Coastal Alliance for Aquaculture Reform

Submission to:

Government of Canada

-and-

Province of British Columbia

Regarding:

Regulation of Finfish Aquaculture

Principles and Recommendations for a New Regulatory Regime

May, 2009

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CAAR wishes to express appreciation to the governments of Canada and British Columbia for providing an early opportunity for input into the process of re-regulation of the finfish aquaculture industry in Canada. This submission is organized in five parts:

The final part of the submission, our recommendations, is by no means complete. We have attempted to focus on the broader and most problematic aspects of finfish aquaculture regulation, where the Salmon Aquaculture Dialogue indicates that industry is willing to entertain change. We intend to provide further comment on regulation as this process develops and would appreciate further and timely consultation as issues emerge.

About CAAR
CAAR was formed in 2001 as a coalition of conservation groups, First Nations and scientists from the Pacific West Coast working to ensure salmon farming in BC is safe for wild salmon, marine ecosystems, coastal communities and human health. Today the coalition has over 10,000 supporters across four continents.

Current Member Organizations
David Suzuki Foundation, Georgia Strait Alliance, Living Oceans Society, T. Buck Suzuki Environmental Foundation, Friends of Clayoquot, Raincoast Conservation Foundation and Watershed Watch Salmon Society

1.0 Executive Summary

The regulatory regime governing finfish aquaculture in BC coastal waters has failed, for over 25 years, to come to grips with some of the most fundamental aspects of the industry's impacts on the marine environment and on coastal communities. A continued reliance on regulatory measures with little basis in science, the failure to investigate knowledge gaps and the complete absence of process for resolving conflicts among resource users has eroded confidence in the ability and willingness of governments to protect wild fish and the marine ecosystems on which they depend.

In order to restore confidence, the new regulatory regime must be science-based, effective, equitable, enforceable and above all, transparent. Relevant data must be monitored, published on a farm-by-farm basis and audited in public reports. Penalties should be higher and should be enforced and enforcement measures publicly reported. An observer programme, or some other independent means of verifying data required to be monitored, should be instituted.

In our submission, the current regime provides little of any of the above attributes of good regulation and simply redistributing elements of existing regulations between provincial and federal purview will not be effective, nor will it resolve any of the problems that give rise to the criticism and conflict that has followed the salmon farming industry for decades.

By far the most effective means of regulating finfish aquaculture would be to minimize its interactions with marine wildlife and habitat, by isolating it from the marine environment in closed, contained systems. CAAR continues to advocate for a transition of this industry to such technology. In the meantime, new regulations for netcage aquaculture must seek to identify the marine resources actually impacted and prescribe effective means for prevention, early detection and reversal of impacts.

If performance based standards are to be used in a new regulatory regime, they must be based on adequate baseline data, solid environmental impact research and independent scientific advice on targets. Lacking this, regulations must take a precautionary approach to ecosystem protection as acknowledged in federal environmental policy and the bar should be set high if we are to protect endangered and threatened wild salmon stocks and other important Pacific marine species.

New regulations must identify key indicators of marine health and monitor for these regardless whether impacts from netcage aquaculture have as yet been fully scientifically verified or not. Knowledge gaps—or worse, denial of or failure to examine potential impacts—must not continue to be used as reasons to fail to monitor such critical indicators as:

- ♦ Juvenile wild salmon health and abundance
- ♦ Water quality/nutrient loading
- ♦ Benthic biota diversity, abundance and health
- ♦ Far-field impacts on resources such as shellfish and crustaceans
- ♦ Impacts on other species, including predators

Interim measures must be put in place immediately to mitigate some of the most egregious problems created by netcage salmon aquaculture. The following issues must be fast-tracked for action:

1.1 Sea Lice Control: Existing triggers are likely 10 times higher than appropriate for survival of pink and chum salmon. Farms must not be sited on juvenile wild salmon migratory routes. Impacts of the use of Slice on species such as prawns must be thoroughly investigated.

1.2 Netcage Waste Control: The entire regulatory scheme must be altered to reflect the diversity of the benthic environment that waste control regulations address. Areas of potential impact must be more broadly defined and monitored and sampling protocols and thresholds designed with scientific rigour. Water quality monitoring must be added to the waste control regime. Triggers for operator remedial action and recovery targets for damaged benthic environments should include species diversity, biomass and health.

1.3 Far-field impacts, particularly those on clam and other shellfish resources, must be monitored and effective action to prevent and reverse these impacts must be undertaken.

