict usually involves two approaches:

1. Separation of uses. Competing uses can often be separated to avoid conflicts.
2. Mitigating measures, such as site design, timing restrictions on use, or access corridors stipulations may allow more than one use of a site and resolve conflict.

Unfortunately, not all conflicts can be resolved to allow multiple use of the same site. It is then the land managers responsibility to determine best use of state lands. Such conflicts are more likely to occur in areas not covered by an appropriate land use plan. (See section on planning processes in Chapter 1. Experience has been, however, many conflicts can be resolved using a systematic approach developed by state agencies over many years of working on resource use conflicts.

Displacement of Public Use

Presence of structures in water can physically displace other uses requiring surface access. Mariculturists sometimes apply for land use of areas larger than physical dimensions of the structures (see Table 1) in order to minimize impacts to their operations from other human activities. Physical displacement can exist for farm site as well as for upland facilities. This may affect an even larger area if other human activities require a degree of solitude.

Culture technique is one variable determining if displacement will occur, and the magnitude of physical displacement. Bottom culture and submerged structures have least impact on natural

resource harvest, boating and on aesthetic enjoyment, but may displace fish and wildlife harvests of bottom dwelling species such as crab and clams.

Alaska Department of Fish and Game and Alaska Boards of Fish and Game cannot legally restrict harvest to single commercial (for profit) users. State law also requires access to other lands must be preserved.

Both long lines and rafts can interfere with recreational and commercial harvest activities. While longlines require only surface floats, in contrast to log boom structures commonly used as rafts, very extensive long line grids are used in other countries such as Japan (see Table 2).

Floating culture of shellfish and seaweed are commonly kept separate by some form of negotiation in other countries. Japanese, fishing cooperatives allocate conflicting uses, prohibiting fishing boats and nets in areas of seaweed culture, (Olson, 1987) and prohibiting suspended culture in near-shore areas where fishing rights are maintained over bottom culture areas (Ito et. al., 1975).

Aesthetic conflicts are less tangible than physical displacement. Long lines may be less objectionable than rafts in terms of their visibility, however some people object to floating structures in front of recreational homes or cabins, to associated activities and noise that results from mariculture operations. Aesthetic objections from recreational home owners have been an issue in New Zealand (Dias 1984), in Washington (Freeman, 1985; E. Hurlburt, pers. comm., 1988), and in British Columbia (Butler, 1986).

Recreation

ACMP standards for recreation requires state agencies give high priority to maintaining public access in coastal waters. Mariculture may block or inhibit public access to important recreation areas.

Expectations and desires for seclusion when recreating in rural Alaska is highly valued by residents and visitors. A mariculture facility, particularly with caretaker facilities located in a smaller cove, will essentially eliminate that sense of seclusion for recreation users other than sea farmers. Tendencies are for traditional recreational users of the cove to find other secluded and aesthetically pleasing areas. Coastal resources

may receive competing use in many areas. Degree and intensity of recreation pursuits are difficult to define and may be dynamic in nature. Rural coastal areas receive dispersed recreation activities by small groups or individuals at widespread and diverse sites.

Anchorage

Potential conflicts exist between anchorages and mariculture development. Mariculture sites need room for floats, rafts and other water borne structures. They also need pristine waters free from high coliform counts and other forms of pollutants. Some organisms and growing facilities are adversely affected by waves from boat wakes.

Boats need room to maneuver and anchor. Some boats inadvertently discharge waste products into water. Some boat operators may ignore sound waste management procedures and choose to discharge contaminants at will. Not all boat harbors in Southeast Alaska have adequate holding tank pumping stations available making it difficult for even conscientious boaters to comply.

Raw sewage means contamination of marine organisms by coliforms. Waste products such as chlorine used by some boats to flush sewage tanks and bilges are highly toxic to mariculture organisms. Heavy metals associated with fuel and oil wastes contain heavy metals readily absorbed and held by many species of sea vegetables.

Current facts indicate large, heavily used anchorages and mariculture facilities are incompatible. Sewage, chlorine from sewage systems, diesel, oils or other waste products discharged from boats near a mariculture facility may result in unacceptably high coliform counts or other forms of pollution. Infrequent boat activity, that does not discharge harmful products into the water is not a significant problem.

This situation could be improved by the compliance by all boats holding sewage and waste products for acceptable disposal. Development of dumping facilities in more commercial harbors may also help to alleviate sewage problems.

Potential mariculture sites proposed in known anchorages should have alternate anchorages nearby. High use anchorages with no nearby alternative anchorages will have difficulty being permitted or leased for mariculture sites.

Smaller, secondary anchorages with alternate anchorages nearby will probably be more successful.

Mitigating measures for this conflict usually means locating the two facilities far enough apart so there is no conflict.

Another potential mitigating measure might be adoption of a "relay" system. Under this system shellfish are taken from contaminated or polluted areas to non contaminated waters. Shellfish are held for a minimum of two weeks to cleanse themselves. Testing indicates when the acceptable product is released for sale. Actual time for this cleansing process may be considerably more than two weeks.

Relaying has not been tried in Alaska. It may require substantial handling and facilities that would add to the cost of products. Further testing would need to be done if this system is considered.

Fish and Wildlife Harvest

Both long line and rafts involve structures that can interfere with commercial and non commercial harvest of fish and wildlife. Long lines require only floats on the surface, log boom structures commonly are commonly used as rafts. Other countries use very extensive long line grids. (See table 2)

Conflicts between mariculture structures and other uses depends partly on if the farmer needs to restrict boat traffic. Farmers may wish to limit boat traffic to reduce vandalism, or reduce wave action. Personal use crab fisheries could be very productive around rafts.

Subsistence harvests are important activities in most areas where mariculture may occur. Conflicts between mariculturists and subsistence users occur as more facilities are developed. Development of direct competition for subsistence resources will increase as new residents enter rural areas or loss of subsistence opportunities occur around mariculture facilities placed in important subsistence resource areas.

Results of a Subsistence Study currently being conducted by ADF&G, Division of Subsistence will be helpful in identifying conflicts.

Conflicts with Other Commercial Uses of the Tidelands and Submerged Lands

Best sites for mariculture facilities may often be best sites for other uses such as mineral or timber transfer and support facilities, log storage, commercial fishing grounds or anchorages, or commercial recreation development. Although mariculture is a new industry in Alaska, some conflicts have surfaced in Kodiak, Prince William Sound, and Southeast. Experiences in British Columbia and Washington have demonstrated these conflicts can occur.

Besides need for space, water quality standards for mariculture may preclude use of favored sites for other commercial or industrial facilities. Forcing more stringent mitigation measures or alternative siting for timber, mineral transfer, or tailings disposal could reduce or eliminate economic viability of resource extraction industries in a given area.

Conversely, mineral or timber transfer sites, log storage sites, and floating camps associated with resource development activities may limit space available or degrade water quality for mariculture facilities, making mariculture development more difficult and less likely.

Commercial Fishing

Commercial fishing seldom occurs in secluded coves and bays that are more commonly suitable for mariculture in the study area. Nevertheless, these protected coves may be important to the commercial fishing fleet because they provide safe anchorages close to fishing grounds or tenders. (See discussion on anchorages earlier in this chapter.)

Potential conflicts may develop due to fishing hook off points. These are locations near shore where commercial fishing nets are set for harvest of fish. Hook off points can occur virtually anywhere along shorelines free of rocks or other obstacles that would tangle nets. Some hook off points are valuable sites for fishing boats as fish migration patterns bring them to the same area year after year. Culture techniques utilized by mariculture operations requiring restricted use of open shorelines have the potential to conflict with hook off points.

Conflicts may be limited to those times of year fish harvest occurs. Separation of uses may be the only practical solution to this type of conflict.

Commercial Recreation

Commercial Recreation In The Form Of Hunting and fishing guiding, or the establishment of recreation lodges have potential for conflict with mariculture development. Aside from potential physical displacement, such recreation development could provide sources of point pollution.

Type and degree of conflict can only be determined on a case by case basis.

Logging

Conflicts with timber harvest operations may occur because floating facilities can interfere with log transfer and floating storage operations. In the study area, timber harvest on Forest Service lands is continuing and operations require log transfer at tidewater, storage of log rafts in protected bays and inlets, and towing rafts to mills. Conflicts may arise because of: 1) the overlap of many siting and operational requirements for log transfer and storage and for mariculture, particularly a requirement for protected waters; and 2) the potential for degradation of water quality in the vicinity of log transfer facilities.

Log transfer and storage area siting involves a detailed review of potential environmental impacts and conflicts with other uses. Suitable sites which meet environmental and industry criteria are generally limited in number. Unless mariculture, log transfer, and storage can co exist, there may be direct competition for sites.

Bark and other organic debris resulting from log transfer and storage can have adverse impacts similar in nature as those associated with floating mariculture facilities (Pacific Northwest Pollution Control Council, 1971; Pease, 1974; Schultz and Berg, 1976; Duval and Slaney Co., 1980). Anaerobic sediments can form and hydrogen sulphide may be released. Freese and O'Clair (1984) documented a relationship between low dissolved oxygen concentrations, high hydrogen sulphide and ammonia concentrations, and mortality in mussels and littleneck clams exposed to decomposing wood wastes under laboratory conditions. Decomposition of log wastes can also release

leachates which are toxic to some species of shellfish (Buchanan et al., 1976)

The close proximity of a log transfer facility and floating mariculture facilities in a small or poorly flushed waterbody could result in contamination, disease, or mortality of cultured animals. Bottom culture should be precluded in areas where large quantities of bark could potentially be deposited. Intertidal storage and upland support facilities should be located to minimize potential problems.

Other types of water quality conflicts may also occur. Use of pesticides at dry land log storage sites has been proposed in Alaska (e.g., the use of lindane mixed in diesel oil to control ambrosia beetle at Thorne Bay in 1983). These substances can be bio-accumulated in shellfish. Requirements for boat and seaplane traffic for timber harvest and transfer operations also increase the potential for hydrocarbon pollution. Sewage discharge from logging facilities would also be of concern as a possible point source of pollution. Logs are sometimes lost and floating debris may damage mariculture structures.

No known mitigating measures exist that could increase compatibility. Distances between TTF's and mariculture sites are determined largely on a case by case basis due to currents and other physical characteristics of the area in question.

Mining

Potential conflicts in the form of direct competition for suitable sites for mineral transfer and mariculture are similar in nature as those between mariculture and logging activities. Remote hardrock mine sites require upland facilities to process ore, transfer facility operations, and for load barges transporting ore to markets. Options for siting mariculture facilities in proximity to the mine site are limited. Water quality impacts can result from mining operations. Disposal of tailings in marine waters that contain high concentrations of heavy metals or result in high levels of turbidity and suspended sediments are inherent conflicts. The potential for water pollution from sewage discharge, boat fuel hydrocarbons, and waste oil is similar to that for logging support facilities and operations.

Urban Development

Industrial and commercial development of shorelines may conflict with requirements of mariculture developments through physical competition for space or through a variety of pollution sources. The degree and type of impact is site specific.

Tongass National Forest manages most lands in the study area. No urban development is planned at this time.

Residential Development

Residential development along shorelines or floathomes can compete for physical space with mariculture facilities. Residential development can also result in point source discharge of sewage. Presence of shoreline residents can result in objections to mariculture on aesthetic grounds. One subdivision exists in the study area with both private and state ownership. Conflicts between mariculture facilities and residential development may be minimal.

Olive Cove contains land in private ownership so the possibility of conflict could exist. Public and agency review should address these potential concerns if a mariculture site is proposed in this area.

Historic or Archeological Sites

Upland development associated with mariculture, or any other upland development, is not compatible with historic or archeological sites. By law, these sites must not be affected or, as a last resort, extensive mitigation is required to identify and record values before impact occurs.

Because of limited surveys of variable intensity, all historical and archeological sites have not been located within the study area. Location of known sites will not be provided in an attempt to prevent vandalism. Applicants desiring upland use must initiate a site survey by a qualified archeologist. A U.S. Forest Service Special Use Permit for upland development will normally be denied when historic or archeological values are found on or adjacent to the requested site. State permits may similarly require extensive mitigation or be subject to denial on these grounds.

Land Speculation

Prior to 1986 British Columbia experienced a dramatic rush for permits which allowed the holder to enter and occupy a site to conduct research for up to one year. It appears that these permits were being issued for large areas of land with little regard for potential impacts to the public. A gold rush image was created resulting in a great deal of public concern, and subsequently a moratorium was imposed. Alaska does not have an investigative permit similar to this permit but we could experience land speculation in other forms, most notably by applying for permits and leases to tie up a site.

Land speculation in this case is described as obtaining land use rights with the intent of not using the land for proposed uses but selling those rights for a profit. This problem is not unique to mariculture and it can occur in any use of state land. Speculation can be greatly reduced by close monitoring of development schedules and writing conditions in land use documents that would allow agencies to revoke permits or leases if the development is not proceeding as proposed.

Impacts on Adjacent Land Owners

Mariculture can impact adjacent land owners in a variety of ways: loss of tidelands access, boat moorage, loss of view, noise, loss of privacy, loss of habitat, and changes in water quality. This has been a significant issue in Washington and British Columbia, and may become a concern in Alaska.

Adjacent land owners have a number of ways to participate in mariculture facility siting. They can participate in development of state land use plans, coastal zone management programs, and local comprehensive plans. Adjacent owners are notified by mail of pending applications and are given an opportunity to comment on projects. A 30 day public notice pursuant to AS 38.05.945 is required for leases. Local governments, regional or village native corporations, and local coastal districts, communities are also notified. Local government or regional native corporation may hold public hearings if necessary. Department of Natural Resources reviews all of these comments and weights the use and enjoyment of the adjacent owner against what is considered to be state's best interest.

Land use conflicts for upland facilities are adjudicated in the study area by Forest Service officials utilizing the Tongass Land Management Plan.

Upland Access

Access is a major consideration under current permit and lease review processes. A part of the state's "best interest" determination is an evaluation of impacts on access, especially to upland owners. Access is important for recreation and hunting on public lands. Water craft, aircraft and in some circumstances by land vehicle access can occur.

In most circumstances, access can be mitigated on a mariculture site by specification of easements or access corridors on permits or leases. In some circumstances there is not sufficient room to separate two uses. Under these circumstances access may be allowed over other forms of development if a reasonable alternative cannot be found.

U.S. Forest Service As Upland Managers

As primary managers of uplands in the study area, the U.S. Forest Service has the responsibility of management of upland permits for mariculture development. Land use designation (LUD) I, II, III, and IV of Tongass Land Management Plan provides guidance for development in Tongass National Forest.

Following is a brief description of four major land use designations:

LUD I (and LUD I Release Areas) - This designation is primarily a wilderness designation. It provides for minimal development compatible with maintenance of natural character of land.

LUD II - This designation is managed in a roadless state to retain its wildland character but would permit wildlife and fish habitat improvement and primitive recreational development. (The study area contains no LUD II lands)

LUD III - This land is managed for a variety of uses. Emphasis is on managing for uses and activities in a compatible and complementary manner to provide the greatest combination of benefits. These areas have either high use or high amenity values in conjunction with high commodity values.

LUD IV - This area will be managed to provide opportunities for intensive resource use and development where emphasis is primarily on commodity or market resources.

The southern half of Etolin Island is currently designated as LUD I Release. These lands are being managed to provide opportunities for solitude and primitive types of recreation in unaltered environment.

Components of mariculture projects occurring above the mean high tide line must be compatible with the goals of the LUD classifications. Development in LUD IV areas is more acceptable than within the LUD I Release area. Development in all LUD areas will be restricted to structures specifically designed to blend into surrounding landscape. Size, location, and color of structures and the amount of trees to be removed will be specified by the Forest Service for development in all LUD's. Although goals for TLMP do not apply to the waters below mean high tide the Forest Service expects permitted activities on water adjacent to the Forest will be compatible with management direction for surrounding uplands. (for additional planning information see Chapter 1, Land Use Planning)

There is currently one Special Use Permit for an upland facility to support mariculture development in the LUD I Release area. No more permits will be issued unless the designation changes to LUD II, III or IV.

Tongass National Forest is presently revising its land management plan for National Forest lands including the Etolin Island area. Specific direction on how the resources on Etolin Island will be managed will appear in the plan. Until the revision is completed current Tongass Land Management Plan direction and guidelines will apply to mariculture developments.

Cumulative Effects of Expanding Tidelands Use

For most of coastal Alaska, mariculture facilities are permitted on an individual basis. Impact from one or two farms may be minimal, but cumulative effects of numerous farms on existing uses may be dramatic. DNR management and area plans provide a process for resolving use conflicts on a regional basis, and best interest finding required under AS 38.05.035(e) provide mechanisms for

resolving conflicts on individual permits/leases. Although a regional perspective is preferred, cost of management and area plans prohibits their use as a routine method of sorting out problems and resolving conflicts. Lack of a regional perspective could lead to significant conflicts over time and is a major problem with the existing process.

During development of statewide guidelines, Alaska should evaluate what British Columbia experienced during its initiation to finfish aquaculture. Immediate needs for coastal planning occurred because they were seeing a loss of access, a loss of anchorages, impacts on upland owners, impacts on recreation, and tourism. British Columbia placed a moratorium on leases and licenses for finfish farming and began an inquiry into finfish aquaculture and its impacts. Inquiries were completed in 1986. How well their conclusions or recommendations apply to Alaska conditions is uncertain.

Following is a list of recommendations from the British Columbia inquiry. They are included here for reference only:

1. The government should develop an aquaculture policy which clarifies direction, agency roles, and the responsibilities of both government and the private sector for the industry. The inquiry indicated that a clear policy would alleviate public concerns over lack of controls and lack of protection of the public resource. It would also serve to offset creation of the image of an uncontrolled land rush, which has generated misunderstanding and suspicion about government objectives.
2. Initiate land use studies that would identify sites of high value for other important coastal interests. Use these studies to direct aquaculture away from major resource and use conflict areas.
3. Local governments should be encouraged to develop or revise district coastal management plans and local land use regulations to address mariculture development within their boundaries.
4. The land management agencies should review their practices involving advertising and notification for proposed aquaculture facilities. This includes notification to local governments. The inquiry recommended a 60-day review period.
5. The land management agencies should require a commitment bond to reduce speculation and a clean up bond in the event of abandonment.

6. The aquaculture industry should be encouraged to institute a program to provide anchorage, access, and emergency assistance to other coastal users.

7. Establish a minimum distance separation guideline for farms as a means of reducing impacts on upland owners and other resource users.

Further study and evaluation of the British Columbia inquiry should be undertaken before determining if these recommendations apply to Alaska.

Summary

While numbers of potential problems are large, it appears that most land use problems associated

with mariculture can be resolved. Appropriate land use plans and permit review process are useful to resource agencies to accomplish resolution of conflict. Developing comprehensive area plans is desirable but time consuming (2-3 years) and expensive. A streamlined process needs to be developed and implemented which evaluates land use issues, including cumulative effect of multiple mariculture operations. Such a process should include provisions for local participation and be designed to reconcile land use conflicts in a timely manner.

Refined policies and regulations are being developed from newer and more accurate information by all resource and review agencies. This will greatly assist land management agencies in resolving conflicts among coastal users.

GUIDELINES AND MITIGATING MEASURES

Relative Measures of Suitability

In developing a mariculture facility several factors need to be considered: 1) if the site is capable of commercial production, 2) is the site able to meet the requirements of the facility design, and 3) is the development an acceptable use of public land and water?

The interactions between factors are complex, and may fluctuate from season to season or from year to year. The economic environment may support development, or can contribute to failures. Other uses sometimes compete for limited resources.

The following discussions are presented to assist agencies or individuals in determining the suitability of a site for select species of shellfish or kelp. It is unlikely any single site will be the "million dollar" site in all respects. Therefore, these indicators will be helpful in estimating the relative suitability of proposed mariculture sites.

