Atlantic salmon aquaculture is a growing industry in the Bay of Fundy on the Atlantic coast of North America. Production is concentrated along the southwestern coast of the Canadian province of New Brunswick (NB) and the southeastern coast (“downeast”) of the US state of Maine. See Figure 1. The two Bay of Fundy aquaculture industries operate in the adjacent territorial waters of each country. The westerly boundary of NB/eastern boundary of Maine is the St Croix River at the coast and it establishes the international limit between Canada and the US. In terms of relative size, the NB aquaculture industry produced 25,000 tonnes of salmon in 2000 while Maine production was 16,000 tonnes.

Atlantic salmon aquaculture was introduced to the NB waters of the Bay of Fundy in 1978 and in adjacent Maine waters in 1984. As the industry has expanded, new coastal sites have been required for salmon cages. These waters have long supported local fisheries for Atlantic herring, American lobster, and giant scallop as well as modest fisheries for a variety of groundfish and soft-shelled clams. These traditional fisheries have formed the socioeconomic base of these adjacent regions in NB and Maine for over a century. More recently, seasonal ecotourism activities have grown in importance. Over the past decade, a decline in harvests in certain of the traditional fisheries has been accompanied by growth in Atlantic salmon aquaculture. The physical characteristics of the area and high flushing rates of the Bay of Fundy tides are very favorable for salmon cage sites. However, there is increasing competition among users of these waters since space is limited and utilization is high. Multiuse conflicts are now in greater evidence.

The Canadian and US jurisdictions have utilized somewhat different approaches to aquaculture policy development in light of the growing pressures on coastal resource use. This paper first describes the role of the traditional fisheries in the local economies. An overview of the developing salmon aquaculture industry is then presented. Management issues are described and institutional arrangements in the two jurisdictions are compared. Conclusions are drawn.

2. TRADITIONAL FISHERIES

For over a century, Charlotte County in the southwestern corner of NB has relied heavily on traditional fisheries for income and employment for local residents. This same picture characterizes Washington County in southeastern Maine. The coastline of these counties is dotted with small fishing villages and fisheries there for lobster, herring, scallop and groundfish have been dominant. Recent years have seen the virtual demise of much of this harvest activity in both regions of NB and Maine. See Table 1.

2.1 NEW BRUNSWICK

Lobster is the remaining primary fishery in the region as landings have nearly doubled over the past decade and the value of landings has increased nearly 4-fold. At the same time, the other traditional NB fisheries in the Bay of Fundy have experienced varied degrees of decline over the decade. The groundfishery was subjected to heavy fishing effort in 1991 and 1992 and landings have been in decline since that time with NB catches in 2000 less than twenty percent of those a decade earlier. Similarly, by 2000, the scallop landings had also declined to approximately twenty percent of those taken in 1990. Meanwhile, herring landings in 2000 were only two thirds of those a decade earlier.
The decline in landings in all these fisheries has been accompanied by declining revenues.

2.2 MAINE

Fishermen from eastern Maine have historically fished their coastal waters for similar species to those in adjacent NB waters. Maine groundfish and scallop landings have fallen over the decade at much the same pace as those in NB’s Bay of Fundy waters. Similarly, the Maine lobster fishery has seen positive growth as catches have doubled and landed values increased 3-fold over the period. But the trend in herring catches in Maine has been upward in contrast to those in southwestern NB.

3. SALMON AQUACULTURE PRODUCTION

Salmon aquaculture in the Bay of Fundy expanded from one experimental NB site in 1978 to 95 NB sites and 28 Maine sites in 2000. Where individual sites originally produced modest outputs of 30,000 fish, today the production levels can approach one million fish per site. The Maine sites are primarily located in Cobscook Bay in the coastal waters of Washington county while the NB sites are mainly found in the coastal waters of Charlotte county including the Fundy Isles of Grand Manan, Campobello and Deer. See Table 2.

