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Limits to Private Aquaculture on Cape Cod

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LIMITS TO PRIVATE AQUACULTURE

ON CAPE COD

BY

KEVIN ROBERT CUTE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

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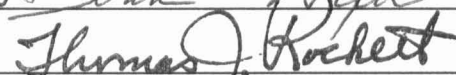
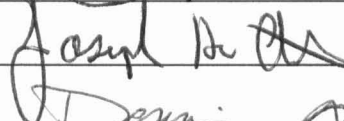

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1996

ABSTRACT

This study examined the potential of social conflict related to private and public rights, to constrain aquaculture on Cape Cod. While the ability of social conflict to constrain aquaculture has been demonstrated in a few cases, its current potential to constrain aquaculture on Cape Cod had not been established prior to this study. This study was based on information gathered from town records and public hearings related to proposed aquaculture ventures. In addition, town officials were interviewed to obtain additional information related to cases. The finding of this study is that private riparian proprietors, and interests in shellfishing tend to constrain aquaculture on Cape Cod today. This study utilized the qualitative case study method described by Merriam (1988).

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PREFACE

This thesis is prepared according to the Manuscript Format, whereby the first part of the paper contains the text, and the second part contains the chapter notes and bibliography.

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INTRODUCTION

Aquaculture on Cape Cod occurs primarily in sheltered embayments. Tideflats and productive shellfish growing waters make these areas prime locations for the shellfish culture operations that characterize aquaculture on Cape Cod. However, public rights in navigation and fishing also exist in the waters of these embayments. In addition, private riparian property is often the dominant characteristic of the shore; unique to Massachusetts, private riparian proprietors may have fee simple ownership of tideflats adjacent to their upland property. This is the setting in which aquaculture on Cape Cod occurs, and from which arise social conflicts that potentially limit its growth.

The problem of social conflict as a constraint to aquaculture is well documented. It has been contended that aquaculture is possible where progressive attitudes exist, but can be constrained where the concept of private control of public resources is opposed (Mattheissen, 1992, p.27). The magnitude of public concern over aesthetic impacts of aquaculture has been related to the sociopolitical climate of a community (Chew, 1993, p.37). In Atlantic Canada, policy makers consider the rights of adjacent riparian land owners, and social acceptability by the local community, in aquaculture siting decisions (Wildsmith, 1992).

However, other factors may be considered, with the status quo maintained to reduce conflict (Wildsmith, 1992, p.27). This scenario is not unfamiliar on Cape Cod. In some cases, various interest groups may generate sufficient opposition to cause the denial of proposed aquaculture ventures, that had the preliminary support of local officials (Merrit, 1996). In other cases, a single interest group may be the source of such opposition (Moore, 1995). In addition, the potential for social conflict in some towns has resulted in the underutilization of certain areas that are suitable for aquaculture (Somerville, 1996). It has become apparent to various towns on Cape Cod that an ad hoc approach to aquaculture is counter productive; planned development that considers the potential for social conflict has reaped benefits were it has been applied (Benjamin, 1996).

It is assumed that the potential for social conflict is inherent among user groups that compete with aquaculture for coastal resources. This study attempts to determine the current potential for social conflict by examining factors that may lessen or intensify the assumed inherent potential for social conflict. Sources of social conflict are identified and analyses of the potential for social conflict are conducted for each town on Cape Cod.

colonial ordinance of 1647" (East Boston Co. v. Commonwealth 89 N.E. Rep. 236, 1909).

While this settled the instant case, it did not provide a precise definition of the term "low water mark" as used in the Colony Ordinance of 1647. The precedent value of such a definition is evident. However, the SJC was slow to address this issue. For example, in *Seawall & Day Cordage Co. v. Boston Water Power Co.* (147 Mass. 61, 1888) the SJC ruled that this term referred to the extreme low water line, again without providing a more precise definition.

The SJC finally established a precise definition for the term "extreme low water" in *Rockwood v. Snow Inn Corp* (566 N.E. 2d 608 Mass. 1991). The dispute in this case was whether a proposed expansion of the Snow Inn violated a zoning bylaw in the town of Harwich. The defendant argued that the expansion was lawful because it would cover less than 15% of the property as required under the bylaw. However, this calculation included a boundary that located the seaward extent of the defendant's tideflats at the lowest level ever reached by the sea at that location. The reasoning for this boundary was based on the SJC's ambiguous ruling in *Sewall & Day Cordage Co. v. Boston Water Power Co.* (147 Mass. 61, 1888).

In rejecting the defendant's claim, the SJC reviewed the precedent for its ruling in *Sewall & Day Cordage Co. v. Boston Water Power Co.* (147 Mass. 61, 1888). While agreeing that the extreme low water line was the correct seaward

boundary of private tideflats in Massachusetts, the SJC cited *Storer v. Freeman* (6 Mass. (6 Tyng) 435, 1810) to establish the basis for its decision in the instant case. In *Storer v. Freeman* (6 Mass. (6 Tyng) 435, 1810), the SJC ruled that the term "low water mark", as promulgated in the Colony Ordinance of 1647, meant the ordinary low water line. This was apparently reinterpreted in *Sparhawk v. Bullard* (1 Met. 95 1840) in which the SJC ruled:

"The object of the ordinance...was to give the proprietors...convenient wharf-privileges, to enjoy which, to the best advantage, it is often necessary to extend their wharves to the low-water mark at such times when the tide ebbs the lowest" (*Sparhawk v. Bullard* 1 Met. 95 1840).

However, as *Sparhawk v. Bullard* (1 Met. 95 1840) cited *Storer v. Freeman* (6 Mass. (6 Tyng) 435, 1810), in the instant case the SJC ruled that its intent in *Sparhawk* must have been to affirm its ruling in *Storer*. Nonetheless, subsequent courts treated the *Sparhawk* ruling as a divergence, which partly led to the dispute in the instant case. However, this inconsistency was eliminated when the SJC reversed its earlier ruling in *Sparhawk*:

"Although neither the ordinance nor *Storer* suggested a formula or specified the criteria for identifying the exact location of an ordinary low water mark, it is entirely clear that the court did not have in mind as the relevant low water mark a line reflecting the lowest level that the sea might ever have reached for any reason" (*Rockwood v. Snow Inn Corp.* 566 N.E. 2d 608 Mass. 612, 1991).

2. Rules for Dividing Private Tideflats

The common characteristic of the following cases is that each involves the dividing of tideflats between coterminous private riparian proprietors. For the purpose of this study, this section is limited to a discussion of the various rules for dividing tideflats that emerged from these cases. This approach provides a comprehensive outline of the current legal framework for dividing tideflats in Massachusetts.

In *Rust v. Boston Mill Corporation* (6 Pick. 158, 1828) the SJC established the legal basis for dividing private tideflats in Massachusetts:

"The (Colony Ordinance of 1647) relates to the owners of upland all around the cove, and it intends that the exterior lines of their flats shall be at right angles with the their upland" (*Rust v. Boston Mill Corporation* 6 Pick. 164-165, 1828).

However, the disputed tideflats in this case were located in a circular cove, and applying the preceding rule in such a case would result in the overlapping of dividing lines.

Recognizing this, the SJC commented:

"I am aware that coves and creeks may be so irregularly formed as to render this or any other mode of dividing the flats according to the ordinance difficult, if not impracticable;" (*Rust v. Boston Mill Corporation* 6 Pick. 168, 1828).

The solution in this case was to draw converging lines in a seaward direction from the corners of the upland portion of the private riparian property. To illustrate the outcome of

such a division the SJC provided a hypothetical example of its application:

"Thus in the case of a circular cove in which there is no natural channel, if a straight line across the mouth of the cove is 100 rods in length and the circular line high-water mark is 200, each owner of a lot abutting on the cove is entitled to run his lines from the two corners of his lot in a direction towards low-water mark, so as to include a parcel of flats, which at the mouth of the cove will be one half the width of the lot at high-water mark; and thus each will hold his share in several" (Rust v. Boston Mill Corporation 6 Pick. 158, 1828).

The result is that each private riparian proprietor receives a wedge shaped parcel of tideflats. Thus, it is necessary to diverge from the "right angle" rule when the shape of the coastline does not at least approximate a straight line. While the resultant seaward frontage is less than the upland frontage, each private riparian proprietor receives a proportionate share of the tideflats within the cove. Applying this rule in the case of a convex headland, essentially the opposite of a circular cove, would require that diverging lines be drawn in a seaward direction from the two corners of a parcel of private riparian property. This would result in a seaward boundary line that is greater than the boundary line at the mean high water line. Nonetheless, it could result in an equitable division of tideflats between private riparian proprietors.

That this represented a new rule for dividing tideflats was affirmed in the SJC in the case of Walker v. The Boston & Maine Railroad (3 Cush., 1, 21, 1849). The terminus of

private ownership in tideflats was determined to be a creek from which the tide did not fully ebb. Because its shape was irregular, applying the rule taken from the Colony Ordinance of 1647 would have resulted in an inequitable division of tideflats. In addressing this point, the SJC ruled:

"...the most that can be done is, to take the colony ordinance...and apply it according to its true spirit, and by as near an approximation as practicable to the rules which have been judicially established, to lay down such a line of division, as to give to each riparian proprietor his fair and equal share" (Walker v. The Boston & Maine Railroad 3 Cush. 1, 21, 1849).

In effect, this is the paramount principle for dividing private tideflats in Massachusetts. It should be noted that the SJC's ruling included the establishment of an artificial straight terminal line along the creek. This was because a strict application of existing rules for dividing tideflats was impossible.

In summation, the division of all tideflats in Massachusetts is based upon the following rules. All of these rules do not necessarily apply in every conceivable case. Rather, they exhaust all possibilities that result in an equitable division of tideflats between coterminous private riparian proprietors:

1. Dividing lines should proceed seaward perpendicular to the mean high water line, with the result that the length of the terminal line of private ownership in tideflats is equal to the proportionate length of each claimants property along the mean high water line (Right Angle Rule: Straight Coastlines).

2. The seaward boundary line should be proportionate to the mean high water line, according to the proportion of each private riparian proprietor's property along the common mean high water line (Proportionate Rule: All Coastline Types).

3. In the case of a convoluted coastline or terminal line of ownership in tideflats, artificial straight lines may be drawn, to provide reference points for dividing lines. Depending upon the overall shape of the common coastline held by coterminous private riparian proprietors, the dividing lines may be at right angles to the coastline, or converge or diverge from it (Baseline Rule: Potentially All Coastline Types).

With respect to aquaculture, the value of this discussion is that it provides methods for identifying public tideflats. Because the wording of title deeds in private riparian property may alienate the adjacent tideflats, such tideflats may be a public trust area under the Colony Ordinance of 1647. The value of knowing the methods for dividing private tideflats is that the precise boundaries of such public trust areas can be ascertained. In addition, if such tideflats extended beyond 1650 feet from the mean high water line they would be a public trust area throughout their entirety, while adjacent private tideflats would only extend to 1650 feet.

E. Aquaculture: Massachusetts Supreme Judicial Court

The SJC has adjudicated several questions regarding aquaculture, but none more important than those in Wellfleet

v. Glaze (403 Mass. 79, 525 N.E.2d 1988) and Pazzolt v. Director of the Division of Marine Fisheries (417 Mass. 565, 1994). The SJC's ruling in the former case set the stage for a ruling that was detrimental to aquaculture in the latter case. Both cases are discussed in this section.

In Wellfleet v. Glaze (403 Mass. 79, 525 N.E.2d 1988), the SJC faced a question regarding the meaning of G.L. c.130 s.67, which was part of the statutory law governing aquaculture. The town of Wellfleet contended that the major purpose of the provision was to prevent environmental damage, as it provided penalties for whoever:

"...in any way disturbs the growth of the shellfish thereon or whoever discharges any substance which may directly or indirectly injure the shellfish upon any such grounds or beds, without the consent of the licensee..." (G.L. c.130 s.67).

As such, the town further contended that the defendant's act of mooring his boats on tideflats wherein an aquaculture operation existed was a violation of the statute. However, the defendant had a fee simple title in the tideflats. On a question as to whether the defendant's action constituted an interference with the public right to an easement in shellfishing on private tideflats, the SJC answered:

"The defendant has the right to use the land in a manner not inconsistent with the public's reasonable use of the area for shellfishing. The allegations of this complaint, however, are that the defendant interfered with the practice of aquaculture on the flats and with pens and mesh used in that practice" (Wellfleet v. Glaze 403 Mass. 79, 81, 525 N.E. 2d 1298, 1998).

Based upon this distinction, the SJC ruled against the town's contention regarding the purpose of G.L. c.130 s.67. In reaching its decision, the SJC cited a report on the status of the state's shellfisheries:

"...which speaks of shellfish as a State asset and which proposes the system of private licensing now at issue to cure the 'almost complete exhaustion of the shellfish supply in certain areas', it cannot be that the major purpose of behind s.67 is the protection of the environment..." (Report on the Mollusk Fisheries of Massachusetts, H.R. Doc. No. 1320, 1909).

While this defeated the town's contention, the more important aspect of this case regarding aquaculture is the SJC's opinion regarding the distinction between the public right to an easement in shellfishing, and aquaculture. The SJC ruled that aquaculture is fundamentally distinguishable from shellfishing. As such, it was ruled that it is equivalent to farming, and can not be considered a derivative of the public right to an easement in shellfishing as understood in the Colony Ordinance of 1647. The significance of this opinion is that it was decisive in the following case.

The decision of the SJC in *Pazzolt v. Director of the Division of Marine Fisheries* (417 Mass. 565, 1994), essentially invalidated a significant portion of the aquaculture industry on Cape Cod today. The dispute in this case was decided on two questions. Regarding the first question, the SJC was asked to decide if the plaintiff owned the tideflats upon which the defendant's aquaculture

operation was located. The second question was related to the legal status of aquaculture in Massachusetts: is aquaculture a derivative of the public right to an easement in shellfishing on private tideflats?

The dispute centered on an aquaculture operation in Truro. The plaintiff argued that the SJC should return a positive finding for the first point and a negative finding for the second. The defendant argued the opposite on both points. In his arguments on the first point, the defendant claimed that the wording in one of the plaintiff's title deeds to the adjacent upland proved that the tideflats had been alienated. He presented as evidence the phrase "to the highwater mark in Provincetown Harbor." However, this phrase was found in only one of a succession of related deeds that each contained the phrase "to the sea." On this evidence, the SJC ruled in favor of the plaintiff.

This ruling and the opinion in *Wellfleet v. Glaze* (403 Mass. 79, 81, 525 N.E. 2d 1298, 1988), that aquaculture is not a derivative of the public right to an easement in shellfishing on private tideflats, rendered the defendant's arguments groundless. In affirming this opinion, the SJC ruled that:

"Activities which have been classified as reasonably related to the public's right to fish are those which are necessary or incidental to the right to fish" (*Pazzolt v. Director of the Division of Marine Fisheries* 417 Mass. 565, 1994).

The outcome with respect to the aquaculture operation was that it was discontinued. This case represents perhaps the most significant constraint to aquaculture on Cape Cod. In Wellfleet, some aquaculturists have been notified by private riparian proprietors to vacate their tideflats. In one case, an aquaculture operation had been located on a private riparian proprietor's tideflats for about 20 years prior to the Pazzolt case (Somerville, 1996). Litigation may result in this case. One of the potential bases for challenging the SJC's decision in the Pazzolt case would be the fact that in *Wellfleet v. Glaze* (403 Mass. 79, 81, 525 N.E. 2d 1298, 1988), the SJC did not hand down a decision regarding the legal status of aquaculture; the comment regarding the legal status of aquaculture was only an opinion. An additional impact of *Pazzolt v. Director of the Division of Marine Fisheries* (417 Mass. 565, 1994) is that the town of Wellfleet has adopted a de facto policy to avoid siting aquaculture ventures in the vicinity of private riparian property (Somerville, 1996).

CHAPTER TWO

THE REGULATORY FRAMEWORK FOR AQUACULTURE

A. Introduction

Because aquaculture on Cape Cod occurs in public trust areas, it is subject to federal and state regulation. In addition, municipalities in Massachusetts have the authority to license aquaculture operations under Chapter 130 section 57 of the General Laws of Massachusetts of 1994. The following discussion illustrates federal and state roles in the regulatory framework for aquaculture on Cape Cod. Because municipalities are authorized to license aquaculture under G.L. c.130 s.57, the discussion on this statute in the section on state regulation serves the purpose of introducing municipal regulation of aquaculture.

B. The Federal Regulatory Framework: Aquaculture Promotion

The federal framework for aquaculture is distinctly bifurcated. An extensive body of law regulates various activities related to aquaculture, and a single statute promotes aquaculture development. This statute, the National Aquaculture Act of 1980 (NAA) (P.L. 96-362) is notable in that it does not establish a licensing and regulatory framework (Wypizinski, 1983, p.5). The NAA originated in the 94th Congress when House Report 370 was introduced in the House of Representatives.

The NAA has three major objectives. First is the declaration of a national aquaculture policy:

"Congress declares that aquaculture has the potential for augmenting existing commercial and recreational fisheries and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States" (Public Law 96-362).