Guidelines for Siting Shellfish and Sea Vegetable Mariculture Facilities and Mitigating Impacts

"Mitigation" is the process of avoiding or minimizing adverse impacts. Proper siting of shellfish and seaweed mariculture facilities should result in avoiding the majority of adverse impacts that might otherwise occur.

Conflicts over mariculture siting have resulted in the development of siting criteria and zoning in both Washington and British Columbia. In both areas, the conflict has primarily been over finfish net pen siting, however the guidelines developed are in use for "all aquaculture proposals involving floating structures and improvements" in British Columbia (B.C. Ministry of Forestry and Lands 1987).

Proposed siting guidelines are based on a review of the interim guidelines for the management of salmon net pen culture in Puget Sound (Science Applications International Corporation 1986), on the draft guidelines for development and operation of aquaculture and fish processing facilities (Department of Fisheries and Oceans Canada, Pacific Region 1986 a,b), on siting guidelines

developed by ADF&G for other forms of coastal development and for area plans.

Guidelines proposed here are based on several assumptions: 1) mariculture in the near future will be similar to that currently practiced (i.e., floating structures will be used, but bottom culture techniques may be proposed), 2) regardless of culture technique used, exclusive use of areas will be desired by farmers, 3) sites require expansion potential, 4) farms require potential for access to and use of adjacent uplands for support facilities and use of intertidal zone and beach above high tide for beaching gear, and storing or hardening shellfish. Some criteria are in conflict (e.g., increasing stocking density to reduce areal extent to minimize user conflicts vs. decreasing stocking density and increasing areal extent to minimize sedimentation impacts). Applicability of each guideline will depend on specific sites and proposal under review but they are included in the report as guidelines to both prospective sea farmer and to project reviewers.

Fish and wildlife concentration areas and human use areas described in criteria have been mapped as part of this project for Etolin Island area.

Guidelines are organized into three phases; siting, project design, and operations. If sites can be selected which avoid areas described under Siting Guidelines, then measures described in subsequent sections to mitigate impacts through design or operation may be unnecessary.

Siting Guidelines

1. To minimize adverse impacts on productive benthic habitats:

1a - Conduct a site survey to determine flushing regime, benthic community composition, and baseline water quality (i.e., dissolved oxygen levels, presence of toxicants or contaminants)

1b - Site floating facilities and intertidal structures where currents are strong enough to disperse organic deposits. Avoid siting in small embayments with sills, natural restrictions to tidal exchange, or existing water quality problems.

1c - Site floating facilities or structures em-

bedded in the substrate in areas with least productive benthic habitat. Avoid shallow areas (less than 40 feet deep at Mean Lower Low Water).

1d - Because bottom culture site requirements are likely to conflict with maintenance of existing productive benthic communities, detailed site analysis including a dive survey should occur prior to siting. Bottom culture requirements should be defined. Information on the existing benthic community, proposed methods of reducing or eliminating predation, stocking rates, and potential effects on competing species should be provided. Feasibility of culture in alternative sites which have lower benthic productivity should be evaluated.

1e - Avoid siting within 300 feet of major herring spawning areas, hard shell clam concentration areas, and major eelgrass and kelp beds. Avoid siting sea vegetables farms within 300 feet of major herring spawning areas and eelgrass beds.

1f - Select least productive intertidal or upland areas for activities involving dredging, fill, significant compaction of vegetation and sediments (e.g., filling or mechanized access), or flow alterations. Avoid use of equipment in productive habitat, particularly tideflats and salt marshes.

1g - Do not allow floating structures to ground at any tidal stage, except for planned beaching of gear for cleaning or fouling control. Beach gear in intertidal area or beach area of lowest biological productivity. Sand or gravel beaches are the preferred sites; avoid tideflats adjacent to streams and salt marshes.

2. To avoid disturbance of sensitive fish or wildlife species or species during sensitive life history stages:

2a - Avoid siting within 330 feet or within a distance determined by the U.S. Fish and Wildlife Service of bald eagle nests.

2b - Avoid siting within a 300 foot radius of mouths of anadromous fish streams at Mean Lower Low Water.

2c - Avoid siting within one mile of: 1) significant harbor seal haul out concentration areas or pupping areas, 2) significant sea otter concentration areas, pupping areas, or feeding areas, and 3) major seabird colonies.

2d - Avoid siting within waterfowl and shorebird seasonal concentration areas.

These guideline distances can be modified on a site specific basis if other measures will mitigate the disturbance or if disturbance is determined to be insignificant.

3. To minimize the effect of creating an attractive nuisance to potential predators or scavengers:

3a - Determine bird or mammal species which are expected to be a predator on the cultured species. Guideline distances for separation from concentration areas to avoid disturbance (#2 above) should be used as criteria if the species is a potential predator. Distance of separation between rearing facilities and predator concentrations can be modified on a site specific basis if other measures will be implemented to minimize predation.

3b - Avoid siting mariculture facilities, including upland support facilities, adjacent to brown and black bear concentration areas.

3c - Avoid siting shellfish farms within areas where diving ducks, particularly scoters and goldeneyes, concentrate seasonally. Rafts or longlines may be sited within 1 mile of concentration areas if they can be sited in deeper waters than the birds traditionally feed on shellfish beds.

3d - Avoid siting shellfish farms within one mile of sea otter concentration areas.

4. To minimize conflicts with and displacement of traditional commercial and non-commercial users of fish and wildlife:

4a - Avoid siting in or adjacent to:

Intensive sport fishing areas

Intensive commercial fishing areas
(purse seine, troll, gill net, set net)

Intensive commercial crab fishing areas

Intensive commercial shrimp fishing areas
(pot, trawl)

Intensive comm. clam harvest areas
(e.g., geoducks)

Intensive comm. abalone harvest areas

Intensive hunting areas (waterfowl)

Intensive noncommercial fish and wildlife harvest areas

Intensive anchorages within day use areas of major communities for sportfishing and other anchorages of local or regional importance

Intensive float plane access areas

Areas of restricted navigation

5. To minimize interference with fisheries enhancement activities:

5a - Avoid siting facilities adjacent to hatcheries or within terminal harvest areas

6. To avoid adverse impacts relating to water quality.

6a - Applicant should gather site specific information on possible contamination sources (e.g., sewage, mine tailings, boat use, etc.)

6b - Applicant should gather site specific information on water characteristics (e.g. salinity, tidal flushing, currents, depths, temperature, etc.)

6c - Applicant should gather site specific information on levels of PSP which may occur naturally in the area, both in native shellfish and bottom sediments.

7. - Land use permit/lease guidelines:

7a - Mariculture and competing uses. Mariculture may be allowed on state tidelands where there is no significant conflict and if the proposal is not in conflict with other guidelines. Siting of mariculture facilities may be more difficult on tidelands designated in area plans for log transfer or storage, mineral transfer or access, commercial activities, crucial fish and wildlife habitat, inten-

sive harvest areas, adjacent to existing or proposed land sales, or developed recreations. These areas will be available for mariculture: 1) if land managers determine it is possible to site, design, and operate the two or more uses compatibly in the area, or 2) there is no feasible and prudent alternative for mariculture while one does exist for competing use. In no case will mariculture be allowed to foreclose access to mineral, timber, or recreation resources unless feasible or prudent alternative access exists. However, in some cases it may be in public interest to concentrate uses in one bay rather than allowing proliferation of uses in many bays.

7b - Upland owner support for mariculture. Upland owners are encouraged to identify areas where mariculture (including upland facilities) should and should not be developed and to communicate their conclusions to DNR and to mariculture industry.

7c - Mariculture caretaker facilities. Floating caretaker facilities for mariculture operations may be allowed. Floating caretaker facilities for mariculture operations will not be allowed in designated recreation or personal use areas unless a determination is made there is no feasible or prudent alternative. Determination will be made available for public comment.

7d - Performance standards. DNR will attach reasonable performance standards to permit or lease for project development and operation. Performance standards are to ensure permitted area is used for the approved activity, the proposal is economically viable, and permit is not held for speculation or removal of a land base from competition. In all cases the approved development plan must be adhered to. If the performance standards are not met, permit or lease may be revoked.

7e - Development plans. A development plan will be required before a lease or permit application for mariculture facilities is approved. Preferred approach is for application and development plan requirements to serve (at the minimum) as basis for DNR, ADF&G, DEC, ACMP, and upland owner review.

7f - U.S. Coast Guard approval. Permits or leases will not be given until U.S. Coast Guard has certified that proposed facility will not be a significant navigational hazard.

Project Design Guidelines

8. To minimize adverse impacts on productive benthic habitats:

8a - Increase distance of floating structures from shore to avoid shallow, productive habitats.

8b - In areas where potential for adverse impacts from organic sedimentation is high, minimize density of stocking and increase areal extent.

8c - Use flexible floating structures to minimize dampening action on waves and current flows (i.e., break water effects) to maintain natural circulation patterns.

9. To minimize adverse impacts of disease or toxicants on natural stocks:

9a - Avoid use of creosoted logs and pilings in structures.

9b - Avoid use of anti fouling chemicals.

10. To minimize adverse impacts on predators or species sensitive to disturbance:

10a - Use non lethal means of predator control.

10b - Use netting or other materials such as plywood to cover culture structures to provide a physical barrier to potential bird, mammal, and invertebrate predators.

10c - To minimize predation by waterfowl, waterbirds, and birds of prey, aquaculture operations should be covered with plywood or netting that has a mesh size small enough to prevent birds from penetrating it and is made of a gauge heavy enough to be visible to birds and to prevent them from becoming entangled in it. This guideline applies to nets used for both above water and underwater protection.

10d - Plywood or mesh covers on rearing structures should be employed to minimize attraction of bears.

10e - To prevent access by predators, use heavy gauge nets to prevent access.

10f - Operations should be designed and managed to minimize attraction of furbearers. If netting is employed, it should be of a mesh size small enough to prevent entrance and made of a gauge or material that cannot be chewed or clawed apart. Sheet metal collars should be placed on cables, boom sticks, and stiff legs attached to shore to minimize furbearer predation.

11. To minimize adverse impacts on other coastal users:

11a - Culture technique chosen can mitigate impacts on other users of the area if other users are not excluded from access to the area. Bottom culture avoids impacts to many commercial and non commercial users of fish and wildlife resources, however harvest of bottom dwelling species may be displaced or precluded. Floating facilities are preferable to structures embedded in intertidal area. Long line culture facilities can be designed to be less visible than raft facilities, however low visibility can create navigation hazards. Long lines, by their nature, are more able to withstand rougher sea conditions than standard construction rafts and are suitable in areas of deeper water. Use of long lines provides greater siting flexibility to avoid sensitive areas or use conflicts, and may, in some cases, be a feasible and prudent alternatives to raft culture.

11b - Reduce areal extent of floating facilities to minimum size needed in areas where conflicting uses occur. Consider increasing stocking densities as a means to minimize areal extent.

11c - Provide navigation lanes or access easements through facilities.

11d - Increase distance of floating structures from shore to minimize use conflicts.

11e - Lower floating structures (e.g. nets, long lines) in the water column to avoid conflicts with navigation and recreational use of the area.

Comment: Lowering cultures, either temporarily or permanently within a range of 12 meters below the surface, has also been recommended to avoid sets of fouling organisms, high surface water temperatures, rocking of scallops, and unstable salinity and temperature conditions. Growth may be reduced under these conditions, but disastrous events may also be avoided.

11f - Design size, color, and height of structures for low visibility where desirable to minimize impacts to aesthetics and where navigational hazards will not be created. Design high visibility marking devices (e.g., lighted buoys) where necessary for safe navigation.

11g - Consolidate facilities to minimize impacts on other users. However, establish separation distances between farms to minimize cumulative impacts on water quality and potential for disease transmission.

Operational Guidelines

12. To minimize adverse impacts on productive benthic habitats:

12a - Set poles and anchors carefully during periods of lowest productivity.

12b - If structures (e.g., nets) are periodically removed, leave poles and anchors in place.

12c - Monitor sediment build up and impacts on substrate/water chemistry. Adjust stocking rates, remove organic deposits, or move facility if anaerobic substrate conditions are unavoidable.

12d - If herring spawn on structures, leave them in water until the spawn hatches.

13. To minimize adverse impacts on predator populations or species sensitive to disturbance:

13a - Use nonlethal predator control measures.

13b - Use nonlethal means of fouling control.

13c - Garbage should be kept to a minimum and incinerated daily. Food should be handled to prevent its odor from attracting bears and stored in bear proof containers. Disposal of shellfish by products or dead animals should be done in such a way as to minimize attraction of bears in a site approved by DEC.

13d - Remove structures during periods of conflict with species sensitive to disturbance.

Comment: This measure was identified as a mitigating measure for Nori farms in Washington (Washington DNR 1987). In a programmatic Federal Environmental Impact Statement, they identified the following mitigative measures: 1) removing all rafts when not in use for a period of one month for production, 2) removing nets not actively used for production, 3) removing nets during herring spawning season if overspawn of herring outside traditional areas was anticipated, 4) removing nets and structures in less than 10 feet of water depth between March 15 until June 15 every year to prevent impacts on juvenile salmon migration.

14. To minimize the impacts of disease, toxicants, or genetic changes on natural stocks:

14a - In the case of disease outbreaks, notify Alaska Department of Fish and Game and follow existing procedures for control of disease. Use of chemicals and disposal of diseased plants or animals must be approved by DEC.

14b - No exotic species of plants or animals can be imported without approval by Alaska Department of Fish and Game. (by law)

14c - Plants and animals shall not be transported between culture areas or from the wild to a culture situation without approval by Alaska Department of Fish and Game. (by law)

15. To minimize adverse impacts on other users:

15a - Remove structures (e.g., Nori nets) during periods of conflict with other fisheries.

15b - Restrict hours or periods of operation to daytime hours if necessary.



Etolin Island Area

Mariculture Pilot Project

CHAPTER 4

Project Review and Permitting

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Chapter 4

PROJECT REVIEW AND PERMITTING

INTRODUCTION

Aquatic farms in marine waters and on adjacent uplands can raise public concerns about environmental and land use effects. Chapters 2 and 3 discuss these considerations for siting or operating shellfish or aquatic plant farms. State and federal agencies have authority to manage or regulate aquatic farms and to resolve or mitigate public concerns. Aquatic farmers must obtain authorizations from state and federal authorities before initiating farm related work.

State and federal aquatic farming authorization occurs in three primary stages: 1) siting and design approvals, 2) stocking approvals, and 3) product distribution authorization. Aquatic farm siting and design involves the most significant commitment of public resources and therefore has the most specific regulatory requirements. This phase also generates the most public interest, primarily because of land use considerations necessary to properly site an aquatic farm.

All development projects occurring in the Coastal Zone of Alaska as established in the Alaska Coastal Management Act must undergo review of their

consistency with the Coastal Standards of the Alaska Coastal Management Program under 6AAC 80. Statewide standards are in effect in the Etolin Island Study Area. Different or more detailed standards may be in effect within the boundaries of Coastal Districts or Coastal Resource Service Areas with approved coastal plans. DNR, DEC, and ADF&G review mariculture projects against the coastal standards in the course of their permit review.

Authorizations for siting and design, stocking, or product distribution phases involved in aquatic farming are listed in Table 4-1. Application materials and issuing agencies are also identified in this table.

This chapter describes the state's interagency project review and authorization process used to schedule timely and thorough project discussions. Specific information about each state or federal resource agency approval required for aquatic farming is also presented.

SITING AND DESIGN PHASE

Alaska Coastal Management Program Project Review Process

As interest in developing Alaska's resources increased during the last decade, industries demanded state agencies become better organized and integrated to streamline the permitting processes for coastal project siting and design. In response to this need, and under Alaska Coastal Management Program (ACMP) authority, Division of Governmental Coordination (DGC)

within the Office of the Governor established in regulation (6 AAC 50) a project review system that: 1) assists applicants in determining what state resource agency siting and design authorizations are necessary for coastal projects, 2) gives state resource agencies and local governments opportunity for concurrent processing of all approvals needed to site these proposed projects, and 3) mediates any objections by applicants to those proposed ACMP conditions.

Coastal project review process, also known as consistency review process, provides a coordinated interagency review to determine project compliance with regulatory standards of the Alaska Coastal Management Program. The process is designed to concurrently allow agencies to exchange resource information and concerns related to an ACMP consistency determination and agency decisions on particular project authorizations. The coastal project review system is designed to allow further administrative refinements for specific types of coastal development projects. Etolin Island Pilot Project provides an opportunity to present the recently developed Consolidated Shellfish Farm Application process. Additional processing improvements will also be recommended.

New mariculture legislation has been passed (SB 514) which will affect processing of shellfish, sea vegetable, and related hatchery proposals. Implementation procedures for this legislation are being developed. New procedures must meet requirements of the bill and maintain existing ACMP interagency project review systems.

Coastal Project Questionnaire and Preapplication Services

A preapplication worksheet, in Coastal Project Questionnaires (CPQ), is designed to help applicants determine state authorizations necessary before project construction can begin. It also cross references related federal permit application requirements. Completed questionnaires are submitted as part of a review packet to help project reviewers understand a proposals scope. A simple yes/no question series in CPQ have been designed by each permitting agency to identify permit requirements. A "yes" answer means that a permit for that aspect of the proposal **may** be necessary. An agency contact list is provided with each CPQ so applicants can speak to appropriate individuals about specific application requirements indicated by "yes" answers.

Before finalizing project plans and submitting an application, an applicant can request the coordinating agency to arrange meetings between applicants and state agency representatives. Preapplication meetings can help identify concerns, relay need for more information, and encourage a mutual project understanding. Preapplication meetings can be arranged by calling or writing to the coordinating agency.

If a permit is required from a federal agency, or from more than one state agency, the project review process is coordinated by a regional office of DGC. If permits from only one state agency are required, the state agency responsible for issuing those permits coordinates the review. Answers to the coastal project questionnaire will determine who the appropriate coordinating agency is.

For initial aquatic farm siting and design, the coordinating agency is always DGC. Table 4-1 lists numerous state and federal permits which may be coordinated under a DGC project review. Aquatic farms in marine waters will require the following approvals (items 1-8 from Table 4-1): **(Subject to change from SB 514)**

1. Consistency Determination, from DGC.
2. Certification of Reasonable Assurance, issued by the Department of Environmental Conservation (DEC), to assure the project will meet state water quality standards,
3. Land Use Authorization. This permit or lease, issued by Department of Natural Resources DNR, conveys interest in state owned tidelands.
4. Approval from upland owner, necessary only if the aquatic farm will need upland facilities. Within the study area most uplands are managed by the U.S. Forest Service.
5. Shellfish Farm Approvals, issued by Department of Fish and Game (ADF&G).
6. Approval by U.S. Army Corps of Engineers to ensure the aquatic farm does not obstruct navigation.

As shown in Table 4-1, most state applications (items 1-6) can be applied for on a single Consolidated Shellfish Application.

To participate in the state's project review process, an applicant must first complete a Coastal Project Questionnaire (CPQ) to determine which authorizations are needed, and then submit all necessary applications.