NB production grew from an initial harvest of 6 tonnes at one cage site to 25,000 tonnes valued at $190 million CAD at 95 cage sites in 2000 [1]. Growth was initially slow and steady but in the five years between 1985 and 1990, salmon production increased by 1800% (from 399 tonnes to 7,265 tonnes). Production then doubled to 14,490 tonnes over the 1991-5 period. Four years later production had reached 22,000 tonnes despite a moratorium on new sites between 1997 and 2001. This production volume is small in relation to that of Norway and Chile. However, production in those countries is spread over long coastlines. In NB, the expansion has been very localized and the farm density is very high with minimum required site separation distances of only 1000 feet. This factor has contributed to serious environmental problems.

The first Atlantic salmon operation was established in Maine’s Cobscook Bay in 1982 with production of approximately 200 tonnes in 1984. By 1988, production had more than doubled, growing to approximately 450 tonnes valued at $3 million USD at 10 sites. By 1992, the number of sites had more than doubled to 21 and there had been a 22-fold increase in production to 10,000 tonnes. By 2000, production had grown to 16,000 tonnes at 28 sites [2]. The increased farm density in the Cobscook Bay region and the proximity to NB sites in adjacent waters has led to environmental problems in the Maine industry as well.

The commercial farming of Atlantic salmon makes a significant economic contribution in both NB and Maine. In 1999, for example, the NB industry contributed $25 million CAD in wages and benefits, primarily in Charlotte County. It generated in excess of 1,125 person-years of direct employment at hatcheries, grow-out sites, processing plants, sales, administration and other activities. In addition were 770 person-years of indirect employment in supplier industries such as feed and packaging and the retail sector [3]. Similarly, in Maine, the industry provided 2500 jobs which generated direct, indirect and induced incomes of $140 million USD in personal income in 1998. About two thirds of the employment is generated in Washington and Hancock Counties through the raising, processing and distribution of Atlantic salmon [4].

4. SALMON AQUACULTURE MANAGEMENT

In the US, no single federal agency has been delegated or statutorily charged with lead responsibility for marine-based aquaculture. Through authorities derived from various statutes, a number of departments such as Agriculture, Commerce, and Interior as well as agencies such as Environmental Protection and US Army Corps of Engineers are involved. The state of Maine, working in conjunction with various federal agencies has historically adopted a joint/federal approach, primarily through its Department of Marine Resources (DMR) [5]. In Canada, the federal role in aquaculture is more clearly delineated through focused statutory authority of the Department of Fisheries and Oceans (DFO). However, the 1989 Canada-NB Memorandum of Understanding on Aquaculture Development essentially placed the full authority for management of the aquaculture industry in the hands of the NB’s Department of Agriculture, Fisheries and Aquaculture (DAFA). Under the terms of the agreement, the federal government was expressly allowed to take measures deemed necessary to protect matters within its jurisdiction but there is little evidence that this has occurred [6]. DAFA finally ceded partial responsibility for environmental management of the industry to the NB Department of Environment (DOE) in 2000 [7]. The Maine Aquaculture Law governing leasing of public marine waters by private interests was enacted in 1973. Maine’s Department of Marine Resources (DMR) has always jointly regulated aquaculture with the state Department of Environmental Protection (DEP) because of the state water classification program and has co-ordinated the water quality classification with federal permitting requirements from the US Army Corps of Engineers [8]. The US Environmental Protection Agency agreed in 2000 to propose national effluent limitations guidelines for commercial and public aquaculture operations by June 2002 and to finalize rulemaking by June 2004 [9]. As a result, a new National Pollutant Discharge Elimination System

### Table 2

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permit system to be introduced in 2002 by DEP will be co-ordinated with the existing DMR requirements [10].

The contentious management issues in both NB and Maine salmon aquaculture relate to environmental regulation and property rights through the site allocation process.

4.1 ENVIRONMENTAL ISSUES

Both the Maine and NB industries have experienced serious environmental setbacks over the past decade.

