

MAINE STATE LEGISLATURE

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**STATE OF MAINE
114TH LEGISLATURE
SECOND REGULAR SESSION**

**Final Report
of the
SUBCOMMITTEE TO STUDY
SALMON AQUACULTURE
IN MAINE**

to the
Joint Standing Committee on
Marine Resources

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EXECUTIVE SUMMARY

Controversy over the potential environmental effects of salmon aquaculture operations prompted the 114th Legislature to undertake a study of these and other related issues. A five member subcommittee of the Joint Standing Committee on Marine Resources met during the summer and fall of 1990. The subcommittee conducted an extensive review of available scientific literature and received a significant amount of testimony from the public and expert witnesses. The subcommittee also visited salmon aquaculture operations in the Eastport and Lubec area.

At a general level, the subcommittee finds that the State's environmental experience with salmon aquaculture has been positive. However, room for improvement exists. The subcommittee's recommendations (see Section V) build on this foundation of experience in Maine and seek to refine the State's regulatory program. Major elements of this refinement include:

- A new requirement that all salmon aquaculture operations be subject to the leasing procedure administered by the Department of Marine Resources;
- Incorporation of the conceptual recommendations of the Parametrix report to develop a regulatory program tiered by level of production;
- Development of a monitoring program that incorporates a more systematized approach to data collection and, overall, more coordinated management of state-collected data on aquaculture operations;
- The addition of two professional staff positions within the Department of Marine Resources to bolster the siting and monitoring program;
- Increased efforts to encourage coordination of federal and state regulatory programs; and
- Initiation of a broad agenda of environmental research.

The subcommittee finds that, based on the inadequate level of knowledge concerning potential effects of genetic and ecological interactions between farm and wild salmon, a conservative approach is warranted. The subcommittee thus recommends that the introduction and use of salmon stocks not native to the western North Atlantic be phased out between now and 1995, consistent with federal action on this issue.

Finally, the subcommittee also identified a number of issues that it felt were significant but with which it could not deal in the time allotted for the study; in particular, the impact of aquaculture operations on the interests of riparian owners. The subcommittee recommends that the Commissioner of Marine Resources form a working group with a representative cross-section of interests to continue discussion of these issues and to seek effective and equitable solutions.

I. Introduction

During the Second Regular Session of the 114th Legislature, the Joint Standing Committee on Marine Resources considered legislation that proposed increasing the level of environmental control on net-pen aquaculture of finfish. This legislation (LD 2352) would have established siting and monitoring criteria that were substantially more detailed and restrictive than those in force at the time. In addition, the bill proposed changes in a number of other state laws governing the operation of aquaculture facilities including the use of pesticides, feeds and antibiotics, import of marine species, and escrow requirements.

Despite taking considerable testimony on the legislation, the committee found that it had insufficient knowledge on which to base a decision on the merits of further environmental regulation of net-pen aquaculture. Instead, the committee chose to undertake a study of the aquaculture industry with particular attention to the net-pen aquaculture of Atlantic salmon. The purpose of the study was to review the adequacy of the laws that govern the monitoring and control of the effects of aquaculture on the environment and review state policies on the development of aquaculture. While the initial study legislation was vetoed, the Legislative Council authorized a subcommittee to undertake the effort.

The specific study elements were:

- The environmental effects likely to be associated with aquaculture in the State and the adequacy of laws and rules designed to protect the environment from potential adverse affects, including:
 - The potential effects of net-pen aquaculture on native fish populations;
 - The various roles and the adequacy of state and federal programs that monitor aquaculture projects; and
 - A review of the study by the Department of Marine Resources on environmental monitoring of aquaculture
- The current and potential economic impacts of existing state policy on the aquaculture industry and proposed policies for the further development of the aquaculture industry in the State.

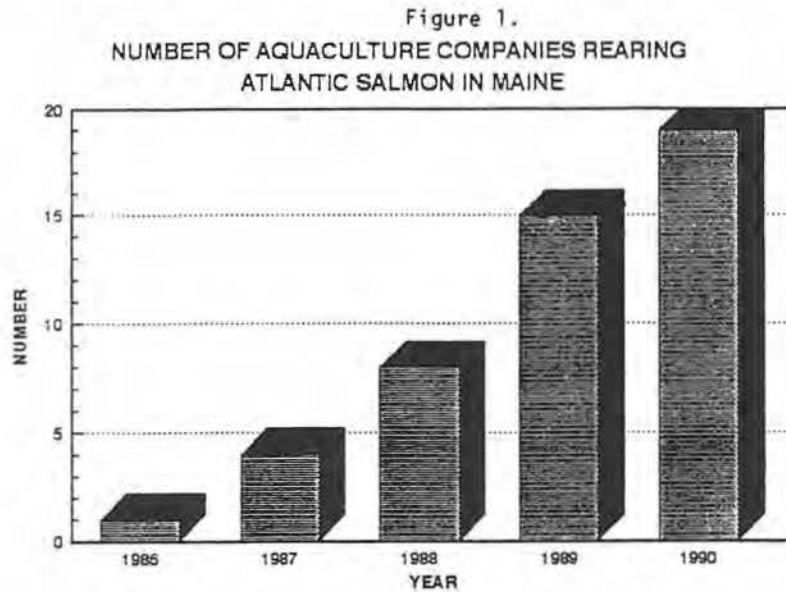
The subcommittee concentrated its efforts on the environmental and related regulatory aspects of salmon aquaculture. The subcommittee reviewed the recently released Aquaculture Development Strategy for the

State of Maine, prepared by the State Planning Office. However, limited time precluded the subcommittee from taking any position on the recommended strategy.

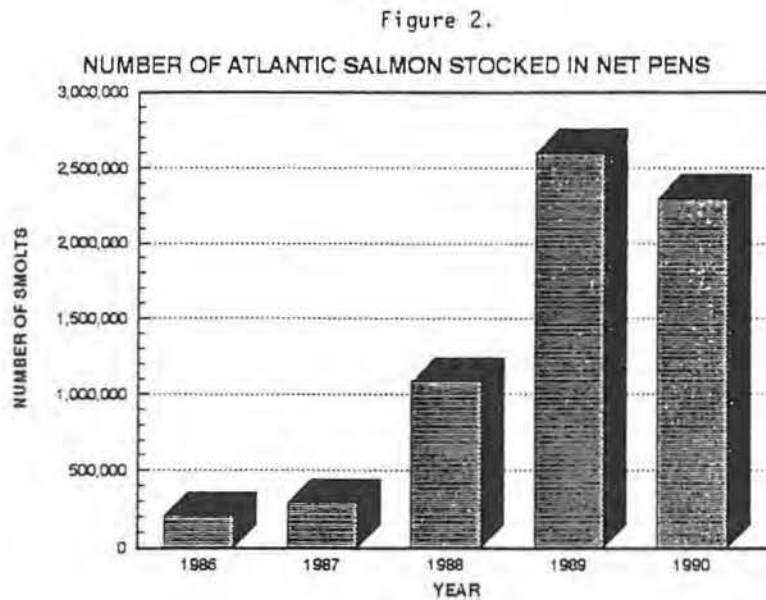
The subcommittee held four public meetings including a field visit to salmon aquaculture operations in Eastport, Maine. Testimony was received from a series of invited experts as well as from the general public.

II. Status of Salmon Aquaculture in Maine

While salmon aquaculture was attempted earlier, commercial operations began in earnest in the 1980's. Of course, Maine has long experience with the rearing of salmon smolt which have been used in regional efforts to restore wild runs on the State's rivers. Two indicators of growth in the industry are shown in Figures 1 and 2 presenting the number of companies rearing Atlantic salmon in Maine and the quantities of salmon stocked in net-pen systems.



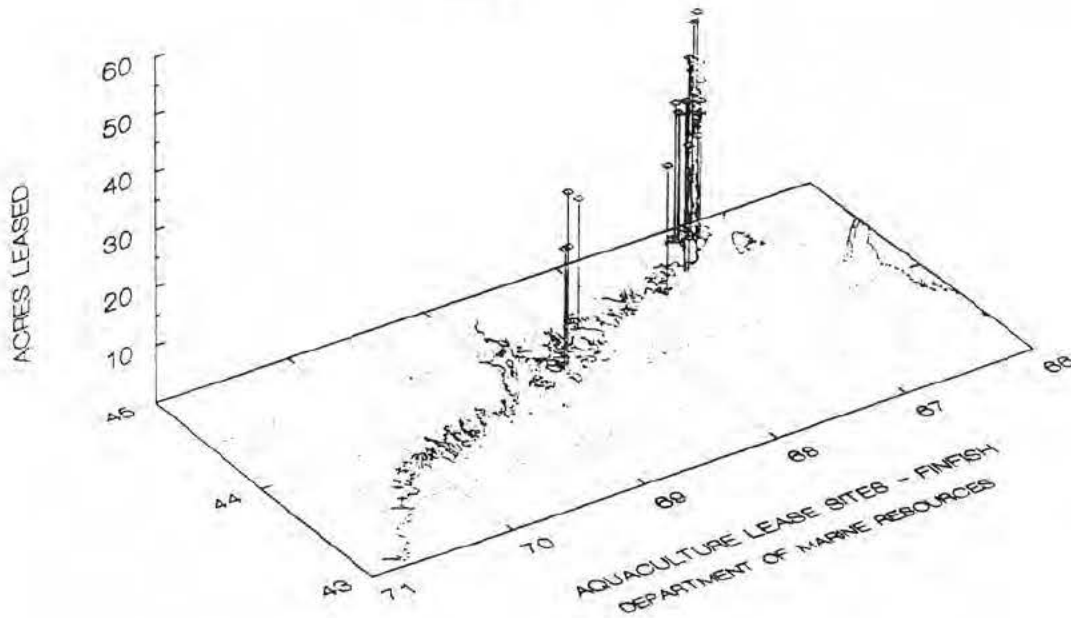
Source: Atlantic Sea Run Salmon Commission



Source: Atlantic Sea Run Salmon Commission

Commercial salmon aquaculture in Maine is practiced primarily on sites leased to private parties by the Department of Marine Resources. The most recent figures available indicate that roughly 243 hectares (600 acres) have been leased for finfish aquaculture or a combination of finfish and shellfish aquaculture. Approximately 200 hectares (500 acres) of this total is devoted exclusively to finfish. According to the Department of Marine Resources, only 19 of the 40 leases that comprise this acreage are in active production at the time of this writing. The vast majority of the active leases are concentrated in Cobscook Bay and adjacent waters (see Figure 3).

Figure 3.



To put Maine's industry into a regional and global context, in 1987, the most recent year with adequate comparative data, Maine's cultured salmon production was 365 metric tons. Cultured salmon production in New Brunswick was 3,500 metric tons in the same year and in Western Europe, 80,000 metric tons. Salmon aquaculture is occurring on a commercial scale in countries around the world including Norway, Scotland, Finland, Chile, Canada (east and west coasts), and Washington State. Even though Maine's production has increased substantially (reaching 890 metric tons in 1989), the State's salmon aquaculture industry clearly operates in the context of inter-related global markets and is, at this point, a relatively minor player in those markets. For a more detailed discussion of salmon aquaculture in Maine and other regions and of aquaculture generally, the reader should refer to An Aquaculture Development Strategy for the State of Maine, published by the State Planning Office (March, 1990).

III. Potential Environmental Effects of Salmon Aquaculture

In the course of developing its findings and recommendations on the environmental effects of salmon aquaculture, the committee reviewed a wide range of scientific literature, state and federal studies and articles in the general press. A bibliography of the most significant material is attached as Appendix E.* Through a series of focussed presentations by experts with a range of views, public testimony, and through its own discussions, the subcommittee explored each of the areas reviewed in this section.

The subcommittee concentrated its attention on the following topics; water column impacts, benthic community impacts, disease control and genetic and ecological interactions. The subcommittee feels that these represent the core environmental concerns most immediately relevant to salmon aquaculture in Maine at this time. The subcommittee recognizes that there may be other potential environmental concerns over the development of salmon aquaculture facilities. However, the resources and time allocated for this study forced the subcommittee to concentrate its attention on what it judged to be the highest priority issues. The subcommittee understands that the complete range of environmental impacts related to salmon aquaculture in Maine is not fully understood or documented as yet. Much of the information that the subcommittee received is based on the experience and opinion of professionals associated with current aquaculture research and practices.

A. Water Column Impacts

The primary water quality impact of salmon net-pen aquaculture is the addition of nitrogen and phosphorus and, at the same time, the removal of dissolved oxygen from the water (Washington Department of Fisheries 1990; Rosenthal et al. 1988). In terms of finfish aquaculture operations, nitrogen and phosphorus come from fish wastes and uneaten feed. If excessive, this nutrient enrichment may cause or sustain phytoplankton blooms and lead to water quality degradation.