Table - 4-1 Permits Which May be Necessary for Mariculture Projects

Permit/Certification	Application Materials	Issuing Agency
Siting and Design Phase		
1. Alaska Coastal Management Program	- Coastal Project Questionnaire - Consolidated Shellfish Farm Application	Division of Governmental Coordination
2. Certificate of Reasonable Assurance	- Consolidated Shellfish Farm Application - Corps of Engineers Application	Dept. of Environmental Conservation
3. Tideland Permit/Lease	Consolidated Shellfish Farm Application	Dept. of Natural Resources
4. State Park Use Permit	Consolidated Shellfish Farm Application	Dept. of Natural Resources
5. Shellfish Farm Permit	Consolidated Shellfish Farm Application	Dept. of Fish & Game
6. Title 16 Permit	Consolidated Shellfish Farm Application	Dept. of Fish & Game
7. Dept. of the Army Permit	Corps of Engineers Application	U.S. Army Corps of Engineers
8. Special Use Permit for Upland Facilities	Separate Agency Application	U.S. Forest Service
9. Beachlog Salvage Permit	Separate Agency Application	Dept. of Natural Resources
10. Material Sales	Separate Agency Application	Dept. of Natural Resources
11. Water Rights (if greater than 500 gal/day)	Separate Agency Application	Dept. of Natural Resources
12. Wastewater Discharge Permit (if greater than 500 gal/day)	Separate Agency Application	Dept. of Environmental Conservation
13. Solid Waste Disposal Permit (if greater than single family use)	Separate Agency Application	Dept. of Environmental Conservation
Stocking Phase		
14. Interim Use Permit	Separate Agency Application	Dept. of Fish & Game
15. Fish Transport Permit	Separate Agency Application	Dept. of Fish & Game
Product Distribution Phase		
16. Sanitary Survey	Separate Agency Application	Dept. of Environmental Conservation
17. Shellstock Shippers Permit	Separate Agency Application	Dept. of Environmental Conservation

Consolidated Shellfish Farm Application

For a proposed shellfish farm, state authorizations listed above can be applied for by filing a single form, the Consolidated Shellfish Farm Application (CSFA). (See Appendix D)

If aquatic farms need an assured fresh water supply, the applicant should apply for water rights. The applicant will also need to apply for a permit from ADF&G to withdraw water if the water source is an anadromous fish stream. Applying to DNR for water rights is **required** if use will exceed 500 gallons per day. Similarly, wastewater discharge exceeding 500 gallons per day requires a permit from DEC. Applicants must also submit separate applications for purchase of state timber or gravel from DNR. These permits are not issued from CSFA forms because they are not essential for a typical aquatic farm. CSFA was limited to most frequently needed authorizations so applicants would not have to supply unnecessary information.

Project Packet

To initiate the state's coastal project review process for aquatic farm project proposals, DGC must receive the following completed packet:

1. Signed Coastal Project Questionnaire.
2. Consolidated Shellfish Farm Application
3. Any state permit applications needed for the project not included in the CSFA.
4. U.S. Army Corps of Engineers public notice (which jointly notices the state's project review)
5. Copies of any federal permit applications needed for the project (originals go the federal agency issuing the permit)
6. Additional pertinent information including public notices from agencies.

Project packet receipt ensures the state can address all administrative and regulatory siting and design matters for this project phase in one inter-agency review.

Project Schedule

Aquatic farm reviews are scheduled by DGC to occur within an established 50-day review schedule. This schedule is initiated upon receipt of a complete project packet. Steps in the state's review process are illustrated in Figure 4-1. DGC sets review schedules and distributes project packet information to all reviewing agency contacts and to affected local government or coastal districts. (See AS 46.40 or 6 AAC 85. for reference to establishment of local coastal districts under the ACMP).

Comment and decision deadlines are set to bring certainty and timeliness to the review, and to promote efficient interagency discussion and resolution of issues. These schedules may be extended if: 1) incomplete applications result in requests for additional information 2) public hearings are conducted, and 3) resource agency field investigations are necessary.

If a state resource agency, a coastal district with an approved plan, or an applicant does not agree with a proposed consistency determination and interpretation of ACMP standards, they may request elevation of the finding to division directors for reconsideration. Further consideration by commissioners of those agencies can also be requested if new policy direction must be established. Each elevation step will be managed under an additional 15 day review schedule. The general public is not eligible to elevate, but may request a public hearing during ACMP review.

Public Notice Systems

The Alaska Coastal Management Program Project Review Process integrates review of permits needed for siting and designing a routine aquatic farm. Although this system can schedule review of coastal projects by agencies and local coastal districts, this process cannot alter specific requirements each agency has for public notice. Individual public notice is required for land management authorizations and most regulatory approvals required for mariculture projects. Three separate public notices are generally required for proposed mariculture projects.

Corps of Engineers (COE) routinely issues a public notice for Section 10 or Section 404 permit applications. A notice of the state's review for ACMP consistency certification and Department

of Environmental Conservation's (DEC) "Certification of Reasonable Assurance" that the project will meet the State's water quality standards is also included within public notices printed by COE.

In addition to public newspaper notice, COE sends information packets to a general mailing list. DGC also sends complete project packets to all participating state and federal agencies and to affected local coastal districts.

Public notice under AS 38.05.945 is required for all land use authorizations DNR is proposing to issue for aquatic farms and related hatcheries as a result of recent legislation (see Appendix G). DNR will be working with other state resource agencies, COE, and DGC to establish procedures to enable concurrent public notice publication where possible.

Under National Environmental Policy Act, U.S. Forest Service is required to provide a public notice and comment period to determine issues related to any Special Use permit application. Timing of this notice is determined independent of COE or DNR notices.

Although timing of all three notices is uncertain, a probable sequence if a aquatic farmer submitted all agency applications concurrently could be: (See Figure 4-1 on next page):

1. The Forest Service would issue a notice addressing caretaker facilities for mariculture upland activities.
2. Within the same month, COE may issue a public notice for a waterborne structure. This notice would also address the state's consistency determination and DEC 401 certification.

3. Concurrent with COE notice, DGC would send a completed packet to a preestablished distribution list which includes Tongass National Forest Ranger District.

4. DNR may issue public notice for use of state lands at this time;

5. DNR contacts the Forest Service as upland owner for comment during consistency processes; and

6. A public notice is issued at the end of DNR's preliminary best interest finding, a procedure which follows conclusion of the consistency review.

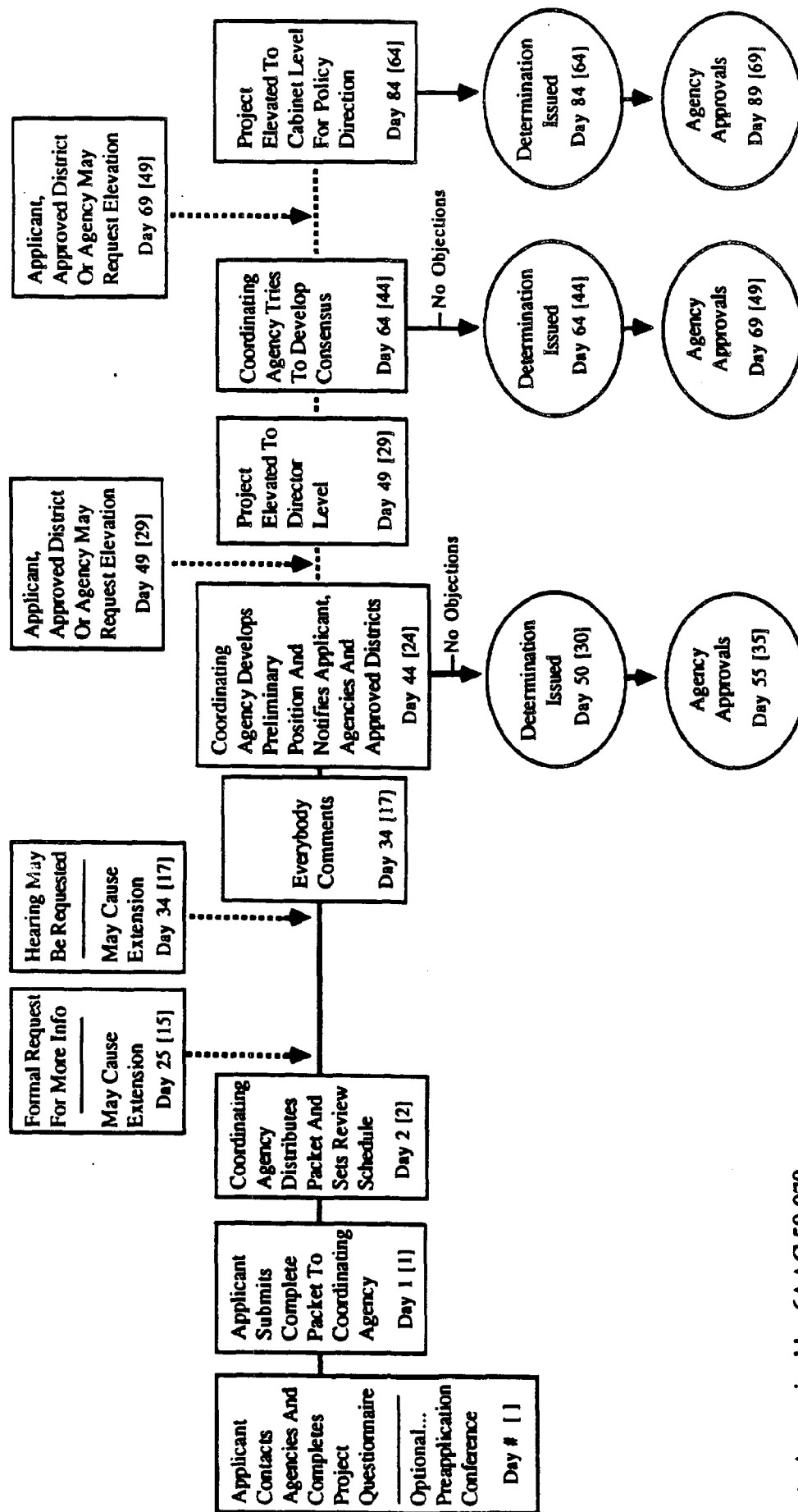
These divergent public notices result from specific agency requirements. During implementation of (SB 514), the new mariculture legislation, an effort will be made to examine and coordinate to the extent possible, public notice for all State and Federal permit applications to occur jointly or concurrently.

Issuance of State Agency Permits

Under state and federal law, any resource related permit for coastal activities must be determined to be consistent with standards of ACMP before state or federal permit are issued. Consistency review processes previously described are used to make the consistency determination, thereby finding each related permit consistent. The consistency determination is the first decision document issued in the state's project review process, because it is required prior to other agency actions on coastal projects. A finding of consistency does not guarantee permit issuance or authorities outside the scope of ACMP may be placed on permits, leases, or other resource authorizations.

PROJECT CONSISTENCY REVIEW PROCEDURES *

Figure 4-1



* As required by 6AAC 50.070.

Day of review schedule on which milestone occurs.

First number is for a 50 day schedule, [#] is for 30 day schedule.

..... Optional milestone

Approvals Routinely Required for Siting Mariculture Projects

Land Management Approvals

Development on uplands and tide/submerged lands in public ownership requires approval from managing agencies prior to such activities. DNR is the state's primary land manager. Division of Land and Water Management (DLWM) within this Department has primary responsibility for issuing the permits or leases necessary for aquatic farm development on state owned lands or waters.

Several federal agencies manage most federal lands in Alaska: U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and U.S. Bureau of Indian Affairs.

The U.S. Forest Service is the responsible land management agency for all federal lands above mean high tide line within the Etolin Island project area. These lands are managed through the local Ranger District office in Wrangell.

DNR Land Use Permits and Leases

DNR currently manages approximately 85 million acres of uplands, about 10 million acres of water, and tidelands along the State's 34,000 mile coastline. DNR also manages approximately 25-30 million acres of submerged land off shore out to the three mile territorial sea boundary.

DNR is mandated by Alaska's Constitution to encourage settlement of the state's land and development of resources by making them available for public use consistent with public interest. State statutes direct departmental management of state owned land to establish a balanced land use for both public and private purposes, and to administer state programs for the conservation and development of natural resources.

New Process

SB 514 was passed in the last hours of the 15th legislature and state agencies are now reviewing that legislation to decide how best to implement it. Implementation will be designed to mesh smoothly with existing coastal project review process to avoid duplication of effort by applicants, government agencies, and the general public interested in commenting on aquatic farm proposals.

This legislation mandates DNR to adopt new regulations. Adoption of regulations allows for public participation in making policy decisions needed to carry out the law. DNR has begun analyzing SB 514 and will propose regulations to interpret it in the near future. In the meantime, this section sets out major requirements of the new legislation and of existing laws and regulations that generally apply to aquatic farm development.

Under new legislation, DNR begins the process of authorizing new aquatic farms by identifying geographic districts within which it will invite site applications. Any person who wants to obtain property rights to develop an aquatic farm on state owned tidelands may participate. The application period for aquatic farm permits will remain open for at least 60 days each year. In line with current agency practice, the application will probably be a consolidated form that provides information other state agencies will need to process their own permits. The applicant will fill out a CPQ and file for any necessary federal permits at the same time.

After consultation with DFG and DEC, DNR will prepare a preliminary finding under AS 38.05.035 (e) explaining why it believes it is in the state's best interests to grant permits for aquatic farm development at particular sites. Conversely, if DNR believes a permit should **not** be issued for a certain site, it will give the applicant a written finding explaining reasons for denial. DNR must prepare land use plans and classification orders for proposed sites that are not classified. Agencies are developing procedures to incorporate classification requirement into the consistency review process.

DNR will hold a public hearing in each district where it proposes to issue aquatic farm permits. It will give public notice under AS 38.05.945, including advertisements in local and statewide newspapers and notice to affected municipal governments or Native regional corporations, regional fish and game advisory councils, coastal resource service areas (local councils authorized to prepare district coastal management plans where there is no municipal government to do so) and others, inviting interested people to testify or to comment in writing on the proposal. If possible, any public notice necessary for a federal permit or for other state permits will be given at the same time.

After considering comments it has received, DNR will prepare a final finding on the proposed permit sites, while DGC issues a conclusive (final) consistency determination. If a proposal is determined to be consistent with ACMP and to be in the state's best interests, an aquatic farm permit will be granted. Other agencies will take similar action under their own statutory authorities.

Permits

An aquatic farm permit is a nontransferable right, valid for three years, to enter, improve, and develop a state tidelands site into an aquatic farm or hatchery. The permittee must post a bond or other security to cover restoration costs if the site is later abandoned. DNR has discretion to renew the permit, but must again give public notice and consider comment received before doing so. If the permittee succeeds in developing the site for aquatic farming or as a hatchery and it is offered for lease, the permittee has first rights to that lease (see below).

Leases

As with other leases issued for state owned land, aquatic farm leases may be assigned (transferred) with the approval of DNR. If the assignee changes use of the site, the lease reverts to the state. Leases are long term property rights: their duration can be as much as 55 years, although the department will probably choose a shorter term (10 to 25 years). If a permittee who developed a site for aquatic farming chooses not to lease it, the lease will be offered to the public. Sites will be leased for not less than their appraised fair market value. The lease will be reappraised and rent adjusted accordingly every five years. The lessee must post a bond or provide other security to cover restoration costs if the site is later abandoned.

Conflict Resolution

ACMP project review process provides a method for resolving conflicts via the "elevation" procedure. A state resource agency, a coastal district with an approved coastal management plan, or an applicant who does not agree with a proposed consistency determination or with an interpretation of ACMP standards has standing to request reconsideration of the determination by state agency division directors. If the dispute is not resolved, it can be elevated further to the level of

resource agency commissioners. If necessary, a final policy decision will be made by the DGC. The general public does not have the same right to require elevation.

Each resource agency also has an administrative appeal process that gives any aggrieved person an opportunity to dispute that agency's action. The ultimate recourse by a person who objects to a final agency decision, including an ACMP determination, is an appeal to Superior Court.

U.S. Forest Service Land Use Permits (Special Use Permits)

Tongass Land Management Plan provides broad direction for all activities, including mariculture, occurring on Tongass National Forest. The forest includes most land above mean high tide line. Tongass Land Management Plan has allocated the study area for the Etolin Island Area Mariculture Pilot Project to a mixture of land use designations. Each land use designation allows a given range of activities to occur within the land unit. Management objectives of land use designations are presented in Chapter 3. Etolin Island Project map (in back pouch) delineates land use designations for this area of Tongass National Forest. Some land around Olive Cove on the east side of Etolin Island is either privately or state owned so direction from Tongass Land Management Plan does not apply.

Any use of federal lands for development requires a Special Use Permit. This may include needs for shoreties, storage facilities, living facilities, water lines, and communications equipment. Special Use Permits usually requires an annual permit and a fee. Forest Service reviews and decisions about upland facilities for mariculture proposals should occur at the same time the state's project review and COE permit review are occurring.

Forest Service approval of permit requests will depend upon whether or not the need for upland facilities can be accommodated on the tideland permitted area, or if there are state or private lands in the vicinity that are suitable. Impacts on surrounding environment are evaluated. Apparent suitability of tideland sites for mariculture purposes is also a determining factor. Compatibility with laws, regulations, land use designations and other projected uses are evaluated. Public project review occurs in accordance with National Environmental Policy Act (NEPA).

NEPA Processes

This determination of permit suitability will be accomplished by following procedures required in National Environmental Policy Act (NEPA). It is the basic national charter for environmental protection, establishing policy, setting goals and providing a means for policy implementation.

NEPA procedures ensure environmental information is available to public officials and citizens **before** any action is taken.

All sites requested for permits will be examined, usually by an interdisciplinary team (IDT) and they will evaluate the project or facility in relation to surrounding environment. This evaluation will then be made available for public review.

Other Mariculture Project Regulatory Approvals Routinely Needed

In addition to approvals for access and use of public lands, a significant regulatory structure is in place to address public issues related to impacts of these uses. These additional public interest considerations are administered through state and federal regulatory agencies as follows:

Other DNR Approvals

Other authorizations from DNR may be required for development of an aquatic farm. A person may obtain ownership of beach logs to be used in construction of rafts by purchasing a beach log salvage permit. This permit is administered through State Division of Forestry. A water appropriation may be obtained from DLWM, giving the aquatic farm developer legal right to continue using a particular quantity of fresh water. Water rights are normally transferred with the permit or lease they serve.

Materials (sand or gravel) on state uplands or tidelands may be purchased from the DLWM to use for fill or other purposes. Materials are sold at fair market value.

If an aquatic farm is proposed within a State Marine Park (none in the Etolin study area) authorization from the Division of Parks and Outdoor Recreation is required.

Department Of Environmental Conservation Approvals

DEC has two divisions involved in permits and certifications necessary for development of aquatic farms. Division of Environmental Health (DEH) has two major mariculture responsibilities. One is to conduct sanitary surveys and certify sites for growing commercial shellfish. This is in compliance with the National Shellfish Sanitation Program. The second responsibility of DEH is product certification prior to marketing. Authorization occurs with issuance of a Shellstock Shippers Permit. This ensures a product free from PSP and other contaminants. Those certifications are described later in this chapter.

Both of these certifications are conducted independently of ACMP review and time frames are outside ACMP time frame. ACMP reviews are completed without these certifications. However, during the project siting and design phase, DEQ will notify DEH of a mariculture proposal. DEH will contact the applicant with information about requirements for the growing site to be certified and to initiate shellfish product commercial sales.

Division of Environmental Quality (DEQ) is responsible for regulating water quality in Alaska. Water Quality Standard Regulations, 18 AAC 70, are guidelines which regulate water pollution. Specific water quality parameters for each designated water use are addressed in the Water Quality Standards section of Chapter 3. For fresh and marine waters these include: fecal coliform bacteria, dissolved oxygen, pH, turbidity, temperature, dissolved inorganic substances, sediment, toxic and other deleterious organic and inorganic substances, color, petroleum hydrocarbons, oils and grease, radioactivity, total residual chlorine and other residues. DEC uses the following procedures to apply appropriate water quality criteria for any water body:

1. If a water body is protected for more than one use class the most stringent water quality criteria will apply.
2. At the boundary between waters protected for different use classes the most stringent use class will apply.
3. In estuaries, where fresh and marine water quality criteria differ within same use classes, the standard will be determined on the basis of

salinity. However marine water quality criteria will apply for dissolved oxygen if salinity is one part per thousand or greater and for fecal coliform bacteria if salinity is 10 parts per thousand or greater.