4.1.1 New Brunswick

Congestion problems in the NB industry during the 1990s led to rampant disease, marine pollution and excess nutrient loading due to the release of surplus food, faeces, pesticides, antibiotics, antifouling agents and other materials. A widespread sea lice infestation developed in caged salmon in 1994. In an effort to combat the infestation, strong chemicals were added to the water at the time. Treatment with approved pesticides is ongoing. The Infectious Salmon Anemia (ISA) virus appeared in NB salmon in 1997. It spread rapidly through many cage sites and over four million fish were slaughtered in an attempt to halt the epidemic. Growers who were issued slaughter orders by DAFA were compensated at $8 per fish (over $30 million CAD) through funds provided by the Canadian and NB governments [11]. The sites were fallowed and an Aquaculture Bay Management Area (ABMA) framework was introduced in 2000 which focused on a single year class site policy [12]. A moratorium on new sites was implemented in 1997 and maintained until 2001. Now, all ABMA must be submitted for approval before allowance of any new sites, boundary adjustments, site subdivision or production increases.

The 2000 Site Allocation Policy describes the level of environmental management as follows:

- site production levels based on specific geographical and environmental characteristics
- marine sediment impacts of sites through an Environmental Monitoring Program - where standards are not met, the licensee must establish and implement Environmental Remediation Plan for the site
- waste management plans incorporated into each license

DAFA and DOE maintain compliance through monitoring, inspection and self-monitoring programs in accordance with the NB’s Clean Environment Act and the Clean Water Act. All fish movements between hatcheries and marine sites are audited.

4.1.2 Maine

A Maine Finfish Aquaculture Monitoring Program established in 1989 and revised in 1991 assures environmental responsibility [13]. It requires

- an annual diver survey documenting bottom conditions at each site
- annual benthic monitoring at each site during the period of peak feed
- an annual dissolved oxygen monitoring survey during “worst case” conditions when feeding rates and water temperatures are highest

These provisions are designed to meet Maine’s Water Quality Standards, Water Classification Program, Waste Discharge Law and Salmon Aquaculture Monitoring Law. Remedial plans are ordered for offenders. A fullscale outbreak of ISA in Cobscook Bay in February 2001 resulted in the slaughter of 1.5 million salmon in 2001, a falling period of one year, and a payment of $16.6 million USD by the federal government to compensate farmers for their loss [14]. Stringent new rules for farmers were applicable beginning 2002 [15]. New requirements are:

- a 30 percent reduction in the number of fish per pen
- a ban on multi-year classes of fish within a single pen
- mandatory falling of sites
- limits on transfers and movement between pens
- audits of farms, vessels and plants.

The situation in Maine is further complicated by the listing of wild Atlantic salmon on eight of Maine’s rivers as “endangered” by the US Fish and Wildlife Service in 2000. The decision is being challenged in the courts by Maine’s governor and a coalition of industry groups who fear that salmon cages will have to be moved offshore to prevent cage escapees from mingling with wild populations inshore where the worry is interbreeding and disease transmission [16].

4.2 PROPERTY RIGHTS

4.2.1 New Brunswick Leases

Canada’s Department of Fisheries and Oceans (DFO) has jurisdiction over the traditional fisheries on both Canadian coasts. The power to legislate property rights is vested in the Canadian provinces under the Constitution Act. Under a Memorandum of Understanding in 1977 and in 1989, NB (DAFA) has seabed jurisdiction in the Bay of Fundy...
while Canada (DFO) has jurisdiction in the watercolumn above it. DAFA is responsible for licensing and leasing all aquaculture sites. Canada (DFO) is responsible for managing the capture fisheries, including the allocation of herring weir privileges. This distinction is significant in that the bulk of the aquaculture sites are located where herring weirs had previously existed.

The initial (1991) NB aquaculture site allocation policy attempted to support participation of local fishing interests. In the early years of industry development, DAFA offered opportunities to as many local individuals as possible. Potential aquaculture sites were defined by existing weir sites due to similar environmental requirements and historical ownership privileges. With the introduction of the new Site Allocation Policy in 2000, the focus changed to sustainability through the ABMA. Access to the industry is now limited to already established fish farmers in an attempt to restructure the existing industry. It also specifies that only those farmers who have licenses and a minimum fifty percent ownership will be permitted to expand. This has changed the local marine property regime since licensing in NB salmon aquaculture now establishes territorial rights and restrictions to the seabed and associated water column to a select few.

4.2.1(a) How are NB Leases Granted?