1.4 Monitoring and reporting of site conditions, including especially sea lice levels, the use of drugs and chemicals, escapes and benthic impacts must be made to regulators on a farm-by-farm basis and the information must be publicly available.

1.5 Escape Control: A program of tagging or marking farmed salmon supplemented by an on-site observer program should be implemented to assist in indentifying incidents of farmed fish escape and prescribing remedial measures.

1.6 Fish diseases having the potential to impact wild fish or other marine species must immediately be listed as reportable and the regulator must be mandated to take all measures necessary to protect the health of wild species, up to and including removal of farmed fish from the marine environment.

CAAR remains convinced, that rather than use this moment to revamp regulations for management of the flawed technology of open netcages, both the federal and provincial governments should seize this opportunity to develop much greater sustainability standards for finfish aquaculture in BC and Canada – specifically a fully supported transition strategy to facilitate the implementation of closed, contained aquaculture systems.

2.0 General observations on emerging international consensus

For several years, salmon farming industry representatives, ENGOs and government representatives have been meeting in an international forum, the Salmon Aquaculture Dialogue, organized by the World Wildlife Fund. Consensus has been reached on issues of concern and guiding principles with the aim of adopting a jointly agreed set of voluntary standards for sustainable aquaculture. This consensus creates a good starting point for analyzing the status of the current regulatory regime in B.C.:

Managing disease and parasites in an environmentally responsible manner
Survival and health of farmed fish
Contamination levels and health effects in local non-target organisms

Chemical and antibiotic treatments
Resistance of parasites, viruses, and pathogenic bacteria to medicinal treatments
Biosecurity and hygiene management

Conserving habitat, biodiversity and ecosystem function
Benthic biodiversity and benthic effects
Water quality in and near site of operation
Nutrient release from production
Interaction with critical or sensitive habitats and species
Interaction with biodiversity (wildlife) including predators
Cumulative impacts

Protecting health and genetic integrity of wild populations
Introduced or amplified parasites and pathogens
Introduction of nonnative species
Introduction of transgenic species
Escapes
Interaction with wild salmonid populations/runs

Using resources in an environmentally efficient and responsible manner
Use of wild fish for feed (dependency on marine protein and lipid sources)
Source of marine raw materials (i.e. origin of fish used in feeds)
Source of vegetable raw materials in feed
Non-biological waste from production
Carbon footprint
Non-therapeutic chemical inputs

Eliminating or mitigating social impacts
Interaction with local communities and other resource users
Respect for indigenous and aboriginal cultures and traditional territories

3.0 Specific observations on regulatory gaps and inadequacies

3.1 Protecting health and genetic integrity of wild populations

Wild fish are at risk from open netcage aquaculture by virtue of competition for habitat that occurs both as a result of poor siting of farms and the escape of farmed fish. They are also at risk from diseases and parasites introduced on the farms, or for which the farms operate as incubators and transmission vectors.

3.1.1 Sea Lice

The control and management of sea lice so as to protect wild marine organisms is a subject properly within the purview of the federal government and should be removed from provincial jurisdiction. The current provincial Sea Lice Management Policy is inadequate in that:

- Its' threshold of 3 motile lice has no scientific basis, and such reports as we have seen, indicate that this threshold is likely frequently exceeded without corrective action being required. For example, in 2008, Marine Harvest's Lee Bay farm had a motile lice count of 10.2 on April 23 during the critical juvenile migration period. Their Chancellor farm was at 9.7 motile on April 25. At least 6 MHC farms were over 3.0. It is completely unknown if the MAL audit picked up these specific violations of the trigger. If it did, no enforcement action was taken that we are aware of.
- it fails to require harvest of larger, adult farmed salmon prior to the out-migration of wild juvenile salmon (policy allows for harvest that may take weeks or months)
- where lice issues are detected, the policy now requires only the "objective" to reduce sea lice abundance "with practical urgency", rather than immediate medication or removal of affected fish.
- it fails to require penalties if policy not followed
- no reporting to government on a farm-by-farm basis occurs, with the result that monitoring and enforcement of control techniques is impossible
- aggregate data provided by the BCSFA to government is based exclusively on self-reporting by industry, with no observer verification
- such periodic auditing as is done by government is not available to the public (current Freedom of Information request for production of the information refused and under appeal), nor is information on remedial action that may have been ordered

A new regulation for the management of sea lice must, at minimum, specify that during the out-migration period for wild salmon (March 1 to June 30), lice levels on wild juvenile salmon must be maintained at background levels. An extension to July 31 should be considered for areas where juvenile Fraser River sockeye are known to migrate. A coast-wide wild juvenile salmon monitoring programme must be in place, and all farmed salmon that have been in salt water for 14 months or more must be harvested by March 1.