The second objective is to develop a national aquaculture development plan. This was accomplished in 1983 when the Joint Subcommittee on Aquaculture of the Federal Coordinating Council on Science, Engineering, and Technology (JSA), promulgated the National Aquaculture Development Plan (House Report 96-660). Volume one describes technologies, problems, and opportunities associated with aquaculture in the U.S. and its territories. Volume two identifies primary species with potential for aquaculture, and includes an extensive bibliography. Finally, the NAA's objective that the federal government encourage aquaculture in the private and public sector is addressed under the JSA's mandate to identify capital requirements and regulatory constraints. Adjunct to this task is the responsibility to identify social constraints to aquaculture development.

The NAA was amended and reauthorized as the National Aquaculture Improvement Act of 1985 (House Report 99-105). Amendments included naming the Department of Agriculture as the lead federal agency for aquaculture, and establishing

the National Aquaculture Information Center within the National Agriculture Library. Another amendment reauthorized and funded five regional aquaculture centers, to provide a link between the federal government and the aquaculture industry. The Northeastern Regional Aquaculture Center serves Massachusetts and twelve other states, and is located at the University of Massachusetts at Dartmouth.

As the lead federal agency under NAA 1985, the Department of Agriculture has established an Office of Aquaculture (Aquaculture: A Guide to Federal Government Programs, 1992, p.iii). In addition, its Cooperative State Research Service and Cooperative Extension Service (CES), have regional offices that include aquaculture promotion as a part of their mission (Aquaculture: A Guide to Federal Government Programs, 1992, pp.6, 8). The CES has established an office on Cape Cod in the Deeds and Probate building in the town of Barnstable.

The Department of Commerce (DOC) has the primary responsibility to promote marine aquaculture. The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) is the primary marine research arm of the DOC (Aquaculture: A Guide to Federal Government Programs, 1992, p.19). The NMFS disseminates aquaculture related information and technical advances gained from its fisheries research programs (Aquaculture: A Guide to Federal Government Programs, 1992, p.19). In

addition, NMFS cooperates with governments, NGO's, universities, and private interests, to promote United States marine aquaculture products (Aquaculture: A Guide to Federal Government Programs, 1992, p.19). Further, the NOAA National Sea Grant College Program conducts research, extension, and educational programs with universities in all coastal and Great Lakes states (Aquaculture: A Guide to Federal Government Programs, 1992, p.19). Finally, NOAA's Marine Advisory Service provides public education, technology transfer, and demonstration projects related to marine aquaculture (Aquaculture: A Guide to Federal Government Programs, 1992, p.19).

In the Department of the Interior, the United States Fish and Wildlife Service (USFWS) promotes the development of marine aquaculture several ways. First, it supports aquaculture projects that are compatible with the goal of conserving marine fisheries resources (Aquaculture: A Guide to Federal Government Programs, 1992, p.25). In addition, it provides technical assistance to the aquaculture industry (Aquaculture: A Guide to Federal Government Programs, 1992, p.25). Finally, it provides information services through the Office of Extension and Publications (Aquaculture: A Guide to Federal Government Programs, 1992, p.25).

C. The Federal Legal Framework: Aquaculture Regulation

Federal regulation of aquaculture is accomplished under the purview of statutory programs related to the government's interest in navigation, environmental protection, and public health. In the case of navigation, the primary issue regarding aquaculture is the placement of structures in navigable water. Effluent discharges, and species and ecosystem damage are the primary environmental protection issues. The public health issue is related to the human consumption of aquaculture products. The following discussion is limited to federal statutes that relate to aquaculture on Cape Cod.

1. Navigation

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C.A. Section 401 et seq.) (RHA) requires a permit for any activity effecting or obstructing navigable waters, and is administered by the Army Corps of Engineers (COE). In the case of aquaculture on Cape Cod, section 10 permits are most pertinent to water column based culture systems. However, bottom culture systems, although seldom an actual obstruction to navigation, are subject to RHA by virtue of their placement in navigable water.

2. Environmental Protection

Section 404 of the Federal Water Pollution Control Act (33 U.S.C.A. Sections 1311-1344), commonly known as the Clean Water Act (CWA), requires a permit for the discharge

of dredge or fill materials into navigable water, and is co-administered by COE and The Environmental Protection Agency (EPA). In response to the potential problem of redundancy, COE has issued a Programmatic General Permit (PGP) to administer the permit programs of both RHA and CWA in Massachusetts. The PGP provides a simplified review process for minimal impact projects that fall within COE permitting jurisdiction (Snow-Cotter, 1993). Most aquaculture operations in Massachusetts fall under "Category II Screened PGP" activities, which are considered to have a relatively low potential for environmental damage. In addition to COE and EPA, Category II Projects are reviewed by USFWS and NMFS (Snow-Cotter, 1993). While PGP's streamline the federal permit process, they are void if a proposed aquaculture operation fails to satisfy any other state or local permit requirements.

The purpose of the National Environmental Policy Act of 1969 (42 U.S.C. Section 4321 et seq.), commonly known as NEPA, is to determine the comprehensive potential environmental impact of proposed projects. Environmental Impact Statements (EIS) are the tool by which NEPA meets this goal (Kalo, 1990, p.166). As EIS's are lengthy and time consuming, Environmental Assessments (EA) are typically substituted for them (Kalo, 1990, p.168). The primary function of an EA is to provide a basis for evaluating whether a project requires an EIS.

The primary tool for regulating the discharge of water from aquaculture projects is The National Pollution Discharge Elimination System (NPDES). NPDES is authorized by Section 402 of the Federal Water Pollution Control Act (33 U.S.C. 1342), which requires a permit for any activity resulting in the discharge of any pollutant into navigable waters. Shellfish hatcheries that discharge such effluents into navigable waters fall under the purview of NPDES (Snow-Cotter, 1993). There is a single shellfish hatchery on Cape Cod, located in the town of Dennis, that is under the purview of NPDES.

3. Public Health

The Food and Drug Administration's National Shellfish Sanitation Program (NSSP) addresses public health issues related to pathogens in all commercial harvests of shellfish (U.S. Dept. of Commerce, 1990). The Interstate Shellfish Sanitation Conference (ISSC) has adopted NSSP standards to assure the public that shellfish in the marketplace is safe to eat (U.S. Dept. of Commerce, 1990). The ISSC, consisting of all coastal and some inland states, requires member states to follow NSSP standards for shellfish harvesting, handling, and marketing (U.S. Dept. of Commerce, 1990). Dealers or shippers from states that do not comply with NSSP standards can be dropped from the FDA's Interstate Shellfish Shippers List (U.S. Dept. of Commerce, 1990). Such action

results in complying states boycotting shellfish from non-complying states (U.S. Dept. of Commerce, 1990).

D. The State Regulatory Framework: Aquaculture Promotion

This section reviews the historic development of G.L. c.130 s.57, the statute under which aquaculture is lawful in Massachusetts today. The purpose of the following discussion is to establish the precedent for G.L. c.130 s.57.

The archetype of G.L. c.130 s.57 was established during colonial times. In 1633 the General Court amended a 1623 Plymouth Colony Law on Inland Fisheries that had established the free and common right of fishing, hunting, and fowling:

"But if any man desire to improve a place and stocke it with fish¹ of any kind for his private use, it shall bee lawful for the court to make any such graunt and for bid all others to make use of it" (A Collection of The Laws of Massachusetts Relating to Inland Fisheries, 1623-1886, p. 34).

This demonstrates that aquaculture once enjoyed a special legal status under which it could supersede the public right in fishing. However, all remnants of this status was lost in 1848 when G.L. c.151 authorized the state to issue licenses for oyster culture; under section one it became unlawful for oyster culture to impair the private or public rights of any person. In 1860 G.L. c.83 s.12 transferred the authority of the state to license oyster culture to the mayor or aldermen of any city, or the selectmen of any town. Although limited to Mount Hope Bay and its tributaries, the

first statute to authorize the culture of all shellfish occurred in 1874, when G.L. c.185 was passed.

Under the Acts and Resolves of 1885 c.220 s.1, public hearings were established as a condition of oyster culture licensing. In 1895 G.S. c.282 s.2 defined the geographic scope of the private rights of riparian proprietors, with respect to siting oyster culture nursery operations:

"nothing herein contained shall authorize the placing of such shells² upon the land of any riparian owner, between high water and low water mark, without the written consent of such owner" (G.S. c.282 s.2, p.288).

Chapter 91 section 105 of the Revised Laws of Massachusetts of 1902 required that oyster culture proposals include a written description of the boundaries of the proposed culture site. Omission of such information made the proposal void. In 1909 this same requirement was applied to quahog culture under G.L. c.469 s.6, with the additional requirement that boundaries be determined by survey. In addition, section seven provided for the revocation of quahog culture leases when non-performance could be proven. Related to this issue, Chapter 597 Section 3 of the Acts of 1914 required that annual production reports be submitted to the appropriate municipal agent.

In 1921 the promulgation of G.L. c.130 marked the first step toward the structure of G.L. c.130 s.57; previously separate oyster and quahog culture statutes were gathered into a single statute.³ Despite the redundancy of several

provisions in the oyster and quahog statutes, each species was authorized separately.⁴ It was not until the Acts of Massachusetts of 1933 c.329 that the term "shellfish" was substituted for oyster and quahog. Thus, Massachusetts had its first comprehensive aquaculture statute. However, section 57 prohibited the siting of aquaculture operations where municipal shellfish propagation projects had occurred in the preceding two years.

In 1973 the scope of aquaculture increased, when G.L. c.130 was amended. Section 68a was promulgated in response to the development of water column based shellfish grow-out systems, commonly referred to as off-bottom culture. Prior to section 68a, aquaculture in Massachusetts was limited to bottom culture. In addition to the advantage of increased productivity per unit area, due to the three dimensional configuration of off-bottom culture systems, section 68a allowed aquaculture to avoid social conflict related to private riparian rights. However, the potential for social conflict related to public rights in navigation and fishing increased. This issue was addressed by a provision that permitted compatible navigation and fishing activities within the lease area. Finally, in 1994 G.L. c.130 was amended to create a single licensing authority for bottom culture and off-bottom culture. Another amendment created a single section, section 57, which encompasses all the

previous sections of G.L. c.130. Thus, aquaculture in Massachusetts today is authorized under G.L. c.130 s.57.

E. The State Regulatory Framework: Aquaculture Regulation

Similar to the federal framework for aquaculture regulation, Massachusetts regulates aquaculture under several statutes. The following discussion identifies statutes and regulatory programs that address issues related to aquaculture as currently practiced on Cape Cod. The primary purpose of each of these statutes is environmental protection.

The Massachusetts Department of Environmental Protection (DEP) administers programs to protect the state's waterways under G.L. c.91. Section 10A regulates activities that include mooring temporary structures. Upon the recommendation of a harbormaster or person empowered to fulfill duties pertinent to local water resources, municipalities are authorized to grant licenses for placing floats or rafts within their waters, subject to DEP approval. Structures larger than 2000 square feet, or that are located outside established harbor lines, must receive direct approval from DEP.

Section 18 requires applicants to submit descriptions of the location, dimensions, and activities of a proposed project. Town planning boards are authorized to conduct public hearings and submit reports to DEP. In order to

receive a favorable determination from DEP, a proposal must show that it serves a proper public purpose, and does not deleteriously effect public rights in tidal lands. DEP is also authorized to develop license conditions, and revoke licenses for noncompliance. Municipalities may request a public hearing upon a determination by DEP. In addition, persons aggrieved by a DEP determination are entitled to an adjudicatory hearing.

Massachusetts regulates aquaculture that occurs in wetlands under G.L. c.131 s.40, the Massachusetts Wetlands Protection Act. Potential activities related to aquaculture that fall under the purview of s.40 include the removal, fill, dredging, or altering of wetlands. The regulatory program that fulfills the purpose of G.L. 131 s.40, is found in 310 CMR s.10.00. At the time of its implementation, 310 CMR s.10.04 "grandfathered" existing aquaculture operations as exempt from the permitting process, which regulates maintenance and improvements to aquaculture operations. Subsequent proposed aquaculture operations are required to obtain a determination of applicability from the appropriate local conservation commission. Public hearings are required under this procedure. A negative determination of applicability exempts any project from the 310 CMR s.10.00 permit process. Finally, G.L. c.30 ss. 62, 62H, the Massachusetts Environmental Policy Act (MEPA), authorizes the Secretary of Environmental Affairs to review proposed

activities to determine their environmental impacts. The Environmental Impact Report (EIR) is the primary tool for making such determinations, and requires descriptions of proposed activities and environmental impacts. EIR's may subsequently impose conditions necessary to minimize an operation's environmental impacts. EIR's are also subject to a thirty day public review period in order to give interested parties an opportunity to submit comment.

CHAPTER THREE

AQUACULTURE ON CAPE COD

A. History of Aquaculture on Cape Cod

A review of the general history of aquaculture indicates that the problem of social conflict is not unique to Cape Cod. Tracing the development of aquaculture from ancient times to the recent past in Massachusetts reveals the fundamental nature of social conflict, its effect on the industry, and the legal response to the competing demands of aquaculture and other interests.

Most records are lost in antiquity but some show that oysters were raised by the Japanese as early as 2000 B.C. (Iversen, 1968, p.29), while Sergius Orata is credited with being the first to culture oysters in ancient Rome. The Roman historian Pliny discussed Orata's purpose in establishing oyster culture:

"The first person who formed artificial oyster beds was Sergius Orata...as he contrived to make a large income by this exercise of his ingenuity" (Watson, 1988, p.32).

Oyster culture was introduced to Britain by the Romans, and it remained after the demise of the empire. A record from the Middle Ages (540 A.D.-1450 A.D.) indicates the relative nature of private rights in aquaculture at this time:

"A man's title was stronger if the oysters could be reached by wading at low water without having to use a dredge...litigation sometimes hinged on this point. When a man went out of his depth, he tended to lose both his control over the growth environment and the full protection of the law-

although in theory, at least, the state owned the seabed out to the three mile limit and could lease any part of it to a private individual or company" (Watson, 1988, p.33).

During the 17th century in England, improvements were made in oyster culture methods, including the enclosing of artificial beds. The importance of these beds is reflected in legal penalties for damaging them or the oysters upon them. Despite legal protection, artificial beds located in deeper waters were especially vulnerable to poaching:

"greedy fishermen in great numbers began dragging their dredges through them...this blind destruction probably contributed to the dramatic collapse of the large oyster fisheries¹ of both England and France" (Watson, 1988, p.35).

This destruction and the overharvesting of natural beds, led Harry Lobb, director of the South of England Oyster Company, to declare:

"The natural Oyster Beds of the United Kingdom are nearly exhausted, for, free to all comers, and from the enormous and increasing demand, the fishermen have dredged them bare. Therefore... 'Private Breeding Beds are an actual necessity'...there is a demand for 100,000 acres of Breeding Beds" (Watson, 1988, pp.34-35).

Trigg's guide to Hayling, published about 1890, describes the farms that Lobb set up:

"The beds are so enclosed that by means of sluices the water is maintained at any depth according to season. The quantity of spat preserved in this manner in 1866 and 1867 was so great that very sanguine anticipation was formed of the commercial success of the company...A large outlay has been expended and they are now the largest and best constructed beds in England" (Watson, 1988, p.35).

The practice of oyster culture accompanied the English settlers to colonial America. However, so did the practice of unregulated harvesting of natural oyster beds. In response to the latter, the General Court of the Massachusetts Bay Colony passed regulations in 1661 with the intent to conserve the supply of natural oysters. However, after 1700 it became apparent that oyster stocks had been overfished, and were depleted in most coastal towns. By 1800 this problem had become critical; oysters had disappeared from the Gulf of Maine and areas north of Boston, and stocks on Cape Cod were in decline (Sweet, 1951, p.4).

To offset this problem, large cargoes of southern stocks of oysters were shipped north. In some cases, oysters were shipped in the spring and subsequently bedded in sheltered waters for use in the early fall. Around 1840 it was noticed that some of these oysters had spawned, and produced quantities of juvenile oysters, or "spat." This led to the experimental planting of clean oyster shells to catch oyster spat in South Norwalk, Connecticut. The success of such experiments led to the passage of laws in 1855 to encourage private oyster culture in Connecticut and New York (Sweet, 1951, p.5).

These laws were resented by traditional oystermen, and in deference to such deep-seated feelings, early statutes provided that private oyster grants could not be issued

where natural oyster beds occurred. In addition, private oyster grants were limited to two acres in size. However, this provision proved ineffective as individual grant holders conveyed their grants to a single grower. The success of this new industry and the failure of small scale operations, resulted in public acceptance of large scale private oyster culture (Sweet, 1951, p.5).

During the establishment of oyster culture in this region, oyster seed was acquired from natural beds and transferred to private grant² areas and allowed to grow to market size. However, the supply of natural oyster seed was soon exhausted, and new methods of capturing larval oysters were developed.