Researchers have identified three mechanisms through which phytoplankton blooms may pose problems for the marine environment (Rosenthal et al. 1988).

- First, dissolved oxygen (DO) in and near facilities could be depleted during times of dense blooms. There are two ways DO depletion might occur: consumption of DO by phytoplankton at night and biochemical oxygen demand (BOD) during anaerobic breakdown of large blooms.

* More extensive bibliographies can be found in the Final Programmatic Environmental Impact Statement - Fish Culture in Floating Net-pens, published by the Washington Department of Fisheries, January 1990.

These problems may be exacerbated by warm temperatures. Both of these processes could result in reducing DO to levels fatal to fish and other marine organisms.

- Second, phytoplankton blooms of some species may cause physical damage to the gills of fish. Phytoplankton that form long chains of cells or diatoms that have long spines could damage the sensitive tissues of the gills and interfere with the uptake of oxygen or the passage of waste products.
- Third, toxic algal blooms have killed wild fish and have been implicated in the deaths of cultured fish in Europe. In addition to direct toxic effects on fish, toxins may accumulate in shellfish and pose health threats to humans (Shumway 1990). Excessive nutrient enrichment is one of a number of factors hypothesized to enhance phytoplankton blooms. In addition, several naturally occurring and variable events are thought to be factors, including: large scale hydrometeorological changes; decreased grazing pressure; upwelling of nutrient rich bottom water; heavy precipitation and freshwater runoff; and the presence of previous phytoplankton blooms (see Shumway 1990 references therein).

While there is concern over nutrient loading as a result of aquaculture activities, research to date strongly suggests that areas that are well flushed and well mixed are unlikely to have excessive phytoplankton growth problems (Washington Department of Fisheries 1990). Definitive models of flushing rates and mixing regimes are lacking for Cobscook Bay. Based on the information the subcommittee received, the present level of understanding and experience indicates that the strong tidal action in Cobscook Bay provides good flushing and a well mixed water column. Flushing action is important in areas of nutrient enrichment because it assists in the dilution of nitrogen and phosphorus (Dan Campbell pers. comm.).

In Maine waters the limiting nutrient for phytoplankton growth is usually nitrogen. In Cobscook Bay, as well as most of the Bay of Fundy, the limiting factor for phytoplankton growth tends to be a combination of sunlight and nitrogen (Clarice Yentsch pers. comm.). The strong mixing action may take phytoplankton out of the zone of optimum light necessary for photosynthesis (John Sowles pers. comm.). Similarly, nutrients such as nitrogen may be unavailable to phytoplankton because of the mixing (Ted Ames pers. comm.). Because of this mixing the addition of nutrients from properly sited salmon net-pen aquaculture may not substantially affect phytoplankton growth in much of Cobscook Bay. There is preliminary evidence that indicates variability in the flushing rate of Cobscook Bay (David Brooks pers. comm.). Small embayments and shallow areas may not have the flushing action associated with the larger, open areas of the bay. Low mixing and a more stratified water column may present favorable conditions for phytoplankton blooms if excessive nutrient

enrichment occurs. Careful siting of aquaculture operations is needed in order to avoid excessive nutrient enrichment and nuisance phytoplankton blooms.

The subcommittee received information that midcoast and western Maine coastal waters possess characteristics (temperature, tidal action, etc.) that are different than those of eastern Maine waters, especially Cobscook Bay. It should be noted that generalizations developed from the aquaculture experience in Cobscook Bay may not be applicable to other coastal waters such as Penobscot and Casco Bays.

In addition to oxygen depletion and other phytoplankton impacts, the other major water quality concern is the increase in ammonia. Ammonia is a waste by-product of and toxic to fish and other aquatic organisms. Although large increases in ammonia have been observed in net-pens they have also been below toxic levels. Again, net-pen sites in well flushed areas should not experience long lasting toxic effects of increased ammonia concentrations (Washington Department of Fisheries 1990). Information received from the Department of Environmental Protection indicates that this is true for Maine net-pen sites.

Temperature and pH were other water quality parameters that the subcommittee considered during the study. Net-pens do not affect surrounding water temperatures at aquacultural operations (Washington Department of Fisheries 1990). Because marine waters have a relatively high buffering capacity, fish wastes do not significantly change the pH of the surrounding waters (Washington Department of Fisheries 1990). Experience in Maine indicates that this is the case here, as well.

B. Benthic Community Impacts

The subcommittee received considerable information on potential effects on the benthic environment, particularly the benthic biological community. Benthic impacts are closely related to water quality concerns. Uneaten feed and fish wastes may accumulate beneath or near net-pens and cause an increase in BOD in benthic sediments (Wildish et al. 1990). This organic enrichment can result in the development of anoxic (absence of oxygen) sediments. Under these conditions only a few organisms can survive in the benthic sediment: those animals that can reach the water through burrows or siphons or anaerobic bacteria that can use organic material for respiration instead of oxygen (Washington Department of Fisheries 1990).

Increased rates of deposition from waste feed and fish wastes may also actually interfere with filter-feeding animals' ability to filter food from the water (Washington Department of Fisheries 1990). Sessile organisms such as oysters and mussels could also be buried under very high rates of deposition (Washington Department of Fisheries 1990). Azoic (absence of

animal life) zones may occur beneath net pens except where water depths are greater than 60 feet or high currents disperse deposits beyond the affected area (Washington Department of Fisheries 1990). To date, monitoring of Maine sites has not revealed the presence of any azoic zones under salmon pens.

Changes in habitat beneath and near net-pens can occur under various rates of deposition. These rates depend on several factors, including: size of the farm; stocking density; feeding rates; and currents. Changes in habitat can occur both chemically and physically. The biological changes may be manifested as lower species diversity and biomass reduction (Washington Department of Fisheries 1990). Recovery of the benthic community in affected areas may require months or years (Washington Department of Fisheries 1990) but Heinig (1990) reported that preliminary evidence suggests a relatively short recovery time once organic deposition decreases or stops (this finding was ancillary to the main thrust of Heinig's research).

The subcommittee received information during the study that significant adverse impacts to the benthic environment have not been found beneath or near net-pen aquaculture operations in Maine. The reasons for this include a combination of the strong tidal action of Cobscook Bay and the siting criteria used by the Department of Environmental Protection and the Department of Marine Resources. The criteria used by the state allows for several important factors to be considered for benthic impacts at proposed sites. During the water quality certification process the state can evaluate the probable depositional effects. The formula used includes current velocity, depth, and salmon production. This analysis is based on the guidelines established in Washington State.

Comparisons have been made between the waste loading of aquaculture facilities and domestic sewage. For example, the impact of a large net-pen operation (50 net-pens) has been compared to that of a small city (10,000 persons). Researchers have cautioned against using such comparisons because of the differences in the characteristics of the wastes (Rosenthal et al. 1988). Aquacultural waste discharges can be divided into two groups, settleable and soluble. Settleable aquacultural waste is a part of the suspended solids load and settles out quickly. Soluble waste from fish farms dilutes rapidly and poses little threat in well flushed areas but would pose a problem in areas that are not well-flushed. Human waste from domestic sewage, however, disperses slowly in marine waters and is much less soluble. Domestic sewage also contains higher levels of toxins and human pathogens than aquacultural wastes.

C. Disease

There are two principal areas of concern regarding disease and salmon net-pen aquaculture. First, there is the potential for the introduction

of disease pathogens from other geographic areas. Second, there is the potential for disease transmission from farmed salmon to wild salmon.

Pathogens could be introduced into Maine through the importation of Atlantic salmon from Europe or other areas. The salmon aquaculture industry has used European stocks (Scotland and Norway, for example). The European industry is more established and eggs have been readily available for the relatively young Maine industry. Concerns over imports exist because distinct stocks occur in different regions of the North Atlantic Ocean and Baltic Sea. Particular diseases may be distributed similarly. When fish or eggs are moved from one region to another there is the risk of transferring associated disease pathogens as well. However, there has not been an occurrence of an introduced disease in Maine during the 25 years of fish importation regulation (David Locke pers. comm.).

The introduction of a pathogenic parasite has been reported in Norway (Hansen and Bakke 1989). Salmon from Baltic Sea stocks are thought to have been infected with a parasitic fluke and imported to Norway for stocking purposes. It is important to note that the fish were not imported for aquacultural purposes and that the parasite survives only in freshwater or brackish water. Unfortunately, for many fish diseases the geographic distribution and method of transmission is unknown (Washington Department of Fisheries 1990).

While disease may spread as the result of the introduction of a pathogen new to a geographic region, there is also the concern that the presence of large numbers of farmed fish in net-pens may increase, in and of itself, the chance of disease transmission to wild fish. While this is a theoretical possibility, the most significant threat to wild fish is from new pathogens introduced by imported, farmed fish. Conversely, wild fish may act as reservoirs of disease and pose a risk to farmed salmon. Viruses and bacteria already present in the environment could affect salmon held in net-pens (Strout et al. 1978). Poor husbandry practices increase the potential for on-site disease problems and may result in the need to use chemical therapeutics.

Concerns have been raised about antibiotic use in finfish aquaculture (Austin 1985; Jacobsen and Berglund 1988). The relationship between antibiotic use, persistence in the environment, and effects on other organisms in the marine environment is not yet fully understood (Austin 1985; Jacobsen and Berglund 1988; Rosenthal et al. 1988). However, a comprehensive review of research on antibiotic use in aquaculture by the Washington Department of Fisheries (1990) included the concerns brought to the subcommittee.

Antibiotic persistence in the environment may occur if antibiotics

accumulate in sediments. Accumulation depends on several factors: dilution rates; solubility; oxidation state of the sediment; and biotransformation of the chemical in the sediment. Terramycin (oxytetracycline), commonly used by aquaculturists, can accumulate under fish net-pens (Jacobsen and Berglind 1988). However, because concentrations were reported on a dry weight basis rather than as part of the wetted sediment the concentrations tend to be overestimated (Washington Department of Fisheries 1990). In addition, the oxidation state of the sediment would have affected the antibiotic's persistence (Jacobsen and Berglind 1988). High oxidation rates will reduce the persistence of this antibiotic.

There has been concern over the development of increased antibiotic resistance among bacteria in waters near net-pens (Austin 1985). There have also been other studies that indicate antibiotic resistant bacteria in Japanese fish farms. These studies, however, were conducted in very different culture systems (warmwater ponds), at higher intensities of drug application and with several antibiotics not registered for use in the United States (Washington Department of Fisheries 1990). Environmental factors such as temperature and dilution rate as well as dosage, frequency of use, and method of application will help determine the probability of developing antibiotic resistant bacteria (Washington Department of Fisheries 1990).

D. Genetic and Ecological Interactions

As the salmon net-pen aquaculture industry has grown so has the concern over potential genetic and ecological interactions with wild salmon. These concerns have been expressed not only in the United States and Canada but also in Europe where wild salmon stocks are important, both recreationally and commercially.

The potential genetic and ecological interactions between farmed salmon and wild salmon are very difficult to document at this time because of the lack of long term studies. The subcommittee addressed two basic issues. First, what is the potential genetic impact of escaped, farmed salmon on wild salmon? Second, what are the potential ecological interactions between escaped, farmed salmon and wild salmon?

Two potential genetic impacts have been identified (NASCO 1987; Washington Department of Fisheries 1990). First, wild populations of salmon may be genetically altered by interbreeding with farmed salmon. Farmed fish may be selectively bred for certain traits that fit their environment (hatcheries and net-pens). This genetic manipulation over time could result in the development of traits unsuitable for living in the wild. For example, rapid growth is an important trait for farmed salmon where food is plentiful. However, food is not usually plentiful in the wild. This trait would probably serve very little use in the wild environment. There is concern that these selected traits could be passed on to wild populations if escaped, farmed salmon interbreed with wild salmon.

The second area of potential genetic interaction is the reduction of genetic variability in wild populations. Maintaining genetic variability within a population may be important for continued reproductive success. This variability enables a population to adapt to changes in the environment (NASCO 1989). Because hatchery environments are more stable than natural environments (food availability, temperature, flow, etc.) the possibility exists that those traits helpful to the salmon's ability to tolerate environmental changes could be lost over time. Reduced variability has been indicated in hatchery-reared trout and Atlantic salmon (Kincaid 1976; Cross 1983). However, reduced variability in hatchery fish may also indicate small numbers of fish used in studies and may not necessarily result from environmental conditions alone (Kornfield pers. comm.).