Water Quality Standards apply to siting and operation of mariculture facilities. Division of Water Quality is responsible for issuing the Certificate of Reasonable Assurance required under section 401 of the Federal Water Pollution Control Act Amendments of 1972, as modified by the Federal Clear Water Act of 1987. Under section 401 any applicant for a federal license or permit to conduct any activity which may result in any discharge into navigable waters of the state must obtain certification from the designated state agency to assure such discharge will comply with State Water Quality Standards. Division of Water Quality also reviews plans for sewage systems and applications for wastewater discharge and solid waste disposal permits, if needed. A description of each of these approvals follows.

18 AAC 70.010 states no person may conduct an operation that causes or contributes to a violation of the Water Quality Standards. Water Quality Standards establish various protected water use classes and criteria. Water quality standards set by 18 AAC 70.010 specify degree of degradation that may not be exceeded in a water body as a result of human actions. All water bodies that are naturally of higher quality than water quality criteria for that use class must be maintained at the existing quality. An applicant may apply for a short term variance that would allow Water Quality Standards to be violated for a predetermined temporary period of time. It is also possible to petition for a reclassification of the water body to a less stringent use class.

Section 18 AAC 70.020 sets out specific water quality criteria that must be maintained in various water use classes. These classes are separated into marine and fresh water uses and include such things as water supplies, water recreation, and growth and propagation of fish, shellfish and other aquatic life and wildlife.

401 Certification

As part of the responsibilities for regulating water quality, the Division of Water Quality must issue a Certificate of Reasonable Assurance that a mariculture project will, during construction and

any time afterward, be consistent with state water quality standards. This certification is made concurrently with ACMP review. The time frame is the same as that for ACMP review.

401 certification is required by COE before they will issue a COE permit for structures in navigable waters or to place fill in wetlands. Any stipulations attached to 401 certifications will be attached and become part of the COE Permit.

Under 401 review, DEQ looks at any impacts a mariculture development might have on surrounding waters. This could include discharge of organic materials from the animals, or addition of any substances into the water by the farmer. Projects will also be reviewed for possible conflicts with other waters uses in the project area. Where appropriate, mitigating measures may be stipulated.

During 401 reviews, it is important that activities associated with caretaker support facilities are clearly defined. All information on storage of hazardous chemicals and sewage treatment needs to be provided. Lack of this information can slow down the review process.

Wastewater Discharge and Solid Waste Permits, System Plan Reviews

Division of Environmental Quality regulates all discharges including: sewage, gray water, and nondomestic (commercial or industrial) wastewater discharges associated with, or affecting, mariculture facilities.

Wastewater Disposal Regulations, 18 AAC 72, establish treatment and disposal requirements for domestic and nondomestic sewage and gray water. Wastewater regulations define minimum levels of treatment. They also define: discharges exempt from needing waste disposal permits; discharges exempt from plan review requirements; criteria for design of wastewater systems, including separation distances and minimum treatments; criteria for plan approval of wastewater systems; and criteria for subdivision plan approval.

The two main regulatory procedures for disposal of wastewater are a wastewater permit and system plan review. Under 18 AAC 72, Wastewater Disposal Regulations, a person who disposes of domestic wastewater into or onto waters or lands

of the state must have a waste disposal permit unless discharge is to a soil absorption system, or is no more than 500 gallons per day, and which meets minimum treatment and system plan review requirements.

Normal treatment for domestic wastewater is secondary treatment. For discharges into marine waters, DEC may grant a waiver down to primary treatment. Domestic wastewater includes gray water, which is defined as wastewater from laundry, kitchen sinks, showers, baths, or other domestic sources. A person who disposes of non-domestic wastewater into or onto waters or lands of the state must have a waste disposal permit.

For wastewater discharges under 500 gallons a day no permit is issued and the DEC completes only a system plan review. Under 18 AAC 72, system plan review is not required for single family dwellings using an on site domestic wastewater disposal system meeting requirements of wastewater disposal regulations. System plan review is required for single family dwellings discharging treated wastewater onto land or into state surface waters and for all wastewater systems that are larger than single family facilities and all commercial/ industrial facilities.

Subdivision plan reviews are also regulated under 18 AAC 72. DEC reviews all property subdivisions of two or more parcels. The review determines types of sewage disposal systems, if any, feasible on the parcels. Department conditions may be placed on the plat limiting types of wastewater disposal system allowed. Treatment systems that will discharge into water will also need further plan review by DEC. An individual lot owner may propose some type of sewage disposal system, other than the type of system approved for subdivisions, by submitting plans for an alternative system. DEC will review plans for conformance with wastewater regulation and approve, conditionally approve, or deny plan approval.

The purpose of Solid Waste Disposal permits is to control or eliminate detrimental health, environmental, and nuisance effects of improper solid waste disposal practices. A person who constructs, modifies, or operates a solid waste disposal site must do so in accordance with regulations in 18 AAC 60, which pertain to solid waste management. A permit is not required for a single family or duplex residence on a farm where solid waste is generated and disposed of on

the premises. "Solid waste" means garbage, refuse, sludge and other discarded material including solid, liquid, semisolid or contained gaseous material resulting from industrial, commercial and agricultural operations, and from community activities.

Department Of Fish And Game Approvals

Alaska Department of Fish and Game (ADF&G) has broad responsibilities to "manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and well being of the state". (AS 16.05.020). Because for profit mariculture currently involves private ownership of cultured shellfish, DFG reviews proposed activities primarily to determine the effects activities will have on state owned fish and wildlife resources and their yields or harvests. In addition, ADF&G is statutorily mandated to "encourage the investment by private enterprise in the technological development and economic utilization of the fisheries resources" and to "... do all things necessary to insure perpetual and increasing production and use of the food resources of Alaska waters..." (AS 16.05.092) ADF&G regulates shellfish mariculture activities in three ways:

1. Through technical review and permitting of proposed shellfish farms. Permits related to technical review of mariculture farm proposals are discussed below.
2. Through issuance of permits for transportation, possession, and release of live fish including exportation or importation of shellfish.
3. Through issuance of interim-use permits for harvest of larval and juvenile shellfish.

Shellfish Farm Permit

The Fisheries Rehabilitation, Enhancement and Development Division of ADF&G has primary responsibility for review and issuance of Shellfish Farm permits. Applications are evaluated to determine that: 1) physical and biological characteristics of proposed locations are suitable for a shellfish farm, 2) proposed farms do not unreasonably or adversely affect management of natural stocks or require significant alterations in existing uses of fish and wildlife resources, 3) farms will not adversely affect fisheries, wildlife,

or their habitats, and 4) plans for operation and staffing demonstrate adequate technical and operational feasibility.

Title 16 Permits

The ADF&G Habitat Division has primary responsibility for reviewing applications and issuing permits for use of fish habitat under Title 16. These permits are required by ADF&G for activities which affect streams, through blockage of fish passage or through a variety of activities, such as water usage, flow diversion or obstruction, pollution, or use of equipment in stream beds that may cause adverse impacts to anadromous fish habitat. Water use for upland facilities or operations and culvert or bridge installation in streams during road construction are types of mariculture activities that may require Title 16 permits. Special area permits are also required by ADF&G for land use activities in legislatively designated state game refuges, sanctuaries, and critical habitat areas.

Under a broad mandate of the Fish and Wildlife Coordination Act, ADF&G reviews COE permits to provide recommendations concerning fish and wildlife resource protection.

U.S. ARMY CORPS OF ENGINEERS APPROVALS

U.S. Army Corps of Engineers (COE) administers Section 10 of the Rivers and Harbors Act of 1899. This law regulates activities which could obstruct navigable capacity of the nation's navigable waters. This act prohibits unreasonable obstructions or use of the nation's waters. Navigability issues address uses of the entire surface and bed of all water bodies subject to tidal action that lie below mean high tide, and all ocean and coastal waters extending seaward from the coastline (mean low tide) or a distance of three geographic or nautical miles.

COE also administers Section 404 of the Clean Water Act which regulates discharge of dredged or fill material in United States waters (including wetlands).

Section 10 and Section 404 Permits

Mariculture activity requires a COE permit for construction of any structure in or over any navigable water of the United States, and accomplishment of any other work affecting course, location, condition, or capacity of such waters. If upland or shoreline work associated with facilities requires placement of dredged or fill materials into waters or wetlands, a COE permit under Section 404 is also required.

COE processes mariculture permit reviews by issuing a public notice for a 30-day permit. A full review allows the general public, state, and federal agencies to formulate responses within this time frame. If there are no objections, a permit will be issued by the COE satisfying Section 10 of the Rivers and Harbors Act and/or Section 404 requirements. If there are objections, the applicant must resolve them before the COE will issue a permit. If the project appears to have unresolvable aspects, Corps of Engineers will determine if it is in the public's best interest to issue the permit over objections of the reviewer. Permit issuance is a broad public interest determination. It is based on evaluation of probable impacts of a proposed activity, intended use, public interest, including conservation, fish, wildlife, economics, water quality, recreation and general environmental concerns.

Issuance of a COE permit requires the project be constructed within three years. Once this requirement is met the COE permit will be valid for the life of the project. If design or operation of the project changes a permit modification is necessary. Complete project modifications review must occur prior to instituting any changes in a COE permit.

STOCKING PHASE

Collection and transport of brood stock for mariculture operations is managed solely by ADF&G. Consistency review requirements, as noted by their absence in Table 4-1, do not apply.

Fish Transport Permit

Fish Transport Permits are required by ADF&G without which "no person may Transport Permits are required by ADF&G without which "no person may transport possess, export from the state, or release into waters of the state any live fish.

In this instance, fish means any species of aquatic finfish, invertebrate or live amphibian, in any stage of its life cycle, found in or introduced into the state." Importation of live fish is also addressed in these regulations. The only fish that may be imported into Alaska for rearing or release into Alaskan waters are oysters originating from locations other than Korea, the Gulf of Mexico, and the Atlantic coast of North America. Before transport a disease history of the specific stock of fish to be transported must be established through inspection and certification by ADF&G fish pathology section. Fish Transport Permits are multiple year permits that allow ADF&G to monitor pathological and genetic considerations of stocks used in mariculture operations in the state.

A separate Fish Transport Permit form must be completed for spat collection operations and to obtain and possess shellfish for farming. Collected spat may be staged, prior to transport, in a central location specified on the permit. A Fish Transport Permit for spat collection allows only temporary possession, limited to 90 days. A Fish Transport Permit must be filled out by the buyer for each transport of shellfish from the staging area to the shellfish farm. The same is true for importation of live oysters and any subsequent movement of them between farms. Fish Transport Permits are exempted from Coastal Zone Management permit review. The time frame for issuance is 45 days.

Interim-Use Permit

Commercial harvest of any fishery resource in Alaska, including larval and juvenile shellfish, requires a valid entry or interim use permit or license. Interim-use permits required by the DFG is a yearly permit necessary for harvest and sale of larval or juvenile shellfish.

PRODUCT DISTRIBUTION PHASE

Development of shellfish farms and shellfish marketing are governed by regulations established in Article II of State of Alaska Fish Inspection Regulations, 18 AAC 34. These regulations require an annual permit be obtained in order to harvest, process, pack, repack, sell, or possess shellfish for sale. Before a permit is issued, growing areas must be certified by DEC, Division of Environmental Health.

The main goal of the Seafood Section is to ensure production of safe and wholesome mariculture products. This is done through a shellfish site certification and processing inspection program that meets requirements of the Federal Food and Drug Administration. Under this program, all shellfish growing areas in Alaska must be cer-

tified. Harvesters and processors must be permitted by the DEC.

During project siting and design phase, DEQ will notify DEH of a mariculture proposal. EH will contact the applicant with information about requirements for growing site certification and permission to initiate shellfish product commercial sales.

Site Certification and Development

A sanitary survey of each proposed site is conducted by personnel from DEC prior to any harvest of shellfish. This survey is composed of two parts, with the first part consisting of water sampling and testing in the area to determine water

quality, and the second part consisting of a shoreline investigation to identify any sources of pollution that may affect the area.

To determine acceptable water quality at the proposed site, water samples are usually collected from five representative sampling stations throughout the growing area. A minimum of 10 to 15 water samples are collected per station during the worst pollution conditions. These water samples are taken over a five day period at both high and low tides. Additionally, native shellfish species, including clams and mussels, are taken for PSP testing.

Shoreline investigation consists of identifying all sources of pollution, such as nearby operating industries, development on adjacent properties or waters, boat harborage, marine traffic, and incoming streams. At this time, additional sampling may be done for specific laboratory tests to evaluate sewage, oil, heavy metals, or pesticide contamination. Standard measurements of oceanographic variables such as pH, salinity, temperature, and water clarity are also done. DEC evaluates laboratory results and determines if the area can be certified.

Costs related to area certification are charged to the individual making the request and include: 1) costs of submitting samples to DEC Palmer Lab, 2) transportation costs of DEC personnel to the site from the nearest town or city which has a commercial airport, 3) providing a boat for sampling and investigation work. If aircraft is provided, the airplane must be adequately covered with required insurance. Boats which are provided must be adequate for weather conditions, Coast Guard approved, and it must have a radio and basic tool supply for maintenance. Samples are currently analyzed free of charge by DEC Palmer Lab.

Because of limited personnel and time involved, growers are advised to contact DEC Anchorage office at least six months in advance of their proposed harvest date to schedule their growing site sanitary survey.

Product Certification Prior To Marketing

DEC also tests and approves products prior to market. The initial step, assuming the growing site is certified, is to file an application for a DEC Shellstock Shippers Permit. This process should begin several months before the grower expects to ship any shellfish.

Applications must include the following:

1. A description of locations where the shellfish will be grown.
2. A sketch drawn to scale showing location of any structures. This should include a shorebase plant with refrigeration or equivalent, where shellstock will be held and packaged.
3. Labeling information for the shellfish product, which must include a waterproof and durable tag or label, must also contain the AK# (to be issued), weight, type of shellfish, a "Keep Refrigerated" or "Keep Frozen" statement, specific area of harvest, date of harvest or code, and name and address of buyer and seller.
4. Cleaning and sanitizing procedures used for containers in which shellfish will be transported.
5. Documentation format for records of shellfish transported or sold; these records must be kept in a bound ledger book.

DEC recommends applications be submitted at least 90 days before project initiation to ensure adequate time for the review process.



Etolin Island Area
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CHAPTER 5

Implementation and Recommendations

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Chapter 5

IMPLEMENTATION OPTIONS AND RECOMMENDATIONS

IMPLEMENTATION OPTIONS

Federal and state agencies review proposed mariculture projects to ensure compliance with applicable regulations and agency management policies. State and federal agencies participating in this project are concerned primarily with effects that proposed waterborne and upland mariculture facilities would have on environmental resources, such as water quality and fish and wildlife habitat; and compatibility with other existing and planned uses of the proposed mariculture site. Individual agency requirements and management authorities are contained in Chapter 4.

Siting guidelines for mariculture facilities recommended in this study could be implemented by participating agencies in a number of ways. A combination of several options may be the best way to implement study recommendations.

Use Of Existing Project Review Procedures

A coordinated permit review process is currently in place among state resource agencies (DEC, DFG, and DNR). This process, known as consistency review process, provides for a coordinated review of a project to determine compliance with the standards of Alaska Coastal Management Program (ACMP). State resource agencies review proposed projects against their own agency requirements at the same time they review the project for consistency with ACMP. This consistency review process is coordinated by the state Division of Governmental Coordination (DGC), a complete description appears in Chapter 4. Chapter 4 also describes how the Forest Service and U.S. Army Corps of Engineer (COE) review of mariculture development could be coordinated with the state's consistency review process.

Participating agencies could use study recommendations as part of their existing project review procedures. Mariculture projects will be reviewed based on ACMP standards and other agency regulations. However, information and recommendations included in this study would be used as a guide to evaluate proposed mariculture projects against these enforceable requirements.

Adoption Of An ACMP Mariculture Standard

All projects proposed within Alaska's coastal area must be evaluated against ACMP standards (6 AAC 80). Projects must be consistent with these standards, or they cannot be approved by state or federal agencies. ACMP standards are general policies guiding various kinds of coastal development, such as energy facilities, timber harvest and processing, and mining.

Recommendations in this study could be used as a basis for developing a new ACMP standard for mariculture development. A new standard would require public and agency review, and approval by the state Coastal Policy Council (CPC). Once approved, the standard would apply to all mariculture development proposed within Alaska. A new standard would be implemented through existing consistency review process, described in Chapter 3.

Adoption Of An AMSA Plan

Some Coastal areas merit special attention because they possess unique aesthetic, ecological, recreational, geophysical, or industrial values or combinations of these values. Such areas may be designated as Areas Which Merit Special Atten-

tion (AMSA). The Alaska Coastal Management Act (A.S. 46.40) defines an AMSA as "...a delineated geographic area within the coastal area which is sensitive to change or alteration and which because of plans or commitments or because a claim on the resources within the area delineated would preclude subsequent use of the resources to a conflicting or incompatible use, warrants special management attention, or which, because of its value to the general public, should be identified for current or future planning, protection or acquisition".

AMSA designation and management plan approval is under the authority of CPC. Any agency or member of the public could nominate the study area for AMSA designation. With concurrence of CPC, a management plan would be prepared for state and private lands (including tidelands) within the AMSA. This plan would include a description of uses and activities allowed and prohibited within the AMSA, enforceable policies used to manage the AMSA, and a description of plan implementation.

Once approved by CPC and the federal government, AMSA plan provisions are binding on state and federal agencies conducting activities or granting permits for activities within the AMSA. Proposed projects would be reviewed against AMSA plan policies during the consistency review process.

Adoption Of An Area Plan

DNR prepares and implements management plans, known as Area Plans, for state owned uplands, tidelands, and submerged lands. Area Plans do not apply to private lands and differ from AMSA plans in this respect. Area plans contain policies that apply to specific uses and activities, such as timber harvest, mining, recreation, or settlement. Planning areas are usually subdivided into management units, and lists of uses allowed or prohibited within each unit are developed. Area plans are reviewed by other agencies, the

public, and approved by the Commissioner of DNR. Once the Area Plan is approved, all DNR decisions regarding land classifications, tideland leases, land use permits, and other authorizations must comply with Area Plan requirements. Area Plan requirements are not binding on other agencies.

There are no Area Plans in effect within the study area. Information in this study would be useful if an Area Plan for the study area is prepared in the future.

Classification Of State Tidelands

State law requires that state owned lands, including tidelands and submerged lands, be classified before they can be leased or sold. Land classification is a formal record of allowable uses for which each parcel of state land will be managed. Information in this study may serve as the basis for future DNR classification of state tidelands within the study area.

Forest Service Area Analysis

Tongass National Forest is presently revising its land management plan for National Forest Lands including Etolin Island. The revised plan will provide specific direction on how resources on Etolin Island will be managed. Recommendations in this study regarding the capability and suitability of the shorelines of Etolin Island for mariculture development could be incorporated into the plan revision. When the Environmental Impact Statement for the plan is completed and Record of Decision is signed, management direction for mariculture facilities on uplands under Forest Service jurisdiction should be consistent with recommendations made in this study. Until such time as the Revised Tongass Land Management Plan is completed, current Tongass Land Management Plan direction and guidelines will apply to mariculture developments.

RECOMMENDATIONS

Following are eight general recommendations proposed by this projects participating state and federal agencies. Legislation passed by the 15th legislature directs state agencies to process mariculture applications unique from all other tideland uses.

A new system allowing mariculture uses on state tidelands is presently being developed as a result of this bill.

These recommendations target aspects of mariculture development that this cooperative study has indicated to be of greatest concern. As mariculture development progresses the acceptance, and implementation of this projects recommendations will direct, and solve some areas of contention previously experienced. Development of final recommendations from this project will occur after public comment is received from this Public Review Draft. Expansion of these recommendations will be considered and analyzed for the Etolin Island Area Mariculture Pilot Project final report.