Oyster culture on Cape Cod evolved from the practice of bedding oysters, as described above. In the early 1700's oysters harvested from local waters were bedded in Wellfleet and Buzzards Bay during springtime, and shipped to Boston for transplant in the fall. The purpose of this was to take advantage of exceptional conditions on Cape Cod that produced rapid growth and superior flavor (Kochiss, 1974, p.39).

However, Wellfleet's oyster beds were rapidly depleted by overfishing and the harvest of shells for lime production. The latter practice impacted the natural production of oysters as it depleted the supply of cultch needed for the setting of larval oysters. In response,

Wellfleet's beds were stocked with oysters from other states; by the 1840's oysters were acquired from the Chesapeake Bay. This allowed the practice of bedding to continue in Wellfleet until about 1870 (Belding, 1909, p.126).

After the Civil War, the leading oyster bedding region in Massachusetts was centered around Boston, which reduced the demand for Wellfleet oysters. Nonetheless, the bedding industry around Boston declined as the supply of oysters gradually decreased. As a consequence, the growing of native oysters was substituted for oyster bedding. Swansea was the first town to permit the selling of private oyster privileges in 1869. The first attempt at actual oyster culture occurred in 1881 when E.W. Cook acquired native oyster seed from Somerset, and planted it in Wellfleet Harbor. Cook's experiment succeeded and was emulated by others, who in turn became prominent oyster growers. By 1900 Wellfleet had re-emerged as a producer of high quality oysters (Kochiss, 1974, p.42-43).

As a result of this success, an extensive grant system developed on Cape Cod. The emergence of Cape Cod as the undisputed center of aquaculture in Massachusetts by the end of the 19th century is evident in the following comment:

"The last census shows that Barnstable county has 562.5 acres of oyster beds, which is more than two-thirds of all the grounds in the state (Deyo, p. 791, 1890).

However, aquaculture did not become established on Cape Cod on a regional basis. This lack of uniformity was perceived to result from the different political response of individual towns, and to the hostility toward aquaculture by traditional oystermen, quahaugers, and private riparian proprietors. As aquaculture required at least a degree of private control over portions of water resources, these interest groups tended to perceive it as an evil monopoly (Kochiss, 1974, pp. 43-44). In contrast, the Massachusetts Commissioners on Fisheries and Game perceived the system of local control as a detriment to the state's legitimate interest in conserving shellfish resources:

"The *present laws* have placed the mollusk fisheries completely in the hands of the Philistines of town government. Petty local jealousies, unsystematic tenure and uncertainty as to private and public rights have prevented the development of private enterprise. By the system of town control we have escaped neither the dangers of monopoly nor of continued depletion of the supply, while the facts concerning the public ownership of the shellfisheries are in danger of becoming obscured" (Commissioners on Fisheries and Game, "Preliminary Report Upon The Shellfisheries of Massachusetts," 1906, p.4).

In response to these problems, the following solutions were proposed: 1) eliminate the public right to take shellfish from privately cultured tideflats; 2) restore complete control over shellfisheries to the state; 3) clarify and enforce the law that riparian proprietors do not possess exclusive rights in the shellfish on their tideflats; 4) convert traditional fishermen to aquaculture (Belding, 1909,

pp.9-12). None of these recommendations ever took effect, and town control of aquaculture continues today.

B. Current Aquaculture on Cape Cod

The current aquaculture industry on Cape Cod is characterized by small scale operations consisting of one to two acre lease sites located on tideflats (Moles, 1996). The current industry is distinguished from the industry during the 1800's; oysters were replaced by quahaugs as the top species produced during the period 1980-1983 (Huff (ed.), 1985, p.11). In addition, advances in hatchery techniques, pioneered by Dr. Victor Loosanoff at the NMFS Milford laboratory in 1954, have resulted in a reliable supply of relatively low cost shellfish seed (Iversen, 1968, p.37). While this innovation has made it possible for the current cottage industry to emerge, it is unevenly distributed throughout Cape Cod. After promising signs of growth beginning in the 1970's, aquaculture was faced with some of the same problems that beset the industry at the turn of the century. This is reflected in a 1986 conference report, "Strategies for Aquaculture Development in Massachusetts":

"This is an exciting time for anyone interested in the future of aquaculture in Massachusetts. The promise, perhaps, has never been brighter, nor the potential opportunities greater. Yet some major obstacles, including water quality problems, regulatory impediments, public attitudes, and insufficient knowledge stand in the way of achieving the promise and realizing the opportunities" (Parker (ed.), 1986, p.vi).

Speaking at the same conference, James Fair, Assistant Director of the Commercial Fisheries Division of the Massachusetts Division of Marine Fisheries, characterized the industry in the state at that time:

"In 1969 we had 39 grants in 8 towns, which totaled about 150 acres. Since that time there has been a great interest in the field. A lot of interest in training on the part of universities and so forth has created a whole new class of people who are interested in aquaculture as a substitute for simply fishing in the wild fisheries. So today we find ourselves with 101 grants which are located in 19 towns and take up about 536 acres. In addition to that, there are pending another 23 grants with over 100 acres" (Parker (ed.), 1986, p.158).

A 1984 study conducted by the Center for Policy Analysis at the University of Massachusetts at Dartmouth, found that Cape Cod encompassed 62 percent of the aquaculture leases and 59 percent of the acreage under cultivation in the state (Huff (ed.), 1985). The following tables were derived from this study. A comparison of tables one and two reflects a characteristic of the current situation on Cape Cod; both large and small aquaculture operations occur on Cape Cod. Table 3 represents aquaculture production in bushels for the years 1980 and 1983.

TABLE 1.
AQUACULTURE LEASES ON CAPE COD (1984)

Town	Number of Leases	Acres
Barnstable	7	126.6
Bourne	1	1.0
Chatham	1	3.0
Dennis	1	1.0
Eastham	7	4.9
Falmouth	1	22.0
Harwich	1	1.0
Mashpee	4	31.6
Orleans	5	2.1
Provincetown	2	5.5
Wellfleet	18	62.0
Yarmouth	3	27.0
Totals	51	287.7

TABLE 2.

LARGEST AQUACULTURE LEASES ON CAPE COD (1984)

Lessee	Species	Town	Acres
Cotuit Oyster	Oyster	Barnstable	53
Cape Cod Oyster	Oyster	Barnstable	25
Olin Kelly	Oyster/Quahog	Falmouth	22
Francis Sullivan	Quahog	Mashpee	20
Sequester Farms	Oyster	Barnstable	13
Irving Puffer	Oyster/Quahog	Wellfleet	10
Total			143

TABLE 3.

AQUACULTURE PRODUCTION IN BUSHELS (1980 and 1983)

Species	1980	1983
Quahogs	564	9,826
Soft Shell Clams	3	2
Oysters	8,656	7,759
Scallops	68	272
Mussels	74	141
Conch	10	0
Totals	9,375	18,000

While the preceding tables represent the number of leases and production levels, it is believed that production figures are inaccurate (Huff (ed.),1985, p.10). There is an incentive to under-report annual production; there are no administrative procedures to verify the accuracy of annual production reports. The benefit of under-reporting is tax avoidance. While the dollar value of total aquaculture is reported at \$733,996, it was subsequently estimated that the actual dollar value was \$7,000,000 (Huff (ed.), 1985, p.10). This would put aquaculture production at 29% of the total shellfish production in Massachusetts in 1983.

The remainder of this chapter describes the current aquaculture industry on Cape Cod. The following table represents the most recent data available at the time of this writing. The total number of aquaculture leases on Cape Cod in 1994 was 121, which occupied a total of 364 acres. The primary species cultured are the quahog (*Mercenaria mercenaria*) and the common oyster (*Crassostrea virginica*). Others include the bay scallop (*Aequipectin irradians*), soft shell clam (*Mya arenaria*), European oyster (*Ostrea edulis*), surf clam (*Spisula solidissima*) and the blue mussel (*Mytilus edulis*) (Moles, 1996).

TABLE 4.

AQUACULTURE LEASES ON CAPE COD (1992-1994)

Town	Number of Leases / Total Acres			Growth
	1992	1993	1994	
Barnstable	2 / 78	4 / 68	5 / 72	+3
Bourne	1 / 1	1 / 1	0 / 0	-1
Brewster	1 / 0.5	1 / 0.5	6 / 7	+5
Chatham	1 / 4	1 / 4	1 / 4	0
Dennis	0 / 0	0 / 0	0 / 0	0
Eastham	7 / 6	8 / 9	11 / 8	+4
Falmouth	1 / 22	1 / 22	1 / 22	0
Harwich	0 / 0	0 / 0	0 / 0	0
Mashpee	3 / 16	3 / 16	3 / 16	0
Orleans	10 / 11	13 / 12	17 / 20	+7
Provincetown	26 / 35	30 / 38	30 / 29	+4
Sandwich	0 / 0	0 / 0	0 / 0	0
Truro	1 / 2	1 / 1	1 / 10	0
Wellfleet	42 / 116	43 / 148	43 / 149	+1
Yarmouth	3 / 25	3 / 25	3 / 25	0
Totals	98 / 316.5	109 / 344.5	111 / 362	+13

Data related to the number of aquaculture leases per town is not available for the duration of the study period (Moles, 1996). Aquaculture production data is also lacking for each year of the study period (Moles, 1996). However, it was indicated that a comparison of 1984 data (Table One) with 1992 data (Table Four) is representative of industry growth pattern during that time span (Moles, 1996). In nine towns, no change in the number of aquaculture leases occurred, three towns showed a decrease of one lease during that time, and one town showed a decrease of five leases. Only three towns showed positive growth between 1984 and 1992, Orleans (+5), Provincetown (+24), and Wellfleet (+24). In some cases, negative growth was related to leases that were not renewed by the lessee (Moles, 1996).

First time operators typically purchase about 50,000 seed which are planted in the months of September or October (Olsen, 1996). Established operations sometimes purchase more than 1 million seed at a time. Seed ranges in size from 1 mm to 12 mm (measured along the longest axis), with 3-4 mm the most popular size (Olsen, 1996).³ In the case of seed up to 4 mm, a field nursery is utilized to raise it to a larger size (about 10 mm) for subsequent field planting.⁴ The advantages of this approach is that the purchase price is lower, and field planting at a larger size tends to minimize mortality.

Nursery systems consist of a series of trays that are located on tideflats and held in place by means of attached supports that are driven into the substratum (Olsen, 1996). This allows the tray to be raised off the bottom, which facilitates better water circulation, and minimizes the deposition of sediment. Their location on tideflats allows ease of access at low tide when they are exposed. Access to the trays is essential for predator control; swimming crab larvae and other predators can enter the tray, metamorphose, and consume a significant portion of the seed. Up to 10,000 seed quahaugs may be planted in a single nursery tray (Massachusetts Aquaculture White Paper, 1995).

Vinyl coated wire mesh (1-1.5 in. sq.), the same material used for lobster traps, is used to construct the nursery trays. The trays are constructed by each aquaculturist according to personal preference. There is no standard tray design, however, dimensions typically range from 18" x 18" x 5", to 5' x 10' x 6" (Olsen, 1996). The trays are filled to a depth of about 1-1.5 inches, with a clean sand-gravel mixture which is acquired from inland sources in order to ensure that it is free of predators (Olsen, 1996). In some cases, substratum from the grow out site is utilized, and it is sifted to remove predators.

Another purpose of substratum in nursery trays is to provide a means for stabilizing the seed. Experiments with trays lacking substratum have demonstrated that seed will

crowd as a function of water circulation. This tends to bury much of the seed, which can decrease growth rate or result in mortality. In the case of quahaugs the seed is very active and will crawl extensively within trays. This energy expenditure may have a negative effect on growth rate. Some aquaculturists forgo nursery operations, and purchase larger seed that is suitable for field planting (Olsen, 1996). One aquaculturist indicated that the additional cost of the larger seed is offset by the time and effort saved by direct planting. In addition, the absence of nursery trays on the lease site may reduce opposition (Benjamin, 1995). Other advantages include a shorter grow out period and a lower mortality rate.

In the case of quahaugs, the substratum of the field grow out site should be a sand-mud composition; it should be sufficiently soft to accommodate burrowing by the seed, and sufficiently firm to accommodate walking by the aquaculturist (Benjamin, 1996). First time operations may require clearing of debris from the grow out site. This is accomplished by raking the surface, which also removes crabs, whelks, and other predators. Depending upon the seed size at field planting, it may take three years before market size is attained.⁵ In such cases, the grow out site may be subdivided into four sections to ensure that a planting site is always available after the first planting

year crop is harvested (Benjamin, 1996). This potentially ensures an annual harvest.

Planting is accomplished by scattering the seed by hand at low tide. Care is taken to ensure an even distribution of seed onto the grow out site. After planting, protective mesh netting (1.5 mm diagonal mesh size) is stretched over the grow out site, and stapled to the substratum by various devices (Benjamin, 1996). A common device for this purpose is iron re-bar, which is bent into a "U" shape. The netting is held down flush with the substratum. Maintenance is simple. The aquaculturist may check the grow out site for predators and debris at low tide. Predator control usually consists of killing or removing any predators present. Access to the grow out site is facilitated either by motor vehicle or by small motorized boat (Benjamin, 1996).

Harvesting is accomplished by hand, utilizing a large bullrake or a small seven tine hand rake. Bullrakes are used to harvest at high tide. They consist of a curved steel basket-like rake that is attached to a long "T" handled pole. The bullrake may be utilized from a small skiff or by an individual wading in the shallow water. Hand rakes are used to harvest at low tide, and the shellfish are placed into containers for storage and retrieval (Benjamin, 1996). In the case of quahaugs, harvesting at the minimum legal size has two advantages; "littlenecks" command the highest price, and require the least grow out period.

This, and good growth rates are the predominant reasons that quahaugs have become the primary shellfish species cultured on Cape Cod (Benjamin, 1996).

While this discussion essentially describes quahog culture, there are two distinctions in the case of oysters:⁶1) oysters require a relatively harder substratum than quahaugs as they do not burrow, and are vulnerable to burial on softer, shifting substrates; 2) some oyster aquaculture operations still acquire seed via spat collection (Olsen, 1996). In the majority of cases, the original method of broadcasting clean shells onto the grant surface is utilized. A recent innovation is the use of perforated plastic disks. They are coated with a fine layer of cement and stacked onto posts, which are driven into the substratum. After the larval oysters have set, they are separated from the disk as individual seed (Olsen, 1996).

CHAPTER FOUR
RESULTS AND ANALYSIS

A. Introduction

This chapter presents the research methods and findings of this study. In order to test the contention that the potential for social conflict to constrain aquaculture on Cape Cod is relatively high, the following tasks were carried out: 1) identify sources of social conflict that have been shown to constrain aquaculture; 2) formulate indicators related to these sources; 3) utilize the indicators to test the stated contention.

The first task was accomplished by searching each towns' records related to aquaculture, and in one case, by the attendance of the principal researcher at a public hearing related to a proposed aquaculture venture. The required information was located among the following offices: 1) Board of Selectmen; 2) shellfish constable; 3) harbormaster; 4) Department of Natural Resources. Sources of social conflict were related to private riparian property, the public right in shellfishing, and multiple use conflict.

In towns where cases of social conflict were identified, town officials familiar with each case were interviewed. This was done to determine whether factors other than social conflict were responsible for the outcome of the case. In all cases, social conflict was confirmed as

the primary issue upon which the outcome of each case was determined. This validated the use of indicators as tools for determining the potential of social conflict to constrain aquaculture.

In addition, town officials with a regulatory or advisory role related to aquaculture were interviewed in each town to determine if social conflict had influenced aquaculture policies. For the purpose of this study, the potential of social conflict to constrain aquaculture has two attributes. The first is direct, and occurs when a proposed aquaculture venture is denied or withdrawn as a result of social conflict. The second is indirect, and occurs when a town policy responds to the potential for social conflict, and limits the growth of aquaculture with respect to potential social conflict. For the purpose of this study, both attributes are considered in conclusions regarding the potential of social conflict to constrain aquaculture.

Based upon the findings in town records, indicators were formulated for the following sources of social conflict: 1) private riparian property; 2) shellfishing. The respective indicators are: 1) the percent of linear mileage of private versus public coastline; 2) the ratio of the number of shellfish permits per acre of estuarine tideflats.

In addition, multiple use conflict was the apparent source of social conflict in two cases. However, indicators

for multiple use conflict were not formulated. Much of the information was not available that could potentially have been used to formulate appropriate indicators. For instance, data relevant to navigational interests was not available. However, as multiple use conflict was identified as a source of social conflict, it remains a valid area of further research.

B. Examples of Social Conflict

1. Case One: Shellfishing; Chatham, 1983

A conflict developed when a bottom culture venture to raise blue mussels was proposed on the "common flats", located in the vicinity of Monomoy Island. Ten letters of opposition addressed to the Board of Selectmen were found in the shellfish constable's files. However, as three were from the same person and essentially identical, the number of letters is considered to be eight.