Potential ecological interactions between farmed fish and wild fish may occur as competition for spawning habitat, superimposition on wild fish redds (spawning sites), and increased risk of introducing disease and parasites to wild populations (Baum 1990; NASCO 1989). If large enough numbers of farmed salmon escaped they may interfere with reproduction of wild fish. Increased competition for limited spawning habitat in rivers or the destruction of viable eggs in wild redds through superimposition may result from the introduction of farmed salmon. Also, transfers of salmon for aquacultural or stocking purposes may result in the introduction of disease pathogens or parasites (Hansen and Bakke 1989; Washington Department of Fisheries 1990; see previous discussion on disease).

The subcommittee received a review of the recommended protocols on genetic and ecological concerns developed by the North American Salmon Conservation Organization (NASCO) of which the United States and Canada are members along with many European countries. Through the efforts of a scientific working group and a series of meetings, NASCO has outlined potential problems and a set of guidelines to reduce adverse genetic and ecological impacts (NASCO 1989). While there remains a large gap in the knowledge of the potential genetic and ecological interactions between escaped, farmed salmon and wild salmon, NASCO is encouraging a conservative approach to reduce potential impacts on North American wild salmon. The general protocols recommended by NASCO are summarized as follows:

- prohibition of European and Icelandic Atlantic salmon stock imports;
- prohibition of the transfer of salmonid eggs and fish from west of the continental divide;
- review of any transfers of non-native fish into areas inhabited by Atlantic salmon;
- management of hatcheries used in producing fish for introductions to minimize adverse impacts to wild salmon;

- management of Atlantic salmon harvest that takes into account size, age, sex and season.

In addition to these general guidelines, NASCO supports the designation of three zones in eastern North America based on the potential impact to wild salmon populations. Each zone would require particular management strategies as well as the above general protocols designed to protect wild salmon and permit aquaculture development (See Appendix F). The reader should note that, with the exception of those items explicitly included in the recommendations in Section V, the subcommittee takes no position on the NASCO proposals.

Additional information received by the subcommittee also offered alternatives to minimize potential genetic and ecological interactions between escaped, farmed salmon and wild salmon. To help reduce the need for imports, it was suggested that local stocks be developed for aquacultural purposes. There was some concern that restricting the availability of salmon stocks may limit the potential for growth of the industry. However, salmon aquaculture in eastern Canada is operating under the NASCO guidelines prohibiting European and Icelandic imports (Tim Carey pers. comm.) and relying on local stocks. Other suggestions included:

- use of sterile or triploid salmon to minimize the risk of interbreeding with wild stocks and reduce the possibility of intraspecific competition;
- escapement prevention through engineering improvements and siting practices;
- development of aquaculture-free zones near rivers that support important runs of wild salmon; and
- establishment of a fishery genetics conservation program that could identify, inventory, and maintain genetic integrity and variability for wild salmon in Maine.

Several of these recommendations, and others, are included in the NASCO guidelines.

In the subcommittee's discussion concerning potential genetic and ecological interactions, several important points were raised. First, while it is technically possible to distinguish wild salmon stocks among Maine's rivers, it is likely that there has already been some intermixing among wild salmon and non-native stocks. The state has introduced hatchery-reared fish in virtually all of Maine's rivers. Second, straying or movement of salmon to non-natal waters is estimated to represent approximately 1% to 2% of Maine salmon. This activity may tend to eliminate genetic distinctiveness between river stocks over time. On the other hand, straying

and the resulting interbreeding may not substantially reduce genetic distinctiveness if intense natural selection processes are operating within each population. There is not adequate scientific information to clearly establish which of these mechanisms may be operating in Maine's salmon rivers. The U.S. Fish and Wildlife Service has undertaken an effort to inventory the genetic composition of some of the wild and hatchery salmon stocks in the state. Third, assuming undesirable traits of farmed salmon are introduced into the wild, continuous introduction is probably necessary if the traits are to persist. Natural selection pressures will tend to remove undesirable traits. Fourth, data collected by the Maine Atlantic Sea Run Salmon Commission indicate that hatchery-reared salmon are not exhibiting high survival rates. There is some question, then, if escaped, hatchery-reared, farmed salmon could survive in enough numbers to adversely impact wild salmon stocks. And finally, the effectiveness of the aquaculture-free zone concept was questioned in light of the distances Atlantic salmon are capable of swimming and the level of natural straying that occurs.

More than any other area reviewed by the subcommittee, substantial questions remain about the potential for and severity of genetic and ecological interactions. Testimony received by the subcommittee was generally supportive of conservative measures in the management of aquaculture development.

IV. Environmental Regulation of Salmon Aquaculture

This section reviews the current structure of state and federal environmental regulation of net-pen salmon aquaculture. The subcommittee focussed its attention in this area on the siting and monitoring regulatory procedures. The subcommittee also reviewed disease control and importation regulations. These regulatory frameworks control the impact of salmon aquaculture on the topics reviewed in the preceding section. Other types of regulation of the salmon aquaculture industry, such as fish processing, drug registration and local regulations, are not reviewed in detail in this report.

A. State Regulation - Siting & Monitoring

Since the enactment of the first comprehensive aquaculture leasing statutes in 1973 (P.L. 1973, c.462 §2), the State has developed a siting and leasing process that is reasonably well-coordinated at the state level. While the Departments of Marine Resources and Environmental Protection are still working to refine their joint siting and monitoring program, the institutional relationships are fairly well defined in practice if not in statute. A relatively minor exception to this observation involves the role of the Bureau of Public Lands which has statutory jurisdiction over the submerged lands of the State. At the moment, the division of this jurisdiction with that of the Department of Marine Resources with regard to leasing of submerged lands for aquaculture is ambiguous. This issue will be discussed further later in this section.

1. Siting - Department of Marine Resources Responsibilities

Generally, a person desiring to start an salmon aquaculture farm first seeks a lease from the Department of Marine Resources (12 MRSA § 6072). Such a lease grants a degree of exclusive use of a portion of the submerged lands of the State and the waters over them. The lease also provides the leasee with a degree of legal protection from poaching (12 MRSA §6073). The need for the lease is premised on the public trust nature of these lands. It is important to note that the statutes regarding aquaculture leasing are unclear on whether a lease is legally required in order to conduct aquacultural operations.

The applicant for a salmon aquaculture lease must submit a variety of information to the Department of Marine Resources including:

- A description of the proposed lease site;
- A list of species to be cultivated and the source of the organisms;

- An environmental evaluation of the site including, bottom characteristics, resident flora and fauna, tide levels and current speed and direction;
- A description of recreational and commercial fishing activity in the vicinity of the proposed lease;
- Where a riparian owner's land to the low tide mark is to be used, a description of the owner's current use of that land and written permission from the owner for the proposed use (NOTE: a riparian owner is defined by the Department as one whose land lies within 1000 feet of the proposed lease site);
- Evidence of financial and technical capability; and
- Any other information the Commissioner of the Department may require.

After the Commissioner determines that the application is complete and if the Commissioner decides that the application could be granted, a public hearing is scheduled. The Department also provides personal notice to all riparian owners listed in the application and general public notice. The Department also notifies a variety of other state and federal agencies of the application at this time.

Prior to holding the public hearing, the Department of Marine Resources conducts its own on-site investigation of the proposed lease to provide its hearing examiner with an independent evaluation of the site.

After taking evidence at the public hearing from the applicant, interveners and the general public, the Commissioner makes a decision on the application. The Commissioner bases the decision on findings made with regard to:

- Effects on the ability of riparian owners to navigate to their lands;
- Impacts on navigation;
- Interference with fishing in the area;
- Impacts on other aquaculture operations in the area;
- Interference with the ability of the area to support ecologically significant flora and fauna;
- The source of organisms to be cultivated; and
- Interference with public facilities in the area.

In addition to the findings described above, the Department of Environmental Protection must have certified the application with regard to water quality standards prior to a decision by the Commissioner of Marine Resources to grant the lease.

As a rule the Department maintains a buffer of at least 2000 feet between finfish aquaculture sites unless both parties agree to be located closer to each other. The applicant can also obtain a waiver of this buffer after demonstrating that the proposed site is "across the

tide" from the existing facility and that tidal flushing rates sufficient to maintain water quality and preclude sedimentation. The Department also requires other buffers around public docking and recreational facilities and around certain sensitive wildlife areas.

2. Siting - Department of Environmental Protection Responsibilities

The Department of Environmental Protection is responsible under state law for restoring and protecting the quality of the State's waters (38 MRSA §464 et seq). Typically, the Department requires a license for the discharge of pollutants to the surface waters of the state (38 MRSA §413). However, the Legislature in 1987, recognizing the need to coordinate the regulatory actions of the Departments of Marine Resources and Environmental Protection, exempted aquaculture facilities in estuarine or marine waters from the licensing requirements of 38 MRSA §413 if a facility had obtained a lease from the Department of Marine Resources, as outlined above, and had been certified by the Department of Environmental Protection as "not hav(ing) a significant adverse effect on water quality or violat(ing) the standards ascribed to the receiving waters' classification" (38 MRSA §413, sub-§2-F).

Following passage of this coordination mechanism, the two Departments have worked jointly to develop siting and monitoring criteria sufficient to satisfy the requirements of both agencies. As discussed further below, this effort is also aimed at providing a basis for consistency with the requirements of federal licensing agencies. If this objective can be achieved, it will have the effect of greatly streamlining the overall regulatory process while maintaining an acceptable level of environmental protection.

The Department of Environmental Protection has developed a regression equation that approximates the depth, current and production relationship recommended as part of the "interim guidelines" in use in Washington State (Science Applications International 1986). Using the expected production of the proposed salmon aquaculture facility as a starting point, the Department uses this equation to determine whether the current and depth at the proposed site are adequate to protect water quality.

As a final observation on the Department of Environmental Protection's responsibilities, it is important to note that the Department has decided that water quality law precludes it from granting certification in class SA waters. This is the highest quality classification of marine and estuarine waters and is typically assigned to waters off state and federal parks and wildlife reserves among other areas.

3. Siting - Parametrix Recommendations

The Department of Marine Resources contracted with Parametrix, Inc. for assistance in reviewing siting and monitoring systems in other jurisdictions and to develop recommended siting and monitoring criteria for Maine. The subcommittee reviewed the draft report (Parametrix, July 1990) during its third public meeting. The draft recommendations for siting criteria were generally consistent with the current procedures followed by the Departments of Marine Resources and Environmental Protection. For example, the Department of Environmental Protection uses as a siting guideline, a formula incorporating fish production, current and water depth. This formula has not been formally adopted by rule. While supporting use of this formula as a guideline, Parametrix recommends against rigid adherence to the formula because of the need to retain consideration of unique site-specific characteristics that can be best evaluated through the application of sound professional judgment.

Overall, Parametrix recommended that all siting investigations be structured to require more detailed information from larger salmon aquaculture facilities (>100,000 lbs annual production) and less detailed information from two categories of smaller facilities (<20,000 lbs/yr and 20-100,000 lbs/year). This hierarchy of site size is not currently part of Maine's siting procedure.

Parametrix also recommended the inclusion of additional information in the application requirements including a development and maintenance schedule, projected annual production, stocking density, various aspects of feeding, and several other factors. The Department of Marine Resources is currently considering inclusion of these suggestions.

4. Siting - Bureau of Public Lands

As mentioned earlier, the Bureau of Public Lands within the Department of Conservation has comprehensive jurisdiction over the use of the State's submerged lands. For the purpose of this discussion, these are the lands located seaward of the low tide mark. The legal definition of submerged lands can be found at 12 MRSA §558-A, sub-§1, ¶D. Uses of the waters that permanently occupy space on or over these lands require leases from Bureau.

While it is possible to read these statutes to require a lease from the Bureau in conjunction with or in the absence of a lease from the Department of Marine Resources, two points are important to keep in mind. First, the Bureau's leasing process includes little or no environmental review. For most activities requiring a Public Land lease (wharves, docks, marinas, underwater cables, etc.),

environmental review is provided by the Department of Environmental Protection. In the case of aquaculture leases, the Department of Marine Resources provides the forum for environmental review as described earlier.

Second, the aquaculture leasing statutes provide that the Commissioner of Marine Resources has the "exclusive" authority to lease (intertidal and subtidal) lands for aquaculture (12 MRSA §6072, sub-§1). This would seem to indicate a legislative intent to designate the Commissioner of Marine Resources as the sole aquaculture leasing authority. However, since an aquaculture lease from the Department of Marine Resources is not required (ie. it's not a violation of 12 MRSA §6072 to practice marine aquaculture without a lease), the question remains as to what is required by state law should an aquaculturalist chose to proceed without a lease from the Department of Marine Resources. This ambiguity has not caused a large number of problems. However, it does introduce some confusion into the regulatory process, particularly for new applicants, and has recently been the subject of considerable public attention in the Taunton Bay area. An aquaculturalist in this area chose, at least initially, to proceed without a Department of Marine Resources lease and to seek a lease directly from the Bureau and a water discharge license from the Department of Environmental Protection. The Bureau of Public Lands has declined to consider the granting of a lease on the grounds outlined above. The Bureau has indicated to the subcommittee that it would welcome clarification of the statutes.