Reporting of lice levels to the federal regulator on a bi-weekly basis during outmigration, on a farm-by-farm basis, must be required, in order that effective measures to reduce impacts on juvenile salmon may be rapidly implemented. Monitoring and reporting on a farm-by-farm basis (rather than as aggregate regional data currently provided through the BCSFA) throughout the year should be required in order to ensure that best management practices are being followed to reduce the use of pesticides.

3.1.2 Escape regulation

The Aquaculture Regulation under the B.C. Fisheries Act currently governs escape control and response measures. While the regulation goes far in establishing minimum requirements for structures and procedures, escapes of farmed salmon continue, making it clear that open netcage technology is ineffective in preventing escapes. It is still frequently the case that the media, rather than farm operators, are the source of initial reports of escapes. The Regulation often fails to result in the recovery of escaped fish and no effective monitoring process appears to be in place. A new regulation governing the escape of farmed fish should include:

- ♦ an observer program similar to that used in commercial fisheries
- ♦ a tagging program or other method of marking to ensure that farmed fish can be identified by farm of origin if they escape and so farmed Pacific salmon can be identified
- ♦ the keeping of records of stocking, mortalities and harvests in a manner that will permit regulators to identify smaller escapes that are not currently reported
- ♦ an online, public escape database to replace Atlantic Salmon Watch, which has been administratively dysfunctional since 2003 and never an accurate compilation of escapes when operating
- ♦ a requirement that farms maintain regional capacity to effect recovery of escaped fish (the current regulation requires only 'reasonable measures' which, in the absence of a requirement to maintain capacity to recover escaped fish, effectively means that no effort is devoted to the recovery of most escapes)
- ♦ stiff penalties to operators for failure to report and for escapes should be consistently imposed

3.1.3 Fish Health and Disease Prevention

The control and management of fish diseases currently suffers important regulatory gaps. The federal Health of Animals Act fails to list any fish disease as reportable. The Provincial scheme, elaborated below, fails to articulate best practices in fish husbandry and is not monitored. This is an appropriate area for federal regulation as it involves risk to the health of wild fish and other marine life.

Presently, farmed fish health is governed only by a Fish Health Management Plan, required to be completed by aquaculture operators and followed as a condition of licence. However, since it has no enforceable standards or remediation measures, there is effectively no regulatory control over fish health.

Gareth Porter's 2006 review of the BC regulatory regime identified a significant gap in disease prevention regulation. His findings on the subject of fish husbandry practices were confirmed by Provincial Fish Health Veterinarian Joanne Constantine, and are excerpted here:

> "The BC MAL does not monitor any of the fish husbandry practices. According to BC's Fish Health Veterinarian, the surveillance audit done by the MAL fish health staff on finfish health at 25 percent of all active salmon sites each quarter on a random sample basis does not check on any of these fish husbandry practices. It is aimed at early detection of disease and sea lice by examining mortalities, taking diagnostic samples and sampling sea lice.
>
> The BCSFA Code of Practice … does not prescribe any concrete norms for any of the three fish husbandry issues, it does not provide any monitoring of fallowing, year class separation or stocking densities.
>
> The Code of Practice calls for aquaculture operators to monitor salmon stocks on a daily basis for "signs of stress or other abnormalities as a preventive measure." However, there are no guidelines for interpreting this language and no effort is made to enforce it.
>
> The MAL does not monitor stocking densities, year class separation or fallowing, according to the Fish Health Veterinarian.
>
> Thus no system of monitoring and enforcement now exists in regard to these fish husbandry issues…

Proper fish husbandry practices, to ensure that the use of drugs and chemicals in the marine environment is minimized, are not currently regulated and should be contained in the new aquaculture regulation, with much more specific definition than currently appears in the voluntary Code of Practice of the BCSFA. Conditions under which fallowing will be a required response to fish health issues should be listed and year class separation should be required.

Federal authorities should immediately list as reportable all diseases that could spread harmful pathogens to wild stocks, including IHN; require immediate reporting to federal regulators of listed diseases; prescribe response times and require veterinary certification of the effectiveness of the treatment employed. Off-label or emergency use of antibiotics, fungicides or pesticides should trigger a requirement to monitor impacts on benthic organisms and other marine life that may be exposed. Such monitoring should be done at industry cost, by government or independent contractors.