One was from a private riparian proprietor, who objected to the potential for increased large truck traffic, and noise and disturbance in the vicinity of his property (Letter to Chatham Board of Selectmen, December 19, 1983). One letter opposed the potential for conflict with the existing horseshoe crab fishery (Letter to Chatham Board of Selectmen, December 27, 1983). Two letters addressed the issue of large truck traffic, however it was unclear if the correspondents were private riparian proprietors (Letters to

Chatham Board of Selectmen, December 13, 1983; December 30, 1983). Two letters objected to the leasing of, although unproductive at that time, historically productive shellfishing grounds (Letters to the Chatham Board of Selectmen, January 1, 1984; January 10, 1984). One letter objected to the potential loss of recreational shellfishing grounds (Letter to the Chatham Board of Selectmen, January, 10, 1984).

In addition, a petition with 313 signatures was found in the shellfish constable's files. The petition objected to the leasing of potentially productive shellfish grounds (Petition to the Chatham Board of Selectmen, January 11, 1984).

A Chatham Shellfish Advisory Committee memo opposed the loss of potentially productive shellfish ground to aquaculture leases. The committee contended that currently unproductive areas would become productive due to the 1978 breakthrough of the Atlantic Ocean at Inward Point. The committee subsequently voted to recommend that the Board of Selectmen deny the proposed aquaculture lease (Chatham Shellfish Advisory Committee Memo, December 7, 1983).

However, before the Board of Selectmen were able to vote on the matter, the applicant withdrew his application. He based his decision on the existing opposition of shellfishers:

"As events progressed toward the grant, shellfishermen typically against grants began a

movement supporting theories and suppositions in opposition to my grant, and grants in general, culminating in a call for a moratorium on grants. The closing of Oyster Pond and threats of pollution in other areas of town prompted further fear among shellfishermen that they were losing productive ground and could not afford to lose any unproductive ground...In light of these present sentiments and emotions concerning this, and other grants, I feel it may be untimely to have a decision rendered on my application. It is, then, with extreme regret and remorse at this time that I am respectfully requesting the Selectmen to withdraw my application for a Shellfish Grant off Monomoy Island" (Letter of John Richards to the Chatham Board of Selectmen, January 11, 1984).

The comment "shellfishermen typically against grants" tends to suggest a perception that shellfishers have a predetermined attitude with respect to aquaculture. In addition, it is clear that pressure from shellfishers is capable of constraining aquaculture.

Regarding shellfishers' attitudes, a recent event on Cape Cod tends to support Richards' perception. An aquaculturist recently established a lease site on the tideflats of a private riparian proprietor under the terms of a legal contract (Hemilla, 1996). Despite the small size of the lease site, its location on private property, and the consent of the private riparian proprietor, it was opposed by shellfishers; prior to the aquaculture venture's inception, it was threatened that the aquaculturist's house would be burned if the venture was pursued (Hemilla, 1996). After the aquaculture venture was established, the aquaculturist's car windshield was smashed (Hemilla, 1996). A tendency among some shellfishers toward such acts are

perhaps universal; experiments on oyster culture in Spain during the 1950's were met with intense opposition from traditional oyster fishers, who destroyed every experiment located on natural oyster beds (Watson, 1988, pp. 41-42).

While current Massachusetts law prohibits aquaculture in productive shellfish areas, it appears that some shellfishers' attitudes against aquaculture remain strident. Although threats of house burning are substituted for the destruction of aquaculture ventures as a method of intimidation, it is apparent that some shellfishers are opposed to aquaculture on Cape Cod today.

2. Case Two: Private Riparian Property; Truro, 1994

A conflict developed at a 1994 public hearing which was held in regard to a private riparian proprietor's proposed bottom culture venture to raise sea clams on tideflats in Cape Cod bay, adjacent to his upland property. Opposition emerged from a group of seasonal residents, whose private riparian property was in the vicinity of the proposed venture. The opposition was led by the applicant's adjacent neighbor. A primary concern of the opponents was the effect that a commercial venture would have on the character of the residential neighborhood (Lessin, 1994). The applicant attempted to address this concern by stating his agreement with a town stipulation that all operations be located at least 600 feet from the mean high water line (Snider, 1996).

This proved to be inconsequential with respect to the opponent's interest in aesthetics.

The Board of Selectmen gave preliminary approval to the proposal, with final approval pending a DMF survey to determine the productivity of the proposed site. The DMF determined that the site was unproductive of shellfish and prepared to issue a permit to allow the proposed venture. However, the opponent's attorney contacted DMF and threatened litigation should the permit be issued (Snider, 1996). As a consequence, DMF refused to issue the permit, which resulted in a de facto denial of the proposed venture (Snider, 1996).

The perception of the applicant was that the dispute was based upon differing interests related to social class structure; seasonal residents may value the coast primarily for aesthetic reasons, while some year round residents may also value it for its potential to generate income (Snider, 1996). This tends to suggest that this case reflect Chew's finding that the magnitude of public concern over aesthetic impacts of aquaculture is related to the sociopolitical climate of a community (Chew, 1993).

Class differences have been considered as factors in potential town planning of aquaculture development in Truro. The results of a 1993 survey by the Truro planning department, indicated relatively high public support of aquaculture as an option for economic development. However,

it was acknowledged that the potential value of aquaculture must be balanced against the value of taxes derived from seasonal residents, many of whom are private riparian proprietors (Brown, 1993). Such consideration is based upon the perception that the potential for social conflict in Truro may be relatively high (Brown, 1993).

C. Interviews of Town Officials

1. Barnstable

In general, the town of Barnstable supports aquaculture development, as evidenced by an approximately 90% approval rate of recent lease proposals (Marcotti, 1996). The Barnstable Department of Natural Resources (DNR) has produced a GIS map of Barnstable Harbor, as a tool for identifying areas with biological potential for aquaculture (Marcotti, 1994). The Department of Natural Resources considers the biological potential for aquaculture to be high in Barnstable Harbor, due in part to the presence of extensive tideflats (Marcotti, 1996).

At the time of this writing, twenty new applications for shellfish grants in Barnstable Harbor had been received. However, social conflict from other shellfishing interests is not unexpected; the lack of standards for determining the productivity of potential aquaculture sites remains an issue of concern (Marcotti, 1996). In addition, embayments such as North Bay and Cotuit Bay are used heavily by navigational

and recreational interests, and are considered off limits to aquaculture (Marcotti, 1996).

2. Bourne

Bourne is in the process of creating an aquaculture development plan (Merritt, 1996). However, a recent proposal to designate seven acres in Buttermilk Bay for aquaculture has generated significant public opposition (Merritt, 1996). The emergence of opposition at the suggestion of aquaculture, is attributed to a basic lack of knowledge regarding aquaculture on the part of the public (Merritt, 1996). The current lack of an aquaculture development plan contributes to this problem. In addition, Bourne has a recent history of social conflict related to aquaculture; a 20 acre plus off bottom culture scallop venture was denied in 1988.

The town has a policy of siting future aquaculture ventures in areas where they will not conflict with existing uses (Merritt, 1996); the potential for social conflict has influenced Bourne's aquaculture policy. Finally, the town shellfish constable considers Bourne to have good biological potential for aquaculture, and is willing to consider appropriate bottom culture and off bottom culture ventures (Merritt, 1996).

3. Brewster

At the time of this writing, Brewster did not have an aquaculture development plan, but the Department of Natural

Resources has a positive opinion of aquaculture (Mant, 1995). The Natural Resources officer has an extensive background in aquaculture, including experience in production systems, and policy work (Brewster Department of Natural Resources Memo, 1993).

The recent designation of a portion of tideflats in Cape Cod bay for aquaculture resulted in approximately 40 to 50 inquiries for aquaculture leases. The town is continuing to try to identify locations appropriate for aquaculture. However, aquaculture will not be allowed on town owned tideflats as they are reserved for the town shellfish propagation program, which supports the town's interest in shellfishing (Mant, 1996).

4. Chatham

Chatham implemented a moratorium on accepting applications for aquaculture in 1985. The town Shellfish Constable indicated that this is in response to competition for inshore waters from shellfishing (Moore, 1996). Compared to shellfishing, Chatham considers aquaculture a relatively low priority (Moore, 1996). Exacerbating the problem of competition for inshore waters is the breakthrough of the Atlantic Ocean at Nauset Spit in 1992. Extensive redistribution of sediment has altered the characteristics of some shellfish growing areas in Pleasant Bay. Because of this, the town has maintained a "wait and

see" attitude regarding the allocation of potential shellfish growing areas for aquaculture.

Nonetheless, Chatham did approve a recent proposal to locate a bottom culture grant offshore in 20 feet of water (Moore, 1996). This indicates the town's willingness to consider aquaculture, however, the town remains committed to reserving inshore waters for shellfishing (Moore, 1996).

5. Dennis

The town of Dennis supports aquaculture, but compared to shellfishing and recreation it is a relatively low priority (Marcy, 1996). The fact that natural shellfish populations are increasing further diminishes the significance of aquaculture (Marcy, 1996). In addition, most of the estuarine tideflats in Dennis are located near private riparian property (Marcy, 1996). The town is willing to consider siting aquaculture on marine tideflats in Cape Cod bay (Marcy, 1996).

6. Eastham

A small aquaculture industry has existed during the study period, with grants typically less than one acre square in size (Lind, 1995). Despite this evidence that Eastham supports aquaculture, several variables tend to diminish its present growth potential. A de facto moratorium on new shellfish grants has been in effect since 1993, due to unresolved problems related to riparian rights (Lind, 1996). In addition, a good natural set of soft

shellfish clams in Nauset Harbor, an area historically used for aquaculture, precludes aquaculture in that area (Lind, 1996).

Conflicts related to both riparian property and shellfishing interests occur in Town Cove, an approximately 500 acre embayment that has been historically used for aquaculture (Lind, 1996). Tidal creeks that could potentially be used for aquaculture present physical constraints; high water current velocities during outgoing tides virtually preclude aquaculture in these areas (Lind, 1996). Potential conflicts with navigational interests also contribute to the problem of aquaculture development in Eastham (Lind, 1996). Nonetheless, the town regards aquaculture as a positive activity and generally supports it (Lind, 1996).

7. Falmouth

Although the town of Falmouth has high ecological potential for aquaculture, shellfishing and navigation interests are considered higher priorities than aquaculture (Souza, 1996). The protected embayments located along Buzzards Bay and Vineyard Sound contain areas that are reserved for recreational shellfish permit holders (Souza, 1996). In addition, navigation interests, including ferry services, tend to predominate along significant portions of these embayments. However, the town recently hired a shellfish constable who is familiar with the problems facing

aquaculture in Falmouth, and he has a history of supporting aquaculture where appropriate (Souza, 1996).

8. Harwich

Because Harwich lacks tideflats, inshore aquaculture is limited to off bottom culture systems. However, Harwich has not had any aquaculture leases since the 1950's during the study period (Leach, 1996). The town harbormaster has indicated that he would encourage aquaculture that avoids conflicts with navigational interests (Leach, 1995). This is evident in the town's recent decision to approve an offshore bottom culture lease, located in 20 feet of water in Nantucket Sound (Leach, 1996).

However, even offshore sites must address local navigational interests; seasonal yacht club races have been historically held in certain areas (Leach, 1996). At the time of this writing, it was unclear if this lease had been planted (Leach, 1996). Because this represents a new culture method on Cape Cod, its potential as a viable means to encourage aquaculture development is unknown.

9. Mashpee

Due to a significant lack of alternate economic opportunities, the town of Mashpee is currently targeting aquaculture as a priority for development (York, 1996). However, the potential for multiple use conflicts is regarded as a significant constraint to aquaculture in inshore waters. Nonetheless, existing grant holders have

developed a reputation for cooperation that is responsible for the town's supportive attitude regarding aquaculture development (York, 1995).

Because the town is intent upon exploring the economic potential of aquaculture in Mashpee, the approximately 10,000 acres of offshore waters in Nantucket Sound are being considered for aquaculture development (York, 1996). However, the effect of current commercial fishing activities in Nantucket Sound on aquaculture is unknown (York, 1996). The town shellfish constable is currently working with commercial fishing groups to develop a plan to accommodate both aquaculture and existing fisheries in this area (York, 1996).

10. Orleans

A Comprehensive Shellfish Management Plan was written in 1986 to encourage aquaculture development:

"Orleans has tremendous areas that are presently unproductive or marginally productive. Therefore, some of these areas should be set aside for shellfish farms" (MacFarlane, 1986, pp.25-26).

At present, Orleans has a proactive attitude toward aquaculture (Jamieson, 1996). Significant demand for aquaculture has led the town to designate 10 acres in Cape Cod Bay for aquaculture development (Jamieson, 1996). Based upon a town regulation to limit the maximum size of aquaculture leases to two acres, this area can accommodate five leases. At the time of this writing, no lease applications had been submitted for this area.

However, Pleasant Bay presently contains 26 grants, with the potential to occupy 52 acres (Jamieson, 1996). Consideration is given to other shellfishing interests in Pleasant Bay; in the event that a grant is vacated, those located on tideflats revert to public use, while grants located subtidally are available to subsequent applicants (Jamieson, 1996). A waiting list has been established to accommodate applicants for such sites, with four individuals currently on the list. In addition, because Town Cove has shown a significant increase in the amount of shellfish, the two existing grants at this location have been "grandfathered", while new grant proposals are not considered (Jamieson, 1996).

To further secure the viability of aquaculture in Orleans, a moratorium on grant applications is in effect until the town completes its Resource Management Plan (Jamieson, 1996). A goal of this action is to minimize social conflict. Also, because the Cape Cod National Seashore encompasses Pleasant Bay, the Town acquired confirmation from the U.S. National Park Service, that aquaculture is an approved activity within the boundaries of the National Seashore (Jamieson, 1996).

11. Provincetown

Provincetown has implemented an aquaculture development policy that is predicated upon preempting social conflict. In response to the interests of private riparian

proprietors, Provincetown allocated a portion of tideflats for aquaculture development in the West End of town, which lacks abutting private riparian property (Benjamin, 1995). Current town policy is to limit all aquaculture ventures to this area (Benjamin, 1995). In effect, Provincetown has zoned a portion of its resources for aquaculture development.

In addition, these areas are sub-divided into plots. Aquaculture proposals will be considered until the final plot is filled, at which time a de facto moratorium on further development will be in effect (Benjamin, 1995). However, if demand for aquaculture development remains high, the town is willing to consider similar zoning in other areas (Benjamin, 1995).

12. Sandwich

Sandwich has not had an aquaculture industry during the study period. In addition, there is no apparent demand for aquaculture development. While Sandwich is willing to consider aquaculture, there is no present effort by the town to initiate development of the industry (Galkowski, 1994).

13. Truro

At present, Truro's policy is to support aquaculture. This is evident in a recent decision by the Board of Selectmen to give preliminary approval to a proposed sea clam culture operation, despite the threat of litigation from adjacent private riparian proprietors (Halway, 1996).

However, the magnitude of public opposition in this dispute indicates a high probability for potential social conflict in Truro. An interesting possibility exists for aquaculture in Truro; an experimental sea scallop cage culture operation was recently approved as it is located in subtidal water (Halway, 1996).

14. Wellfleet

Wellfleet is the historic and current center of aquaculture on Cape Cod. However, recent social conflict related to private riparian property has had a significant impact on aquaculture. The town has responded by planning aquaculture development in areas that are as free as possible of social conflict. The town's recent plan to site aquaculture leases near Egg Island was based partly on the fact that the area is removed from private riparian property. (Somerville, 1996). Similarly, despite the area's ecological suitability for aquaculture, it is unlikely that Black Fish Creek will be considered for siting aquaculture in the near future, due partly to the presence of private riparian property (Somerville, 1996).

Subsequent to the SJC decision in the Pazzolt case, Wellfleet instituted a moratorium on accepting new aquaculture lease proposals in 1993 (Somerville, 1996). However, prior to that time, the town instituted a waiting list in 1986 to accommodate applicants (Somerville, 1996). The town stopped accepting waiting list applications in

1992, due to the number of applications pending (Somerville, 1996). The most recent grants were approved in 1989 (Somerville, 1996).

15. Yarmouth

Yarmouth is supportive of aquaculture. The town is cautiously examining the possibility of designating 12 acres in Cape Cod Bay for bottom culture of sea clams grants (Montague, 1995). A potential constraint to aquaculture in this area is the occasional presence of block ice during the winter months (Montague, 1995). The town shellfish constable indicated that an additional 5 acres in Yarmouthport may be suitable for aquaculture (Montague, 1995). Finally, the town is willing to consider proposals for grants in the waters of Nantucket Sound (Montague, 1995). A constraint to utilizing this area is the current closed status of shellfishing waters. However, it is anticipated that they are likely to be re-classified as open (Montague, 1995). Despite these possibilities, Yarmouth considers aquaculture a low priority relative to existing shellfish and navigation interests.

D. Proposed Standard Indicators of the Potential for Social Conflict

This section introduces two proposed standard indicators (PSIs) of social conflict, one related to private riparian property, the other to shellfishing. The PSI of

the potential for social conflict related to private riparian property is the percent of linear mileage of private versus public coastline in the town of Truro during 1994. Information regarding the mileage of coastline for each town on Cape Cod was derived from "The Extremes of Cape Cod Including a Geological Abstract", a 1996 report produced by the Cape Cod Commission. The PSI of the potential for social conflict related to shellfishing, is the ratio of the number of shellfish permits per acre of estuarine tideflats in Chatham during 1984. As such, the values of the standard indicators are directly related to cases in which proposed aquaculture ventures were denied or withdrawn in response to social conflict.