Under the NB Aquaculture Act (1988), the regulations which apply have 4 components: designated aquaculture land, the aquaculture license, the aquaculture occupation permit, and the aquaculture lease. Designation of a potential aquaculture site as designated aquaculture land (seabed) is the first step. The aquaculture license is the primary mechanism under the Act to control aquaculture activities and is directly related to the individual sites which have been designated as aquacultural land. The term of the license can be up to twenty years. The aquaculture occupation permit grants limited rights to an aquaculture site and is typically issued with the license. It authorizes the aquaculturist to use the site pending the completion of the requirements for an aquaculture lease to be issued. The aquaculture lease can be held for a period up to twenty years and is the vehicle under which ownership rights of the Crown are transferred to the aquaculturist.

4.2.1(b) How Does NB Process Applications

Phase 1 of the review process begins with an application being received by DAFA which consists of applicant information, purpose of application, general location information, stock identification, and proposed facilities to be located on site. In Phase 2, the Site Development Plan is filed and shorefront owners, identified on the site development plan, are notified of their right to submit written comments with respect to location with a specified period of time. Applicants are instructed to give public notice in local newspapers of their intent to develop or alter a marine aquaculture site. The application undergoes interagency review. Following the closing date for comments from the general public and on receipt of the comments from the various government agencies, Phase 3 occurs in the form of a review of applications by the Aquaculture Site Evaluation Committee (consisting of representatives from DAFA and DFO). This committee makes its recommendation to the Minister (of DAFA) for acceptance or rejection of the application. In Phase 4, the Minister makes the final decision on the application. If accepted, an Occupation Permit and License are issued and operation of the site begins. The applicant proceeds with a legal boundary survey of the site. In Phase 5, the applicant registers the Plan of Aquaculture Survey and provides pre-development baseline data on site conditions. In Phase 6, the land is designated as “aquaculture land” and in Phase 7 the lease is granted with the farmer required to have a Surveyor’s Aquaculture Site Report completed and filed within 120 days. The time line for this process can be up to three years. The site operates from receipt of the Occupation Permit but there is no security of tenure until the lease is granted [17].

The 2000 Policy specified an increased level of consultation with the public, the commercial fishery and other affected stakeholders. Information with respect to advertised sites was to be made available on the DAFA website but there is no evidence of this to date. Meanwhile, the removal of the moratorium on additional sites in 2000 resulted in 16 applications. Nine were eventually approved. Another round of site applications is currently progressing through the evaluation process.

4.2.2 MAINE LEASES

The leases for finfish aquaculture in Maine are located along the Washington county coast with a small number to the west in coastal Hancock county. The first Maine Aquaculture Plan was released by the State Planning Office in 1980 and the state issued its Aquaculture Strategy in 1990. The Strategy was updated in 1997 by the Commissioner of Marine Resources and state legislation was then enacted in 1998 permitting DMR to grant marine lease sites to companies, individuals, and scientists wishing to conduct experiments. This new legislation has resulted in the establishment of small short term “experimental” farms in addition to the regular leases[18].

4.2.2(a) How Are Leases Granted in Maine
Aquaculturists submit a lease application to DMR that describes the proposed operation, its exact location, and a description of the site and surrounding area. A standard lease covers up to 100 acres of subtidal water, is in effect for up to ten years, and may be renewed. Experimental leases cover up to 2 acres, are in effect for up to 3 years, and may not be renewed. For any lease to be granted, it must meet statutory criteria whereby the lease cannot unreasonably interfere with navigation, the coming and going of riparian landowners, fishing and other uses of the area including other aquaculture uses, the ability of the lease site and surrounding area to support ecologically significant species, and the public’s enjoyment of public parks and facilities within 1000 feet of the proposed lease. Applicants must demonstrate they have a reliable source of organisms that they plan to raise and the financial capacity to meet their public obligations. Applicants must obtain all required federal and state permits for their operations [19].