Recommendation 1: Minimum Distance Between Sites

All issues affecting public safety and environmental protection should be thoroughly evaluated during permit reviews. Appropriate minimum distances should be established during this process.

At a minimum, public access shall be maintained. Affects on other farms should be considered during permitting.

Important considerations in permitting adjacent farms are:

1. Safe and viable navigational access.
2. Water quality degradation due to cumulative impacts.
3. Depletion of food resources for the cultured species.
4. Impacts on habitat.

During permit adjudication it will be the applicants responsibility to demonstrate that future mariculture operations will affect the existing farmers operation. Full consideration should be given at this time to demonstration of possible impacts on present mariculture operations from proposed developments.

Recommendation 2: Annual Reports

An annual report should be required of all permitted mariculture developments. This annual report would contain sufficient information to establish an information data base for use in managing Alaska mariculture development.

Issues

State of Alaska does not presently have ability to investigate and record data necessary to establish a sound systematic information base on mariculture development. Information gathered from actual operations would generate a more accurate picture of development and site capability parameters than is currently possible any other way.

Requirements of the annual report should be well developed. Information requested from sea farmers should clearly be identified as pertinent to area management. Reasonable amounts of information should be requested and should be reasonably obtainable by sea farmers.

As a top priority, information from PSP testing should be compiled and made available to resource managers. This information will be available from each lot of shellfish tested prior to marketing, and from various tests performed during and incidental to the sanitary survey.

Recommendation 3: Farm Viability

A mariculture farm development plan should be required for state tideland permitted and leased uses. Adherence to the development plan shall be monitored throughout the life of the project to ensure continued operation viability. Operations adherence to the development plan should be a

condition of both permits and leases for mariculture developments.

Issues

Mariculture operations on public lands should be required to maintain a level of enterprise that has been identified in their development plan. Mariculture farms that operate at levels far below their proposed plans should not be allowed to occupy public lands at the possible displacement of potential farmers and the public.

Recommendation 4: Permit Tracking And Monitoring

A permit tracking and monitoring system should be developed to determine and monitor commercial viability of mariculture developments. This system should be based largely on an annual report from actual development sites.

Issues

Concerns among permitting agencies are that use of state resources permitted to individuals and developers actually be developed in a manner consistent with good business and development practices. It is in the state's best interest to ensure responsible development balanced with resource protection.

1. Good potential sites that are permitted and then not developed for many years preclude more aggressive developers from a legitimate opportunity.
2. Good sites may be tied up by farmers whose goal is to have a cabin at a remote site and a subsistence lifestyle. These farmers may install minimal facilities with small numbers of organisms and in fact market minimal product quantities. The concern is that public resources be permitted or leased to legitimate developers, not subsistence users.
3. Speculation is a concern. An individual or organization may apply for appropriate permits with intent of acquiring a sight to obtain land rights that may be sold or traded at a later date. There is some concern sites may be permitted for the express purpose of shellfish and that the site be developed for finfish if it becomes legal.

If under the proposed tracking and monitoring system a site is not developed as a legitimate business venture or according to an approved development plan the permit would be revoked.

Part time farmers contribute to overall development of mariculture in Alaska. Part time farmers can postpone high initial capital costs by beginning with modest investments and adding to facilities as expertise and capital are acquired. This approach is acceptable and can continue if progressive development with the goal of independent, viable enterprise is demonstrated by the sea farmer.

Recommendation 5: Public Notification Process

Mariculture project public notification should include all groups with potential information pertinent to that development.

Issues

Current public notification process may not reach all individuals or organizations with proposed development information. A list of likely candidates for notification includes but is not limited to:

- Fish & Game Boards
- Conservation Groups & Organizations
- State Parks Advisory Boards
- Commercial Fishing Organizations
- Fisheries Enhancement Group
- Organized Mariculture Development Groups

Recommendation 6: Consistency With Other Uses

Mariculture development should be consistent with any approved plans. All mariculture developments permitted by the State of Alaska adjacent to lands under management of other agencies should consider any land use designations by those adjacent land managers.

Issues

A variety of uses occur on state tidelands either through natural phenomenon or by law. Mariculture sites should be developed 1) where there is no significant conflict with existing designated

uses, 2) where conflict with natural fish and wildlife resources are minimal, or 3) where conflicts can be mitigated.

State of Alaska manages lands adjacent to the federal government, local communities and boroughs and private lands. The state manages a significant majority of all tidelands in Alaska. Consistent management designations and objectives on adjacent properties is optimal with regards to maintaining integrity with the public and other land management agencies.

Recommendation 7: Future Studies

Scope and time frame of this project does not allow for an in depth evaluation of several issues related to Alaska mariculture viability. Future studies should investigate and report on the following issues:

1. A PSP data base, should be developed. Sources of information include the annual shellfish farm permit report, PSP testing done by DEC and other state and federal agencies.
2. Capability parameters of mariculture in Alaska.
3. Flushing capabilities of potential mariculture sites (central to many aspects of mariculture development). An inventory of situations that may develop anaerobic conditions would be very helpful to technical agencies and prospective sea farmers alike.
4. Funds should be made available for work on a regular basis to integrate information made available from studies already underway or planned for the future. Specifically included here are the current Marine Advisory Program's Remote Sensing Project and the results of the present subsistence study.
5. Conduct a study similar to the Etolin Island Area Mariculture Pilot Project if other forms of sea culture becomes authorized or legalized.

Recommendation 8: Implementation

Siting guidelines and criteria developed in this study should be used by agencies in reviewing proposed projects, with recognition that flexibility is required to accommodate specific sites. The evolution of the industry should also be considered in the review of new or innovative techniques.

Issues

Reasonable regulation of any land use requires development of **consistent** siting criteria and guidelines. During the development phase measures to mitigate potential impacts in areas less than ideal can reduce potential social and environmental impacts. This study has proposed criteria and guidelines (see Chapter 3) describing mitigating measures on a case by case basis in an effort to refine as the industry continues to grow and develop.

This study is not mandated to be accepted or adopted as policy. The intention is to provide a comprehensive analysis of mariculture development within the study area for permitting agencies, prospective sea farmers and interested public. No other study on mariculture development in Alaska contains a general discussion such as this one.

Mariculture is in a state of development; new and innovative techniques and technology that may alter the growing of sea organisms as we know it today. Flexibility will be necessary to properly evaluate and permit proposed developments in the future.



Etolin Island Area

Mariculture Pilot Project

APPENDIXES

- A - Marine Advisory Program's Remote Sensing Project
- B - Agency Authorities in the Study Area
- C - 1988 Coastal Project Questionnaire
- D - Consolidated Shellfish Farm Application
- E - Agency Contacts
- F - References/Bibliography
- G - Senate Bill 514

Appendix A - Marine Advisory Program

UNIVERSITY OF ALASKA - MARINE ADVISORY PROGRAM
PROJECT TITLE: FEASIBILITY OF USING REMOTE SENSING TO
IDENTIFY THE AQUACULTURE POTENTIAL OF
COASTAL WATERS

Project Summary

(1) Key words; remote sensing, aquaculture, estuaries, oysters

(2) Objectives:

(A) To test the feasibility of using conventional, free access aerial and satellite sensors to collect selected oceanographic data from estuaries and adjacent waters. In addition, to test the feasibility of the routine analysis of complex environmental data by state resource managers.

(B) Using standard bathymetric or navigational charts as base maps, to make use of a conventional chart overlay system; to identify areas appropriate for the commercial suspended cultivation of Pacific oysters (*Crassostrea gigas*). This study will be limited to the considered essential for the cultivation of oysters. Each variable (such as mixed layer temperature) will be charted on a Mylar overlay sheet superimposed on the master chart of the estuary under study.

(C) To establish a set of physical and biological criteria determined to be essential to the successful cultivation of oysters using standard suspended techniques (i.e. tray and longline culture). It is anticipated that project results can also be applied to the selection of culture sites for other species with environmental requirements occupying relatively narrow ranges.

(D) Major objective of this study is to compare the environmental requirement of oysters with the analyzed data charts. The expected outcome will be the delineation of estuarine areas with a significant potential for oyster culture.

(E) This project is restricted to a study site in central Southeast Alaska. The long term objective of the project is to make a contribution to the development of a simple, possible automated, environmental assessment procedure that can be applied to the needs of resource managers.

(F) To establish a set of catalogs, inventorying a set of significant environmental variables to be considered either individually or in combination to predict the probable success of oyster culture.

(G) To suggest methods by which the procedure can be used locate areas capable of supporting other types of aquaculture.

(H) By the identification of prime culture areas, it is hoped that this project will allow for the protection of potential oyster culture areas and efficient use of coastal resources.

(I) To assist other states and provinces in the implementation of similar environmental mapping and cataloging procedures.

(3) Methodology

A) Obtain and refine base map for primary and alternate study sites. These two areas have existing commercial oyster cultures operations. It is believed that both areas possess many additional culture sites.

(B) Formulate set of environmental criteria customarily used to select suspended culture sites (reviews of literature and field practice). Each criterion will be stated in form of permissible range and as an optimum value (latitudinal corrections to be made). Selection criteria are as follow:

- (a) temperature of mixed layer (degrees C\0)
- (b) surface current velocity (cm/sec)
- (c) salinity (parts per thousand)
- (d) plankton count to be interpreted in form of chlorophyll
a (ug/l)
- (e) turbidity (NTU - with extreme bias favoring sites
lacking turbidity)

Note: not included in this list are two major qualifying criteria (depth and wave energy)

(C) Study to concentrate on conditions during four seasonal periods:

- (a) late winter (temperature minimum)
- (b) mid spring and late fall (periods of salinity minimum)
- (c) late summer (temperature maximum)

(D) Each of the above environmental criteria will be linked to a specific aerial or satellite sensor(s). Particular to sensor to be used will be based on ease of public access to data, relative accuracy of data, frequency of data, cost, and ease of interpretation. Archived as well as actual data to be considered.

(E) As stated in item (C) above, data collection to be most intensive during four seasonal "windows (each approximately fourteen days long). Multiple data sets will be acquired within each seasonal window in order to determine "average" values (may be necessary to place heavy reliance on archived data for several variables). Accuracy of all remotely sensed data to be verified via "ground truth " data consisting of direct oceanographic measurements.

(F) Environmental data for each of the five criteria will be mapped and analyzed using computerized "geographic information system" (GIS) technology. Standard procedures will be used. A subcontractor (Recon Research, Bend Oregon) has agreed to perform certain aspects of this work.

(G) This project faces several major challenges. Two anticipated problems to be

overcome are gaining access to some data and resolution difficulties. The major challenge will be to develop strategies to interpret the seasonal behavior of salinity which currently is not possible to measure via remote sensing techniques available to non-military researchers.

(H) Oyster culture requirements (in the form of five environmental criteria) will be compared to the mapped data. General areas and, hopefully, prime microenvironments, capable of supporting suspended oyster culture will be mapped. Determining the feasibility of creating single purpose estuary resource maps of this sort (oyster culture, scallop culture, salmon farming, etc.) is the major objective of this project.

(I) The system developed by this project will be graded on its accuracy, practical operation, cost and applicability to other species (assumes focus on aquaculture, although other economic activities may also benefit). The evaluation will determine whether this procedure is appropriate for routine large-scale examinations of the natural world.

Not examined in this study is the potential of computerization and automation of data collection, analysis, and mapping functions.

(J) Resource maps will be circulated among estuary users prospective oyster farmers, water resource managers, and policy makers. The decision to implement the system and proceed with large scale environmental cataloging will be the responsibility of regional managers.

(4) Expected Results

(A) This project provides for mapping of several types of environmental data using standard techniques. However, this project is unique in that it attempts to interpret massive data sets gained by satellite during four seasonal periods. This project will begin the development of an automated or semi-automated system capable of the rapid integration of mapped environmental information, the comparison of this information to the known growth requirement of cultured organisms, and the delineation of estuarine regions capable of supporting specific aquaculture activity.

(B) It is expected that this method of environmental assessment will have reasonable accuracy, be relatively inexpensive, and will become an important tool in the initial identification of potential aquaculture sites.

(C) Preliminary and final project results will be transmitted to regional resource managers and members of the developing aquaculture industry by means of a Pacific Sea Grant technical publication.

(5) Summary of Rationale:

(A) The establishment of bivalve aquaculture requires careful consideration of oceanographic conditions.

(B) Traditional methods of oceanographic examination though of unquestioned accuracy, are costly, time consuming and unable to cope with the rapid examination of multiple environmental variables.

(C) Various states and provinces, with the rise of various water resource user groups (tourism, expanded urbanization, aquaculture, etc.) are faced with the increased need to catalog the environmental characteristics of coastal regions.

(D) It is unlikely that most states will have available the necessary technical and financial resources needed to develop comprehensive estuarine resource inventories using traditional direct sampling procedures. Pacific states and the Province of British Columbia are now facing steady pressure from a variety of prospective coastal resource users.

(E) Use of remote sensing may provide a means of acquiring and cataloging environmental information which, though of significantly lower accuracy than directly sampled data, can be used in the effective planning of coastal development.

(F) Moreover, it is expected that the practical application of remote sensing will be both timely and inexpensive.

(G) This project will test the utility of currently available sensors. It is quite possible that weaknesses uncovered during this project will be resolved through the advent of a new generation of more sophisticated environmental sensors.

Appendix B - Agency Authorities in the Study Area

STATE AUTHORITIES

Alaska Department of Fish and Game

- 16 US 661 et seq. Fish & Wildlife Coordination Act
- AS 16.05.050(10) Interim-Use Permit, Experimental Gear Permit
- AS 16.05.251 Regulations of the Board of Fisheries
- AS 16.05.840 Fishway Act
- AS 16.05.870 Anadromous Fish Act
- 5 AAC 40. Permits for Private non Profit Hatcheries
- 5 AAC 41. Transportation, Possession and Release of Live Fish
- 5 AAC 41. Shellfish Farm Permit
- 5 AAC 95. Protection of Fish & Game Hatcheries
- 6 AAC 80 ACMP Standards

Alaska Department of Environmental Conservation

- Sec. 401 Federal Clean Water Act
- Title 33 CFR Federal Dredge and Fill Regulations
- AS 03.05.020 Powers of the Commissioner of DEC
- AS 03.05.025 Seafood Processing Permits and Plans of Operation
- AS 03.05.035 Sale and Labeling of Frozen Meat, Fish, and Poultry
- AS 03.05.040 Inspection
- AS 03.05.050 Products in Violation of Regulations

AS 03.05.090	Penalty for Violations
AS 17.20.230	Detention or Embargo of Goods
AS 17.20.250	Destruction of Adulterated or Misbranded Goods.
AS 46.03.020	Powers of the Department
AS 46.03.060	Plan Review for Sewage Disposal
AS 46.03.090	Plan for Pollution Disposal
AS 46.03.100	Waste Disposal Permit
AS 46.03.110	Waste Disposal Permit Procedure
AS 46.30.140	Air Quality
AS 46.07.020	Monitor Public Water Systems
AS 46.03.060	Broad Water Quality Enforcement
6 AAC 80.	ACMP Standards
18 AAC 34.	Fish Inspection Regulations
18 AAC 60.	Solid Waste Management
18 AAC 62.	Hazardous Waste
18 AAC 70.	Water Quality Standards
18 AAC 72.	Wastewater Disposal
18 AAC 80.	Drinking Water

Alaska Coastal Management Program

AS 44.19.155.	Alaska Coastal Policy Council
AS 46.40.	Alaska Coastal Management Act
6 AAC 50.	Project Consistency Review Process
6 AAC 80.	ACMP Standards

Department of Commerce and Economic Development

No Authorities

Department of Transportation and Public Facilities

6 AAC 80 ACMP Standards

DNR - Division of Forestry

AS 41.17.010 Forest Resources and Practices

AS 45.50.235 Log Salvage

AS 38.05.110 Sale of Timber & Materials

AS 38.05.115 Sale Limitations

6 AAC 80. ACMP Standards

11 AAC 71.400 Log Salvage

11 AAC 95. Forest Resources and Practices

DNR - Division of Mining

AS 38.05.185 Mining Rights

AS 38.05.250 Offshore Prospecting Permits

6 AAC 80 ACMP Standards

11 AAC 86.500 Offshore Prospecting Permits

11 AAC 86.135 Mineral Deposits Open to Location

DNR - Division of Land and Water Management

AS 38.04.005 Public and Private Land Use

AS 38.04.010 Public Land for Private Use

AS 38.04.015 Public Retention of Lands

AS 38.04.020 Land Disposal Bank

AS 38.04.021 Municipal Entitlement

AS 38.04.065 Land Planning

AS 38.04.070 Management Categories

AS 38.04.050 Land Disposals

AS 38.04.070	Leasing of State Lands
AS 38.04.082	Shore Fisheries
AS 38.05.127	Access to Public Waters
AS 38.05.290	Land Selections
AS 46.15.030	Appropriation of Water
AS 46.15.050	Instream Flow
AS 46.15.145	Federal Reserve Water Rights
11 AAC 54	Disposal of Lands
11 AAC 55	Planning and Classification
11 AAC 58	Leasing of Lands
11 AAC 62	Tide and Submerged Lands
11 AAC 64	Shore Fisheries Leasing
11 AAC 66	Municipal Entitlement
11 AAC 67	Disposal of Land
11 AAC 71	Timber and Material Sales
11 AAC 86	Mining Rights
11 AAC 93	Water Management
6 AAC 80	ACMP Standards

FEDERAL AUTHORITIES

U.S. Forest Service

The Creative Act (1891)

The Organic Act (1897)

The Weeks Law Act (1911)

The Multiple Use-Sustained Yield Act (1960)

The Wilderness Act (1964)

The Land and Water Conservation Fund Act (1964)

The National Environmental Policy Act (1969)
The Endangered Species Act (1973)
The Forest and Rangelands Renewable Resources Act (1974)
The Sikes Act (1974)
The National Forest Management Act (1976)
The Federal Land Policy and Management Act (1976)
Alaska National Interest Lands Conservation Act (1980)

U.S. Army Corps of Engineers

Rivers and Harbors Act (1899) (Section 10)
Clean Waters Act (33 U.S.C. 1344, Section 404)

U.S. Fish and Wildlife Service

16 U.S.C. 668 Bald Eagle Act 1940
16 U.S.C. 742(a) Fish and Wildlife Act 1956
16 U.S.C. 757(a) Anadromous Fish Conservation Act
16 U.S.C. 703 Migratory Bird Treaty Act of 1918
16 U.S.C. 1361-1362 Marine Mammal Protection Act of 1972
16 U.S.C. 1371-1384 Fish and Wildlife Coordination Act
16 U.S.C. 1451 Coastal Zone Management Act of 1972
16 U.S.C. 1221-1226 Estuary Protection Act
42 U.S.C. 4321 National Environmental Policy Act

National Marine Fisheries Service

16 U.S.C. 1361, 1362 Marine Mammal Protection Act of 1972
16 U.S.C. 1451 Coastal Zone Management Act of 1972
16 U.S.C. 1371-1384 Fish and Wildlife Coordination Act
42 U.S.C. 4321 National Environmental Policy Act

Appendix C - 1988 Coastal Project Questionnaire

STATE OF ALASKA

OFFICE OF THE GOVERNOR

OFFICE OF MANAGEMENT AND BUDGET
DIVISION OF GOVERNMENTAL COORDINATION

STEVE COWPER, GOVERNOR

CENTRAL OFFICE

P.O. BOX AW
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHEAST REGIONAL OFFICE

431 NORTH FRANKLIN
P.O. BOX AW, SUITE 101
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHCENTRAL REGIONAL OFFICE

2600 DENALI STREET
SUITE 700
ANCHORAGE, ALASKA 99503-2798
PHONE: (907) 274-1581

NORTHERN REGIONAL OFFICE

675 SEVENTH AVENUE
STATION H
FAIRBANKS, ALASKA 99701-4596
PHONE: (907) 451-2818

1988 COASTAL PROJECT QUESTIONNAIRE

Dear Applicant:

The State of Alaska has a system for reviewing and processing all the resource-related permits, leases, and approvals which are required for proposed projects in coastal areas of Alaska. The project consistency review process is based on the Alaska Coastal Management Program and is designed to improve management of Alaska's coastal land and water uses. Project proposals are reviewed to:

- Determine the project's consistency with the Alaska Coastal Management Program.
- Identify permits required by the state resource agencies, that is, the Alaska Departments of Environmental Conservation, Fish and Game, and Natural Resources.
- Trigger the issuance of necessary permits and other authorizations by state resource agencies.