The purpose of the PSIs is to provide guidelines for analyzing the current potential for social conflict with respect to both private riparian property and shellfishing in each town on Cape Cod. The current potential for social conflict is partly analyzed by comparing PSI values with current indicator values. Current indicators of the potential for social conflict represent 1994 conditions, and are based upon the same variables that were used to formulate standard indicators of the potential for social conflict.

1. Private Riparian Property

The PSI value of the potential for social conflict related to private riparian property was derived from Case

Two: Private Riparian Property; Truro, 1994. The PSI value is: $21 \text{ linear miles of private coastline} / 24 \text{ linear miles of total coastline} = 0.88$. This value represents an estimate of the prevalence of private coastline associated with a case in which private riparian property was the source of social conflict that led to the denial of a proposed aquaculture venture.

As Case Two showed, the magnitude of public opposition was an important factor in the withdrawal of the proposed aquaculture venture. This opposition was related to the prevalence of private riparian property, which characterized the coastline in the vicinity of the proposed aquaculture venture. It is assumed that other towns on Cape Cod with a similar prevalence, or percent, of private coastline may have a similar potential for social conflict related to private riparian property. Therefore, current indicator values that are equal to or greater than 0.88 are considered to represent a relatively high potential for social conflict related to private riparian property.

In addition, the distribution of private versus public coastline is potentially significant with respect to the potential for social conflict. As it is assumed that aquaculture is most likely to occur in areas adjacent to public coastline, it is important that such areas be as free as possible of the influence of private coastline. However, much of Cape Cod is similar to Truro; areas of public

coastline tend to be relatively small, distributed intermittently, and located adjacent to long stretches of private coastline. Therefore, the percent and distribution of private coastline are both considered in analyses of the potential for social conflict related to private riparian property.

It is also important to note that both PSI and current indicator values are only preliminary estimators of the potential for social conflict; the value 0.88 is not considered to represent an absolute boundary that definitively measures the potential for social conflict related to private riparian property. In effect, the value 0.88 serves as a guideline for analysis. For the purpose of analysis, table five (p.108) lists current indicator values with other variables pertinent to the potential for social conflict related to private riparian property. A comparative analysis of the variables listed in table five is the basis for determining the relative potential for such social conflict in each town on Cape Cod.

In the following section, the percent of public coastline is included in abstracts of indicator data for each town on Cape Cod. It is important to note that a relatively high percent of public coastline in a town, does not necessarily indicate that aquaculture is less likely to be constrained. Public riparian property on Cape Cod is characterized by federal, state, and town ownership, and

policies regarding aquaculture for each parcel of public riparian property are unknown. Policies prohibiting aquaculture would confer public riparian property with an even greater exclusionary nature than private riparian property; in the case of private riparian property, aquaculture is at least theoretically possible as shown in the case of Hemilla (1996).

Finally, it is important to understand the meaning of the potential for social conflict within the context of this study. It is assumed that the potential for social conflict is inherent in any case where different interest groups compete for the same resource. In the case of private riparian property and aquaculture, the relative availability of sites that are removed from private riparian property is a primary criteria regarding the relative potential for social conflict. Relatively long stretches of public coastline, and/or the presence of extensive tidflats removed from private riparian property are considered to represent opportunity to minimize the potential for social conflict related to private riparian property. In addition, town policies that limit aquaculture to areas removed from private riparian property are considered to represent a variable that may minimize the potential for social conflict related to private riparian property. As a primary function of policy making is to respond to potential conflicts, such policies are also assumed to represent the acknowledged

inherent potential for social conflict related to private riparian property.

Trends in recent growth of aquaculture are considered to represent the effectiveness of town policies to promote aquaculture. As information related to the most recent growth of aquaculture is limited to the period 1992-1994, trends in growth during this period are examined. It is important to note that growth of aquaculture does not necessarily imply a relatively low potential for social conflict. Rather, it may indicate an effective policy response to a relatively high potential for social conflict. For this reason, growth of aquaculture that is shown to be related to town policies that represent a response to the potential for social conflict, are considered to represent a relatively high potential for social conflict. This applies to both the potential for social conflict related to private riparian property and shellfishing.

2. Shellfishing

The PSI value of the potential for social conflict related to shellfishing was derived from Case One: Shellfishing; Chatham, 1983. The PSI value is: $2614 \text{ shellfish permits} / 1134 \text{ acres of estuarine tideflats} = 2.31$. This value represents an estimate of the demand for shellfishing associated with a case in which shellfishing was the source of social conflict that led to the withdrawal of a proposed aquaculture venture.

While it is clear that the purchase of a shellfish permit represents a demand for shellfishing, the inclusion of total acreage of estuarine tideflats as a part of the indicator requires clarification. As Case One showed, shellfishers may oppose aquaculture despite the requirement that it be located on tideflats that are unproductive of shellfish. In effect, such opposition represents a potential demand for all estuarine tideflats in a town, implying that the potential for social conflict related to shellfishing may apply to virtually all estuarine tideflats on Cape Cod. In addition, with respect to this research, estuarine tideflats are significant; virtually all aquaculture and shellfishing on Cape Cod occurs in these areas (Sherwood, 1996). As such, the total acreage of estuarine tideflats per town is considered to represent a meaningful part of the indicator of social conflict related to shellfishing. Therefor, current indicator values equal to or greater than 2.31 are considered to represent a relatively high potential for social conflict related to shellfishing.

As in the case of private riparian property, PSIs are only preliminary estimators of the potential for social conflict; the value 2.31 is not considered to represent an absolute boundary that definitively measures the potential for social conflict related to shellfishing. In effect, the value 2.31 serves as a guideline for analysis. For the

purpose of analysis, table six (p.125) lists current indicator values with other variables pertinent to the potential for social conflict related to shellfishing. A comparative analysis of the variables listed in table six, is the basis for determining the relative potential for such social conflict in each town on Cape Cod.

Finally, it is important to understand the meaning of the potential for social conflict related to shellfishing within the context of this study. It is assumed that the potential for social conflict is inherent when aquaculture competes with shellfishing for the same resource. Because aquaculture on Cape Cod is limited to tideflats that are unproductive of shellfish, the presence of unproductive tideflats may lessen the potential for social conflict related to shellfishing. While Case One indicated that shellfishers may oppose the proposed siting of aquaculture on any tideflats, the current presence of 111 aquaculture ventures located primarily on estuarine tideflats throughout Cape Cod, tends to suggest that the potential for such opposition may not absolutely preclude aquaculture. However, the relative productivity of tideflats on Cape Cod is currently unknown. Nonetheless, based upon the current number of aquaculture ventures on Cape Cod, it is assumed that at least some areas of tideflats are unproductive of shellfish.

In addition, marine tideflats are generally considered to be available for aquaculture as they are relatively unproductive of shellfish (Sherwood, 1996). Therefore, the presence of large areas of marine tideflats is assumed to represent potential opportunity to minimize social conflict related to shellfishing. In addition, town policies that limit aquaculture to tideflats that are determined to be unproductive, are considered to represent a variable that may minimize the potential for social conflict related to shellfishing. As a primary function of policy making is to respond to potential conflicts, such policies are also assumed to represent inherent potential for social conflict related to shellfishing. Trends in recent growth of aquaculture are considered to represent the effectiveness of town policies to promote aquaculture. As information related to the most recent growth of aquaculture is limited to the period 1992-1994, trends in growth during this period are examined.

Information regarding the acreage of tideflats was acquired from a 1985 coastal resource assessment survey that was co-conducted by the Lloyd Center for Environmental Studies and the Massachusetts Coastal Zone Management Program (Hankin, et al, 1985). At the time of this writing, this represented the most recent data available, and it was determined to be appropriate for the purpose of this study (Rice, 1994). This data is particularly meaningful with

respect to the PSI of the potential for shellfishing to constrain aquaculture. The PSI is derived from Case One: Chatham; 1983. The Lloyd Center/MCZMP study was initiated shortly after 1983, and was completed more than one year prior to the 1986 breakthrough of the Atlantic Ocean at Chatham.

The other part of the ratio is the number of shellfish permits issued per town in 1994. This information was acquired from DMF and represents 1994 grouped data for commercial, recreational, and senior citizen shellfish permits. Grouped data was utilized, as it reflects current conditions under which competition for shellfish resources occurs; commercial, recreational, and senior citizen shellfishing on Cape Cod occurs almost exclusively on tideflats (Sherwood, 1996). Marine tideflats are generally unproductive of shellfish, and are considered to be relatively more available for aquaculture (Sherwood, 1996).

E. Abstracts of Information Related to Current Indicator Values.

1. Barnstable

Barnstable is the largest town on Cape Cod, with an area of 62 square miles. Barnstable has 689 acres of marine tideflats, and 1,957 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 86 linear miles of coastline in Barnstable; 55 miles are privately owned and

31 are public property. The percent distribution of coastline by ownership type is 0.64 private and 0.36 public. On its north coast, a narrow band of tideflats extends approximately 700 feet from the coastline to Cape Cod Bay (NOAA Chart No.13246). Barnstable Harbor encompasses approximately 670 acres of tideflats (Barnstable Harbor Intertidal Flats Map, 1994). On its south coast, a band of tideflats extends approximately 420 feet from the coastline toward Vineyard Sound (NOAA Chart No.13237). Cotuit Bay, North Bay, West Bay, and East Bay, are large, sheltered embayments, located along the southwest coast.

2. Bourne

Bourne is the fourth largest town on Cape Cod with an area of 41 square miles. It has 35 acres of marine tideflats, and 166 acres of estuarine tideflats (Hankin et al, 1985, p.12). There are approximately 62 linear miles of coastline in Bourne; 57 miles are privately owned and five are public property. The percent distribution of coastline by ownership type is 0.92 private and 0.08 public. Disregarding the Cape Cod Canal, its only water boundary is with Buzzards Bay, which lacks the extensive tideflats of Cape Cod Bay (NOAA Chart 13246).

3. Brewster

Brewster is the sixth largest town on Cape Cod, with an area of 25 square miles, and six miles of coastline. Brewster has 2,532 acres of marine tideflats, and fifteen

acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately six linear miles of coastline in Brewster; four miles are privately owned and two are public property. The percent distribution of coastline by ownership type is 0.66 private and 0.33 public. Its only water boundary is to its north at Cape Cod Bay. A broad expanse of tideflats extends approximately 1000 feet to 7000 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). The coastline lacks embayments, and is relatively straight and uninterrupted.

4. Chatham

Chatham is the twelfth largest town on Cape Cod, with an area of 17 square miles, and 70 miles of coastline. Chatham has 1,098 acres of marine tideflats, and 1134 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 70 linear miles of coastline in Chatham; 62 miles are privately owned and eight are public property. The percent distribution of coastline by ownership type is 0.89 private and 0.11 public. A narrow band of tideflats extends approximately 360 feet from the coastline of Nauset Beach, a barrier beach, to the Atlantic Ocean (NOAA Chart 13248). Along Nantucket Sound, a narrow band of tideflats extends approximately 420 feet from the coastline (NOAA Chart 13229). Located at the southeast corner of Chatham, Morris Island has a broad, convoluted expanse of tideflats that extends at least 1000 feet from the coastline (NOAA

Chart 13248). Chatham Harbor is a large embayment that is sheltered from the Atlantic Ocean by Nauset Beach. It is surrounded by bands of tideflats. On its western boundary, tideflats extend between 60 feet to 2200 feet from the shoreline to Chatham Harbor, and on its eastern boundary from 60 feet to 1040 feet (NOAA Chart 13248). In addition, Chatham Harbor has several large expanses of tideflats.

5. Dennis

Dennis is the tenth largest town on Cape Cod, with an area of 21 square miles, and 24 miles of coastline. Dennis has 880 acres of marine tideflats, and 122 acres of estuarine tideflats (Hankin, et al 1985, p.12). There are approximately 24 linear miles of coastline in Dennis; fifteen miles are privately owned and nine are public property. The percent distribution of coastline by ownership type is 0.63 private and 0.37 public. It has a narrow band of tideflats along its northwest coast that extends approximately 420 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). These tideflats expand continuously to the east and extend approximately 4800 feet from the coastline to Cape Cod Bay at their broadest point. Sesuit Harbor, a narrow estuarine embayment is bounded at its mouth by Cape Cod Bay (NOAA Chart 13246). On its south coast, it has a narrow band of tideflats that extends between approximately 210 feet to 1170 feet from the coastline to Nantucket Sound (NOAA Chart 13329). Located at

the border of Yarmouth, the Bass River heads inland from Nantucket Sound to Grand Cove, a small sheltered embayment.

6. Eastham

Eastham is the fourteenth largest town on Cape Cod, with an area of fourteen square miles and 35 miles of coastline. Eastham has 2,275 acres of marine tideflats and 543 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 35 linear miles of coastline in Eastham; 34 miles are privately owned and one is public property. The percent distribution of coastline by ownership type is 0.97 private and 0.03 public. Eastham has a broad band of tideflats that extends between 2130 feet and 4200 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). Eastham's entire boundary with Cape Cod Bay is characterized by this relatively uniform band of tideflats. Eastham has virtually no tideflats along its east which is exposed to the Atlantic Ocean (NOAA Chart 13246). In addition, Nauset Harbor, a large, convoluted, sheltered embayment is located on the east coast of Eastham (NOAA Chart 13246).

7. Falmouth

Falmouth is the second largest town on Cape Cod, with an area of 46 square miles and 67 miles of coastline. Falmouth has 127 acres of marine tideflats and 180 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 67 linear miles of coastline in Falmouth; 47

are privately owned and 20 are public property. The percent distribution of coastline by ownership type is 0.70 private and 0.30 public. Falmouth does not have any significant tideflats along its border with Buzzards Bay or Vineyard Sound (NOAA Chart 13230). Falmouth is characterized by relatively sheltered embayments along both of its coasts, particularly Vineyard Sound. From west to east respectively, Little Pond, Great Pond, Green Pond, Bourne's Pond, and Eel Pond are deeply indented narrow embayments that border Vineyard Sound. Waquoit Bay is a more exposed embayment that bounds Mashpee to the east (NOAA Chart 13237).

8. Harwich

Harwich is the eighth largest town on Cape Cod, with an area of 23 square miles, and ten miles of coastline. Harwich has zero acres of marine tideflats, and zero acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately ten linear miles of coastline in Harwich; nine miles are privately owned and one is public property. The percent distribution of coastline by ownership type is 0.90 private and 0.10 public. Harwich has a water boundary with Vineyard Sound, and the coast is relatively uniform and lacks embayments (NOAA Chart 13229). Its largest body of water on Vineyard Sound is the Herring River which bounds Mashpee to the east (NOAA Chart 13229). In addition, Harwich

is bounded by Pleasant Bay at its northeast corner (NOAA Chart 13246).

9. Mashpee

Mashpee is the fifth largest town on Cape Cod, with an area of 26 square miles, and 25 miles of coastline. Mashpee has zero acres of marine tideflats, and 52 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 25 linear miles of coastline in Mashpee; 20 miles are privately owned and five are public property. The percent distribution of coastline by ownership type is 0.80 private and 0.20 public. Mashpee has only one water boundary which is located along Vineyard Sound (NOAA Chart 13237). At its southwest corner Mashpee encompasses a portion of Waquoit Bay, and at its southeast corner it encompasses a portion of Popponessett Bay (NOAA Chart 13237).

10. Orleans

Orleans is the thirteenth largest town on Cape Cod, with an area of 14 square miles, and 50 miles of coastline. Orleans has 414 acres of marine tideflats, and 2,028 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 50 linear miles of coastline in Orleans; forty four miles are privately owned and six are public property. The percent distribution of coastline by ownership type is 0.88 and 0.12 public. A broad band of tideflats along Cape Cod Bay extends approximately 3300 feet

from the coastline (NOAA Chart 13246). Orleans has virtually no tideflats along its boundary with the Atlantic Ocean. However, adjacent to this coast, Orleans encompasses the north half of Pleasant Bay which is sheltered from the Atlantic Ocean by a barrier beach. Pleasant Bay is characterized by narrow bands of tideflats along most of its shoreline.

11. Provincetown

Provincetown is the smallest town on Cape Cod, with an area of ten square miles, and 24 miles of coastline. Provincetown has 43 acres of marine tideflats and 162 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 24 miles of coastline in Provincetown, all of which are privately owned. It has a narrow band of tideflats that extends between approximately 300 feet and 2100 feet from the coastline to Provincetown Harbor (NOAA Chart 13246). Along its boundary with Cape Cod Bay, a narrow band of tideflats extends approximately 375 feet from the coastline (NOAA Chart 13246). On its boundary with the Atlantic Ocean, Provincetown has virtually no tideflats. Hatches Harbor, a small sheltered embayment is located at the northwest corner of Provincetown (NOAA Chart 13246)..