### 4.2.2 (b) How Does Maine Process Applications?

Once the aquaculturist submits the application, it is reviewed for completeness by DMR. Then public notice requesting comments is sent to shorefront property owners within 1000 feet, municipalities and interested parties, and is published in local newspapers. DMR biologists visit the proposed site to verify its exact location, interview the local harbormaster about historic and current uses of the area and about possible impacts on navigation. For all standard leases and some experimental leases, biologists document bottom conditions including the plants and animals, by scuba diving over the site or by use of video cameras. For all finfish operations, the applicant must conduct a detailed environmental impact study of the site that will provide a baseline for determining future impact of the site. The US Army Core of Engineers, Maine Department of Environmental Protection (DEP) and other agencies submit comments about potential impacts.

All standard leases require a public hearing and, for experimental lease applications, public hearings are scheduled when five or more people request a hearing. DMR schedules and advertises the formal, adjudicatory public hearing and the DMR Hearing Officer conducts the hearing. The Hearing Officer then writes a draft decision based on all relevant testimony that has been received either at the public hearing or submitted to DMR. Members of the public who demonstrate that the farm will substantially and directly affect them may be granted intervenor status and are then allowed to comment on the draft decision. The DMR Commissioner affirms, modifies, or rejects the draft decision. If approved, a final lease is granted. The entire process can have a time line of over one year [20]. Six farm applications have been rejected in recent years due to potential conflicts [21].

### 5 POLICY ISSUES

Certain policy issues are persistent and common to the aquaculture sectors of both these national coastal regions of the Bay of Fundy. They may be broadly categorized under headings of conflict and jurisdiction.

#### 5.1 CONFLICT

Conflicts related to salmon aquaculture are abundant in both NB and Maine. Many coastal residents and tourist businesses in Maine have been strongly opposed to aquaculture lease sites in their area. These groups want to maintain their concept of a pristine view without rafts and buoys and activities associated with aquaculture. In some cases, aquaculture proposals have met organized opposition and even hostility from these groups. The level of public opposition from similar groups in NB is virtually nonexistent with only one case publicly documented to date. Meanwhile traditional fishermen in both NB and Maine have successfully lobbied against cage site infringement in certain lobster and scallop nursery areas. But controversy persists as the aquaculture industry presses for expansion and tensions escalate in affected local communities. The trend is for each new site application to be subjected to increased public scrutiny and/or opposition.

Issues related to the environmental effects of pesticides and other chemicals and cage discharge are also common concerns in the salmon aquaculture industries of both NB and Maine. In Maine, infractions are now being pursued although there is no evidence this occurs in NB. For example, notices of pollution violations were issued to three companies for six cage sites in Maine in November 2000 and remedial plans were ordered. One company was subjected to criminal investigation and appeared in court in February 2001 on nine violations of state law for failing to report positive ISA tests on time. Three companies were also recently found guilty of not obtaining required federal discharge permits [22]. Concern among environmentalists persists in NB because the use of pesticides and antibiotics continues and data are not publicly available. When standards set by the Environmental Monitoring Program are not met, an environmental remediation plan for the site must be developed and implemented by the grower but violators have never been publicly charged. In June 2002, the Bay of Fundy Keeper Program was licensed through the efforts of the New Brunswick Conservation Council (NBCC) in an effort to raise the profile of environmental/ecosystem concerns along the Bay of Fundy coastline in NB and to advocate for the public’s right to protect and defend the condition of this waterbody [23]. Beyond this, concerns over the transmittal of disease
between NB and Maine salmon cage sites has led to the recent formation of a bilateral working group on aquaculture by the Maine and NB governments [24].

The further issue of potential conflict between hatchery reared and wild salmon stocks is also common to Maine and NB. Wild salmon returns to their native rivers in both Maine and NB have declined drastically in recent years. There has not been a commercial salmon fishery in the Bay of Fundy since 1982. While the species has been declared “endangered” on Maine rivers, the same is not true in NB. Disease transmission from farm to wild has been documented on one NB river [25].

5.2 JURISDICTION

At issue in both NB and Maine is the promotion of salmon aquaculture and its regulation by the same agency - DAFA in NB and DMR in Maine. This has the potential for conflict of interest problems at the provincial/state level.