If a federal permit or permits from more than one state agency are required, the consistency review process is coordinated by a regional office of the Division of Governmental Coordination (DGC). If permits from only one state agency are required, the state agency responsible for issuing those permits coordinates the review. Your answers to this questionnaire will determine who is the appropriate coordinating agency. Contact the nearest DGC regional office for more information.

Before you settle on your final project plans and submit your application, the state can arrange for meetings between you and state agency representatives to review your completed coastal project questionnaire. Preapplication meetings can help identify concerns and information needs, and encourage a mutual understanding of your project. To arrange for a preapplication meeting, call or write the coordinating agency contact.

To begin the review process you must complete the attached Coastal Project Questionnaire to determine which permits are needed. The consistency review begins upon receipt of your complete application packet. A complete packet includes:

- A signed Coastal Project Questionnaire.
- Copies of any state permit applications needed for the project (originals go to the state agency issuing the permit).
- Copies of any federal permit applications needed for the project (originals go to the federal agency issuing the permit).
- Any additional pertinent information including public notices from agencies.

YOUR PROJECT CANNOT BE REVIEWED UNTIL A COMPLETE PACKET INCLUDING ALL APPLICATIONS IS RECEIVED. You must submit the completed packet to the appropriate state agency in the region where the proposed project is to occur. Attached is a list of regional agency contacts and a map of the coastal area with the regions delineated. All packets must be submitted to the Division of Governmental Coordination (DGC), with the following exceptions:

1. If a fee is required, submit the original application, coastal project questionnaire, and fee to the state resource agency with the fee requirement (include a copy of that permit application in the packet to DGC).
2. If a state permit application requires confidential information, submit the entire packet to the state resource agency with that requirement.
3. If the project is a placer mining activity, submit the Annual Placer Mining Application, instead of the questionnaire, to the Department of Natural Resources, Division of Mining.
4. If you need permits from only one state resource agency and no federal agencies, submit the entire packet to the state resource agency requiring the permits.

If one or more federal permits are required, submit the original federal permit application(s) to the federal agency and send a copy of those federal applications to the appropriate state agency along with your packet of other applications.

STEPS IN THE REVIEW PROCESS

Start-up: You will be notified when the review starts. You will receive your project's assigned review number, review schedule, and other information. Participants in the review process include:

1. You, the applicant;
2. State resource agencies and the Division of Governmental Coordination;
3. The affected local coastal community; and
4. Other interested members of the public.

Information requests: Agencies may request additional information from you during the review. The coordinating agency may stop the review until that information is received.

Proposed determination: After reviewing comments on your project, the coordinating agency will develop a proposed consistency determination which will be presented to you, state resource agencies, and coastal districts.

Conclusive determination: A conclusive consistency determination will be issued upon agreement of the proposed determination by you, state resource agencies, and coastal district with an approved program.

Elevation (appeal) process: If you do not concur with the proposed determination for your project, you may request elevation, or further review by division directors within the state resource agencies. The directors review the proposed determination and any additional information included in the elevation request, then issue a second proposed determination.

You may then elevate the review to the commissioners of the resource agencies if the director-level review does not satisfy your interests. This is the final step in the administrative appeal process. Each elevation review can take no longer than 15 days. State resource agencies and coastal districts with approved programs may also request elevation.

In addition to the state's elevation process, if your project requires a federal permit and you disagree with the state's final conclusive consistency determination, you may appeal to the U.S. Secretary of Commerce in Washington, D.C., as provided in 15 CFR 930.125(H).

Permits: Agencies will issue state permits covered by the determination within five days after the conclusive consistency determination is issued unless that agency finds that additional review is necessary to fulfill other statutory requirements. The agency will notify you if their permits will not be issued.

Review Schedules

The coordinating agency must complete the review of your project within 30 or 50 days. A 30-day review schedule will be used if all associated state permits must by statute or regulation be issued in 30 days. A 50-day review schedule will be used for projects with approvals requiring a 30-day public notice. The coordinating agency may grant extensions to these schedules as provided under 6 AAC 50.110. For example, if your project is located in the unorganized borough, the comment and decision deadlines may be extended for 10 days. The deadlines may also be extended at the request of the applicant, or to receive additional information requested by a resource agency.

	<u>30-Day Review</u>	<u>50-Day Review</u>
Consistency review begins	Day 1	Day 1
Deadline for regional reviewers to request additional information	Day 15	Day 25
Public and agency reviewer comments due	Day 17	Day 34
Notification for elevation	Day 29	Day 49
Conclusive consistency determination issued (unless elevation requested)	Day 30	Day 50
If elevated, director's determination	Day 45	Day 65
If elevated again, commissioner's determination	Day 60	Day 80

Coastal Project Questionnaire and Certification Statement

Please answer all questions. Include maps or plan drawings with your packet. An incomplete questionnaire may be returned and will delay the review of your packet.

APPLICANT INFORMATION

1. _____ Name of Applicant	2. _____ Contact Person
_____ Address	_____ Address
_____ City	_____ City
_____ State	_____ State
_____ Zip Code	_____ Zip Code
_____ Phone	_____ Phone

PROJECT INFORMATION

1. Provide a brief description of your project and ALL associated facilities (caretaker facilities, etc.):

Starting Date for Project _____ Ending Date for Project _____

PROJECT LOCATION

1. Please give location of project. (Include nearest community or identifiable body of land or water.)

Township _____ Range _____ Meridian _____ Section _____ Aliquot Parts _____ USGS Map _____

2. Is the project on: (please mark with ✓)

State Land _____ Federal Land _____ Private Land _____ Municipal Land _____

3. Project is located in which region of the state (see attached map):

Northern _____ Southcentral _____ Southeast _____

PERMIT APPROVALS

1. Do you currently have any State or federal approvals for this project? If yes, please list below. (Note: *approval* means permit or any other form of authorization.)

Yes	No
☐	☐

<u>Approval Type</u>	<u>Approval #</u>	<u>Expiration Date</u>
----------------------	-------------------	------------------------

FEDERAL APPROVALS

1. Will you be placing structures or fills in any of the following: tidal waters, streams, lakes, or wetlands*?

Yes	No
☐	☐

* If you are uncertain whether your proposed project area is in a wetland, contact the Corps of Engineers, Regulatory Branch at (907) 753-2720 for a wetlands determination. If you are outside the Anchorage area, call toll free 1-800-478-2712.

If yes, have you applied for or do you intend to apply for a U.S. Army Corps of Engineers (COE) permit? Please indicate at right and describe below.

Yes	No
☐	☐

2. Have you applied for or do you intend to apply for a U.S. Environmental Protection Agency National Pollution Discharge Elimination System (NPDES) permit? Please indicate at right and describe below. (Note: Any wastewater discharge requires an NPDES permit.) Yes ☐ No ☐

3. Have you applied for or do you intend to apply for permits from any other federal agency? If yes, please list below. Yes ☐ No ☐

Agency	Approval Type	Date submitted (or intend to submit)
_____	_____	_____
_____	_____	_____
_____	_____	_____

DEPARTMENT OF NATURAL RESOURCES APPROVALS

1. Is the proposed project on state-owned land or will you need to cross State lands for access? Yes ☐ No ☐

2. Is any portion of your project placed below the ordinary high water line of a stream, river, lake or other water body? Yes ☐ No ☐

3. Will you be dredging? If yes, location of dredging is: Yes ☐ No ☐

Township _____ Range _____ Meridian _____ Section _____

• Location of disposal site for dredged materials:

Township _____ Range _____ Meridian _____ Section _____

4. Will you be filling with rock, sand or gravel? If yes, amount? _____ Yes ☐ No ☐

• Location of source: Township _____ Range _____ Meridian _____ Section _____

• Location of area to be filled: Township _____ Range _____ Meridian _____ Section _____

5. Do you plan to use any of the following state-owned resources? Yes ☐ No ☐

Timber

• If yes, amount? _____

• Location of source: Township _____ Range _____ Meridian _____ Section _____

Other Materials

• If yes, what material? _____
(peat, building stone, silt, overburden, etc.)

• Location of source: Township _____ Range _____ Meridian _____ Section _____

6. Are you planning to use any fresh water? Yes ☐ No ☐

• If yes, amount (gallons per day)? _____

• Source? _____

7. Will you be building or altering a dam? Yes ☐ No ☐

8. Do you plan to drill a geothermal well? ☐ ☐

9. Will you be exploring for or extracting coal? ☐ ☐

10. Will you be exploring for or extracting minerals on state-owned land? ☐ ☐

11. Will you be exploring for or extracting oil and gas on state-owned land? ☐ ☐

12. Will you be harvesting timber from 10 or more acres? ☐ ☐

13. Will you be investigating or removing historical or archaeological resources on state-owned land? Yes ☐ No ☐

14. Will the project be located in a unit of the Alaska State Park System?

Yes ☐ No ☐

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Natural Resources (DNR). Continue to the next section.

If you answered YES to ANY questions in this section, contact DNR to identify and obtain necessary application forms.

Based on your discussion with DNR, please list (below) the approval type needed and date submitted.

Approval Type

Date Submitted (or intend to submit)

_____	_____
_____	_____
_____	_____

Have you paid the filing fees required for the DNR permits?

Yes ☐ No ☐

If you are not applying for DNR permits, indicate reason below:

- _____ a. _____ (DNR contact) told me on _____ (date) that no DNR approvals or permits were required on this project.
- _____ b. Other: _____

DEPARTMENT OF FISH AND GAME APPROVALS

1. Will you be working in a stream, river, or lake? (This includes running water or on ice, within the active floodplain, on islands, the face of the banks, or the stream tideflats down to mean low tide.)

Yes ☐ No ☐

Name of stream or river: _____ Name of lake: _____

If you answered "no", proceed to question #2.

If "yes", will you be doing any of the following:

- | | | |
|---|------------------------------|-----------------------------|
| a) Building a dam, river training structure or instream impoundment? | Yes ☐ | No ☐ |
| b) Using the water? | ☐ | ☐ |
| c) Diverting or altering the natural channel stream? | ☐ | ☐ |
| d) Blocking or damming the stream, (temporarily or permanently)? | ☐ | ☐ |
| e) Changing the flow of the water or changing the bed? | ☐ | ☐ |
| f) Pumping water out of the stream or lake? | ☐ | ☐ |
| g) Introducing silt, gravel, rock, petroleum products, debris, chemicals or wastes of any type into the water? | ☐ | ☐ |
| h) Using the stream as a road (even when frozen), or crossing the stream with tracked or wheeled vehicles, log-dragging or excavation equipment (backhoes, bulldozers, etc.)? | ☐ | ☐ |
| i) Altering or stabilizing the banks? | ☐ | ☐ |
| j) Mining or digging in the beds or banks? | ☐ | ☐ |
| k) Using explosives? | ☐ | ☐ |
| l) Building a bridge (including an ice bridge)? | ☐ | ☐ |
| m) Installing a culvert or other drainage structure? | ☐ | ☐ |
| n) Constructing a weir? | ☐ | ☐ |

o) Other in-stream structure not mentioned above?

Yes ☐ No ☐

2. Is your project located in a State Game Refuge, Critical Habitat Area, or State Game Sanctuary?

☐ ☐

3. Does your project include the construction and operation of a salmon hatchery?

☐ ☐

4. Does your project affect or is it related to a previously permitted salmon hatchery?

☐ ☐

5. Does your project include the construction of a shellfish or sea vegetable farm?

☐ ☐

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Fish and Game (DFG). Continue to the next section.

If you answered YES to any of the questions under 1 or 2, contact the Regional DFG Habitat Division Office for information and application forms.

If you answered YES to questions 3, 4 or 5, contact the DFG Private Nonprofit Hatchery Office at the F.R.E.D. division headquarters for information and application forms.

Based on your discussion with DFG, please list (below) the approval type needed and date submitted.

Yes ☐ No ☐

Approval Type

Date Submitted (or intend to submit)

_____	_____
_____	_____
_____	_____

If you are not applying for permits, indicate reason below:

_____ a. _____ (DFG contact) told me on _____ (date) that no DFG approvals or permits were required on this project.

_____ b. Other: _____

DEPARTMENT OF ENVIRONMENTAL CONSERVATION APPROVALS

1. Will a discharge of wastewater from industrial or commercial operations occur?
(See #2 in "Federal Permits" section)

Yes ☐ No ☐

2. Will your project generate air emissions from the following:

☐ ☐

a) Diesel generators totaling more than 10,000 hp?

☐ ☐

b) Other fossil fuel-fired electric generator, furnace, or boiler totaling greater than 10,000 hp, or 9,000 kWh, or 100,000,000 btu/hr?

☐ ☐

c) Asphalt plant?

☐ ☐

d) Incinerator burning more than 1000 lbs. per hour?

☐ ☐

e) Industrial process?

☐ ☐

3. Will a drinking water supply be developed that serves more than a single-family residence?

☐ ☐

4. Will you be processing seafood?

☐ ☐

5. Will food service be provided to the public or workers?

☐ ☐

6. Will the project result in dredging or disposal of fill in wetlands or placement of a structure in waterways? (Note: your application for this activity to the Corps of Engineers will also serve as your application to DEC.)

☐ ☐

7. Is sewage or greywater disposal involved or necessary?

☐ ☐

8. Will your project result in the development of a currently unpermitted facility for the disposal of domestic or industrial solid waste? ☐ ☐
9. Will your project require offshore drilling or vessel transport of oil, or other petroleum products as cargo, or include onshore facilities with an effective storage capacity of greater than 10,000 barrels of such products? ☐ ☐
10. Will your project require the application of oil or pesticides to the surface of the land? ☐ ☐

If you answered NO to all questions in this section, you do not need a permit or approval from the Alaska Department of Environmental Conservation (DEC). Please continue to the next section.

If you answered YES to any of these questions (see #6 Note), contact the DEC Regional Office for information and application forms.

Based on your discussion with DEC, please list (below) the approval type needed and date submitted.

Approval Type

Date Submitted (or intend to submit)

_____	_____
_____	_____
_____	_____

If you are not applying for permits, indicate reason below:

- ___ a. _____ (DEC contact) told me on _____ (date) that no DEC approvals or permits were required on this project.
- ___ b. Other: _____

Certification Statement

The information contained herein is true and complete to the best of my knowledge. I certify that the proposed activity complies with, and will be conducted in a manner consistent with, the Alaska Coastal Management Program.

Signature of Applicant or Agent

Date

To complete your packet, please attach your state permit applications and copies of your federal applications to this questionnaire.

**WHEN ON STATE AND PRIVATE LAND NOT SUBJECT
TO AN ADOPTED LOCAL COASTAL PLAN**

LANDWARD BOUNDARY
 SEAWARD BOUNDARY (usually 3 mile limit)
 COASTAL ZONE

System of _____

SCALE

OFFICE OF COASTAL MANAGEMENT
APRIL 1979

NORTHERN REGION

**SOUTH CENTRAL
REGION**

SOUTHEAST
REGION CITY AND COUNTRIES

U.S. consular officials are urged to request consular assistance from the appropriate U.S. consulate in the country of origin of the alien.

the fact that the company is not a public company, and the fact that the company is not a public company.

1

DATE

Page 2 of 2

CITY AND COUNTY

SOUTHEAST REGIONAL CONTACTSDEPARTMENT OF NATURAL RESOURCESOil & Gas Activities

DNR/Commissioner's Office
 400 Willoughby Ave.
 Juneau, AK 99801-1796
 (907) 465-2400
 CONTACT: Jim Powell

Mining Activities

DNR/Mining*
 Box 107016
 Anchorage, AK 99510-7016
 (907) 762-2163
 CONTACT: Jerry Gallagher

Forestry Activities

DNR/Forestry
 400 Willoughby Avenue
 Juneau, AK 99801-1796
 (907) 465-2491
 CONTACT: Jim McAllister

Agriculture Activities

DNR/Agriculture
 915 S. Bailey
 P.O. Box 949
 Palmer, AK 99645-0949
 (907) 745-7200
 CONTACT: Mark Weaver

Activities on State Park Lands

DNR/Parks
 400 Willoughby Avenue
 Juneau, AK 99801-1796
 (907) 465-4563
 CONTACT: Linda Kruger

All Other Activities

Southeast District Office
 DNR/Land and Water Management
 400 Willoughby Avenue
 Juneau, AK 99801-1796
 (907) 465-3400
 CONTACT: Andy Pekovitch

*Street Address:

3601 "C" Street
 Frontier Building

DEPARTMENT OF FISH AND GAMEDFG/Habitat Division

P.O. Box 20
 Douglas, AK 99824-0020
 (907) 465-4290, 465-4291
 CONTACT: Rick Reed or
 Janet Hall

Area Offices

Department of Fish and Game
 P.O. Box 667
 Petersburg, AK 99833
 (907) 772-3801
 CONTACT: Don Cornelius

Department of Fish and Game
 2030 Sealevel Drive, Room 205
 Ketchikan, AK 99901
 (907) 225-2027
 CONTACT: Jack Gustafson

Department of Fish and Game
 State Office Building
 P.O. Box 510
 Sitka, AK 99835
 (907) 747-5828
 CONTACT: Dave Hardy

Hatchery Permits

DFG/FRED Division
 1255 West Eighth Street
 P.O. Box 3-2000
 Juneau, AK 99802-2000
 (907) 465-4160
 CONTACT: Jerry Madden or
 Kevin Duffy

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DEC/Southeast Office
 P.O. Box 2420
 9000 Old Glacier Highway
 Juneau, AK 99803
 (907) 789-3151
 CONTACT: Dick Stokes

OFFICE OF MANAGEMENT AND BUDGET

Division of Governmental Coordination
 Pouch AW
 431 N. Franklin Street
 Juneau, AK 99811-0165
 (907) 465-3562
 CONTACT: Diane Mayer
 Lorraine Marshall

SOUTHCENTRAL REGIONAL CONTACTS

2/88

DEPARTMENT OF NATURAL RESOURCES

Oil & Gas Activities

DNR/Oil and Gas*
Box 107034
Anchorage, AK 99510-7034
(907) 762-2547
CONTACT: Bill Van Dyke

Mining Activities

DNR/Mining*
Box 107016
Anchorage, AK 99510-7016
(907) 762-4222
CONTACT: Jerry Gallagher

Forestry Activities

DNR/Forestry*
Box 107005
Anchorage, AK 99510-7005
(907) 762-2123
CONTACT: Dan Ketchum

Agriculture Activities

DNR/Agriculture
915 S. Bailey
P.O. Box 949
Palmer, AK 99645
(907) 745-7200
CONTACT: Dean Brown

Activities on State Park Lands

DNR/Parks*
Box 107001
Anchorage, AK 99510-7001
(907) 762-4565
CONTACT: Al Miners

All Other Activities

Public Information*
Southcentral District Office
DNR/Land and Water Management
Box 107005
Anchorage, AK 99510-7005
(907) 762-2270
CONTACT: Janetta Pritchard

*Street Address:

3601 "C" Street
Frontier Building

DEPARTMENT OF FISH AND GAME

DFG/Habitat Division
333 Raspberry Road
Anchorage, AK 99518-1599
CONTACT: (Southcentral):
Phil Brna
Gary Liepitz
(907) 267-2284
(Southwest and Western):
Denby Lloyd
Kim Sundberg
(907) 267-2346