In addition, the importation of eggs should be banned altogether, as Canada has not approved the only drugs considered effective for their disinfection. The use of the "Emergency Drug Release" programme for such drugs should be discontinued. Some operators report that imports are no longer required, in that broodstock facilities have been developed within the province, so a ban on imports should impose no hardship.

Finally, any consideration of proper fish husbandry should take into account impacts on all wild marine species. While the requirements of the Fish Health Management Plan include a consideration of impacts on wild fish, these considerations appear within the context of timely application of medication only and do not involve any monitoring or sampling to ensure that impacts on wild fish, or predators of farmed fish, are not occurring.

3.2 Conserving habitat, biodiversity and ecosystem function

3.2.1 Benthic Biodiversity and Benthic Effects

Benthic impacts are regulated primarily through the Finfish Aquaculture Waste Control Regulation, the shortcomings of which have been thoroughly analyzed by Sergio Paone, Ph.D., on behalf of the David Suzuki Foundation. Please see Appendix A for a full elaboration of the issues, summarized here as follows:

- the chemical surrogates and sampling methods currently being used in impact assessment and monitoring in B.C. do not provide any meaningful information about the ecological condition of the environment near fish farms (Levings et al, 2002) (Hargrave et al, 2003)
- threshold level of sulfide is unscientific, far too high and fails to account for variations in site conditions
- no measures to regulate water quality, heavy metals, pesticides, antibiotics
- no measures to monitor or regulate disease pathogens or antibiotic resistance transference

- ♦ impacts directly beneath the farm, as well as those occurring beyond the farm's tenure, are not monitored or regulated
- ♦ cumulative impacts not monitored or regulated
- ♦ far-field impacts not monitored or regulated
- ♦ biodiversity indicators poor and allowable losses in biodiversity unacceptable
- ♦ sampling methods prevent proper analysis of impacts
- ♦ remediation standard is based on chemical, not biological recovery and fails to identify benthic communities at risk

Many of the shortcomings of this regulation result in harmful alteration of fish habitat within the meaning of the Fisheries Act. In order to bring the regulation of aquaculture waste within the federal regulatory system, it will be essential to address this central fact. Indicators appropriate to determining impacts on biodiversity and ecosystem function need to be developed and implemented within a response framework that ensures effective action to remove fish from netpens when impacts are detected and ensure fallowing until biodiversity has recovered. Introduction of a benign tracer into farm feeds would assist in identifying impacts, particularly far-field impacts.

3.2.2 Water quality in and near site of operation

Water quality issues remain unregulated and unaddressed, with the consequence that far-field impacts are experienced and there is no effective regulatory response. The Finfish Aquaculture Waste Control Regulation fails to address water quality either within or beyond the farm tenure, by focusing on a single indicator of the impact of farm waste. A new regulation should require water quality sampling both on- and off-site, and licence conditions should prescribe the sampling method and area deemed appropriate for the site.

3.2.3 Nutrient release from production

The Finfish Aquaculture Waste Control Regulation also fails to monitor nutrient release and its effect on marine organisms beneath and beyond the farm tenure. Nutrient release from decaying feces has the potential to contribute to plankton blooms. As the salmon farm sewage decays it releases nutrients such as nitrogen and phosphorous into the water. Changes in nutrient levels can alter the plankton community, since the different plankton species have varying degrees of response to changes in nutrient levels. Evidence shows that the excess nutrients added to water by fish farms can result in higher incidences of plankton blooms. Some of the key findings include:

- Increased growth of attached filamentous algae near fish cages in Baltic archipelagos (Ruokalathi,1988; Ronnberg,1992)
- The establishment of a link between blooms of the toxic plankton algae *Prymnesium parvum* , which killed 750 tonnes of salmon and rainbow trout in fish farms in a Norwegian fjord, and the nutrient loading from the fish farms (Kaartvedt,1991).
- A monitoring program between 1988 and 1997 looked at 4 sites in the Quody Region of the Bay of Fundy. Two sites were located near fish farms whereas the other two

were located away from fish farms. The waters near the fish farms had higher levels of a diatom known to cause blooms in the area (Smith, 2001).

- In hybrid striped bass aquaculture ponds, dinoflagellate blooms were found on 10 of 14 occasions to co-occur with concentrations of urea (caused by sewage decomposition) in excess of 1.5 mM nitrogen. When urea levels were <1.5 mM nitrogen, on seven occasions, no evidence of dinoflagellate blooms was observed in these ponds (Gilbert, 1999).

A new regulation should require monitoring of nutrient levels on a regional basis and licence conditions should prescribe the monitoring regime appropriate for each farm and its area of impact.