In its deliberations, the subcommittee resolved to address this ambiguity. A related finding and recommendation is located in Section V.

5. Siting - Riparian Owners Concerns

During the course of its investigation, the subcommittee received and discussed concerns of riparian owners over the visual and noise impacts of salmon aquaculture operations as well as their concerns over impacts on marine ecosystems and conflicts with neighboring uses. Ecosystem impacts and the related regulatory structure is discussed elsewhere. Under the state's current siting process, the only special consideration given to riparian owners regards the ingress and egress to their property.

The subcommittee noted that salmon aquaculture operations can have visual and noise impacts through the size, design, color and lighting of the pen structures and through the general operation of boats, machinery and other ancillary equipment. Along some portions of the Maine coast, these facilities are entirely consistent with the general character of the traditional fishing industry which requires

piers, docks, floats and processing facilities. However, in other areas, the traditional fishing industry has a much lower profile and more transitory presence. Thus the impact of aquaculture facilities varies greatly according to case-specific factors. In addition, proximity to the facility has an effect on the magnitude of these impacts.

Recognizing the legitimacy of these impacts, the subcommittee has included a recommendation to continue the effort to address these concerns in a balanced way. The recommendation is found in Section V.

6. Monitoring - Current Practice

Under current practices, the Departments of Marine Resources and Environmental Protection conduct parallel, coordinated monitoring programs. The Department of Marine Resources attempts to visit each salmon aquaculture site for a diver evaluation once a year. Lease agreements typically impose a general condition that "the Commissioner may commence revocation proceedings if he determines that ... the lease activities are substantially injurious to marine organisms". In some situations, a lease agreement may require adherence to monitoring schedules and related activities as subsequently specified by the Department's Aquaculture Environmental Scientist. The Department has also worked with aquaculturalists to establish voluntary data collection efforts on stocking, feed use, production, disease incidence and drug use. As noted below, the Department also receives monitoring data required under the water quality certification process administered by the Department of Environmental Protection.

The Department of Environmental Protection, through the requirement for water quality certification discussed earlier, does attach monitoring requirements as a condition of certification. While these are in the process of refinement and revision, the basic elements can be described. The core of the monitoring effort is a twice-annual characterization of the benthic substrate and associated community along with videos of the bottom conditions. In addition, the leaseholder must report the maximum number of pounds on site at any time during the year, the maximum density of stocking and the total amount of food used during the year. Typically, the Department of Environmental Protection limits monitoring requirements to benthic considerations and does not require water chemistry monitoring. However, the Department has required water chemistry monitoring at salmon aquaculture sites other than those in Cobscook Bay where the Department had concerns over water chemistry impacts due to lower tidal flushing and mixing rates. All data is directed to the Aquaculture Lease Administrator at the Department of Marine Resources along with copies of any monitoring data collected by the leaseholder to satisfy the requirements of federal agencies.

The close working relationship between the staff of the two departments and the requirement imposed on every lease for water quality certification by the Department of Environmental Protection has established a basic foundation for a system to collect monitoring data in a coordinated fashion. The subcommittee, recognizing progress made to date, did express concerns over the continued coordination of monitoring data and other vital information on fish health and transport of stocks between hatcheries and farms. The subcommittee also discussed the relative advantages of voluntary versus mandatory reporting systems and the need for adequate state staff resources to effectively use monitoring data submitted by the industry. In addition, the subcommittee discussed the difficulty of interpreting monitoring results when the current understanding of Maine's marine ecosystems remains incomplete.

7. Monitoring - Parametrix Recommendations

The basic thrust of the draft Parametrix recommendations is to create a more systematic framework for the collection and analysis of monitoring data for salmon aquaculture pen sites. Many of the specific elements recommended for inclusion in the monitoring effort are, in fact, already part of current monitoring programs. However, the intensity and detail of monitoring is higher for some areas (particularly the characterization of the benthos) and potentially lower in others.

As with the siting requirements, Parametrix structured its recommendations according to the scale of operation. For the largest operations (>100,000 lbs/year production), Parametrix recommended a detailed baseline survey after the pen structures were installed but prior to the introduction of fish. This procedure would characterize the sediment chemistry and benthic infauna at a fairly detailed level. It is not clear to what extent this information is currently collected as part of the leasing proceeding or water quality certification process. Review of lease agreements and monitoring reports indicates that the proposed baseline survey is more rigorous analytically and more detailed in terms of the number of parameters sampled than current practices in the state. It is important to remember that Parametrix does not recommend the proposed baseline survey for aquaculture facilities with less than 100,000 lbs in annual production.

In addition to the proposal for baseline surveys of large facilities, Parametrix recommended varying levels of annual monitoring for different levels of production. For small scale operations (<20,000 lbs/year), Parametrix recommends no annual monitoring. For somewhat larger operations (20-100,000 lbs/year) Parametrix recommends an annual diver survey. For the largest category of operations (>100,000 lbs/year), Parametrix recommends a diver

survey and analysis of sediment chemistry and benthic infauna with three replicates at each sampling station. Annual sampling during summer months to determine water quality impacts was also recommended for the largest categories. The parameters measured would be dissolved oxygen, temperature, pH, ammonia, nitrite/nitrate and concentration of un-ionized ammonia (the more toxic form). The Department of Marine Resources is now considering whether or not to incorporate this proposal into its requirements.

B. Federal Regulation - Siting and Monitoring

Federal regulation of the siting and monitoring of finfish aquaculture in the marine environment has a relatively short history. As a direct result, it is currently undergoing comprehensive, though not necessarily rapid, revision at the regulatory level. The following discussion outlines the general provisions governing the siting and monitoring of marine finfish aquaculture and the current status and objectives of revision efforts.

1. U.S. Army Corps of Engineers

At this time, the U.S. Army Corps of Engineers has the only active federal licensing and monitoring program in Maine. The Corps of Engineers' jurisdiction stems from Section 10 of the Rivers and Harbors Act of 1899 (33 USC §403). While the primary concern of the Corps of Engineers under this Act is navigation, its authority extends to a wide range of other considerations including the full range of environmental considerations. Before describing the current requirements, it is important to say that the information and criteria described in the following discussion are undergoing active revision with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. These two agencies review and comment on all "Section 10" applications submitted to the Corps of Engineers.

For its application, the Corps of Engineers requires a detailed and comprehensive list of information. This list subsumes all information requested by the Department of Marine Resources and information recommended by the draft Parametrix report. In the area of water chemistry, the Corps of Engineers information requirements appear to be far more detailed. The actual siting criteria (versus the application information) appear generally comparable to those employed by the state with the addition of explicit mention of endangered species and various categories of federal recreation area, monuments and reserves.

The monitoring requirements of the Corps of Engineers focus on water column chemistry and related parameters. Testing of these parameters is required monthly during July, August and September.

A benthic survey is required. Its focus is on sedimentation and the "biological effect" of the sedimentation. A hydrographic survey (current speeds and directions) and fish inventory data is also required. As mentioned above, all of these requirements are undergoing active revision with the objective of focussing the requirements on key indicator criteria rather than the current comprehensive approach.

The Corps of Engineers is also actively interested in coordinating its regulatory process with that of the Department of Marine Resources in order that the burden on the applicant be minimized. It is investigating the possibility of establishing a general permit for certain categories of marine finfish aquaculture. If the criteria and requirements for this permit could be made coincident with the State's requirements, the Corps of Engineers direct involvement in permit processing could be substantially diminished for all but the most unusual proposals. The Corps of Engineers has stated to the subcommittee that this is its intent.

2. U.S. Environmental Protection Agency

While the U.S. Environmental Protection Agency (EPA) has not been active in marine finfish aquaculture licensing in the Northeast, it has been involved in licensing actions in Washington State through the state Department of Ecology. The EPA derives its authority from the Clean Water Act, specifically 33 USC §1342. This portion of the Act requires a National Pollution Discharge Elimination System (NPDES) permit for all point source discharges into navigable waters of the nation. The use of feed and fish feces in the net pen facilities are considered point source discharges.

In Washington State, the EPA has delegated its licensing authority to the state Department of Ecology after that department demonstrated that it had in place all of the elements of a water quality regulatory system required by the EPA. The Maine Department of Environmental Protection, which would be the logical agency for a similar delegation, has chosen not to apply for delegated licensing authority. Thus, aquaculture facilities in Maine must apply directly to the EPA.

While three NPDES permits have been issued in Washington State, the requirements incorporated into those licenses may or may not be relevant to Maine for several reasons. First, the permits were issued (in April, 1990) by a state agency and are currently under appeal within the State of Washington. Second, the State of Washington is in a different administrative region of the EPA. Regional offices of the EPA sometimes have the latitude to operate differently within general guidelines though such guidelines do not yet exist for marine finfish aquaculture. Third and last, the regional representative attending the subcommittee's discussion of federal

regulatory issues indicated the EPA was considering a "national permit" for marine finfish aquaculture. This is roughly analogous to the Corps of Engineers' "general permit". For all the reasons cited in this paragraph, the potential requirements of an EPA license are not discussed further here.

The EPA did represent to the subcommittee that it was actively interested in coordinating the development of its requirements with those of the Corps of Engineers and the State.

3. U.S. Coast Guard

The Coast Guard's interests are strictly limited to navigational issues, principally the design, placement, anchorage and marking (including lights) of the net-pen structures. While these considerations do have some interaction with the visual impacts noted under the Riparian Owners discussion, they do not affect the ecological impacts of salmon aquaculture and are not discussed further here.

C. Disease Control

Disease control is a combination of import controls and on-site management.* In Maine, the Departments of Marine Resources and Inland Fisheries and Wildlife cooperatively administer an import control program which regulates the import of non-indigenous strains of Atlantic Salmon and other species from outside the state. Imported eggs are disinfected at the point of shipping and upon receipt. The broodstock for imported eggs are also inspected at spawning time according to protocols developed by the American Fisheries Society. State hatcheries are inspected by the Department of Inland Fisheries and Wildlife following American Fisheries Society guidelines and the recently-developed New England Salmonid Health Guidelines. These two departments also control the movement of marine cage-reared broodstock or eggs from the saltwater to freshwater hatcheries within the State.

The Department of Marine Resources is currently revising its import control regulations to incorporate provisions of the New England Salmonid Health Guidelines regarding the import of live fish, the movement of stocks between fresh and saltwater within Maine and the reporting of serious disease pathogens if detected on-site at an aquaculture facility. The Department is also developing record-keeping requirements for finfish aquaculturalists regarding the incidence of fish mortality and disease treatments among other factors.

* Subcommittee staff are indebted to Rod Getchell of the DMR for an excellent summary and presentation of disease control procedures in Maine from which the following discussion is largely adapted.

Testimony to the subcommittee indicated that the Fish Health Laboratory at the University of Maine (Orono) has played a key role in the provisions of analytical services in the area of disease, particularly as regards certification of stocks prior to transport. It appears from testimony that private laboratories may also be preparing to offer similar services.

Regarding direct, on-site disease control, operational practices designed to minimize stress and, in the case of a disease outbreak, administration of medicated feed are the most common practices. In the United States, only three drugs are currently permitted to be used for disease control in fish for human consumption (Terramycin, Romet and sulfamerazine). Other antibiotics may be used on a limited basis by special permit from the U.S. Food and Drug Administration.

The U.S. Food and Drug Administration regulates drug availability but not the prescription process. In the United States, a fish grower does not need a prescription to buy medicated feeds containing the three permitted drugs. However, in Maine the situation is somewhat different. Salmon growers in Cobscook Bay are primarily serviced by Canadian feed manufacturers. Canada requires a prescription for medicated feeds from a licensed veterinarian. A Cobscook Bay grower must then obtain a prescription for medicated feed bought from Canadian manufacturers. A copy of the prescription is filed with the provincial agency overseeing aquaculture. United States agencies do not receive this information. Should Maine growers switch to U.S. manufacturers or initiate production of their own feed in Maine, a prescription will not be required. The treatment record requirements currently under development by the Department of Marine Resources may provide a mechanism to monitor drug use in salmon aquaculture in Maine.

D. Genetics & Ecological Interaction

There has been little federal or state regulatory action to control any potential negative impacts of genetic or ecological interactions between wild and farmed salmon stocks until very recently. The recommendations of North Atlantic Salmon Conservation Organization, of which the U.S. is a member, have been discussed earlier (see Section III D). At this writing, the U.S. Army Corps of Engineers is including in its permits a prohibition on the import of west coast, European and Icelandic salmon stocks to east coast salmon farming operations after 1995. Canadian restrictions on imports now coincide with this regulatory strategy. While these actions are also based on concerns over disease, they serve as conservative steps to minimize the potential risk of genetic and ecological interactions.