12. Sandwich

Sandwich is the third largest town on Cape Cod, with an area of 44 square miles, and 16 miles of coastline. Sandwich has zero acres of marine tideflats and seven acres

of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 16 linear miles of coastline in Sandwich; fourteen miles are privately owned and two are public property. The percent distribution of coastline by ownership type is 0.88 private and 0.12 public. It has isolated stretches of tideflats that extend up to approximately 300 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). Old Harbor, a sheltered riverine estuary, is the only embayment in Sandwich (NOAA Chart 13246). To its west, Sandwich is bounded by the Cape Cod canal (NOAA Chart 13246).

13. Truro

Truro is the ninth largest town on Cape Cod, with an area of 22 square miles and 24 miles of coastline. Truro has zero acres of marine tideflats and 93 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 24 linear miles of coastline in Truro; twenty one miles are privately owned and three miles are public property. The percent distribution of coastline by ownership type is 0.88 private and 0.12 public. It has discrete stretches of tideflats that extend approximately up to 1680 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). On its opposite coast with the Atlantic Ocean, Truro has virtually no tideflats. The Pamet River is a sheltered riverine estuary located on Cape Cod Bay (NOAA Chart 13246).

14. Wellfleet

Wellfleet is the eleventh largest town on Cape Cod, with an area of 20 square miles, and 37 miles of coastline. Wellfleet has 1,107 acres of marine tideflats and 787 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 37 linear miles of coastline in Wellfleet; 36 are privately owned and one is public property. The percent distribution of coastline by ownership type is 0.98 private and 0.02 public. Wellfleet has a continuous stretch of tideflats that extend approximately up to 1680 feet from the coastline to Cape Cod Bay (NOAA Chart 13246). On its opposite coast with the Atlantic Ocean, Wellfleet has virtually no tideflats. In Wellfleet Harbor, extensive tideflats extend to an approximate maximum of 2570 feet from the shoreline (NOAA Chart 13250).

15. Yarmouth

Yarmouth is the seventh largest town on Cape Cod, with an area of 25 square miles and 29 miles of coastline. Yarmouth has 1,065 acres of marine tideflats and 477 acres of estuarine tideflats (Hankin, et al, 1985, p.12). There are approximately 29 linear miles of coastline in Yarmouth; 25 miles are privately owned and four are public property. The percent distribution of coastline by ownership type is 0.86 and 0.14 private. It has a continuous stretch of tideflats that extend to an approximate maximum of 7200 feet from the coastline of Cape Cod Bay and taper in an easterly

direction to approximately 1000 feet from the coastline (NOAA Chart 13246). Along Nantucket Sound, Yarmouth has tideflats that range from approximately 420 to 1080 feet from the coastline (NOAA Chart 13229). Yarmouth's embayments are relatively small; Uncle Roberts Cove and Lewis Pond are located on its boundary with Nantucket Sound (NOAA Chart 13246), and Yarmouthport is located on Cape Cod Bay (NOAA Chart 13250).

F. Analysis

1. Current Indicators of the Potential for Social Conflict Related to Private Riparian Property.

Table five illustrates current indicator values for each town on Cape Cod. The potential for social conflict related to private riparian property is preliminarily considered to be relatively high in towns that have a current indicator value equal to or greater than 0.88, the PSI value.

Other variables include the distribution of public coastline, and the quantity, in acres, of both estuarine and marine tideflats. These variables are included in order to analyze their effect on the potential for social conflict. The potential effect of both variables could be to lessen or intensify the potential for social conflict. Long stretches of public coastline may lessen the potential for social conflict, as extensive areas of public property may

facilitate siting aquaculture ventures that are removed from private riparian property. It is assumed that the potential for social conflict related to private riparian property is relatively low when aquaculture ventures can be sited in such areas.

The opposite is assumed in the case of an intermittent distribution of relatively short stretches of public coastline; the presence of extensive stretches of adjacent private coastline may result in a relatively higher potential for social conflict. It is assumed that the potential for social conflict related to private riparian property is relatively high when aquaculture ventures are sited in the vicinity of extensive areas of private riparian property.

A relatively large quantity of tideflats may lessen the potential for social conflict; this characteristic may facilitate siting aquaculture ventures that are removed from private riparian property. It is assumed that the potential for social conflict related to private riparian property is relatively low when aquaculture ventures can be sited in such areas. This may be most significant in cases where such tideflats occur beyond 1,650 feet from the coastline; this distance represents the seaward limit of private riparian property in Massachusetts. Conversely, a relatively small quantity of tideflats may intensify the potential for social conflict.

Marine tideflats are not typically utilized for aquaculture, as they tend to be more exposed to wind, waves, and ice. However, Brewster has recently sited some aquaculture ventures on marine tideflats (Mant, 1996). While the potential for marine tideflats to support aquaculture is currently uncertain, they are generally considered to be available for aquaculture (Sherwood, 1996). Therefore, a relatively large quantity of marine tideflats, especially those that occur beyond 1650 feet from the coastline, may lessen the potential for social conflict in these areas. In addition to the variables in table five, recent growth trends (Table Four) in aquaculture are considered in the following analyses. Further, town aquaculture policies are considered where applicable.

Table 5.
Variables Associated with the Potential for Social
Conflict Related to Private Riparian Property

Town	Current Indicator Value	Distribution of Public Coastline	Acres of Tideflats	
			<u>Estuarine/Marine</u>	
Barnstable	0.64	extensive	1,957	/ 689
Bourne	0.92	intermittent	166	/ 35
Brewster	0.66	intermittent	2,532	/ 15
Chatham	0.89	extensive	1,098	/1,134
Dennis	0.63	intermittent	122	/ 880
Eastham	0.97	intermittent	543	/2,275
Falmouth	0.94	intermittent	180	/ 127
Harwich	0.90	intermittent	0	/ 0
Mashpee	0.80	intermittent	52	/ 0
Orleans	0.88	intermittent	414	/2,028
Provincetown	1.00	intermittent	162	/ 43
Sandwich	0.88	intermittent	7	/ 0
Truro	0.88	intermittent	93	/ 0
Wellfleet	0.98	intermittent	787	/1,107
Yarmouth	0.86	intermittent	477	/1,065

Based upon current indicator values, it is preliminarily assumed that the potential for social conflict related to private riparian property is relatively high in ten towns on Cape Cod. In addition, as the current indicator value for Yarmouth is only .02 less than the PSI value, it is preliminarily assumed that the potential for social conflict is relatively high in Yarmouth. This tends to suggest that the potential for social conflict with respect to private riparian property is relatively high in 11 towns on Cape Cod. Other variables associated with the potential for social conflict related to private riparian property will be examined in order to clarify this preliminary assumption.

Towns other than Yarmouth that have current indicator values less than 0.88, are preliminarily assumed to have a relatively low potential for social conflict related to private riparian property. This applies to Barnstable, Brewster, Dennis, and Mashpee. In Barnstable, a large quantity of estuarine tideflats in the vicinity of a long stretch of public coastline along Barnstable Harbor may lessen the potential for social conflict in this area. Some of these tideflats are located beyond 1650 feet from the coastline. These conditions, and the town's policy to promote aquaculture in areas removed from private riparian property, and potential social conflict in general are perceived to contribute to the recent growth of aquaculture

in Barnstable (Marcotti, 1996). While the large quantity of estuarine tideflats provides opportunity for aquaculture, Barnstable's policy to limit aquaculture to these areas is at least in part in response to the potential for social conflict related to private riparian property (Marcotti, 1996). Therefore, the contention that the potential for social conflict is relatively high is tentatively accepted for Barnstable.

Brewster lacks long stretches of public coastline and has only 15 acres of estuarine tideflats. However, a large quantity of marine tideflats, including some that extend beyond 1650 feet from the coastline has been considered in town decisions regarding aquaculture. Brewster recently developed a policy to promote the siting of aquaculture ventures on marine tideflats (Mant, 1996). The recent growth of aquaculture in Brewster has been attributed at least partly to this policy (Mant, 1996). This policy was implemented in response to the demand for estuarine tideflats by shellfishing interests and the town's policy to reserve portions of estuarine tideflats for town shellfish propagation projects (Mant, 1996). The apparent lack of evidence of social conflict related to private riparian property, and a town policy that primarily addresses shellfishing interests, tends to make conclusions regarding the potential for social conflict in Brewster somewhat tenuous. Therefore, the contention that the potential for

social conflict related to private riparian property is relatively high is tentatively considered to be uncertain for Brewster.

Dennis is similar to Brewster with respect to the distribution of public coastline, and the quantity of estuarine tideflats. The distribution of public coastline in Dennis is intermittent, and despite having 122 acres of estuarine tideflats, most are located in the vicinity of private riparian property (Marcy, 1996). However, similar to Brewster, a large quantity of marine tideflats may lessen the potential for social conflict related to private riparian property. The current lack of aquaculture in Dennis may be partly related to the current lack of a policy to promote it. As demonstrated in Brewster, such a policy may contribute to the growth of aquaculture. Because of physical similarities with Brewster and the recent growth of aquaculture in that town, it is tentatively assumed that aquaculture could also grow in Dennis if marine tideflats were targeted for aquaculture development.

Regarding the potential for social conflict related to private riparian property in Dennis, it is contended that insufficient evidence precludes a definitive conclusion. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is tentatively considered to be uncertain for Dennis.

Mashpee possesses some moderately long stretches of public coastline that may lessen the potential for social conflict in these areas. However, Mashpee has a relatively small quantity of estuarine tideflats, and they tend to be located close to the coastline. In addition, Mashpee has no marine tideflats. The relative lack of opportunity to site aquaculture ventures in areas removed from private coastline may support the contention that the potential for social conflict related to private riparian property is relatively high in Mashpee. The current indicator value, 0.80, may further support this contention. These variables may suggest that the recent lack of growth of aquaculture in Mashpee, is associated with a relatively high potential for social conflict related to private riparian property.

However, the potential for multiple use conflict in Mashpee may obscure the magnitude of the potential for social conflict related to private riparian property. The town's recent decision to deny a proposed aquaculture venture was in response to increasing demand for in shore waters from several sources, including recreation, navigation, and shellfishing interests (York, 1996). The town shellfish constable perceives the current potential for multiple use conflict to be significant in inshore waters; this has contributed to the town's de facto decision not to target inshore waters for aquaculture (York, 1996). Further, the town's recent consideration of the possibility of off

shore aquaculture was in response to the potential for multiple use conflict in inshore waters (York, 1996).

Nonetheless, evidence of the potential for social conflict related to private riparian property in Mashpee has been reported. A private riparian proprietor voiced concerns related to the aesthetic impact of a shellfish propagation project that was essentially a town managed aquaculture venture (York, 1996). Despite this, and the preceding variables that may suggest a relatively high potential for social conflict related to private riparian property, conclusions regarding this are somewhat tenuous with respect to the potential for multiple use conflict.

Further, ambiguity is inherent in the possibility that the potential for multiple use conflict includes the potential for social conflict related to private riparian property. It may be arguable that the potential for social conflict related to private riparian property is relatively high in Mashpee. However, as mentioned above, the potential presence of multiple use conflict in Mashpee may obscure the relative magnitude of the potential for social conflict related to private riparian property. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is tentatively considered to be uncertain for Mashpee.

Of the towns that are preliminarily assumed to have a relatively high potential for social conflict related to

private riparian property, Truro may represent the case in which this assumption is most tenable. This is based upon the finding that private riparian property was identified as the cause of the denial of the proposed aquaculture venture in Case Two. The fact that Case Two occurred in 1994 tends to further support the contention that the potential for social conflict related to private riparian property is relatively high in Truro. Therefor, the contention that the potential for social conflict is relatively high is tentatively accepted for Truro.

Of the remaining towns with current indicator values equal to or greater than 0.88, only Chatham has any areas of extensive stretches of public coastline. Although it is assumed that this may lessen the potential for social conflict related to private riparian property, the demonstrated potential of social conflict related to shellfishing to constrain aquaculture in Chatham may obscure its potential to constrain aquaculture. It is likely that the recent lack of growth of aquaculture in Chatham is most closely related to the potential for social conflict related to shellfishing. In addition, the town's policy to exclude aquaculture from estuarine embayments may also obscure the potential for social conflict related to private riparian property. Further, a large quantity of marine tideflats may lessen the potential for such social conflict in Chatham. Therefor, the contention that the potential for social

conflict related to private riparian property is relatively high is tentatively considered to be uncertain for Chatham.

Eastham, Orleans, Provincetown, and Wellfleet, are towns with relatively high current indicator values. However, each town shows recent growth of aquaculture. Several factors have contributed to this growth. All four towns have a large quantity of estuarine tideflats, including large portions that are removed from private coastline. While aquaculture is not currently sited on marine tideflats in these towns, Eastham has 2,275 acres, Orleans has 414 acres, and Provincetown has 43 acres of marine tideflats. Wellfleet has no marine tideflats. Although some of these factors may lessen the potential for social conflict related to private riparian property, an examination of each towns' aquaculture policies tends to suggest that the potential for social conflict related to private riparian property is relatively high in some of these towns.

Eastham has recently imposed a de facto moratorium on new aquaculture proposals due to unresolved potential problems related to the prevalence of private riparian property in areas that are considered to be appropriate for aquaculture (Lind, 1996).

In Orleans, some aquaculture ventures are located on private tideflats, but only under the terms of a legal contract with the owners of the tideflats. In addition,

recent aquaculture ventures have been sited on tideflats removed from private riparian property, at least partly to avoid potential social conflict related to private riparian property (Jamieson, 1996).

Provincetown's current policy of limiting aquaculture leases to certain tideflats in the "west end" of town is at least partly due to the lack of adjacent private riparian property at this location (Benjamin, 1996). In addition, Provincetown has adopted a policy to site all future aquaculture ventures in areas that are potentially free of social conflict related to private riparian property (Benjamin, 1996).

In Wellfleet, the town's recent policy to site aquaculture ventures on public tideflats was in response to complaints from private riparian proprietors that emerged after the SJC's decision in the Pazzolt case (Somerville, 1996). The recent siting of aquaculture ventures near Egg Island was based upon the availability of public tideflats in that area, and a lack of adjacent private riparian property (Somerville, 1996).

While aquaculture has experienced recent growth in these towns, it has been at least partly associated with policies that address the potential for social conflict related to private riparian property. In Eastham and Wellfleet, the occurrence of moratoriums was directly related to the potential for such social conflict. While

the potential for social conflict related to private riparian property has at least temporarily halted aquaculture in Eastham, it at least continues to constrain it in Provincetown and Wellfleet. In effect, the potential for social conflict related to private riparian property excludes aquaculture from certain areas in Provincetown and Wellfleet. In addition, aquaculture ventures occur on private tideflats in Orleans only because the interests of private riparian proprietors are legally protected. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is tentatively accepted for Eastham, Orleans, Provincetown, and Wellfleet.

Although Yarmouth has a current indicator value slightly less than 0.88, as previously mentioned, it is preliminarily accepted that the potential for social conflict related to private riparian is relatively high in Yarmouth. Variables supporting this contention are generally lacking. While the general distribution of public coastline is intermittent, some areas of moderately long stretches of public coastline do occur. In addition, Yarmouth has 477 acres of estuarine tideflats, and 1,065 acres of marine tideflats. Marine tideflats in Yarmouth have large portions that are removed from private coastline, including some that extend beyond 1650 feet from the

coastline. These variables may lessen the potential for social conflict related to private riparian property.

Yarmouth has not experienced recent growth of aquaculture. While Yarmouth is generally supportive of aquaculture, it is considered a secondary priority with respect to shellfishing and navigation interests (Montague, 1995). Nonetheless, the town has recently begun to examine the potential for siting sea clam aquaculture ventures on marine tideflats in Cape Cod Bay (Montague, 1995). The decision to target marine tideflats in Cape Cod Bay is at least partly related to the perception that the potential for social conflict is minimal in this area (Montague, 1995).

Consideration of the potential for social conflict was included in the town's tentative plan to target these marine tideflats for aquaculture. Due to a recent conflict between a private riparian proprietor and an aquaculturist, the town is aware of the potential for social conflict related to private riparian property. The proprietor objected to the potential siting of an aquaculture venture on his tideflats because they were designated as a conservation area (Montague, 1995).

Yarmouth is similar to Brewster in its response to the potential for social conflict. Both towns have a large quantity of marine tideflats, including extensive areas that are removed from private riparian property. In addition,

both towns have policies to target these areas for aquaculture. However, Yarmouth has experienced social conflict related to private riparian property; its aquaculture policy response is predicated partly upon addressing strategies for minimizing the potential for such social conflict. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is tentatively accepted for Yarmouth.

Bourne and Falmouth also have indicator values greater than 0.88, and both are similar to Mashpee with respect to the potential for multiple use conflict. In Bourne, a proposed off bottom aquaculture venture was denied in 1988, due primarily to the magnitude of multiple use conflict (Merritt, 1996). In Falmouth, a virtually identical proposed aquaculture venture was submitted in 1990. As in the case of Bourne, the proposed venture was denied due primarily to multiple use conflict (Souza, 1996). In both cases, interests in private riparian property were among the more prevalent sources of opposition to the proposed ventures.