3.2.4 Siting: Interaction with critical or sensitive habitats and species

Appropriate siting of aquaculture operations is an essential early step in conserving habitat, biodiversity and ecosystem function. Given the ecological values of the BC coast, the abundance of wild salmon streams and the prevalence of open netcages on wild salmon migratory routes, it is CAAR's firm position that the only acceptable siting is in closed, contained facilities on land or in the water.

Siting criteria for open netcages are presently, and will likely continue to be the joint responsibility of the federal and provincial governments, in consultation with local government and First Nations. Siting criteria are currently dispersed among diverse authorities within each government.

Federally, DFO confines its involvement to acting as the Responsible Authority when a proposed site involves impacts on sensitive marine habitat and a potential HADD triggers a CEAA review. While the Province defers entirely to DFO in determining what is 'sensitive marine habitat', it appears that DFO has never considered a juvenile salmon migration route to be 'sensitive marine habitat'. Thus, no farm siting application has ever been rejected through the federal process for this reason. Protection of migrating juvenile salmon is left to provincial guidelines in this respect, which prescribe only a 1 km separation between a farm site and a salmon-bearing stream—a standard that has no basis in science, has been found by the Salmon Aquaculture Revew to be inadequate, and does not protect migrating salmon after they enter the ocean.

Furthermore, the lack of adequate resources for DFO field staff has led to serious gaps in the accurate identification of wild salmon streams. It is not infrequent for DFO, after one brief site visit, to label a stream as non-anadromous habitat when local and traditional knowledge and observation by independent scientists confirms the presence and use of the waterway by one or more species of salmon.

Provincially, siting criteria appear as a set of guidelines, subject to revision. These criteria are not science-based and fail to incorporate current understanding of the geographic extent of finfish aquaculture impact. Fourteen years after the Salmon Aquaculture Review identified appropriate siting criteria only some of the criteria have been adopted and others have been modified without scientific basis. Some of the recommended criteria have been dropped altogether.

Neither the provincial nor federal approaches to siting has proved effective in preventing the following issues from arising in connection with farm siting:

- ♦ farms allowed on juvenile salmon migration routes
- ♦ cumulative impacts not taken into account
- ♦ far-field effects not taken into account (particularly the contamination of wild shellfisheries traditionally harvested by First Nations)
- ♦ remediation of environmental impacts of tenures granted before siting criteria were adopted
- ♦ recreational and commercial moorages are not taken into account
- ♦ impacts on other species: herring spawning areas; rockfish habitat; shellfish
- ♦ operational issues that might reasonably be foreseen at the time of siting a tenure, such as the use of SLICE and its impact on prawns
- ♦ farms are not banned in Rockfish Conservation Areas

The new regulatory regime should incorporate in one, federal regulation all of the siting criteria that will apply on all sites, recognizing that some of those criteria are imposed for social purposes other than protection of the environment—e.g., to resolve user conflicts—while others are imposed exclusively for the protection of the environment. Those latter criteria should be based in science and experience with the industry and should leave room for the stipulation of monitoring and sampling protocols appropriate to individual sites to be imposed as licence conditions. Where there is inconclusive science, a precautionary approach should be taken.

Within the regulation on siting, discretion should be reserved to federal approving authorities to reject sites that otherwise comply with regulatory siting criteria where there is concern for HADD, impact on resources used by First Nations or where the conservation of fish or other marine organisms is otherwise in issue. Discretion should be reserved to provincial approving authorities to reject sites where user conflicts, local government objections or the public interest indicates that the site is inappropriate.

3.2.5 Interaction with wildlife, including predators

Marine mammals, birds and other species are at risk from open netcage finfish aquaculture operations and from the regulations that currently govern escapes. The provincial Aquaculture Regulation requires operators to take action against predators, with the result that:

- ♦ permits for marine mammal kills are allowed
- ♦ no monitoring or studying impacts of marine mammal kills is undertaken
- ♦ reporting of marine mammal entanglements and drowning is ‘encouraged’ but not a mandatory requirement
- ♦ kills are under-reported, as only self-reporting is required

- ♦ fish kills (e.g. sharks) from entanglement in nets are not reported and no penalties are attached to such mortalities
- ♦ no reporting is required for other species such as birds, bears – no penalties attach to destruction of these species

New regulations should insist on barrier techniques and management practices that reduce predator/prey interaction and provide for rapid response to citizen complaints regarding predator destruction on farms. Reporting of death of wildlife by entanglement or drowning should be mandatory. Annual reports on all marine mammal deaths (deliberate and accidental) must be compiled and publicly available.