V. Findings & Recommendations

A. Siting and Monitoring

General Findings: The subcommittee finds that siting practices of the state through the Department of Marine Resources leasing process and the more recent Department of Environmental Protection water quality certification process have been successful in avoiding any significant adverse impacts on the water chemistry, benthic communities and general water quality in the areas developed for marine finfish aquaculture.

At the same time, the subcommittee finds that the siting criteria would benefit from refinement based on experience in other parts of the world and from further research within the state.

The subcommittee recognizes that a great deal of the state's positive environmental experience with salmon aquaculture can be attributed to the characteristics of Cobscook Bay and other marine waters along Maine's eastern coast. Relatively deep, well-mixed and flushed waters; the relatively low incidence of algal blooms and swift currents all combine to offset the effects of net-pen aquaculture. These conditions do not exist everywhere along the Maine coast. In addition, areas with higher levels of human development and resulting nutrient loading may be more sensitive to net-pen aquaculture impacts.

The subcommittee further finds that monitoring of current finfish aquaculture leases is not well integrated into a systematic framework that would complement necessary research in addition to providing more reliable assurances of environmental adequacy of operations. Furthermore, the Department of Marine Resources has a single, full-time professional with which to conduct the scientific side of its siting and monitoring program. The subcommittee finds that the statutory objectives of environmental protection cannot be met at this staffing level.

Recommendation: The subcommittee generally supports the recommendations of the Parametrix Report (in its draft version) including the establishment of a hierarchy of regulatory requirements based on the production levels of the facility and in regard to the need for a more systematized approach to data collection in the monitoring process. The subcommittee does understand the Department of Marine Resources and Environmental Protection are working in these directions and supports that effort. The subcommittee recommends careful consideration in the selection of specific monitoring requirements, sampling procedures and analytical methods. Self-reported monitoring data should not substitute for controlled research and individual aquaculture operations

should not be expected to bear the cost of "research-grade" sampling if the immediate goals of environmental protection at that site can be satisfied by a lower level of sampling intensity, complexity and cost. (See the later recommendations for research responsibilities.)

Recommendation: In recognition of the state's positive experience and in order to limit regulatory costs for small-scale operations, the subcommittee recommends that the Commissioner of Marine Resources be give authority to establish a permit-by-rule system for small-scale aquaculture lease consistent with the conceptual hierarchy outlined in the draft Parametrix report.

Recommendation: The subcommittee recommends that the resources available to the Aquaculture Environmental Scientist at the Department of Marine Resources be augmented by the addition of two professional staff. The responsibilities of these staff should be concentrated on siting evaluations, monitoring and data analysis and support for the aquaculture-related marine research efforts underway in the Department, the Department of Marine Resources and at the University of Maine through its Aquaculture Innovation Center.

Findings - Coordination of Regulatory Efforts: While state-level regulation of finfish aquaculture is generally well coordinated, the subcommittee finds that the following factors introduce confusion and inefficiencies into the regulatory process:

- The lack of a requirement for a Department of Marine Resources lease for net-pen salmon aquaculture and other forms of marine aquaculture requiring on-site structures,
- The unclear legal responsibilities of the Bureau of Public Lands in the leasing process,
- An unnecessary restriction on the possession of undersized fish as it currently relates to Atlantic Salmon aquaculture, and
- The lack of operation coordination among federal agencies and between state and federal agencies.

This condition is not in the best interests of the state from both an environmental and economic perspective.

Recommendation: The subcommittee recommends that a lease from the Department of Marine Resources be required prior to the operation of marine aquaculture facilities that require floating structures which essentially preclude other uses of that site. Such operations would include net-pen and other variants for salmon aquaculture and raft-based suspension culture of shellfish. Ocean ranching of finfish and bottom culture of shellfish would not require the lease.

Recommendation: The subcommittee recommends that net-pen finfish aquaculture and suspended shell-fish aquaculture be explicitly exempted from the need for a submerged lands lease from the Bureau of Public Lands. The Commissioner of Marine Resources should, as a routine matter, seek comments from the Bureau on every aquaculture lease application. The statutory authority for such review already exists.

Recommendation: The subcommittee recommends that an exemption from the current minimum size requirements of the Atlantic Salmon possession laws (12 MRSA §6553, sub-§1) be provided for legitimate aquaculture operations.

Recommendation: The subcommittee recommends that the state continue its efforts to foster a cooperative and coordinated working relationship with and between the relevant federal agencies regulating aquaculture in Maine. The subcommittee further recommends that the Marine Resources Committee seek the assistance of the State's congressional delegation to encourage more rapid development of the promising approaches to federal coordination that have been discussed with the subcommittee. Specifically, these include the U.S. Army Corps of Engineer's proposed general permit and the U.S. Environmental Protection Agency's national permit for net-pen aquaculture. Finally, the subcommittee recommends that the Marine Resources Committee include in its request to the congressional delegation support for an amendment to the Clean Water Act or adequate administrative interpretation to allow the use of the proposed national permit system by the U.S. Environmental Protection Agency for aquaculture facilities located outside the baseline of the territorial sea. It is the subcommittee's understanding the §403(c) of the Clean Water Act related to ocean discharges currently precludes this approach.

B. Disease Control

Findings: While the potential hazard of the spread of fish diseases through imports and movement of stocks within the state is quite real, the testimony received by the subcommittee indicates that the current regulatory system is functioning well. The subcommittee finds that the State has a sound, well-coordinated system of import and disease control in place and that the respective agencies, the Departments of Marine Resources and Inland Fisheries and Wildlife, are taking timely steps to integrate new procedures designed to improve the system.

The subcommittee further finds that, after review of available literature, the use of antibiotics in salmon aquaculture does not pose any undue risk to public health or the environment under current treatment regimes, environmental conditions and with the antibiotics currently in use. Should these any of these factors change, this assessment should be reconsidered.

Recommendation: The subcommittee supports the efforts of the relevant state agencies to integrate useful portions of the New England Salmonid Health Guidelines into their import and disease control procedures. The subcommittee further supports the development of mandatory disease and drug use reporting requirements for salmon aquaculture as a means to monitor the incidence of disease, types of drugs used and intensity of use.

C. Genetic and Ecological Interactions

Findings: The subcommittee finds that there are theoretical risks to native salmon stocks from interbreeding and ecological interactions with escaped, non-indigenous strains of Atlantic Salmon and, possibly, other species. While current research results are not definitive, the potential severity of the effects poses a sufficient threat to Maine's restoration efforts and native runs to warrant a conservative course of action.

Recommendation: The subcommittee recommends that the Department of Marine Resources, in cooperation with the Atlantic Sea Run Salmon Commission and the Department of Inland Fisheries and Wildlife, adopt as part of the import control program the following provisions:

- a prohibition of European and Icelandic Atlantic salmon stock imports, effective as soon as possible;
- a prohibition on the transfer of salmonid eggs and fish from west of the continental divide, effective as soon as possible; and
- a prohibition on the introduction to the marine waters of the state after January 1, 1995 of any stocks already in the state that are derived from west coast, European or Icelandic salmon stocks imported prior to implementation of the import prohibition discussed above.

The subcommittee recommends that limited exemptions from these prohibitions be allowed for research purposes. Such exemptions must be limited in duration and can not include pilot or demonstration scale production facilities in the marine waters of the state.

Recommendation: The subcommittee recommends that the Department of Marine Resources, in cooperation with the Atlantic Sea Run Salmon Commission, continue to monitor research results and to initiate discussions with their Canadian counterparts regarding this issue. If resources become available, the Department should initiate a cooperative research program with its Canadian counterparts to evaluate the actual hazards posed to wild Atlantic Salmon stocks by aquaculture escapement.

Recommendation: The subcommittee recommends that the Department of Marine Resources, in conjunction with the Atlantic Sea Run Salmon Commission and the Department of Inland Fisheries and Wildlife, should cooperate to the extent permitted by available resources in the genetic inventory program being conducted by the U.S. Fish and Wildlife Service.

Recommendation: The subcommittee recommends that the Department of Marine Resources, in conjunction with the Aquaculture Innovation Center, should also investigate the design, construction and operation of "low-escapement" pens or floating tank technologies.

D. Coordination of Information Collection

Findings: The subcommittee finds that effective state oversight of net-pen aquaculture requires a coordinated effort to collect and utilize monitoring and performance data. The subcommittee further finds that much of the necessary data is collected formally or informally under current state programs. However, the existing data is not always readily available and its collection is the responsibility of several different agencies. The subcommittee has previously recognized the role of inadequate staff support in this area (see recommendations under Siting and Monitoring).

Recommendation: The subcommittee recommends that the Department of Marine Resources should take the lead in establishing a information system for the collection and use of monitoring and research data related to net-pen aquaculture. Such a system should be developed in cooperation with the Atlantic Sea Run Salmon Commission, the Department of Environmental Protection and the Department of Inland Fisheries and Wildlife. Such a system should include information in the following areas;

- Geophysical site characteristics, including currents and bathymetry;
- Benthic habitat effects, including changes in community structure and function;
- Water column effects, including water chemistry and plankton;
- Feeding and production/harvest data sufficient to estimate effluent loading;
- Import and transfer data, including both projected and actual deliveries of smolt to farms and transfers of broodstock and/or eggs to hatcheries;
- Disease/mortality incidence and use of therapeutics; and
- Other ancillary information, including neighboring uses at the lease site, nearby sensitive wildlife areas, etc.

The subcommittee emphasizes that, on the basis of all testimony presented to it during the 1990 interim, the above list represents categories of information already being collected by or otherwise made

available to state agencies and does not represent any additional intrusion into aquaculture operations. The subcommittee also notes that it expects ongoing and new research to be a significant source of needed information in addition to the monitoring data required as part of the regulatory process.

Recommendation: The subcommittee recommends that the authority of the Commissioner of Marine Resources to obtain needed information be clarified to ensure accurate and timely reporting and to establish the Department's lead role with respect to other state agencies involved in aquaculture.

Recommendation: Recognizing the legitimate interest of aquaculture operations to protect truly proprietary information, the subcommittee recommends that the Commissioner of Marine Resources be given limited authority to shield proprietary information from Freedom of Access provisions (1 MRSA §401 et seq). Such authority must be exercised with discretion and in full recognition of the public's right of access to information concerning the quality of public resources (such as the waters of the state). As an example, the extremely limited scope of legitimately proprietary information under the laws administered by the Department of Environmental Protection is worthy of note. The proposed authority also may not be used to shield otherwise publicly available information from public access.

E. Research Needs

Findings: The subcommittee finds that the State's environmental protection efforts as well as the aquaculture industry would benefit from a well-conceived, adequately funded program of research conducted in close cooperation with the relevant regulatory agencies.

Recommendations: The subcommittee recommends that the State initiate and fund, with industry support, a research program with the following objectives:

- In areas currently under development for marine finfish aquaculture, research should be targeted towards:
 - establishing a set of broad "ecosystem health" parameters for relatively large areas (eg Cobscook Bay or portions thereof). Systematic sampling of ambient nutrient concentrations is an important part of such an effort. Such research could facilitate more efficient monitoring of water quality and other environmental parameters to detect changes resulting from the cumulative impact of net-pen aquaculture in an area; and
 - developing a more complete operational understanding of the biogeochemical and physical dynamics around individual finfish aquaculture operations. The recovery of benthic community

and nutrient loading are of particular interest. Improved understanding of these dynamics will enable siting and monitoring regulation to more tightly focussed on critical, relevant parameters with potential cost-savings as well as more reliable environmental protection. Cage rotation, feeding regimes, limited stocking densities and other possible mitigation measures should also be investigated as part of this effort.

- In other areas of the State not currently under development for marine finfish aquaculture, research efforts should examine the potential impacts of finfish aquaculture in areas with lower mixing and flushing rates, lower current speeds and wider temperature ranges. The purpose of such research is to prepare the State for the potentially different issues raised by future expansion of the finfish aquaculture industry should attractive downeast sites be fully developed.
- In order to support continued monitoring genetic and ecological interactions between wild and farmed salmon, research should be undertaken to:
 - Inventory the genetic characteristics of different salmon strains;
 - Explore means of tagging, marking or otherwise identifying farmed salmon and salmon stocked in the restoration program; and
 - Further characterize key existing spawning habitat that could be monitored for possible ecological interaction.

F. State Planning Office Aquaculture Development Strategy

Findings: The subcommittee reviewed the Aquaculture Development Strategy developed by the State Planning Office. However, the subcommittee was unable, due to a lack of time, to fully assess the recommended actions.