In addition, both towns have variables that may further support the contention that the potential for social conflict related to private riparian property is relatively high. One variable is the intermittent distribution of relatively small areas of public coastline that are adjacent

to long stretches of private coastline. The other is that both towns lack large quantities of either estuarine or marine tideflats. Regarding the recent growth of aquaculture, Bourne shows negative growth, and Falmouth shows no growth.

Despite this, other variables further support the contention that the potential for multiple use conflict is relatively high in both towns. At the time of this writing, neither town had established policies to limit aquaculture to areas that are relatively free of the potential for social conflict. However, a recent attempt by Bourne to designate such an area of Buttermilk Bay for aquaculture was met with public opposition from several sources (Merritt, 1996). This tends to suggest that the current potential for multiple use conflict is relatively high in Bourne. Similar evidence in Falmouth may be lacking due to the town's current hesitance to promote aquaculture development. However, this is primarily due to the town's sensitivity to the potential for multiple use conflict (Souza, 1996).

Similar to Mashpee, conclusions regarding the current potential for social conflict related to private riparian property in these towns are subject to the potential for social conflict related to multiple use conflict. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is

tentatively considered to be uncertain for Bourne and Falmouth.

The remaining towns with current indicator values equal to or greater than 0.88 are Harwich and Sandwich. Both towns essentially lack opportunity to site aquaculture ventures; Harwich has no estuarine or marine tideflats, and Sandwich has seven acres of estuarine tideflats, and no marine tideflats. In addition, both towns have an intermittent distribution of public coastline, which is characterized by small public parcels that are adjacent to long stretches of private coastline.

Neither town has shown recent growth of aquaculture, and both lack policies to promote it. While the lack of opportunity is probably the primary constraint to aquaculture in these towns, Harwich is willing to approve sub-tidal aquaculture ventures that do not interfere with existing uses of water resources (Leach, 1996). Nonetheless, sufficient evidence to make a definitive conclusion regarding the potential for social conflict related to private riparian property is lacking. Therefore, the contention that the potential for social conflict related to private riparian property is relatively high is tentatively considered to be uncertain for Harwich and Sandwich.

This analysis tends to support the contention that the potential for social conflict related to private riparian

property is relatively high in seven towns on Cape Cod. This contention is uncertain in eight towns.

2. Current Indicators of the Potential for Social Conflict Related to Shellfishing

Table six illustrates current indicator values for each town on Cape Cod. The potential for social conflict related to shellfishing is preliminarily considered to be relatively high in towns that have a current indicator value equal to or greater than 2.31.

Other variables include the quantity, in acres, of both estuarine and marine tideflats, and the presence or absence of broad expanses of both types of tideflats. These variables are included in order to analyze their effect on the potential for social conflict. For the purpose of this study, it is important to clarify terminology related to tideflats. The quantity of tideflats is related to the total acreage of tideflats in a town, while the presence or absence of broad expanses of tideflats is related specific portions of tideflats.

It is assumed that the occurrence of tideflats that are unproductive of shellfish is relatively higher in towns with relatively larger quantities of tideflats. The value of unproductive tideflats is that aquaculture on Cape Cod is limited to such areas. It is further assumed that large quantities of tideflats may include relatively large areas of unproductive tideflats. The value of broad expanses of

unproductive tideflats is that aquaculture ventures may be limited to such areas. This may lessen the potential for social conflict related to shellfishing. Conversely, it is assumed that a relatively small quantity of tideflats and/or the lack of broad expanses of unproductive tideflats, may intensify the potential for social conflict related to shellfishing.

Provincetown provides a potential model for promoting the growth of aquaculture; recent growth of aquaculture in Provincetown is perceived to be related to the town's policy to limit aquaculture to a single broad expanse of unproductive tideflats and to reserve other tideflats for existing uses (Benjamin, 1996). In addition, the chairman of the Provincetown Shellfish Advisory Committee attributes the lack of social conflict to this policy (Benjamin, 1996).

In addition to the variables in table six, recent growth trends (Table Four) in aquaculture are considered in the following analyses. Further, town aquaculture policies are considered where applicable.

Table 6.

Variables Associated with the Potential
for Social Conflict Related to Shellfishing

Town	Current Indicator Value	Quantity of Tideflats	Broad Expanses of Tideflats
		Estuarine/Marine	Estuarine / Marine
Barnstable	1.61	1,957 / 689	yes / yes
Bourne	11.64	166 / 35	no / no
Brewster	37.80	15 / 2,532	no / yes
Chatham	2.01	1,134 / 1,098	yes / yes
Dennis	4.29	122 / 880	no / yes
Eastham	3.43	543 / 2,275	yes / yes
Falmouth	12.46	180 / 127	no / no
Harwich	n/a	0 / 0	no / no
Mashpee	11.88	52 / 0	no / no
Orleans	0.76	414 / 2,028	yes / yes
Provincetown	1.26	162 / 43	yes / no
Sandwich	n/a	7 / 0	no / no
Truro	2.25	93 / 0	yes / no
Wellfleet	1.26	787 / 1,107	yes / yes
Yarmouth	1.93	477 / 1,065	yes / yes

Based upon current indicator values, it is preliminarily assumed that the potential for social conflict related to shellfishing is relatively high in six towns on Cape Cod. In addition, as the current indicator value for Truro is only .06 less than the PSI value, it is preliminarily assumed that the potential for such social conflict is relatively high in Truro. This tends to suggest that the potential for social conflict related to shellfishing is relatively high in seven towns on Cape Cod. Other variables associated with the potential for social conflict related to shellfishing are examined to further clarify preliminary assumptions regarding the potential for such social conflict in each town on Cape Cod. Harwich and Sandwich do not have current indicator values, as Harwich lacks both estuarine and marine tideflats, and 1994 data for the number shellfish permits is not available for Sandwich. It may be that the lack of recent growth of aquaculture in both towns is related to the quantity of tideflats; Harwich has no tideflats and Sandwich has only seven acres of estuarine tideflats. In addition, neither town has developed an aquaculture policy. These variables make conclusions regarding the potential for social conflict related to shellfishing somewhat tenuous. Therefore, assumptions regarding the potential for such social conflict for Harwich and Sandwich are not made.

Of the towns with indicator values less than 2.31, Chatham may represent the most tenable case regarding the contention that the potential for social conflict related to shellfishing is relatively high. This is based partly upon the finding that shellfishing was identified as the cause of the withdrawal of the proposed aquaculture venture in Case One. More importantly, Chatham continues to enforce its policy of excluding aquaculture from estuarine tideflats (Moore, 1996).

In addition, it is probably unlikely that the recent lack of growth of aquaculture is related to a lack of opportunity; Chatham has a large quantity of both estuarine and marine tideflats, including broad expanses of both types of tideflats. As such, it is assumed that the recent lack of growth of aquaculture is related to Chatham's current aquaculture policy. Therefore, the contention that the potential for social conflict related to shellfishing is relatively high is tentatively accepted for Chatham.

The remaining towns with an indicator value less than 2.31 possess variables that may lessen the potential for social conflict related to shellfishing. Barnstable, Orleans, Provincetown, Wellfleet, and Yarmouth all have a relatively large quantity of estuarine tideflats, and except for Provincetown, they also have a relatively large quantity of marine tideflats. Recent growth of aquaculture has occurred in each town except Yarmouth. In Barnstable,

STATEMENT OF THE PROBLEM

It is commonly acknowledged that social conflict presents potential constraints to aquaculture on Cape Cod. However, the presence of potential social conflict is often observed after the fact. The emergence of social conflict in response to aquaculture, has discouraged both towns and private citizens from subsequently pursuing potentially beneficial opportunities. In part, this is due to uncertainty regarding the potential for social conflict. It is contended that the potential for social conflict with respect to aquaculture, is relatively high on Cape Cod.

METHODOLOGY

This study is based on the qualitative case study method as defined by Merriam (1988, p.9). Unlike experimental, survey, or historical research, qualitative case study does not claim to any particular methods for data collection or data analysis (Merriam, 1988, p.10). Any and all methods of gathering data from testing to interviewing can be used in a qualitative case study (Merriam, 1988, p.10). The data for this study includes public comments,¹ written correspondence, and interviews. In addition, qualitative case studies allow the use of both qualitative and quantitative data. Quantitative data used in this study includes the mileage of coastline and the acreage of tideflats. The decision to focus on qualitative case

studies stems from the fact that researchers are interested in insight, discovery, and interpretation, rather than hypothesis testing (Merriam, 1988, p.10). In addition, qualitative case study is a design particularly suited to situations where it is impossible to separate the phenomenon's variables from their context (Merriam, 1988, p.10). McNally-Wright found the qualitative case study method suitable to her study of public criticism and the Massachusetts Chapter 91 program, which was "a study of the dynamic interaction between a large number of participants over the seven years of program development within a specific context" (McNally-Wright, 1992, p.4). Similarly, this research is a study of interactions between a large number of participants, potential aquaculturists and their opponents, over a 22 year period (1973-1994) on Cape Cod. In addition, qualitative case studies require boundaries (Merriam, 1988, p.9-10). Nineteen seventy-three provides a meaningful origin for this study as it marks the beginning of "modern" aquaculture on Cape Cod; Chapter 130 of the General Laws of Massachusetts was amended in 1973 to address advances in aquaculture technology. Nineteen ninety-four was chosen as the terminal point of the study as it represents current conditions.

CHAPTER ONE

THE PUBLIC TRUST DOCTRINE AND PRIVATE RIPARIAN RIGHTS

A. Introduction

Aquaculture on Cape Cod is subject to private and public rights in estuarine waters and tideflats. Public rights include the easements of fishing, fowling, and navigation along the shore, while private riparian rights are a special class of rights that are vested in private ownership of riparian property. In Massachusetts, certain activities related to private riparian rights may result in the extinguishment of public easements in private tideflats and tidewaters. Accordingly, a discussion of the public trust doctrine and private riparian rights is instructive for understanding the basis for social conflict related to aquaculture on Cape Cod. This chapter outlines the origin and development of these legal principles from ancient times to the present in the United States. In addition, a review of Massachusetts Supreme Judicial Court (SJC) case law illustrates the dynamic relationship between these principles, and intimates their effect on aquaculture on Cape Cod.

B. Historic Development of the Public Trust Doctrine and Private Riparian Rights

The public trust doctrine in Massachusetts is derived from the Institutes of Justinian, which were codified between 529 and 534 A.D. (Slade (ed.), 1990, p.xvii). This Roman civil law insured that all citizens had free use of the waters and shores of the sea (Slade (ed.), 1990, p.xvii). This legal character was lost with the collapse of the Roman empire; the shoreline and other marine resources fell into private ownership (Lahey, 1985, p.56).

During the subsequent feudal period the Crown of England claimed title to the shore, including the authority to grant private ownership in portions of it to subjects (Lahey, 1985, p.56). However, the grievance that this interfered with navigation and commerce was a leading cause for the signing of the Magna Carta² (Boston Waterfront Development Corporation v. Commonwealth 393 N.E.2d 356, 358, 1979).

After the Magna Carta, a legal theory developed in England which divided the Crown's title to land below the mean low water line into two distinct interests. The first was a proprietary *jus privatum* interest, or right of property in the soil, which the King could grant to a private party subject to the *jus publicum* (New England Law Review (16) 1, 1980, p.114). The second was called the *jus publicum*, or royal prerogative, by which the King held this

land in his sovereign capacity in trust for all subjects and their free exercise of the common right rights of navigation and fishing (Commonwealth v. Alger 61 Mass. (7 Cush.) 53, 90, 1853). The *jus publicum* could not be granted to a subject without an act of Parliament, so it was eventually understood to be under the sole control of the Parliament, while the *jus privatum* remained vested in the King (Commonwealth v. Alger 61 Mass. (7 Cush.) 53, 90, 1853). Endowed with this theory, English common law passed to the Massachusetts Bay Colony via the Crown's right of discovery (Commonwealth v. City of Roxbury, 75 Mass. (9 Gray) 451, 478, 1857). The companies chartered to settle the colony were appointed as agents of the Crown by James I and Charles II. They were empowered with:

"full dominion over all the ports, rivers, creeks, and havens, etc. in as full and ample measure as they were before held by the Crown of England" (Commonwealth v. Charlestown, 18 Mass. (1 Pick.) 180, 182, 1822).

This vested both the *jus privatum* and *jus publicum* in the charter companies. The Massachusetts Bay Colony Ordinance of 1641 was included in the colony's original Body of Liberties, and it adopted the *jus publicum* of English common law:

"Every Inhabitant that is an howse holder shall have free fishing and fowling in any great ponds and Bayes, Coves and rivers, so farre as the sea ebbes and flowes within the presincts of the towne where they dwell, unlesse the free men of the same

Towne or the Generall Court have otherwise appropriated them,"... (The Book of General Laws and Libertyes, at 50, 1649).

However, the *jus publicum* in the Massachusetts Bay Colony diverged from English common law when the General Court amended the Colony Ordinance of 1641 in 1647:

...[I]t is declared that in all creeks, coves, and other places, about and upon salt water where the Sea ebs and flows, the Proprietor of the land adjoining shall have propertie to the low water mark where the Sea does not ebb above a hundred rods³, and not more wheresoever it ebs farther"... (The Book of the General Lawes and Libertyes 50, 1649).

This produced a significant change in the legal character of tideflats adjacent to private riparian property; private riparian proprietors could now possess a fee simple title in tideflats adjacent to their upland property. The object of the ordinance was to promote marine commerce, and the provision that created fee simple title in tideflats acquiesced to the Massachusetts Bay Colony's inability to fund the construction of wharfs (*Storer v. Freeman* 6 Mass. (6 Tyng) 435, 438, 1810). The significance of this provision is that it included the fundamental right of private proprietors to exclude the public from their land. The effect of the Colony Ordinance of 1647 on public rights in private tidelands and associated tidewaters was that they became conditional. However, public rights in submerged lands⁴, and in waters located below the seaward limit of private riparian property remained absolute.

The Colony Ordinance of 1647 had not been amended since that year, and was subsequently recognized by Massachusetts' highest court as a part of the state's common law:

"This ordinance was annulled (after the American Revolution) with the charter by the authority of which it was made; but from that time to the present, a usage has prevailed, which now has force as our common law..." (Storer v. Freeman 6 Mass. (6 Tyng) 438, 1810).

In addition, the United States Supreme Court has clearly indicated its support for this decision. In a landmark case, the court distinguished the authority of the states to amend colonial laws, and upheld the validity of such laws:

"The common law of England...at the time of the emigration of our ancestors, is the law of this country, except so far as it has been modified by the charters, constitutions, statutes, or usages of the several Colonies...When the Revolution took place, the people of each state became themselves sovereign; and in that character hold the absolute right to all their navigable waters, and the soil under them for their own common use, subject only to the rights since surrendered by the Constitution" (Shively v. Bowlby 152 U.S. 1, 14, 15, 1894).

As this decision relates to Massachusetts, the Colony Ordinance of 1647 describes the current relationship between the public trust doctrine and private riparian rights. This relationship has been a frequent topic of adjudication by the SJC. The following review of the resultant case law highlights some important legal concepts that further define the relationship between these legal principles. Understanding this relationship is necessary to understanding aquaculture on Cape Cod; virtually all

aquaculture on Cape Cod occurs on public trust lands or on private tideflats. The following cases address principles of the public trust doctrine, while a subsequent section addresses principles of private riparian rights.

**C. The Public Trust Doctrine: Massachusetts Supreme
Judicial Court**

In *Commonwealth v. Coombs* (2 Mass. Rep. 492, 1807) the SJC found several procedural irregularities in a Court of Sessions order to construct a bridge in the town of Brunswick. While these errors were found to be sufficient ground upon which to invalidate the order, the SJC furthered emphasized that the bridge was unlawful, as it was partly located over a navigable river. In addressing this point, the SJC cited the character of navigable water as a controlling factor in this dispute:

"The statute gives a general authority to the Sessions to lay out highways; but the statute must have a reasonable construction. This authority therefore cannot be extended to laying out of a highway over a navigable river whether the water be fresh or salt, so that the river may be obstructed by a bridge. A navigable river is, of common right, a public highway; and a general authority to lay out a new highway must not be so extended so as to give a power to obstruct an open highway already in the use of the public"
(*Commonwealth v. Coombs* 2 Mass. Rep. 492, 1807).

This decision protected the public right in navigation, and recognized that this right is inherent in navigable waters. In addition, the SJC implied that activities in public trust

areas, are subject to the purposes of the public trust doctrine.