Finfish aquaculture also involves a potentially significant "by-catch" issue – species such as herring, juvenile salmon, black cod or eulachon swim into netcages and are eaten by farmed salmon or reared and harvested illegally. They are attracted by the feed, by lights illuminating the floats and in some cases by night use of "grow lights'. There is no regulation that seeks to prevent or monitor the impact of bycatch and consequently no basis on which to assess that impact. This issue must be addressed by new regulations in a manner that is equitable with the approach used in commercial and sport fisheries, such as the use of observers or other independent verification.

3.2.6 Cumulative Impacts

As a result of the failure to monitor key indicators of ecosystem function, described above, and the failure to monitor indicators on a regional basis, it has been impossible to engage in meaningful cumulative impact assessment. The cumulative effects of multiple farm sites within a region must be considered on both a prospective and retrospective basis, once monitoring data are collected. Remedial action must be mandated, including fallowing, operational controls and removing or relocating farms where cumulative impacts are found.

3.3 Using resources in an environmentally efficient and responsible manner

Regardless what regulatory regime is in place, the culturing of carnivorous fish continues to be unsustainable in that it depletes ocean resources. The use of fish for feed depletes resources essential for other marine life and for human consumption, depending upon what species are used for protein and where they are harvested. The desposition of waste, chemicals and drugs from open netcages has deleterious effects for other marine life.

If the current regulatory culture, which aims to facilitate and encourage the development of finfish aquaculture is to continue, a concerted effort to find sustainable feed sources must be undertaken. In view of the fact that section 31 of the Fisheries Act says, "No one shall catch, fish for, take, buy, sell, possess or export any fish for the purposes of converting it into fish meal…" CAAR recommends that a ban on the importation of feed made from whole, round fish should be phased in, as a means of encouraging innovation and reducing impacts of this industry worldwide.

Impacts on the benthic environment and species such as clams and prawns must be studied, with an emphasis on far-field impacts that have, thus far, been ignored or discounted by regulators.

3.4 Eliminating or mitigating social impacts

The failure of the regulatory system to provide, thus far, an approach to siting farms that actually resolves user conflicts and protects marine resources, particularly those used and enjoyed by First Nations, sport and commercial fishermen, has had far-reaching social impacts, which may not be capable of redress. Going forward, it is essential that a new regulatory system should prevent user conflicts from occurring, recognizing that far-field impacts and impacts on other species are among the predictable consequences of siting decisions.

In addition, measures must be implemented for the protection of human health. These would include:

- public signage on the farms when using pesticides and antibiotics in feed – commercial prawn, crab and recreational fisheries could be impacted
- labeling of farmed fish so consumers are fully informed and can exercise their right to choose products not exposed to antibiotics, colourants and pesticides.

4.0 Principles for establishing a new regulatory regime

The regulatory regime in British Columbia has eroded public confidence in both the industry and the ability of government to regulate its impacts. This is in large part because the regime has been characterized by a lack of transparency, inadequate consultation, denial or marginalization of impacts reported by other marine resource users (particularly First Nations), denial of the weight of peer-reviewed and published scientific evidence by regulatory agencies, the failure to undertake or require timely, independent and appropriate research into impacts and mitigation measures and the refusal to release for public scrutiny information concerning disease and treatment measures that have the potential to impact marine resources beyond the farm tenure. Many of the standards and thresholds that have been set by regulation lack scientific foundation and fail to take into account impact beyond the farm tenure. The regulatory environment overall is disjointed and obscure, contained as it is in a variety of instruments ranging in effect from legislation through regulation, policy and guidelines.

The following principles are recommended to rectify the weaknesses in the regulatory regime and restore public confidence:

4.1 Transparency

Generally, where an issue or impact arises as a result of any finfish aquaculture operation, regardless of site-specific considerations, the issue or impact should be governed by legislation or regulation, not by licence conditions, policies or other means. Inspection and enforcement measures should be clearly set out and capable of being activated by citizen complaint. Science-based monitoring and reporting on impacts must be required and must be verified by some independent means on at least a periodic basis. Monitoring data must be made public and government should produce periodic public reports on all monitoring, inspection and enforcement measures, in particular on a site by site basis.

Where an issue or impact arises regionally, or as a result of site conditions common to a significant number of sites, the issue or impact should be governed by regulation and treated as outlined above.