Hatchery Permits

DFG/FRED Division
1255 West Eighth Street
P.O. Box 3-2000
Juneau, AK 99802-2000
(907) 465-4160
CONTACT: Jerry Madden or
Kevin Duffy

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DEC/Southcentral Office
437 E Street, Second Floor
Anchorage, AK 99501
274-2533
CONTACT: Bob Flint

OFFICE OF MANAGEMENT AND BUDGET

Division of Governmental Coordination
2600 Denali Street, Suite 700
Anchorage, AK 99503-2798
(907) 274-1581
CONTACT: Patty Bielawski
Louisa Rand

NORTHERN REGIONAL CONTACTSDEPARTMENT OF NATURAL RESOURCESOil & Gas Activities

DNR/Oil and Gas*
 Box 107034
 Anchorage, AK 99510-7034
 (907) 762-2547
 CONTACT: John Wharam

Mining Activities

DNR/Mining*
 Box 107016
 Anchorage, AK 99510-7016
 (907) 762-4222
 CONTACT: Jerry Gallagher

Forestry Activities

DNR/Forestry*
 Box 107005
 Anchorage, AK 99510-7005
 (907) 762-4500
 CONTACT: Dan Ketchum

Agriculture Activities

DNR/Agriculture
 915 S. Bailey
 P.O. Box 949
 Palmer, AK 99645
 (907) 745-7200
 CONTACT: Mark Weaver

Activities on State Park Lands

DNR/Parks
 4418 Airport Way
 Fairbanks, AK 99709
 (907) 479-4136
 CONTACT: Al Meiners or Dave Snarski

All Other Activities

North Central District Office
 DNR/Land and Water Management
 4420 Airport Way
 Fairbanks, AK 99709
 (907) 479-2243
 CONTACT: Gayle Berger

*Street Address:

3601 "C" Street
 Frontier Building

DEPARTMENT OF FISH AND GAME

DFG/Habitat Division
 1300 College Road
 Fairbanks, AK 99709
 CONTACT: Al Ott
 (907) 452-1531

Hatchery Permits

DFG/FRED Division
 1255 West Eighth Street
 P.O. Box 3-2000
 Juneau, AK 99802-2000
 (907) 465-4160
 CONTACT: Jerry Madden or
 Kevin Duffy

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DEC/Northern Office
 1001 Noble Street, Suite 350
 Fairbanks, AK 99701
 (907) 452-1714
 CONTACT: Paul Bateman (Arctic)
 Joyce Beelman (Interior)

OFFICE OF MANAGEMENT AND BUDGET

Division of Governmental Coordination
 675 Seventh Avenue, Station H
 Fairbanks, AK 99701-4596
 (907) 451-2818
 CONTACT: Elizabeth Benson
 Patti Wightman

Appendix D - Consolidated Shellfish Farm Permit Application

STATE OF ALASKA

OFFICE OF THE GOVERNOR

DIVISION OF GOVERNMENTAL COORDINATION

STEVE COWPER, GOVERNOR

CENTRAL OFFICE

P.O. BOX AW
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHEAST REGIONAL OFFICE

431 NORTH FRANKLIN
P.O. BOX AW, SUITE 101
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHCENTRAL REGIONAL OFFICE

2600 DENALI STREET
SUITE 700
ANCHORAGE, ALASKA 99503-2798
PHONE: (907) 274-1581

NORTHERN REGIONAL OFFICE

675 SEVENTH AVENUE
STATION H
FAIRBANKS, ALASKA 99701-4596
PHONE: (907) 456-3084

Dear Shellfish Farm Applicant:

The Shellfish Farm Application is designed to help you obtain the authorizations routinely required by the State of Alaska Departments of Natural Resources (DNR), Fish and Game (DFG), Environmental Conservation (DEC), and Division of Governmental Coordination (DGC) to site and construct your shellfish mariculture project. This form can be used to apply for the Shellfish Farm Permit or Fish Habitat Permits from DFG, Water Quality Certification (401) and System Plan Review Approvals from DEC, Land Use Permits and Leases from DNR, and the Coastal Zone Consistency Certification from DGC. It also addresses your use and discharge of up to 500 gallons per day of fresh water and solid waste disposal for single family use.

A Coastal Project Questionnaire, which is available from any of these agency offices, must also be submitted with your application to help determine which specific permits must be obtained prior to constructing your project. If you determine that your specific project design requires additional permits for activities such as an increase in water use, discharge or solid waste disposal, or use of state owned timber or gravel you must also file supplementary applications with the standard Shellfish Farm Application.

Please read this application carefully. A fully completed application will help the state agencies to process your request promptly. Incomplete or incorrect information may result in requests for additional information, processing delays, or the application may be returned to you for resubmission. You will receive a notice and processing schedule for the state coastal zone consistency review from DGC when your application has been accepted for processing. Your permits will also be processed on this schedule.

01-A35LH

If you need technical assistance in completing this application, please refer to the list of agency representatives provided at the back of the coastal project questionnaire. If you have questions about this application process, or you are not able to determine which agency can best answer your technical questions, contact the Division of Governmental Coordination in Juneau at 465-3562, in Anchorage at 274-1581, or in Fairbanks at 451-2818.

Stocking your Farm or Selling your Products.

In addition to the permits and approvals which you are applying for in this consolidated permit application, you will also need to separately apply for and obtain a Fish Transport Permit from ADF&G to obtain and hold broodstock, and a Growing-Area Certification and a Harvester's Permit from DEC in order to sell your product. These permits are not covered by this application since they are required for later phases of your project.

A Fish Transport Permit is required by ADF&G in order to hold, transport, and raise live fish including shellfish. You will need this permit before you can obtain, hold, or begin raising your product. We encourage you to contact the Fisheries Rehabilitation, Enhancement and Development (FRED) Division in Juneau at 465-4160 or in Anchorage at 267-2157 as early as possible in order to apply for and obtain a Fish Transport Permit.

You should contact DEC regarding area certification requirements so that you can be reasonably sure that your site will qualify. We recommend that you apply for growing area certification and a harvester's permit at least six months before you intend to harvest shellfish. To obtain more information on certification requirement please contact DEC in Anchorage at 563-0318.

jbak87122401DMF

State of Alaska
Consolidated Shellfish Farm Permit Application

General Instructions

1. Fill in the blanks on the form provided.
2. If additional space is needed to fully answer a particular question, attach additional pages marked with the corresponding number in the application.
3. Applications must be typed or printed clearly in ink.
4. Applications must be signed by the applicant or an authorized representative.
5. The application and a coastal project questionnaire must be sent to the Office of Management and Budget's, Division of Governmental Coordination in the region in which the farm is to be located.

OMB/DGC
Southeast Regional Office
431 North Franklin Street
P.O. Box AW, Suite 101
Juneau, Alaska 99811-0165
(907) 465-3562

OMB/DGC
Southcentral Regional Office
2600 Denali Street
Suite 700
Anchorage, Ak 99503-2798
(907) 274-1581

OMB/DGC
Northern Regional Office
675 Seventh Avenue
Station H
Fairbanks, AK 99701-4596
(907) 451-2818

6. The Department of Natural Resources requires an application filing fee of \$50. Please submit the filing fee along with a copy of your completed application to the appropriate regional office.

DNR
Southeast Regional Office
400 Willoughby Avenue
Suite 400
Juneau, Alaska 99801

DNR
Southcentral Regional Office
3601 C Street, Anchorage
Mailing Address:
P.O. Box 107005
Anchorage, Alaska 99510

DNR
Northern Regional Office
4420 Airport Way
Fairbanks, Alaska 99709

7. **Please note:** This application is for a specific mariculture project. You will need to submit a new application if you change any of the following:

- A. The species to be propagated
- B. The size or design of your operation
- C. The location of your operation
- D. Request a long-term tidelands lease for a previously permitted site

PERMIT APPLICATION
State of Alaska Consolidated Shellfish Farm

3/15/88

APPLICANT INFORMATION

1. Name _____
Mailing Address _____
City _____ State _____ Zip Code _____
Phone _____
2. Business Name (if applicable) _____
Business Address _____
City _____ State _____ Zip Code _____
Phone _____
3. Authorized Agent (if applicable) _____
Address _____
City _____ State _____ Zip Code _____
Phone _____

PROJECT INFORMATION

1. Provide a brief description of the facility and your overall proposal. Include upland facilities as well as tide and submerged land facilities.

2. What experience, expertise, and other resources do you have available for this project?

PROJECT LOCATION

1. Is the Project on: (please mark with ✓)
State Land _____ Federal Land _____ Private Land _____ Municipal Land _____
2. Township _____ Range _____ Meridian _____ Section _____
3. Number of acres applied for:
Uplands _____ Tidelands _____
4. Provide the names and addresses of the landowners of adjacent uplands and tidelands.
- | Uplands | Tidelands |
|---------|-----------|
| A _____ | A _____ |
| B _____ | B _____ |
| C _____ | C _____ |

5. Attach topographic maps (U.S.G.S. Scale 1: 63360) and nautical charts to this application that show the site location and general area. Clearly indicate the site location on the charts and maps.

SITE PLAN & PHYSICAL DESCRIPTION

1. Provide a site plan drawn to scale (no less than 1" = 50') which shows the layout and location of the following:
 - A. The rafts or other production facilities employed (please include size and number).
 - B. Anchoring systems and shoreties.
 - C. Docks, floathomes, or caretaker facilities, including source of freshwater for domestic use and processing water, wastewater disposal systems, and solid waste storage and disposal. (Note: you are encouraged to use existing permitted sites for the disposal of solid wastes.)
 - D. Any freshwater discharges.
 - E. Roads or air strips.
 - F. Other upland or tideland facilities at the site associated with the farming operation.
 - G. Fuel and chemical storage.
 - H. Properties referenced in #4 of the previous section.
2. On the site plan, draw lines and identify the tide level at the following stages:
 - Mean Lower Low Water (MLLW)
 - Mean Higher High Water (MHHW)
 - Mean High Water (MHW)
3. Diagram surface tidal current speed and direction at maximum tide flow on the site plan or nautical chart.
4. Water depth at the site of culture gear at MLLW would be: _____

SITE SUITABILITY

1. Physical and Biological Characteristics
 - A. Have you conducted an on-site investigation? yes _____ no _____
 - B. Provide any information you may have regarding tidal flushing, water temperature, salinity, and turbidity/sedimentation at the site. Include the dates these data were obtained.

 - C. Describe the bottom type composition at the site (if more than one type, indicate percent).
sand _____ mud _____ rock _____ gravel _____ eelgrass _____
other: _____

 - D. Describe winter conditions at the site (temperatures, icing, storms, etc.).

E. Do anadromous fish (e.g. salmon) use any streams in the area for spawning? yes _____ no _____

If yes, indicate which streams are used and label them as such on the site plan.

F. Is the target species naturally present in the area? yes _____ no _____

If yes, describe abundance and condition.

G. Describe measures you would propose to control predation by marine mammals, seabirds, or other potential predators.

WATER QUALITY

NOTE TO APPLICANT: Sewage or industrial discharge(s) may accumulate in, or harm the growth or consumptive use of your shellfish product. Oysters, mussels and scallops are filter feeders and may accumulate fecal coliform bacteria from sewage discharges. If a caretaker facility is located near the culturing operation there may be a risk of contamination. DEC will require that the wastewater treatment systems used on caretaker facilities meet Alaska State Water Quality Standards criteria for harvest or consumption of raw mollusks or other aquatic life.

A. Were there any sources of past pollution at the site, such as a shorebased seafood processor, industrial facility, or a town or village? yes _____ no _____

If you answered yes to the above, identify:

- The type of previous use (i.e. mine, village, seafood processor) _____
- The last known date of use _____
- The distance from site of previous use to your project site _____

B. Are there any currently active sources of human or industrial pollution in the area?
yes _____ no _____

If yes, please describe:

- The type of discharge(s) _____
- The location and distance from your site _____
- The name of the discharger(s), if known _____

- C. If there is a caretaker's facility proposed for the site, please submit the following information for review of your sewage disposal system plan:

(Note: outhouses and septic systems must maintain a minimum 100 foot horizontal separation distance from surface waters and a minimum of 4 foot vertical separation distance from the high ground water table.)

1. The location and description of proposed and existing domestic wastewater treatment works, disposal systems, or sewers;
2. the location of waters, including any drinking water wells, fresh water, salt water within 200 feet of the proposed wastewater disposal system;
3. the proposed discharge location;
4. (if disposal is into subsurface land) the soil information used to determine absorption-field area required for domestic wastewater disposal systems, including soil tests, borings, test holes, and percolation tests.

CURRENT LAND USE STATUS

Describe the type and intensity of all present uses of the project site and the surrounding area (e.g. commercial development, mining, timber harvest or transfer, sheltered anchorage, subsistence, recreation, commercial fishing, sport fishing, or residential use, etc.).

FARM OPERATION AND DEVELOPMENT

1. Species to be raised:

Species

Annual Production Goal

A	_____	_____
B	_____	_____
C	_____	_____

2. Please provide a timetable showing approximate dates for installation of spat collection gear, placement of production facilities, date of first sale, and a schedule for reaching expected maximum production.

3. Donor Stock

Have you submitted a Fish Transport Permit application to the Department of Fish and Game?
yes _____ no _____

If yes, date of application _____

Certification Statement

The information contained herein is true and complete to the best of my knowledge. I understand that I must separately apply for and hold a Fish Transport Permit from the Department of Fish and Game in order to hold, transport, and raise shellfish, and a Growing Area Certification and a Harvesters Permit from the Department of Environmental Conservation in order to sell my product.

Signature of Applicant or Agent

Date

Appendix E - Agency Contact List

STATE OF ALASKA PERMIT/LEASE AGENCY CONTACT LIST

DEPT. OF NATURAL RESOURCES

Oil and Gas Activities

DNR/ Oil & Gas
400 Willoughby
Juneau AK 99801
(907) 465-2400

Forestry Activities

DNR/Forestry
400 Willoughby
Juneau AK 99801
(907) 465-4500

Mining Activities

DNR/Mining
Box 7016
Anchorage AK 99510
(907) 762-4222

Agricultural Activities

DNR/Agriculture
915 S. Bailey
P.O. Box 949
Palmer AK 99645
(907) 745-7200

Activities on State Lands

DNR/Parks
400 Willoughby
Juneau AK 99801
(907) 465-4563

All Other Activities

Southeast District Office
Division of Land & Water Mgmt
400 Willoughby
Juneau AK 99801
(907) 465-3400

DEPT. OF FISH AND GAME

DFG/Habitat Division

P.O. Box 20
Douglas AK 99824
(907) 465-4290

Fisheries Rehabilitation & Enhancement Division

Shellfish Farm Permits
1255 West Eighth St.
P.O. Box 3-2000
Juneau AK 99802
(907) 465-4160

Area Offices:

Dept. of Fish & Game
P.O. Box 667
Petersburg, Alaska 99833
(907) 772-3801

Dept. of Fish & Game
2030 Sealevel Drive, Rm. 205
Ketchikan AK 99901
(907) 225-2027

Dept. of Fish and Game
P.O. Box 667
Petersburg, Ak. 99833
(907) 772-3801

OFFICE OF MANAGEMENT & BUDGET

DEPT. OF ENVIRONMENTAL CONSERVATION

DEC/ Southeast Office
P.O. Box 2420
9000 Old Glacier Highway
Juneau, Ak 99803
(907) 789-3151

Division of Governmental Coordination
P.O. Box AW
431 N. Franklin St.
Juneau AK 99811
(907) 465-3562

Appendix F - References

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PERSONAL COMMUNICATIONS

John Church, former oyster grower in Blashke Islands, Wrangell, Alaska

Eric Hurlburt, Shellfish/Aquaculture Coordinator, Washington Dept. of Fisheries, Olympia, Washington

Michael Kaill, Mariculture Coordinator Fisheries Rehabilitation and Enhancement and Development Division Alaska Dept. of Fish and Game, Juneau, Alaska

Brian Paust, Marine Advisory Program Agent, Cooperative Extension Service, Univ. of AK. Petersburg, Alaska

Dr. Tom Shirley, Professor, School of Fisheries, Univ. of AK. Southeast, Juneau, Alaska

Appendix G - Senate Bill No. 514

Offered: 5/9/88
For Today's Supplemental Calendar
Original sponsor: Rules Committee

5-2170X

1 IN THE SENATE

BY THE RULES COMMITTEE

2 HOUSE CS FOR CS FOR SENATE BILL NO. 514 (Rules)

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 FIFTEENTH LEGISLATURE - SECOND SESSION

5 A BILL

6 For an Act entitled: "An Act relating to the farming of aquatic plants and
7 shellfish; prohibiting the farming of Atlantic sal-
8 mon; extending the moratorium on finfish farming
9 until July 1, 1990; establishing the Alaska Finfish
10 Farming Task Force; and providing for an effective
11 date."

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

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

14 (1) aquatic farming in the state would

15 (A) provide a consistent source of quality food;

16 (B) provide new jobs;

17 (C) increase state exports;

18 (D) create new business opportunities; and

19 (E) increase the stability and diversity of the state's
20 economy; and

21 (2) development of aquatic farming in the state would increase
22 the availability of fresh seafood to Alaskans and would strengthen the
23 competitiveness of Alaska seafood in the world marketplace by broadening
24 the diversity of products and providing year-round supplies of premium
25 quality seafood.

26 (b) It is the policy of the state

27 (1) to encourage the establishment and responsible growth of an
28 aquatic farming industry in the state; and

29 (2) that allocation of aquatic farming sites be made with full

1 consideration of established and ongoing activities in an area.

2 * Sec. 2. AS 16.40 is amended by adding new sections to read:

3 ARTICLE 2. AQUATIC FARMING.

4 Sec. 16.40.100. AQUATIC FARM AND HATCHERY PERMITS. (a) A
5 person may not, without a permit from the commissioner, construct or
6 operate

7 (1) an aquatic farm; or

8 (2) a hatchery for the purpose of supplying aquatic plants
9 or shellfish to an aquatic farm.

10 (b) A permit issued under this section authorizes the permittee,
11 subject to the conditions of AS 03.05 and AS 16.40.100 - 16.40.199, to
12 acquire, purchase, offer to purchase, transfer, possess, sell, and
13 offer to sell stock and aquatic farm products that are used or reared
14 at the hatchery or aquatic farm. A person who holds a permit under
15 this section may sell or offer to sell shellfish stock to the depart-
16 ment or to an aquatic farm or related hatchery outside of the state.

17 (c) The commissioner may attach conditions to a permit issued
18 under this section that are necessary to protect natural fish and
19 wildlife resources.

20 (d) Notwithstanding other provisions of law, the commissioner
21 may not issue a permit under this section for the farming of, or
22 hatchery operations involving, Atlantic salmon.

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

26 (1) the physical and biological characteristics of the
27 proposed farm or hatchery location must be suitable for the farming of
28 the shellfish or aquatic plant proposed;

29 (2) the proposed farm or hatchery may not require

1 significant alterations in traditional fisheries or other existing
2 uses of fish and wildlife resources;

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

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

8 Sec. 16.40.110. PERMIT APPLICATION, RENEWAL, AND TRANSFER. (a)

9 An applicant for an aquatic farming or hatchery permit required under
10 AS 16.40.100 shall apply on a form prescribed by the commissioner. An
11 application for a permit must include a plan for the development and
12 operation of the aquatic farm or hatchery, which must be approved by
13 the commissioner before the permit is issued.

14 (b) An application for renewal or transfer of a permit must be
15 accompanied by fees required by the commissioner, a report of the
16 disease history of the farm or hatchery covered by the permit, and
17 evidence that satisfies the commissioner that the applicant has com-
18 plied with the development plan required under (a) of this section.
19 The commissioner may require a health inspection of the farm or hatch-
20 ery as a condition of renewal. The department may conduct the in-
21 spection or contract with a disease diagnostician to conduct the
22 inspection.