Recommendation: The subcommittee recommends that the full Marine Resources Committee seek a presentation of the Aquaculture Development Strategy early in the 1991 legislative session. The full committee should, at that time, make its own findings and recommendations regarding the proposed strategy.

G. Continuing Issues

Findings: The subcommittee finds that a number of issues warrant continued discussion. Effective and equitable resolution of these issues will require more time than the subcommittee had during the 1990 interim.

Recommendation: As a venue for such discussion, the subcommittee recommends that the Commissioner of Marine Resources convene a working group or groups consisting of a representative cross-section of interests appropriate to the issue under discussion. Interests could include the aquaculture industry, the academic research community, regulatory agencies, local government, riparian landowners and others as appropriate. This working group process should be used to explore the aspects and possible resolutions of concern over the impact of net-pen aquaculture operations on riparian owners. Recognizing that this issue is analogous to many local zoning problems, the working group should examine the questions of compatibility of land uses neighboring the proposed aquaculture facilities and should consider the relative permanence of these facilities in comparison to other traditional fisheries activities.

Other topics for working group consideration could include the potential impacts of genetic and ecological interaction, development of suitable sources of local broodstocks and the development of new escapement control methods. The subcommittee recommends that the Commissioner report to the full Marine Resources Committee by February 1, 1992 on any recommendations from the working groups.

APPENDIX A
COUNCIL-AUTHORIZED MANDATE FOR STUDY



SEN CHARLES P. PRAY
 SEN NANCY RANDALL CLARK
 SEN CHARLES M. WEBSTER
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 CHAIR

SEN DENNIS L. DUTREMBLE
 VICE-CHAIR

STATE OF MAINE

114th LEGISLATURE

LEGISLATIVE COUNCIL

May 9, 1990

Honorable Joseph C. Brannigan, Senate Chair
 Honorable James Mitchell, House Chair
 Joint Standing Committee on Marine Resources
 114th Maine Legislature
 Augusta, Maine 04333

Dear Senator Brannigan and Representative Mitchell:

The Legislative Council has considered your request to convert the proposed statutory study of the Development of the Aquaculture Industry to a Legislative Council study in light of the Governor's pocket veto of LD 2352. I am pleased to inform you that the Council has approved your request with the understanding that you will appoint a subcommittee of no more than 5 members, which will meet up to 4 times and complete its work no later than November 1 of this year. Please notify Sally Diamond as soon as possible of your appointments to the study subcommittee, including your designation of a chair.

We appreciate your bringing this matter to our attention and look forward to sharing the results of the study.

Sincerely,


 John L. Martin, Chair
 Legislative Council

cc: Martha Freeman, Director, Office of
 Policy and Legal Analysis

Study of the Development of Aquaculture in Maine

Joint Standing Committee of Marine Resources

Purpose: Aquaculture is a rapidly growing industry with potentially significant effects on the State's environment and economy. The purpose of the study is to review the adequacy of the laws that govern the monitoring and control of the effects of aquaculture on the environment and review state policies on the development of aquaculture.

Specific Study Elements: The subcommittee will examine the following issues:

1. The environmental effects likely to be associated with aquaculture in this State and the adequacy of laws and rules designed to protect the environment from potential adverse affects, including:

A. The potential effects of net-pen aquaculture on native fish populations;

B. The various roles and the adequacy of state and federal programs that monitor aquaculture projects; and

C. A review of the study by the Department of Marine Resources on environmental monitoring of aquaculture that is scheduled for completion in July, 1990.

2. The current and potential economic impacts of existing state policy on the aquaculture industry and proposed policies for the further development of the aquaculture industry in the State.

Membership: The subcommittee shall consist of 5 members of the Marine Resources Committee.

Meetings: The subcommittee shall meet at the call of the chairs. No more than 4 meetings may be held, including one meeting of the full committee.

Reporting date: The subcommittee shall complete its work, together with any proposed legislation, by November 1, 1990.

APPENDIX B
PROPOSED LEGISLATION

PROPOSED LEGISLATION

Bureau of Public Lands Lease Exemption.

Sec. 1. 12 MRSA §558 A, sub-§10 is enacted to read:

10. Aquaculture exemption. A lease for the use of submerged lands under this section is not required for the development and operation of any aquaculture facility if the owner or operator of the facility has obtained a lease from the Commissioner of Marine Resources under §6072. Ancillary equipment and facilities permanently occupying submerged lands on the lease site and not explicitly included in the lease granted by the Commissioner of Marine Resources are not exempt from the requirements of this section.

Import Prohibitions

Sec. 2. 12 MRSA §6071, sub-§3 is enacted to read:

3. Salmon imports prohibited. It is unlawful to import for introduction into any waters of the state any Atlantic salmon, live or as eggs, that originate in any Icelandic or European territorial waters or any other species of salmon originating west of the United States continental divide. After January 1, 1995, it is unlawful to introduce into any waters of the state any Atlantic salmon that originate in any Icelandic or European territorial waters or any other species of salmon originating west of the United States continental divide including any fish raised within the state from eggs or broodstock that are subject to the import prohibition under this subsection. The Commissioner may grant an exemption from the provisions of this subsection for a term not to exceed two years, renewable upon application, for legitimate research. Such research does not include pilot, demonstration or full-scale aquaculture production of salmon in the coastal waters of the state.

DMR LEASING STATUTE REQUIREMENT FOR NET-PEN & SUSPENDED CULTURE LEASE

Sec. 3. 12 MRSA §6072, sub-§1-A is enacted to read:

1-A. Lease requirement; finfish and suspension shellfish culture. It is unlawful for a person to construct or operate in the coastal waters of the State a facility for the culture of finfish in nets, pens or other enclosures or for the suspended culture of shellfish without a lease issued by the commissioner under this section. A person who violates this subsection is subject to a civil penalty, payable to the State, of no more than \$1,000 per day of the violation.

**DMR LEASING STATUTE
PERMIT BY RULE FOR SMALL-SCALE OPERATIONS**

Sec. 4. 12 MRSA §6072, sub-§16 is enacted to read:

16. Permit-by-rule; small-scale salmon operations. The Commissioner may adopt by rule a leasing procedure for the aquaculture of finfish that waives the provisions of subsections 5 and 6. The Commissioner shall limit eligibility for this procedure to applicants proposing aquaculture operations with a production level no higher than 20,000 pounds per year of finfish. The Commissioner shall develop a set of standard conditions that incorporate the siting criteria of subsection 7 and other provisions of this section as applicable. The Commissioner shall attach these standard conditions to any lease granted under the provisions of this subsection. Expansion of production levels beyond 20,000 pounds per year of finfish at any site leased under this subsection is contingent upon issuance of a new lease subject to all provisions of this section. No person may hold, directly or indirectly, more than one lease granted under this subsection at any given time.

INFORMATION COLLECTION & COORDINATION

Sec. 5. 12 MRSA §6076 is enacted to read:

§6076 Aquaculture Monitoring Program

The department is the state agency responsible for establishing and maintaining a comprehensive information base pertaining to all aspects of the siting, development and operation of finfish aquaculture facilities within the state.

1. Coordination. The commissioner shall coordinate the data collection efforts of the department with those of other state agencies that regulate or assist the finfish aquaculture industry. All agencies of the state shall cooperate with the department in the establishment of the information system and shall provide all available information requested by the commissioner.

2. Data requirements. The commissioner shall ensure that, at a minimum, information in the following site-specific categories is collected and organized in such a manner as to allow effective enforcement of all laws pertaining to finfish aquaculture at individual facilities.

A. Geophysical site characteristics, including currents and bathymetry;

B. Benthic habitat characteristics and effects, including changes in community structure and function;

- C. Water column effects, including water chemistry and plankton;
- D. Feeding and production data sufficient to estimate effluent loading;
- D. Smolt and broodstock introduction and transfer data;
- E. Disease incidence and use of chemical therapeutics; and
- F. Other ancillary information as the commissioner may find necessary.

3. Data collection, authority. The commissioner may require persons holding licenses under this title related to finfish aquaculture to report information in the categories listed in subsection 2.

4. Confidentiality. Except as provided in paragraphs A and B, information obtained by the department under this section is a public record as provided by Title 1, chapter 13, subchapter I.

In addition to remedies provided under Title 1, chapter 13, subchapter I, the Superior Court may assess against the department reasonable attorney fees and other litigation costs reasonably incurred by an aggrieved person who prevails in the appeal of the department's denial for a request for information.

A. Information submitted to the department under this section may be designated by the person submitting it as being only for the confidential use of the department, its agents and employees, other agencies of State Government, as authorized by the Governor, employees of the United States Environmental Protection Agency and the Attorney General and employees of the municipality in which the aquaculture facility is located. The designation must be clearly indicated on each page or other portion of information. The commissioner shall establish procedures to insure that information so designated is segregated from public records of the department. The department's public records must include the indication that information so designated has been submitted to the department, giving the name of the person submitting the information and the general nature of the information. Upon a request for information, the scope of which includes information so designated, the commissioner shall notify the submitter. Within 15 days after receipt of the notice, the submitter shall demonstrate to the satisfaction of the department that the designated information should not be disclosed because the information is a trade secret, production, commercial or financial information, the disclosure of which would impair the competitive position of the submitter and would make available information not otherwise publicly available. Unless such a demonstration is made, the information must be disclosed and becomes a public record. The department may grant or deny disclosure for the whole or any part of the designated information requested and within 15 days shall give written notice of the decision to the submitter and the person

requesting the designated information. A person aggrieved by a decision of the department may appeal to the Superior Court. All information provided by the department to the municipality under this paragraph is confidential and not a public record under Title 1, chapter 13. In the event a request for the information is submitted to the municipality, the municipality shall submit that request to the commissioner to be processed by the department as provided in this paragraph.

B. The commissioner shall not release the designated information prior to the expiration of the time allowed for the filing of an appeal or to the rendering of the decision on any appeal.

C. Any information that is collected by any other state agency or information required by the department for the purpose of obtaining a permit, license, certification or other approval may not be designated or treated as designated information under paragraph A.

D. The commissioner may adopt rules to carry out the purposes of this section. The rules shall be consistent with the provisions of Title 1, chapter 13, subchapter I.

E. It is unlawful to disclose designated information to any person not authorized by this section.

(1) Any person who solicits, accepts or agrees to accept, or who promises, offers or gives any pecuniary benefit in return for the disclosure of designated information is guilty of a Class D crime and to the civil penalty of subparagraph (2).

(2) Any person who knowingly discloses designated information, knowing that he is not authorized to do so, is subject to a civil penalty of not more than \$5,000.

(3) In any action under this paragraph, the court shall first declare that the information is a trade secret or production, commercial or financial information, the disclosure of which would impair the competitive position of the submitter and would make available information not otherwise publicly available.

MINIMUM SIZE EXEMPTION FOR AQUACULTURE

Sec. 6. 12 MRSA §6553, sub-§9 is enacted to read:

9. Exemption. A person holding a lease under §6072 for the aquaculture of Atlantic salmon is exempt from the provisions of this section.

FUNDING FOR MONITORING & RESEARCH

Sec. 7. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1991-92	1992-93
MARINE RESOURCES, DEPARTMENT OF		
Positions	(2)	(2)
Personal Services	\$ 75,000	\$75,000
All Other	20,000	10,000
Capital	8,000	-
TOTAL	\$103,000	\$85,000

Provides funds for two positions to assist in the leasing and monitoring of aquaculture operations and to undertake related research.

	1991-92	1992-93
ENVIRONMENTAL PROTECTION DEPARTMENT OF		
Positions	(1.8)	(1.6)
Personal Services	\$ 62,308	\$ 56,183
All Other	69,474	69,474
Capital		1,000
TOTAL	\$131,782	\$123,375

Provides funds to support marine research on the environmental effects of net-pen finfish aquaculture operations. Research will concentrate on nutrient loading and biologically based compliance criteria for net pen aquaculture.

APPENDIX C
INTERESTED PARTIES LIST

AQUACULTURE STUDY INTERESTED PARTIES

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APPENDIX D
SPO RECOMMENDATIONS

1 Develop and disseminate information about aquaculture.

Aquaculture is a relatively new industry in Maine. To develop its potential and—once developed—to maintain a competitive position in domestic and international markets, the State must generate and disseminate sufficient information about the field. It should designate public and private institutions that can (1) adapt information acquired elsewhere about aquaculture, (2) develop new information, and (3) disseminate this material to potential users.