In Maine, restocking of cages has begun in Cobscook Bay following the falling period required by the ISA outbreak. But public concern over industry growth has escalated over the past year with the result that Maine legislators in the past session considered a bill placing a moratorium on new sites and requiring local government approval of new sites. The bill was controversial and faced opposition from DMR and the industry. While it had the support of lobstersmen, property owners in coastal communities, and environmental groups, a compromise could not be reached and it was not subjected to a vote. The Joint Standing Committee on Marine Resources will continue deliberations on a revised bill through 2002, with the issue revisited by the legislature in 2003 [26].

In NB, the NBCC has lobbied both the provincial and federal governments on aquaculture issues in the public interest since 1990. Many of the concerns raised by the NBCC were validated by the 2000 Report of the Auditor General of Canada [27]. The Report concluded that DFO is not fully carrying out its regulatory responsibilities to enforce the Fisheries Act with respect to salmon farming operation, that there are shortfalls in research and monitoring to assess the impacts of salmon farming operations, and that DFO did not have a formal plan for managing risks and assessing the cumulative environmental effects of proposals for new sites. DFO has historically justified its inaction because of the 1989 Memorandum of Understanding with DAFA but did not take exception to the Auditor General conclusions in this instance.

6. CONCLUSIONS

The morass of federal and state/provincial regulations applicable to salmon aquaculture in the Bay of Fundy has created management problems and a growing public opposition to the industry. A certain vacuum in federal oversight exists to the detriment of aquaculture management, particularly in NB. There, confidentiality provisions of the Aquaculture Act prevent public access to site specific information such as disease occurrences and pharmaceutical or pesticide use. There are also no public hearings in the lease application process. In contrast, Maine provides much greater environmental information through the DMR website. And public hearings in Maine permit all stakeholders a voice in the lease application process. Moreover, Maine salmon farmers have been prosecuted for violations while such is not the case in NB. In Maine, public pressure has led the legislature to consider a moratorium on expansion. In NB, the expansion decision remains at the discretion of the Minister (of DAFA). Thus the future direction of the industry may diverge in the two jurisdictions as Maine seeks to consider net social benefits of the industry while NB continues with the promotion of salmon aquaculture as a regional development tool.

However, market forces may also play a role in the future direction of the industry on both sides of the border. Declining prices through global competition and the increasing costs of environmental compliance are having an impact. There is a strong trend towards large vertically integrated companies that control the process from the production of feed and smolts to final distribution to the consumer. Cross-border integration of the industry is the norm. International firms such as Stolt Sea Farm and Connors Aquaculture operate in both NB and Maine, on Canada’s Pacific coast, and in other countries such as Norway and Chile. Small growers are becoming marginalized as a form of oligopolistic agri-business takes shape.

In both NB and Maine, sustainability of the industry is now a primary concern as the capacity of this area of the Bay of Fundy ecosystem to support a growing industry is questioned by stakeholders. Ongoing disease, sea lice and crowding problems persist. Pressure on traditional fisheries remains controversial. Financial support from taxpayers is a contentious issue. The dual government role of promotion and regulation of the industry is a concern. In the past, Maine has learned from management mistakes made in NB as development of the industry there has lagged that of NB. Now, the growing pressure for some form of control on industry growth in “downeast” Maine may be instructive for NB stakeholders and policymakers.

References

Fisk, Andrew. 2002. *Review of Aquaculture Leasing in Maine.* Department of Marine Resources. On line at: www.state.me.us/dmr
Maine Department of Marine Resources, 2002. On line at: www.state.me.us/dmr/aquaculture/index.htm

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Table 1 NB and Maine Groundfish, Herring, Scallop, and Lobster Landings
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</tr>
<tr>
<td>2000</td>
<td>95</td>
<td>28</td>
<td>25,000</td>
<td>16,386</td>
</tr>
</tbody>
</table>

Source: NB Department of Agriculture, Fisheries and Aquaculture
Maine Aquaculture Innovation Centre

Table 2  Salmon Aquaculture: New Brunswick and Maine

* Cod, haddock, halibut, pollock

Source: Canada, Department of Fisheries and Oceans
Maine Department of Marine Resources

Table 2  Salmon Aquaculture: New Brunswick and Maine