23 (c) A person to whom a permit is transferred may use the permit
24 only for the purposes for which the permit was authorized to be used
25 by the transferor, and subject to the same conditions and limitations.

26 Sec. 16.40.120. AQUATIC STOCK ACQUISITION PERMITS. (a) A

27 person may not acquire aquatic plants or shellfish from wild stock in
28 the state for the purpose of supplying stock to an aquatic farm or
29 hatchery required to have a permit under AS 16.40.100 unless the

1 person holds an acquisition permit from the commissioner.

2 (b) An acquisition permit authorizes the permit holder to ac-
3 quire the species and quantities of wild stock in the state specified
4 in the permit for the purposes of supplying stock to

5 (1) an aquatic farm or hatchery required to have a permit
6 under AS 16.40.100;

7 (2) the department.

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

16 (d) The commissioner shall deny or restrict a permit under this
17 section upon finding that the proposed harvest will impair sustained
18 yield of the species or will unreasonably disrupt established uses of
19 the resources by commercial, sport, personal use, or subsistence
20 users. The commissioner shall inform the Board of Fisheries of any
21 action taken on permit applications for species that support commer-
22 cial fisheries subject to limited entry under AS 16.43 and of any
23 permits denied because of unreasonable disruption of an established
24 use. A denial of the permit by the commissioner must contain the
25 factual basis for the findings.

26 (e) The Board of Fisheries may adopt regulations for the conser-
27 vation, maintenance, and management of species for which an acqui-
28 sition permit is required.

29 (f) Except as provided in (d) of this section or in a regulation

1 adopted under (e) of this section, the commissioner shall issue a
2 permit if

3 (1) wild stock is necessary to meet the initial needs of
4 farm or hatchery stock;

5 (2) there are technological limitations on the propagation
6 of cultured stock for the species sought;

7 (3) wild stock sought is not fully utilized by commercial,
8 sport, personal use, or subsistence fisheries; or

9 (4) wild stock is needed to maintain the gene pool of a
10 hatchery or aquatic farm.

11 (g) Aquatic plants and shellfish acquired under a permit issued
12 under this section become the property of the permit holder and are no
13 longer a public or common resource.

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

18 Sec. 16.40.140. LIMITATION ON SALE, TRANSFER OF STOCK, AND
19 PRODUCTS. (a) A private hatchery required to have a permit under
20 AS 16.40.100 may sell or transfer stock from the hatchery only to an
21 aquatic farm or other hatchery that has a permit issued under AS 16.-
22 40.100, except that shellfish stock may also be sold or offered for
23 sale to an aquatic farm or related hatchery outside of the state.

24 (b) Stock may not be transferred to or from an aquatic farm or
25 hatchery required to have a permit under AS 16.40.100 without prior
26 notice of the transfer to the commissioner. A notice of transfer
27 shall be submitted at least 45 days before the proposed date of trans-
28 fer.

29 (c) A notice of transfer must be accompanied by a report of a

1 health inspection of the stock. The department shall conduct the
2 inspection or contract with a disease diagnostician to conduct the
3 inspection. The cost of inspection shall be borne by the department.

4 (d) The department may restrict or disapprove a transfer of
5 stock if it finds that the transfer would present a risk of spreading
6 disease.

7 (e) A person may not sell, transfer, or offer to sell or trans-
8 fer, or knowingly purchase or receive, an aquatic farm product grown
9 or propagated in the state unless the product was grown or propagated
10 on a farm with a permit issued under AS 16.40.100. The permit must be
11 in effect at the time of the sale, transfer, purchase, receipt, or
12 offer.

13 Sec. 16.40.150. DISEASE CONTROL AND INSPECTION. (a) The de-
14 partment shall order the quarantine or the destruction and disposal of
15 diseased hatchery stock or of aquatic farm products when necessary to
16 protect wild stock. A holder of a permit issued under AS 16.40.100
17 shall report to the department an outbreak or incidence of disease
18 among stock or aquatic farm products of the permit holder within 48
19 hours after discovering the outbreak or incidence.

20 (b) A holder of a permit issued under AS 16.40.100 shall allow
21 the department to inspect the permit holder's farm or hatchery during
22 operating hours and upon reasonable notice. The cost of inspection
23 shall be borne by the department.

24 (c) The department shall develop a disease management and con-
25 trol program for aquatic farms and hatcheries.

26 (d) The department may enter into an agreement with a state or
27 federal agency or a private, state-certified provider to provide ser-
28 vices under (b) and (c) of this section, or inspections under AS 16.-
29 40.110(b).

1 Sec. 16.40.160. REGULATIONS. The commissioner may adopt regu-
2 lations necessary to implement AS 16.40.100 - 16.40.199.

3 Sec. 16.40.170. PENALTY. A person who violates a provision of
4 AS 16.40.100 - 16.40.199, a regulation adopted under AS 16.40.100 -
5 16.40.199, or a term or condition of a permit issued under AS 16.40.-
6 100 - 16.40.199, is guilty of a class B misdemeanor.

7 Sec. 16.40.199. DEFINITIONS. In AS 16.40.100 - 16.40.199

8 (1) "aquatic farm" means a facility that grows, farms, or
9 cultivates aquatic farm products in captivity or under positive con-
10 trol;

11 (2) "aquatic farm product" means an aquatic plant or shell-
12 fish, or part of an aquatic plant or shellfish, that is propagated,
13 farmed, or cultivated in an aquatic farm and sold or offered for sale;

14 (3) "aquatic plant" means a plant indigenous to state water
15 or that is authorized to be imported into the state under a permit
16 issued by the commissioner;

17 (4) "commissioner" means the commissioner of fish and game;

18 (5) "hatchery" means a facility for the artificial propa-
19 gation of stock, including rearing of juvenile aquatic plants or
20 shellfish;

21 (6) "positive control" means, for mobile species, enclosed
22 within a natural or artificial escape-proof barrier; for species with
23 limited or no mobility, such as a bivalve or an aquatic plant, "posi-
24 tive control" also includes managed cultivation in unenclosed water;

25 (7) "shellfish" means a species of crustacean, mollusk, or
26 other invertebrate, in any stage of its life cycle, that is indigenous
27 to state water or that is authorized to be imported into the state
28 under a permit issued by the commissioner;

29 (8) "stock" means live aquatic plants or shellfish

1 acquired, collected, possessed, or intended for use by a hatchery or
2 aquatic farm for the purpose of further growth or propagation.

3 * Sec. 3. AS 03.05.011(a) is amended to read:

4 (a) To carry out the requirements of this title, the commis-
5 sioner of environmental conservation may issue orders, regulations,
6 permits, quarantines, and embargoes relating to

7 (1) examination and inspection of premises containing
8 products, articles, and commodities carrying pests;

9 (2) establishment of quarantines for eradication of pests;

10 (3) establishment of standards and labeling requirements
11 pertaining to the sale of meat, fish, and poultry;

12 (4) tests and analyses which may be made and hearings which
13 may be held to determine whether the commissioner will issue a stop
14 order or quarantine;

15 (5) cooperation with federal and other state agencies;

16 (6) regulation of fur farming; for purposes of this para-
17 graph, "fur farming" means the raising of and caring for animals for
18 the purpose of marketing their fur, or animals themselves for breeding
19 stock;

20 (7) examination and inspection of meat, fish, and poultry
21 advertised for sale or sold to the public;

22 (8) enforcement of quality assurance plans developed in
23 cooperation with appropriate industry representatives;

24 (9) establishment of standards and conditions for the
25 operation and siting of aquatic farms and related hatcheries, includ-
26 ing

27 (A) restrictions on the use of chemicals; and

28 (B) requirements to protect the public from contami-
29 nated aquatic farm products that pose a risk to health;

1 (10) monitoring aquatic farms and aquatic farm products to
2 ensure compliance with this chapter and with the requirements of the
3 national shellfish sanitation program manual of operations published
4 by the Food and Drug Administration.

5 * Sec. 4. AS 03.05.040(a) is amended to read:

6 (a) On any business day during the usual hours of business the
7 commissioner or an authorized inspector may, for the purpose of in-
8 specting agricultural, [OR] fisheries, or aquatic farm products or
9 aquatic farm sites subject to regulation, enter a storehouse, ware-
10 house, cold storage plant, packing house, slaughterhouse, retail store
11 or other building or place where those products are kept, stored,
12 processed or sold.

13 * Sec. 5. AS 03.05.100 is amended to read:

14 Sec. 03.05.100. DEFINITIONS. In this chapter,

15 (1) "agricultural products" does not include fish or fish-
16 eries products;

17 (2) "aquatic farm" and "aquatic farm product" have the
18 meanings given in AS 16.40.199;

19 (3) "fish or fisheries products" means any aquatic animal,
20 including amphibians, or aquatic plants or parts of those plants,
21 animals or amphibians that are usable as human food.

22 * Sec. 6. AS 16.05.050 is amended by adding a new paragraph to read:

23 (17) to permit and regulate aquatic farming in the state in
24 a manner that ensures the protection of the state's fish and game
25 resources and improves the economy, health, and well-being of the
26 citizens of the state;

27 * Sec. 7. AS 16.05.251 is amended by adding a new subsection to read:

28 (f) Except as expressly provided in AS 16.40.120(d) and (e) and
29 16.40.130, the Board of Fisheries may not adopt regulations or take

1 action regarding the issuance, denial, or conditioning of a permit
2 under AS 16.40.100 or 16.40.120, the construction or operation of a
3 farm or hatchery required to have a permit under AS 16.40.100, or a
4 harvest with a permit issued under AS 16.40.120.

5 * Sec. 8. AS 16.05.930 is amended by adding a new subsection to read:

6 (g) AS 16.05.330 - 16.05.720 do not apply to an activity au-
7 thorized by a permit issued under AS 16.40.100 or 16.40.120, or to a
8 person or vessel employed in an activity authorized by a permit issued
9 under AS 16.40.100 or 16.40.120.

10 * Sec. 9. AS 16.05.940(14) is amended to read:

11 (14) "fish or game farming" means the business of propagat-
12 ing, breeding, raising, or producing fish or game in captivity for the
13 purpose of marketing the fish or game or their products, and "captivi-
14 ty" means having the fish or game under positive control, as in a pen,
15 pond, or an area of land or water that [WHICH] is completely enclosed
16 by a generally escape-proof barrier; in this paragraph, "fish" does
17 not include shellfish, as defined in AS 16.40.199;

18 * Sec. 10. AS 16.10 is amended by adding a new section to read:

19 Sec. 16.10.269. LIMITATIONS. AS 16.10.265 - 16.10.267 do not
20 apply to the purchase or sale of aquatic farm products from a holder
21 of a permit issued under AS 16.40.100 or stock from a holder of a
22 permit issued under AS 16.40.120.

23 * Sec. 11. AS 16.43.140 is amended by adding a new subsection to read:

24 (d) This chapter does not apply to activities authorized by a
25 permit issued under AS 16.40.100 or 16.40.120.

26 * Sec. 12. AS 16.51.180(5) is amended to read:

27 (5) "seafood" means finfish, shellfish, and fish by-prod-
28 ucts, including but not limited to salmon, halibut, herring, flounder,
29 crab, clam, cod, shrimp, and pollock, but does not include aquatic

1 farm products as defined in AS 16.40.199;

2 * Sec. 13. AS 38.05 is amended by adding a new section to read:

3 Sec. 38.05.083. AQUATIC FARMING AND HATCHERY SITE LEASES. (a)

4 The commissioner may offer to the public for lease a site that has
5 been developed for aquatic farming or related hatchery operations
6 under a permit issued under AS 38.05.856. Before offering the site to
7 the public, the commissioner shall offer the site to the permittee.

8 (b) A site shall be leased under this section for not less than
9 the appraised fair market value of the lease. The value of the lease
10 shall be reappraised every five years.

11 (c) A lease under this section may be assigned, but if the
12 assignee changes the use of the site the lease reverts to the state.

13 (d) Before entering into a lease under this section, the commis-
14 sioner shall require the lessee to post a performance bond or provide
15 other security to cover the costs to the department of restoring the
16 leased site in the event the lessee abandons the site.

17 * Sec. 14. AS 38.05 is amended by adding new sections to read:

18 Sec. 38.05.855. IDENTIFICATION OF SITES FOR AQUATIC FARMS AND
19 HATCHERIES. (a) The commissioner shall identify districts in the
20 state within which sites may be selected for the establishment and
21 operation of aquatic farms and related hatcheries required to have a
22 permit under AS 16.40.100.

23 (b) The commissioner shall schedule at least one 60-day period
24 each year during which a person may submit an application that identi-
25 fies a site in a district for which the person wishes to be issued a
26 permit under AS 38.05.856.

27 (c) Based on applications received under (b) of this section,
28 and after consultation with the commissioner of fish and game and the
29 commissioner of environmental conservation, the commissioner shall

1 make a preliminary written finding under AS 38.05.035(e) that proposes
2 sites in each district for which permits may be issued under AS 38.-
3 05.856.

4 (d) After notice is given under AS 38.05.945 and a hearing is
5 held under AS 38.05.946(b), the commissioner shall issue a final
6 written finding under AS 38.05.035(e) that identifies sites in each
7 district for which permits shall be issued under AS 38.05.856 and that
8 specifies conditions and limitations for the development of each site.

9 Sec. 38.05.856. TIDELAND AND LAND USE PERMITS FOR AQUATIC FARM-
10 ING. (a) The commissioner may issue a tideland or land use permit
11 for the establishment and operation of an aquatic farm and related
12 hatchery operations. A permit under this section is valid for three
13 years after the date of issuance. The permit may not be transferred.

14 (b) Before renewing a permit under this section, the commission-
15 er shall allow interested persons to submit written or oral testimony
16 concerning the renewal to the commissioner within 30 days after the
17 date of the notice. The commissioner may hold a hearing to take
18 testimony.

19 (c) Before issuing or renewing a permit under this section, the
20 commissioner shall consider all relevant testimony submitted under
21 this section or AS 38.05.946(b). The commissioner may deny the appli-
22 cation for issuance or renewal for good cause, but shall provide the
23 applicant with written findings that explain the reason for the
24 denial.

25 (d) Before issuing or renewing a permit under this section, the
26 commissioner shall require the permittee to post a performance bond or
27 provide other security to cover the costs to the department of restor-
28 ing the permitted site in the event the permittee abandons the site.

29 (e) The commissioner shall adopt regulations establishing

1 criteria for the approval or denial of permits under this section and
2 for limiting the number of sites for which permits may be issued in an
3 area in order to protect the environment and natural resources of the
4 area. The regulations must provide for the consideration of upland
5 management policies and whether the proposed use of a site is compati-
6 ble with the traditional and existing uses of the area in which the
7 site is located.

8 * Sec. 15. AS 38.05.945(a) is amended to read:

9 (a) This section establishes the requirements for notice given
10 by the department for the following actions:

11 (1) classification or reclassification of state land under
12 AS 38.05.300 and the closing of land to mineral leasing or entry under
13 AS 38.05.185;

14 (2) zoning of land under applicable law;

15 (3) a decision under AS 38.05.035(e) regarding the sale,
16 lease, or disposal of an interest in state land or resources; [AND]

17 (4) a competitive disposal of an interest in state land or
18 resources after final decision under AS 38.05.035(e);

19 (5) a public hearing under AS 38.05.856(b);

20 (6) a preliminary finding under AS 38.05.035(e) and 38.05.-
21 855(c) concerning sites for aquatic farms and related hatcheries.

22 * Sec. 16. AS 38.05.945 is amended by adding a new subsection to read:

23 (g) Notice at least 30 days before action under (a)(5) or (6)
24 shall be given to appropriate

25 (1) regional fish and game councils established under
26 AS 16.05.260; and

27 (2) coastal resource service areas organized under AS 46.-
28 40.110 - 46.40.210.

29 * Sec. 17. AS 38.05.946 is amended by adding a new subsection to read:

1 (b) The commissioner shall hold a public hearing in each dis-
2 trict identified under AS 38.05.855 within 30 days after giving notice
3 of a preliminary finding under AS 38.05.035(e) and 38.05.855(c) con-
4 cerning sites for aquatic farms and related hatcheries.

5 * Sec. 18. Notwithstanding any other provisions of law, a person who is
6 lawfully operating an aquatic farm or related hatchery in the state on the
7 effective date of this Act is entitled to continue lawful operations at the
8 existing site. The person may obtain an initial lease or permit for the
9 person's existing operations under AS 38.05.083 or 38.05.856, enacted by
10 secs. 13 and 14 of this Act, but as a condition of obtaining the lease or
11 permit the person must agree that during the term of the lease or permit
12 the person will not change the use of the site.

13 * Sec. 19. LAND MANAGEMENT REPORT REQUIRED. The commissioner of natu-
14 ral resources shall submit to the legislature not later than January 30,
15 1989, a report detailing the department's implementation of AS 38.05.083
16 and 38.05.856, enacted by secs. 13 and 14 of this Act. The report must
17 include

18 (1) the number of applications received under AS 38.05.083 and
19 38.05.856, and the number of leases and permits issued, according to type
20 of aquatic farm product;

21 (2) the restrictions attached to permits and leases;

22 (3) a discussion of the system the department implements for
23 issuing leases and tideland and land use permits;

24 (4) the level of public involvement in the issuance process; and

25 (5) a discussion of how the program is working, and the depart-
26 ment's plans for modifications of the program.

27 * Sec. 20. ALASKA FINFISH FARMING TASK FORCE. (a) The legislature
28 finds that the farming of finfish raises a series of socio-economic, bio-
29 logical, and environmental issues requiring an in-depth examination.

1 (b) The Alaska Finfish Farming Task Force is established to study the
2 issue and make a report of findings for administrative and legislative
3 consideration. The governor shall appoint a five-member task force com-
4 posed of state residents who are not state employees and who represent a
5 broad spectrum of expertise, including one representative of commercial
6 salmon fishermen, one aquatic farming advocate, one private economist, one
7 fisheries biologist, and one public member with no involvement in the
8 seafood or aquatic farming industry.

9 (c) The task force shall submit an interim report to the legislature
10 not later than January 30, 1989, and a final report to the legislature not
11 later than January 30, 1990. The reports must address finfish farming in
12 the state in freshwater, in marine environments, and in tanks or other
13 enclosed structures that contain marine water and that are located on land,
14 and shall address related hatchery operations. The reports may address
15 other issues the task force considers appropriate. The reports must exam-
16 ine

17 (1) whether the farming of finfish can be conducted in a manner
18 that protects the health of the state's fishery resources;

19 (2) criteria for the siting of finfish farms to minimize land
20 use conflicts and to protect the environment;

21 (3) net economic costs and benefits of finfish farming in the
22 state to state residents, including jobs created or lost for state resi-
23 dents, tax revenue (assuming an appropriate tax rate), cost of state regu-
24 lation and monitoring, and effects on markets for salmon caught by the
25 state's commercial fishing fleets;

26 (4) the cost of providing adequate regulation of finfish farming
27 to protect wild stocks, the environment, public health, and existing bene-
28 ficial uses of the state's coastal water and land, and the role of the
29 private sector in providing pathological and other services;

1 (5) identification and analysis of appropriate sources of supply
2 of stock for finfish farms, including but not limited to private nonprofit
3 hatcheries, private for-profit hatcheries, and wild stock, and their likely
4 effect on existing state policy; and

5 (6) strategies for improving the marketability of Alaska salmon,
6 particularly those high-value species competing with farmed salmon for
7 domestic and export sales.

8 * Sec. 21. Section 4, ch. 70, SLA 1987, is amended to read:

9 Sec. 4. Section 1 of this Act is repealed July 1, 1990 [1988].

10 * Sec. 22. This Act takes effect immediately under AS 01.10.070(c).