To fully pursue a new information strategy, the State must create and fund a set of institutions similar to those used successfully in American agriculture:

- **A strong university/ technical college/ industry/ government capability in basic research and applied development** should be supported, both for adopting new technology developed elsewhere, and developing and testing new technology within the state. The State and University must be committed to defining the forefront of biological sciences as they apply to aquaculture.
- **An active university/ technical college/ industry program for determining research requirements and disseminating new information** should be encouraged, as follows:
 - *Extension services* similar to those used in agriculture should be provided, but with an important modification. Instead of using extension agents as intermediaries between researchers and the industry, researchers (even basic researchers) and industry experts need to be brought into direct and frequent contact.

As was done successfully in Canada, a *seminar series* should be initiated to bring world aquaculture experts to Maine to provide technology transfer in such areas as fish husbandry, disease control, environmental criteria for cultured species, seaweed culture, and animal nutrition.
 - The *University* should work to secure funding to fully implement its new undergraduate and graduate aquaculture curriculum. Earlier University programs in shellfish culturing created the first generation of aquaculture entrepreneurs in the State; expanding these programs to finfish and support services can be expected to further benefit the industry.
 - *Short courses*, tailored to the requirements of aquacultural entrepreneurs starting small-scale operations, should be developed and offered by the University and/or technical colleges. Currently such a program, which may serve as a model effort, has been initiated by the Marine Trades Center at the Washington County Technical College, in conjunction with Sea Grant, Cooperative Extension, the Job Opportunity Zone program, and the industry.
 - The *technical colleges* should implement a course of study for aquaculture workers and technicians. The program planned at Washington County Technical College should be supported.
- The **Maine Aquaculture Innovation Center (MAIC)**, a joint research effort of the Maine Aquaculture Association and Maine Agricultural Experiment Station, should function as a coordinating forum for the research, teaching, and extension interests of the State, University, technical colleges, and industry.



A researcher evaluates virus growth in fish cells in the Aquatic Animal Health Laboratory at the University of Maine, Orono.

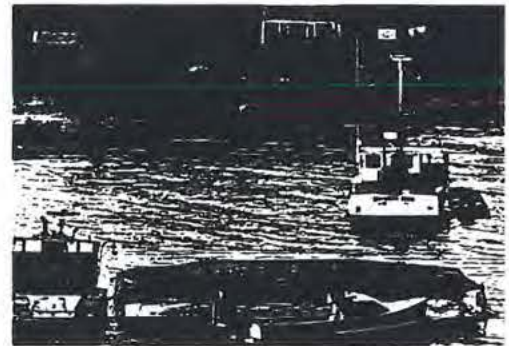
Any research and development tasks should aim to fill information gaps about efficient production of aquacultured species through all life history stages and about effects of aquaculture on the environment. Important elements of the strategy should include:

- Integration of aquaculture training with industry **internships**.
- Development of **demonstration farms** in finfish and shellfish. Demonstration farms are an important and effective way to transmit new technology to small entrepreneurs. They are also a very economical way to provide training and test new strains of cultured species. The Darling Center and the Washington County Technical College are logical institutions at which to develop demonstration farms.
- **Coordination** among all state institutions, as well as private research and higher education institutions, that have expertise in aquaculture and supporting programs (e.g., business, engineering, oceanography, fisheries, genetics, and microbiology).

2 Cultivate a positive investment climate for small entrepreneurs.

Small individual entrepreneurs and family-owned firms, especially those in traditional fisheries, depend on an investment process that permits them to acquire new technology, experience, and capital in small increments. This allows the small entrepreneur to gain experience, reduce risk, prove new technology, and establish a track record without large up-front costs. For this kind of investment to succeed, information about technology and marketing must be readily accessible, and regulations must not require a large initial investment. The traditional fishing industry is a source of exceptional, proven entrepreneurial talent. This valuable resource can only be mobilized if the State creates a favorable investment and market climate for small aquaculture business by taking the following actions:

- Minimize the *initial* (not final) regulatory requirements faced by small operations. The current permitting approach should be supplemented with an alternative small-scale, general **experimental permit**. The basic guidelines of this permit should include:
 - *minimal requirements* (e.g., siting should not interfere with navigation);
 - *small size* (1/10 acre for nets and pens; 1/2 acre for bottom culture);
 - *limited duration* (3-4 years);
 - a requirement that during the experimental period, the leaseholder gather and make public the site-specific *environmental data* necessary for meeting full regulatory requirements; and
 - the *short courses and other services* previously outlined should be tied in some explicit way to the experimental permitting process, to increase the likelihood of both regulatory and eventual economic viability.
- Use the experimental lease approach just described to improve the regulatory **assessment of environmental impact**. Under the State's current procedures,



Three thousand salmon are raised in a floating pen at Allen's Island in Muscongus Bay. Local fishermen, a private landowner, and the Island Institute are cooperating in a research and experimental project to demonstrate a small aquaculture operation. The offshore site's waters are protected enough for fish to survive winter "superchill."

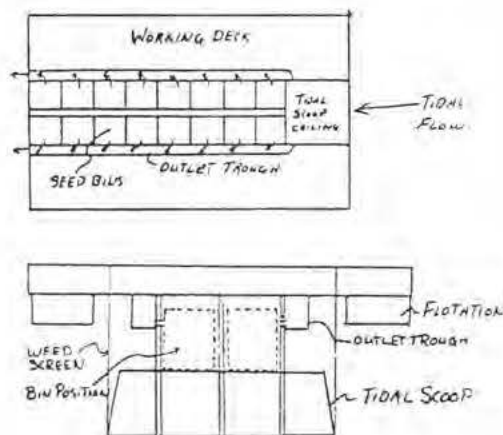
an assessment of environmental impact must be made before any practical experience with a site is acquired. This is not optimal given that conditions from site to site may vary. Consequently, an experimental period during which site-specific data could be gathered would be beneficial from an environmental, as well as economic, perspective.

- Support the Finance Authority of Maine's efforts to encourage Legislative funding of the **Natural Resources Capital Investment Fund**, a revolving loan fund that would provide necessary financing for piers, pens, nets, work platforms, and related equipment.
- Take steps to **minimize the costs, time, and uncertainty** that Maine firms face in marketing aquaculture products. The State's policy should be to establish organized market mechanisms capable of providing Maine firms with flexibility in their marketing approach. Given the large number of species that may be cultured in the future, the highly varied nature of sales contracts and conditions, and the rapid change that characterizes the seafood market, Maine firms need to be in a position where they can readily locate new buyers and arrange (or rearrange) their contracts. The State can facilitate this flexible structure by pursuing the following.

- Continue joint development by the industry and State of *grading and inspection standards*. Such standards assure public health and describe product quality for efficient and flexible marketing.
- Establish an *electronic clearinghouse* or other appropriate public market mechanism. Any mechanism of this sort should be tied to the existing Portland Fish Exchange (currently used for wild seafood). Sellers of cultured (or, when appropriate, wild) seafood should be given access to what might be termed a "near futures market," in which they can arrange contracts to deliver a product at some specified future date. Such a market would provide greater certainty for sellers and buyers, create low-cost access to a national network of brokers and wholesalers, and generate better prices for sellers.

However, it is important to note that the electronic trading of seafood (either cultured or wild) can only succeed if quality descriptors for the product are well-established and provide the basis for third-party arbitration of disagreements between buyers and sellers.

- Assist the aquaculture industry and the Portland Fish Exchange in developing other specific *opportunities for marketing* cultured products.
- Assist the industry in establishing a *marketing cooperative*.
- Extend the *'Certified Maine Seafood' program* (the Department of Marine Resources' voluntary quality inspection) from wild seafood to cultured products (e.g., mussels and salmon) that meet the same standards.



A locally-designed tidal-powered upwelling nursery for growing shellfish. Very small hatchery oysters, clams or scallops are placed in the floating, moored pen to grow to an intermediate stage. The pen requires a minimum one-knot current to function.

3 Designate a lead state agency to support development of aquaculture.

If Maine is to develop a progressive aquaculture policy, the State must designate a lead agency to be responsible for organizing and disseminating information about the industry.

The Department of Marine Resources (DMR) is the most appropriate state agency to assume lead status. The DMR is the only agency in the state with sufficient fisheries experience and understanding of the issues involved in aquaculture development. The agency is also experienced in balancing the competing demands of fostering industry development and enforcing regulations.

Key responsibilities for DMR would be to administer permits; collect statistics; disseminate information about the industry; and provide a state link with the United States Department of Agriculture (USDA), the lead federal agency for U.S. aquaculture development. In addition, DMR services should be expanded in pathology and health certification for imported and exported fish and shellfish.

4 Ensure consistency and predictability in the regulatory process.

Aquaculture is a business with many inherent risks. Variables affecting operations include weather conditions; diseases; changing markets; and, of course, the availability of financing. To meet the demands of aquaculture entrepreneurship, growers and lenders must have confidence in time-frames and costs for business development. Uncertainty impedes small and large firms alike, and limits their ability to finance aquaculture ventures.

In most cases, it is not regulation itself that hinders aquaculture. Rather, it is the time required to obtain permits; uncertainty about the roles of regulatory agencies; and inadequate information about which regulations apply in specific situations. Maine's aquaculture industry cannot effectively plan for the future if the current variations in permitting schedules and cost continues.

The present regulatory approach also creates uncertainty for the State regarding eventual environmental impacts of each aquaculture site. Current procedures require a forecast of environmental impacts, but do not provide the basis for collecting site-specific data necessary for a reliable forecast. Given that the marine environment is complex and subject to continual change, good environmental forecasts depend on a multi-year history of data from a particular site.

The State could help assemble better general and site-specific data by building upon interagency discussions currently underway (at both the state and federal level). The goals of the discussions should be to:

- Minimize state and federal agency **redundancy in water-quality requirements and permitting activities.**
- Review **current statutes** to identify and—where appropriate—eliminate provisions that either do not apply to the industry or deter its development.
- Establish a **"one-stop shopping" format** for lease applicants in which the lead agency would develop a single application and coordinate the involvement of other agencies. The lead agency would also offer technical assistance in



Salmon are harvested when they reach three years old, at this pen complex off Eastport. Ocean Products began raising salmon in 1982, and now has over 125 employees.

answering permitting questions; publish a guidebook on aquaculture regulation in Maine; and hold annual workshops in different locations to educate lease holders and lease applicants about technical information (e.g., changes in law, general permitting guidelines, and specific agency regulations).

- Increase **deterrents** to violating aquaculture leases. Currently, fines assessed by the court system are often \$50 for a first offense, even if thousands of dollars of production are at risk. The penalty assessed should be increased, and should include loss of shellfish license and restitution for the dollar value of the stolen product. In addition, the DMR needs to take a more active role in marking lease boundaries (perhaps by flagging) to give the industry a greater presence on the water. A lack of lease protection, or even the perception that leases are inadequately protected, serves as a disincentive to aquaculture investment.
- Streamline **federal permitting procedures**, as this appears to be the most significant regulatory issue affecting the industry.

5 Pursue a coordinated development strategy encompassing aquaculture and traditional fisheries.

Aquaculture and traditional fisheries share many of the same markets, resources, suppliers, and labor skills. Most importantly, aquaculture can become an important economic opportunity for Maine citizens currently engaged in traditional fisheries. From the State's perspective, their entrepreneurial abilities and water-related skills should be viewed as valuable human resources that provide an important component in developing aquaculture. Consequently, the development of aquaculture and traditional fisheries should be closely coordinated.

- The DMR should continue to **extend its marketing programs to aquaculture products**.
- The **electronic exchange, grading, and inspection programs should be extended to cultured fisheries products**.
- **People currently engaged in traditional fisheries should be viewed as the principal audience for the University and technical college programs** previously mentioned. Those programs should be based on the premise that aquaculture and traditional fisheries are a single, integrated industry.

6 Protect, preserve, and enhance coastal water quality.

Clean water is essential for the health of the aquaculture industry. However, the state's marine and coastal waters are threatened by growing pollution from overboard discharges, industrial wastes, failing septic systems, inadequate municipal sewers, combined sewer overflows, and non-point sources. Pollution poses the greatest threat to shellfish, since filter feeders tend to accumulate bacteria, viruses, heavy metals, and hydrocarbons. The State must act to assess the status of our coastal waters and sediments, and to determine trends over time.

Aquaculture can become an important economic opportunity for Maine citizens currently engaged in traditional fisheries.

- Full support of the Department of Environmental Protection (DEP) and the DMR's **Marine Environmental Monitoring Program** is needed to assess the extent, effects, trends, and sources of pollution in Maine's coastal waters. The State should consider funding of \$100,000 per year for DEP to monitor status and trends at 30 sites coast-wide.
- DMR's monitoring programs for **paralytic shellfish poisoning (red tide) and other toxins** needs to be expanded.
- For the DEP and DMR to determine environmental impacts and seafood-growing capacities for pen culture sites, \$120,000 is needed for a **baseline study** involving bottom sampling of invertebrates; hydrographic studies; sediment studies; literature review; and field work/diving.
- Maine should cooperate with the Environmental Protection Agency to initiate **watershed management programs**.