In *Gray v. Bartlett* (20 Pick. 186, 1838), the SJC ruled against the plaintiff's claim of a right to utilize a portion of his wharf that extended below the mean low water line. The plaintiff made this claim under an assumed acquired private right of easement against the defendant. This claim was contended on the basis that the extension, which was shown to obstruct navigation to the defendant's wharf, had been constructed openly and with the acquiescence of the defendant's grantor. In addition, the plaintiff claimed that the extension did not damage the public right in navigation, as it was not an actual obstruction to navigation. In rejecting these claims the SJC described their inadequacy as applied to the locus in which the extension of the wharf occurred:

"The principle of prior occupancy...and the acquiescence of the ancestors of the defendant, does not apply to any part of the premises in controversy, below low-water mark, because, as to that the possession was not adverse...It was a public domain, over which Mr. Parkman had no control; and his right to use it, was a right in common with all the rest of the community..."
(*Gray v. Bartlett* (20 Pick. 186, 1838)).

The implication of this decision is that private rights in areas below the mean low water line are unlawful, as such areas are the domain of the public trust doctrine.

The case of *Drake v. Curtis* (1 Cush. 395, 413, 1848) distinguished the character of public rights in the area

above the mean low water line from the area below this line. The plaintiff claimed that the public's use of the tidewaters above his private tideflats for the purpose of sailing, amounted to a disseisin.⁵

While the SJC rejected this claim, it recognized the unique relationship between the public trust doctrine and private riparian rights in tidewaters in Massachusetts:

"The constitution of the (colony) ordinance (of 1647)...has been, that, although such (private riparian) proprietor has a fee in the soil of the flats, he holds it *sub modo*; he may build a wharf or other permanent structure upon it, or he may enclose it with rows of piles, so as to other persons from sailing over it; yet, until he does so, whilst the tide is in, and the flats covered, it is public navigable water" (Drake v. Curtis 1 Cush. 395,413, 1848).

The implication for the public right of easements in fishing, fowling, and navigation, in tidewaters lying above private tideflats, is that they are extinguished upon the enclosure of such tideflats.

While Drake v. Curtis (1 Cush. 395,413, 1848) upheld a conditional limit to the public trust doctrine, Commonwealth v. Alger (7 Cush. 53, 1851) upheld its ultimate paramource. The question in this case centered on a portion of the defendant's wharf which extended beyond a harbor line⁶ in Boston Harbor. The harbor line had been established by a series of acts and resolves,⁷ and was intended to protect the public right in navigation in Boston Harbor by preventing encroachments beyond it. The defendant claimed that as the wharf was located within the boundaries of his

private tideflats, it was lawful under the Colony Ordinance of 1647. In addition, it was claimed that the wharf was not an actual obstruction to navigation as it did not extend significantly beyond the harbor line.

While the SJC recognized the Colony Ordinance of 1647 as authorizing private riparian proprietors to build structures within the boundaries of their tideflats, it qualified that its authority is:

"...subject, however, to the reasonable use of other individual proprietors and of the public for the purposes of navigation;..." (Commonwealth v. Alger 7 Cush. 53, 1851).

The SJC interpreted this to mean that the public purpose of the harbor line statutes overruled private riparian rights in tideflats. In rejecting the claims of the defendant in this case, the SJC upheld the right of the legislature to make the harbor line statutes regardless of their effect on the defendant's private riparian rights:

"...the act of fixing a line within the harbor of Boston, beyond which no proprietor should erect a wharf or other permanent structure, although to some extent it prohibited him from building such structures on flats of which he owned in fee, was a constitutional law, and one which was competent for the legislature to make; that it was binding on the defendant, and rendered him obnoxious to its penalties, if he violated his provisions" (Commonwealth v. Alger 7 Cush. 104, 1851).

In addition, the issue of whether the wharf was an actual obstruction to navigation was deemed immaterial. The SJC's decision in Commonwealth v. Alger (7 Cush. 53, 1851) demonstrates that the geographic reach of the public trust

doctrine extends beyond the limit of the mean low water line. Theoretically, the legislature is authorized to completely impinge upon the private rights of private riparian proprietors for the purpose of protecting the public right in navigation.

In *Crocker v. Champlin* (202 Mass. 437, 1909), the plaintiff complained that the construction of a dam had permanently flooded his private tideflats. His complaint was based upon the resultant diminution of value of his tideflats. The SJC agreed with this assessment, but rejected the plaintiff's claim that this amounted to a taking:

"The owners of flats in this Commonwealth acquired by the Colony Ordinance of 1647 hold them subject to the right of the Commonwealth to cover them with deep water by means of a permanent dam maintained for purposes of navigation, and their diminution in value from being thus permanently covered with water is not a taking of property from the owners" (*Crocker v. Champlin* 202 Mass. 437, 1909).

This comment clarifies the intimation of *Commonwealth v. Alger* (7 Cush. 53, 1851). Namely, a legislative decision to promote or protect the public right in navigation that results in the deprivation of a private riparian proprietor's right in private property, does not result in a taking. Black's law dictionary defines a taking as a governmental action that directly interferes with or substantially disturbs a property owner of the use and enjoyment of their property. While a strict interpretation

of this definition appears to establish that a taking had occurred in *Crocker v. Champlin* (202 Mass. 437, 1909), the effect of the public trust doctrine on the principle of taking is evident in this case; the private riparian proprietor is left without recourse with respect to a potential claim of damage to his property value. This illustrates the significance of the public trust doctrine as a legal principle that protects and promotes public rights in easements in private riparian property in Massachusetts.

In *Barry v. Grela* (372 Mass. 278, 1977), the plaintiff claimed a right to walk across private tideflats in order to reach a public jetty for the purpose of fishing. This case was decided in favor of the plaintiff. The SJC ruled that as an appurtenance to the established public right to an easement in shellfishing on private riparian property, the act of walking upon private tideflats for this purpose was lawful. The SJC related its decision to the established right of the public to shellfishing on private tideflats when covered by water; no difficulty was found in applying this principle to the instant case:

"In...Packard the (shell)fishing was done by people who came by boat. But we think the same principle applies to access over flats on foot to property of others, so long as the purpose is "fishing". In *Opinion of the Justices*, (365 Mass. 681, 687, 1974), we said, "We are unable to find any authority that the rights of the public include a right to walk on the beach". But that language is not to be taken as limiting the right of fishing." (*Barry v. Grela* 37 Mass. 278, 1977).

It is important to emphasize that the SJC's decision in this case was based upon the fact that the access was appurtenant to a public right in an easement to fishing on private riparian property. The SJC has consistently ruled against access to private riparian property that is not appurtenant to public rights in easements.⁸

In the final case of this section, Boston Waterfront Development Corporation v. Commonwealth (393 N.E.2d 356, 1979), the SJC handed down a landmark decision that showed the immutable nature of the public trust doctrine in Massachusetts. The dispute in this case centered on the planned development of condominiums on a parcel of private riparian property in Boston Harbor. The parcel, which carried a fee simple title by statute⁹, was located on submerged land. While the SJC recognized the nature of ownership in the parcel, it ruled that its use was:

"subject to a condition subsequent that it be used for the public purpose for which it was granted...to promote trade and commerce by enabling and encouraging the owners of flats to build wharves, warehouses, and other structures thereon for the use and convenience of those [utilize]...the ports and harbors" (Boston Waterfront Development Corporation v. Commonwealth 393 N.E.2d 356, 1979).

A counter argument to this opinion was that such a construction of the public purpose intended by the statutes was too narrow with respect to current demand for the property:

"Restricting the use of Lewis Wharf to conformity

with this purpose severely encumbers the land because this purpose was conceived at a time when Boston was a booming shipping port. Shipping, or "commerce marine" no longer constitutes a large part of the demand for waterfront property in Boston. Recently, this land has been in much greater demand for residential and business purposes"...(Boston Waterfront Development Corporation v. Commonwealth 393 N.E.2d 356, 1979).

The diametrically opposed perspectives of the SJC and the Boston Waterfront Development Corporation reflect the nature of the dispute in this case: ancient principles of the public trust doctrine were challenged by modern private economic interests. In its analysis, the SJC relied upon precedent from the highest judicial authority.

In a landmark decision, the United States Supreme Court limited the use of certain submerged lands in Chicago Harbor to the express intent of the statute which conveyed them (Illinois Central Railroad v. Illinois, 146 U.S. 387, 1892). The statute promoted the public purpose of erecting wharves and docks for the improvement of navigation and marine commerce. With respect to the instant case, this represented a direct precedent as the dispute in both cases was virtually identical.

Finally, the SJC intimated the effect of its decision on parcels similar to the one which was the subject of the dispute in the instant case:

"land below low-water line can be granted only to fulfill a public purpose, and the rights of the grantee to that land are ended when that purpose is extinguished, and voidable when that purpose is not being carried out" (Boston Waterfront

Development Corporation v. Commonwealth 393 N.E.2d 356, 1979).

The purpose of this discussion was twofold: to illustrate the scope and significance of the public trust doctrine in Massachusetts, and to introduce some of its aspects that are of importance to aquaculture.

One of these aspects was introduced in *Commonwealth v. Coombs* (2 Mass. Rep. 492, 1807). The implication for aquaculture in this case, is that proposed structures in navigable waters are potentially unlawful. However, the authority of the legislature to promote public rights in public trust areas implies the legal basis for aquaculture in Massachusetts.

Commonwealth v. Alger (7 Cush. 53, 1851) and *Boston Waterfront Development Corporation v. Commonwealth* (393 N.E. 2d 356, 1980), represent divergent methods in which the legislature may promote public rights in the face of potentially competing private riparian rights. In the former case, harbor lines represent a means of protecting a public right by preventing private development beyond them. In the latter case, private development of public trust areas is allowed, with the caveat that the development be related to a public purpose. Further, the use of the public trust area is limited to the express intent under which the authority to use it was granted.

This latter case is analogous of aquaculture in Massachusetts. While different degrees of private rights

are conferred by wharfing statutes (fee simple title) and aquaculture legislation (leases), both are intended to serve public interests. In the case of aquaculture, the addition of spawn to the public shellfishery represents a contribution to the public right in shellfishing. Nonetheless, the SJC has ruled that the public trust doctrine is inextinguishable. Therefore, aquaculture is subject to the public rights in fishing, fowling, and navigation, except in the case of the enclosure of private tideflats. In this case, aquaculture may be excluded by the private riparian proprietor.

**D. Private Riparian Rights: Massachusetts Supreme
Judicial Court**

Private riparian rights are a special class of rights that are vested in ownership of private riparian property. While the scope of private riparian rights may vary between states, it is commonly accepted that they include:

1. The right to have the water remain in place and to retain, as nearly as possible, its natural character.
2. The right of access, including:
 - a) the right to maintain contact with the body of water
 - b) the right to accretions
 - c) the first right to purchase adjacent submerged land if it is sold to the state
 - d) if filling of submerged land is permitted by the state, the preferential right to fill adjacent submerged land
 - e) the right to draw nets onto the shore

f) the preferential right to secure
ferry franchises

3. Subject to reasonable restrictions, the right to wharf out to the navigable portion of the body of water

4. The right of free use of the water immediately adjoining the property for the transaction of such business associated with wharves or other structures (Kalo, 1990, p.120).

While a comprehensive discussion of these rights is beyond the scope of this study, two issues related to private riparian rights in Massachusetts are discussed as they have a potential relationship to aquaculture on Cape Cod: 1) establishing title in private tideflats; 2) rules for dividing private tideflats. The following cases are limited to these issues.

1. Establishing Title in Private Tideflats

Because riparian proprietors may own tideflats adjacent to their upland property in fee simple, such tideflats possess characteristics of real property. A fundamental characteristic of real property is that it may be subdivided and sold as separate parcels. In a comment from the first case in this section, the SJC upheld this principle regarding private tideflats in Massachusetts:

"(a riparian proprietor) may sell his upland without the flats, or the flats, or any part thereof without the upland" (Storer v. Freeman 6 Mass. (6 Tyng) 437, 1810).

Thus, it is erroneous to assume that all tideflats in Massachusetts that are adjacent to private riparian

property, are owned by the upland proprietor. While the presumption of law under the Colony Ordinance of 1647 is that private riparian property includes title to the adjacent tideflats, specific wording in a title deed may alienate the one from the other. This is shown in *Storer v. Freeman* 6 Mass. (6 Mass. (6 Tyng) 437, 1810).

The question in *Storer v. Freeman* 6 Mass. (6 Mass. (6 Tyng) 437, 1810) was whether the defendant's act of entering tideflats adjacent to the plaintiff's riparian property constituted a trespass. In deciding for the defendant, the SJC discussed the effect of the wording of a deed under which the plaintiff acquired title to the upland parcel. The inclusion of the phrase "to the sea-shore" was decisive:

"...we shall for *shore* substitute *flats*. The land described will then extend to the flats, and not be bounded by the flats. On this substitution the construction is manifest. The land conveyed extends to the flats, but not over them; and flats, being bound of the land conveyed, are not a part of it. Thus, by a strict and technical construction of the description of the land conveyed, we are satisfied that no part of the flats passed by the first deed" (*Storer v. Freeman* 6 Mass. (6 Tyng) 439, 1810).

It is important to note that the terms shore or seashore describe tideflats. The SJC cited a high authority in establishing this point:

"This question is largely considered by Lord *Hale*...his definition of the sea-shore is "that ground that is between the ordinary high water mark and the low water mark" (*Storer v. Freeman* 6 Mass. (6 Tyng) 439, 1810).

Because the location of the shoreline changes daily with the tide, the land that lies between the high water line and the low water line constitutes the shore.

In *Valentine v. Piper* (22 Pick. 85, 1839) the SJC addressed a demandant's claim to tideflats on two points: 1) can private proprietorship in riparian land be established in the absence of a title deed; 2) if affirmed, are the adjacent tideflats included? Regarding the question of title in the upland parcel, the SJC found for the claimant under the principle of adverse possession¹⁰:

"Where a great number of circumstances concur, such as a peaceable possession of an estate, the presence of those, who upon any other hypothesis would have an adverse title, without claim, all tending to show an undisputed ownership on the part of those who set up such non-appearing grant, they have been considered as presenting so strong a presumption of fact, that a deed has been executed, that is allowed to stand as proof of such deed" (*Valentine v. Piper* 22 Pick. 93, 1839).

The second question was settled in favor of the claimant under the previously discussed principle of the Colony Ordinance of 1647. However, the SJC also distinguished a proviso under which the principle of the Colony Ordinance of 1647 operates in conveying tideflats to private riparian property:

"It is true, that an owner may separate his upland from his flats, by alienating the one, without the other. But such a conveyance is to be proved, not presumed, and therefore ordinarily proof of title in the upland thus bounded, carries with it title in the flats" (*Valentine v. Piper* 22 Pick. 94, 1839).

This showed that the establishment of a private title in riparian property in Massachusetts is sufficient to establish a title in the adjacent tideflats.

In *Niles v. Patch* (13 Gray, 254,257, 1859), the SJC established that in a title deed, the meaning of the word "beach" is equivalent to the meaning of the word "shore."¹¹ That is, the word beach is understood to describe tideflats. The objective of this case was to determine the boundaries of a parcel of riparian property that possessed a valid title deed. The SJC decided that the upland property did not include the adjacent tideflats as it was described as bounded "by the beach."

What distinguishes this case from *Storer v. Freeman* (6 Mass. (6 Tyng) 435, 1810) is the SJC's further comment regarding other terms in a title deed that would include ownership in tideflats:

"Had the term been "sea," or "salt water", or "bay or harbor," it might have brought the grant within the operation of the colony ordinance, and carried the beach or flats, if the grantor owned it."
(*Niles v. Patch* 13 Gray, 254, 257, 1859).

An examination of this case and *Storer v. Freeman* (6 Mass. (6 Tyng) 435, 1810) reveals guidelines for establishing whether private riparian property that is held under a valid instrument includes adjacent tideflats. In the case of deeds that contain nouns describing tideflats, ownership is conditional and based upon the construction of the prepositional phrase in which the noun occurs. In the case

of deeds that contain nouns describing bodies of water, ownership is certain.

Another issue related to establishing title in private tideflats is determining the seaward extent of ownership in such tideflats. In *East Boston Co. v. Commonwealth* (89 N.E. Rep. 236, 1909) the SJC was asked to clarify the language in a colonial grant of riparian land that was related to this issue. While the grant was clear in conveying fee simple title in certain tideflats, it was ambiguous regarding the location of their seaward boundary:

"Noddle's Island is granted to Samuel Maverick to enjoy, to him and his heirs forever, yielding and paying yearly at the General Court, to the Governor for the time being, either a fat wether, a fat hog, or forty shillings in money...It is declared that the flats round about Nodle's Island do belong to Nodle's Island to the ordinary lowe water marke" (1 Mass. Col. Rec. 291, in; *East Boston Co. v. Commonwealth* 89 N.E. Rep. 236, 1909).

The SJC referred the problem of interpreting the meaning of the term "ordinary lowe water mark" to a Master's discretion. In answering, the Master cited the Colony Ordinance of 1647:

"The line of low-water, like the line of high water, is gradually and constantly changing from day to day in different parts of the month, and in different parts of the year, from the highest spring tides to the lowest neap tides. If the distinction intended is between extreme low-water mark and the ordinary or common line of low-water, having reference to all times and seasons, the only way of reaching the correct result is to take the average of the low tides, which gives us the line of mean low water. The use of the word "ordinary" distinguished this grant from the