Policies should not be used to govern significant aspects of aquaculture operation except as interim measures to deal with new issues or experimental treatments and processes. Wherever a policy is deemed desirable, a rigorous process for monitoring and evaluating its effectiveness and elevating it to the status of a regulation should be put in place at the same time as the policy is passed. Reporting on policy monitoring and evaluation should be public and the process governed by an issue-specific timeline for transitioning the policy to a regulation.

Where an issue or impact is specific and unique to a particular site, the use of licence conditions or agreements with impacted third parties is appropriate. In such cases, effective monitoring and disclosure to impacted third parties is essential.

4.2 Effectiveness

In order to be effective, any regulatory regime must be adequately funded, monitored and enforced. The current regime has suffered from the lack of all three aspects of an effective system. This industry, by virtue of its remote locations, is an expensive one to monitor and inspect. Self-reporting measures have not been effective and have in fact resulted in 'data' that are misleading and counter-productive (Atlantic Salmon Watch escape reports are one excellent example of this).

Creative approaches to inspection and monitoring are indicated. The use of trained Fisheries Guardians and citizen observers should be considered, with appropriate powers to require the production of information essential to proper monitoring. Periodic, independent verification of site conditions, records and far-field impacts should be required. Followup on monitoring and inspection reports, with effective enforcement measures including the removal of farm stock and the suspension of licences where indicated, must be an assured outcome of the monitoring process and publicly reported.

4.3 Equity

The regulations governing finfish aquaculture must treat that industry equitably with all other marine resource users. Issues such as bycatch, preservation of genetic diversity in wild stocks, preservation of fish habitat and protection of threatened and endangered marine life are common to all fisheries and consideration must be given to regulating aquaculture in a manner that is equitable with other gear types. The regulations must also consider the relative equities of granting public tenure to aquaculture and other applicants for land and water tenures. Rules governing the deposition of waste and other deleterious substances into the marine environment should be the same for all.

4.4 Enforceability

New regulations should incorporate a range of regulatory responses that can be enforced rapidly where indicated (for example, to require the harvest of fish where they pose a danger to the marine environment) and carry penalties for non-compliance that represent significant deterrence. Operator responses to thresholds and norms prescribed in the regulations and

policies should be mandated, not discretionary, with reporting and auditing of the response and inspection where indicated to verify site conditions.

Auditing functions should be greatly enhanced by requiring reporting, on a farm-by-farm basis, of appropriate indicators. For example, the failure to compare stocking and harvest tonnages on a farm-by-farm basis has resulted in production levels in excess of licence restrictions on some sites. An appropriate audit of the data supplied would yield accurate and useful information concerning losses from mortality and escape, helping to identify issues with siting or operations before they create significant environmental impacts.

5.0 Recommendations

5.1 Standards and thresholds set by regulation should be science-based. Where there is little or no Canadian data, standards from jurisdictions that have conducted appropriate research and monitoring should be incorporated on an interim basis, while resources are assigned to scientific research in Canada that will ultimately inform the development of Canadian-based standards and regulations.

5.2 Funding for research should be provided by industry and directed by government to address knowledge gaps.

5.3 Regulations put in place in this process should be subject to review within a relatively short timeframe (appropriate to the monitoring, evaluation and research measures implemented during this process), to ensure timely incorporation of new data in effective regulatory measures.

5.4 Funding for aquaculture regulation, including especially monitoring, evaluation/auditing and enforcement, should be increased by both levels of government and pooled to ensure effective use of resources. These costs should be recovered from industry.

5.5 A process for resolving citizen complaints and user conflicts should be created, with transparent reporting of the results.

5.6 Far-field impacts must be thoroughly studied and effective remedial and preventive measures prescribed.

5.7 A new regulation under the Fisheries Act should be created, governing siting, licensing and operation of finfish aquaculture. That regulation should strive to codify measures of general application to the industry that are currently dispersed among various government agencies as regulations, policies, guidelines, manuals, voluntary codes and licence conditions. It should provide broad powers to require site-specific measures such as monitoring protocols to be established as licence conditions, coupled with a range of enforcement measures up to and including licence cancellation.

5.8 A new regulation for the management of sea lice must specify, at minimum, that during the out-migration period for wild salmon (March 1 to June 30), lice levels on wild juvenile salmon must be maintained at background levels.

5.9 Bi-weekly reporting of lice levels on a farm-by-farm basis to the federal regulator must be required.

5.10 Escape regulations must be tightened, using a combination of observers, a marking program, record keeping and auditing.

5.11 A ban on the importation of salmon eggs should be instituted, and fish diseases listed as reportable. Regulators should have the primary duty to protect wild species and the power to order removal of infected farm stock from the marine environment. Off-label or emergency use of antibiotics, fungicides or pesticides should trigger a requirement to monitor impacts on benthic organisms and other marine life that may be exposed.