7 Develop a comprehensive plan for use of coastal waters.

As aquaculture increases in Maine and becomes a more integral part of our food-producing industry, issues will intensify concerning:

- **Water quality** (the importance of clean water for the industry, as well as environmental impacts of the industry); and
- **Suitable sites** for growing operations in a coastal environment characterized by competing uses (such as marina development, traditional fishery areas, and views from private shorefront property).

If we are to sustain our coastal resources and develop them in a balanced, rational manner in the years ahead, the State needs to develop criteria for allocating scarce resources among competing uses. Aquaculture, previously an uncommon use of Maine's coastal areas, will need greater attention as it takes its place among many uses of our coastal resources.

A mussel-dragger brings in a harvest of bottom-cultured shellfish off Vinalhaven Island. Joe Upton is a good example of fishermen who have diversified by adding aquaculture to their operations.



APPENDIX E
BIBLIOGRAPHY

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Note: In addition to these, staff collected other readings that include scientific journal articles, government reports, popular articles and newspaper articles. These are also available in the subcommittee's study files.

APPENDIX F
NASCO SUGGESTED PROTOCOLS

NASCO SUGGESTED PROTOCOLS FOR TRANSFERS & INTRODUCTIONS

Zoning of River Systems

Atlantic salmon populations on the east coast of North America have been variously affected by civilization. Overharvesting, and degradation and loss of habitat due to human industrial and development activities have depressed levels of salmon stocks in many rivers; selective fishing pressures have changed composition of populations; enhancement and repopulation efforts have resulted in mixing of stocks; non-indigenous salmonid species have been introduced to increase salmonid production; and most recently commercial salmon farming, with its attendant risks of disease spread and dilution of wild gene pools, has reached a production level that now supersedes harvest levels of wild stocks.

Not all river systems and salmon populations have been affected equally by these activities, however. Many rivers in Newfoundland/Labrador and Northern Quebec have been unaffected by habitat perturbation by humans, other than commercial fishing in coastal waters and sportfishing in freshwater, and are unique in that they contain most of the remaining pristine Atlantic salmon populations in the world. Conversely, in the Maritime provinces of Canada and the Northeast USA, habitat alterations (eg dams, pollution) in certain rivers have had significant impact on natural populations. Remedial measures and alternative developments that have been initiated include enhancement with hatchery-reared stocks, introduction of non-indigenous salmonid species, and commercial aquaculture.

Given the mounting pressures to further introduce and/or transfer salmonid stocks to support fisheries development and commercial aquaculture, the Scientific Working Group recommends designation of three zones in eastern North America based on the degree of impact by man on wild Atlantic salmon populations. The Scientific Work Group further recommends that government agencies adopt fisheries management measures in each zone that will: (a) Protect selected salmon stocks in order to maintain valuable gene pools over the long term; and (b) Facilitate fishery restoration, enhancement, and aquaculture developments so that impact on existing salmon stocks will be minimized.

These measures are based on application of the "stock concept", which recognizes the individuality of groups of Atlantic salmon sharing a common environment and a gene pool which permits self-perpetuation. There may be one or several "stocks" of Atlantic salmon in a given river system, each of which can be deleteriously affected by even subtle changes to the environment or the gene pool.

The proposed geographic areas to be included in each zone (see Appendix II), a general description of types of river systems in the zones, and recommended management measures to be applied in each zone are as follows:

Zone I - Geographic Area: Northern Quebec, Labrador, Newfoundland (west coast) and Anticosti Island.

Description of Rivers: Generally pristine rivers with no manmade habitat alterations, no history of transfers of fish into the watersheds, and no culture operations in the watersheds.

Management: Protect river and manage fisheries to ensure a minimum effective size of breeding population of Atlantic salmon; no fish from culture facilities will be stocked; and no cage culture permitted in marine waters; enhancement of populations only permissible by moving juveniles or broodstock from within the same watershed; establishment or re-establishment of Atlantic salmon populations only permissible by moving juveniles or broodstock from nearby watersheds having similar habitat characteristics, and then only if a minimum effective breeding population is maintained.

Zone II Geographic Area: Quebec rivers flowing into Gulf of St. Lawrence south of Pte. des Monts, Gaspé region of Quebec, Magdalen Islands, Prince Edward Island, New Brunswick, Nova Scotia, Newfoundland (except west coast), St. Pierre and Miquelon Islands, Maine - east of Rockland.

Description of Rivers: Watersheds in which habitat has been altered, where wild salmon stocks or hatchery-reared fish not native to the watershed have been released, and/or where mariculture is conducted; but where only native Atlantic species are present in cage culture (introduced species such as rainbow trout would be treated as indigenous if a population has been established for ten or more years, and have had no impact on Atlantic salmon stocks).

Management: Permit enhancement and aquaculture activities in freshwater and the marine environment, but with native Atlantic species only (preferably local stocks); permit culture of non-indigenous species in land-based facilities having minimal risk of escapement.

Zone III Geographic Area: Great Lake drainage, southern Quebec draining to St. Lawrence River, Maine west of Rockland, New Hampshire, New York, Connecticut, Massachusetts, New Jersey, Rhode Island, and Vermont.

Description of Rivers: Rivers where habitat have been altered, where fish communities are destabilized, and exotic species may be present.

Management: Use of non-indigenous species may be permitted, provided that their introduction or transfer meets the requirements that follow.

Within each zone, river systems are generally similar and could be assigned the same class as the zones. For example, in Zone II, river systems would be categorized as Class II. It is proposed that there be flexibility, however, in assigning a higher classification to a river system than the zone in which it is located, to allow additional protection for valuable Atlantic salmon stocks. Over the long term, as detailed inventories of rivers and their Atlantic salmon populations become available, the principles of the zoning system could be succeeded by a more sophisticated classification of individual watersheds based on management needs.

Suggested Protocols

The recommended protocols developed by the Scientific Working Group and its Subcommittees on fish health, genetic and ecological concerns with salmonid introductions and transfers are given in papers NAC(89)14, NAC(89)15 and NAC(89)16 respectively. The basic premises used in preparing these protocols were:

- A. To minimize the risk of introduction and spread of infectious disease agents (fish health);
- B. To conserve genetic variance in North American Atlantic salmon stocks (genetics); and
- C. To minimize the intra and interspecific impacts of introductions and transfers on Atlantic salmon stocks (ecology).

To facilitate review of the potential impact of these protocols on ongoing salmonid management, development and aquaculture activities in eastern Canada and north east USA, a synopsis is presented below of protocols applicable universally throughout the region, and those protocols that are specific to each of the three Zones described in Section 3.

- A. Suggested Protocols Applicable to all Three Zone Classifications:
 - 1. To protect genetic variance, do not allow importation of Atlantic salmon stocks from Europe (including Iceland). Also, manage salmon harvest to be stratified with respect to fish size, age, sex and seasonality.
 - 2. To protect against inadvertent introduction of "emergency" diseases (IHN, PKD, VHS, Ceratomyxosis, and Whirling Disease): do not allow transfer of salmonid fish or eggs from west of the Continental Divide or IHN endemic areas. Require complete fish health inspection reports (minimum of three inspections over a twenty-four month period) prior to movement of any stocks.
 - 3. To protect against interspecific competition (ecological impact), review and evaluate fully the potential for such impact prior to any movement of non-native fish into an area inhabited by Atlantic salmon. Be aware that perturbed ecosystems pose the greatest potential for successful colonization by exotics.

4. Hatcheries are used widely in producing stocks for the introduction, re-establishment, rehabilitation and enhancement of Atlantic salmon. Hatchery rearing programs to support these activities must be carefully managed to minimize impact of wild populations, including the following measures:
 - a. Use only F1 progeny from wild stocks;
 - b. Select broodstock from all phenotypes, ages, and representatives of the entire spawning run of a donor population;
 - c. Avoid selection of the "best" fish during the hatchery rearing period; and
 - d. During spawning, make only single pair matings from a broodstock population of no less than 100 parents.

B. Zone I

Zone I consists of Class I watersheds where every effort must be made to maintain the genetic integrity of Atlantic Salmon stocks. The following summary protocols apply:

1. General within the Zone
 - no fish which have been reared in a fish culture facility are to be released into the wild.
 - no non-indigenous salmon stock or species may be introduced into a Class I watershed.
2. Rehabilitation:
 - fisheries management techniques will be used to ensure sufficient spawners such that spawning escapement exceeds a minimum target level to maintain an effective breeding population.
 - habitat that becomes degraded will be restored to the extent possible.
3. Establishment or re-establishment of Atlantic salmon in a river or part of a watershed where there are no salmon:
 - use transfers of adults or juvenile salmon from the residual population in other parts of the watershed.
 - if there is no residual stock, a near-by salmon stock which has similar phenotypic characteristics to the lost stock should be transferred (provided an effective breeding population is maintained in the donor watershed).
 - if biological characteristics of original stock are not known or there was no previous stock in recipient watershed, then transfer broodstock or early life stages from a nearby river having similar habitat characteristics.

4. Aquaculture:
 - aquaculture is restricted to land based facilities and the rearing of reproductively sterile fish, or indigenous fish species such as brook trout or arctic charr.
 - no cage culture is permitted.
5. Commercial Salmon ranching:
 - no commercial salmon ranching is permitted.

C. Zone II

Zone II is an area where only species indigenous to the Atlantic Coast are present, where there has been alteration of the habitat, where restoration and enhancement of salmon populations have taken place, involving the release of non-indigenous stocks, and/or where cage culture is practiced. The following protocols apply:

1. General within the Zone:
 - Introduction of non-indigenous species is not permitted, except reproductively sterile fish or introductions to adequately contained land-based facilities where risk of escapement is minimal.
 - Restoration, enhancement and aquaculture activities are permitted in the freshwater and marine environments, but with native Atlantic coast species only (preferably local stocks).
2. Rehabilitation and Enhancement
 - The preferred methods are: to improve degraded habitat and ensure escapement of sufficient spawners through fisheries management.
 - If further measures are required, use residual stocks for rehabilitation and enhancement. If the residual stock is too small, select a donor stock having similar life history and biochemical characteristics from a tributary of near-by river.
 - Stocking of hatchery-reared smolts is preferred, to reduce competition with juveniles of the natural stocks.
3. Establishment or re-establishment into rivers having no salmon populations
 - To establish a stock, use a salmon stock from a nearby river having similar stream habitat characteristics.

- If re-establishing a stock, use a stock from a nearby river which has similar characteristics to the original stock.
 - It is preferable to stock rivers with broodstock or early life history stages (eggs and fry).
 - If eggs are spawned artificially, use single pair matings and optimize the effective number of parents.
4. Cage Culture/Marine Enclosures
- It is important to apply methods which minimize escapees.
 - Develop domesticated broodstock based on local stocks; or, if local stocks are limited, on nearby stocks.
5. Commercial Salmon Ranching
- Commercial salmon ranching will only be permitted if it is demonstrated that the activity will not negatively affect wild Atlantic salmon stocks.

D. Zone III

Zone III is an area where most rivers are Class III, having been subject to the highest degree of environmental and biological change from the pristine conditions, as a result of man's activities. These watersheds usually have undergone changes which have diminished the productive capacity for Atlantic salmon by alteration of the habitats and/or by change in the fish fauna from the historical compositions. The residual salmon production potential can be preserved for optional enhancement if the following considerations involving introductions and transfers of fishes are used to limit the biological impact of fish movements:

1. General - within the Zone
 - Indigenous and non-indigenous salmonid and non-salmonid fishes may be considered for introduction or transfer if fish health and genetic protocols are followed and negative impacts on Atlantic salmon can be shown to be minimal using careful ecological impact evaluation.
2. Rehabilitation
 - Habitat quality should be upgraded wherever possible.
 - Rebuilding stocks can be achieved by controlling exploitation and by stocking cultured fish.
3. Establishment or re-establishment
 - Transfer source stocks from nearest rivers having similar habitats.

- Stock with juvenile stages (eggs, fry and/or parr).
If eggs are spawned artificially, use single pair matings and optimize the effective number of parents.

4. Aquaculture

- Use of local stocks is preferred but non-indigenous stocks may be cultured.
- Marine cage culture can be widely practiced but preferred locations are distant from watersheds with residual potential for Atlantic salmon production.
- Culture of non-indigenous species in land-based facilities on Class II watersheds is permitted in adequately controlled facilities where risk of escapement is minimal.

5. Commercial Salmon Ranching

- Commercial salmon ranching is permitted if it is demonstrated that the activity will not negatively affect Atlantic salmon rehabilitation or enhancement programs or the development of wild Atlantic salmon stocks.