5.12 The management of fish farm wastes should be transferred to federal authority under a completely new regime that identifies more appropriate indicators of marine health, effective monitoring protocols and provides for transparent reporting. Indicators must address biodiversity, biomass and the health of benthic biota. The response framework must ensure effective action to remove fish from netcages when impacts are detected and ensure fallowing until biodiversity, biomass and health have recovered. Introduction of a benign tracer into farm feeds would assist in identifying impacts, particularly far-field impacts.

5.13 Water quality sampling should be required both on- and off-site, and licence conditions should prescribe the sampling method and area deemed appropriate for the site.

5.14 Nutrient levels in water and in bottom sediments should be monitored on a regional basis and licence conditions should prescribe the monitoring regime appropriate for each farm and its area of impact.

5.15 Siting criteria should be brought together in a single regulation containing science-based criteria that strive to minimize impacts on other species and habitat. This regulation should also stipulate that Rockfish Conservation Areas and Marine Protected Areas will not be considered appropriate for fish farming. Discretion should be reserved to federal approving authorities to reject sites that otherwise comply with regulatory siting criteria where there is concern for HADD, impact on resources used by First Nations or where the conservation of fish or other marine organisms is otherwise in issue. Discretion should be reserved to approving authorities to reject sites where user conflicts, local government objections or the public interest indicates that the site is inappropriate.

5.16 Impacts on other species should be reduced by prescribing (a) barrier techniques and management practices that reduce predator/prey interaction and (b) rapid response to citizen complaints regarding the killing of marine mammals or birds. Entanglement and drowning death reporting should be mandatory. Annual reports on all marine mammal deaths (deliberate and accidental) must be collected on a site-specific basis and publicly available.

5.17 Bycatch issues, such as the consumption or harvest of wild species in netcages must be addressed by new regulations in a manner that is equitable with the

approach used in commercial and sport fisheries, such as the use of observers or other independent verification.

5.18 The cumulative effects of multiple farm sites within a region must be considered on both a prospective and retrospective basis, once monitoring data are collected. Remedial action must be mandated, including fallowing, operational controls and removing or relocating farms where cumulative impacts are found.

5.19 A ban on the importation to Canada of fish feeds made from whole, round fish should be implemented.

5.20 Measures must be implemented for the protection of human health. These would include:

- public signage on the farms when using pesticides and antibiotics in feed – commercial prawn, crab and recreational fisheries could be impacted
- Labeling of farmed fish so consumers are fully informed and can exercise their right to choose products not exposed to antibiotics, colourants and pesticides.

5.21 Vessels carrying fish from farms for processing should be licensed as fish packing vessels, not as marine cargo vessels.

5.22 CAAR believes that, in view of myriad known impacts of this industry on other species, coastal communities and other marine resource users, a full-cost/benefit analysis of the salmon aquaculture industry should be undertaken. That analysis should examine the externalized environmental, economic and social costs of salmon farming. Ultimately, it is CAAR's position that the industry must be transitioned to closed, contained technology to minimize both its adverse impacts and the cost of regulation.

Appendix A

Excerpts from the David Suzuki Foundation's submission to the Province of British Columbia, prepared in response to consultations on the **Finfish Aquaculture Waste Control Regulation**. (Prepared for the David Suzuki Foundation by Sergio Paone, Ph.D.)

Introductory Comments

The British Columbia government has selected a simplistic performance-based standard to try and regulate the impacts of finfish farming on the ocean benthic environment. We have great reservations about that approach in that there are some serious problems associated with using performance-based standards to try and regulate waste from salmon farms. Such an approach assumes that the ecosystem response to the waste remains constant over time. If the regulations help to achieve the government standard at a given time, changes in the environment may result in those same regulations failing at a different time. This is particularly so if cumulative effects exist.

Performance based standards are also a problem when one considers the variations that occur in the environment from one farm site to the next. Take the example of sulphide concentration. The government is setting one value for this standard. Even if this value proves to be achievable for one site, it may not be appropriate for other sites that may have different environmental conditions.

The BC government's approach is also flawed in that it is not an ecosystem-based one. When considering the effects of fish farm waste on the marine ecosystem, one should include all the effects of that waste on the total marine environment. The draft waste regulations only look at the impact of the waste to the benthic environment in the vicinity of the fish farm, specifically within the tenure boundary. Even then, the area directly beneath the farm is excluded. This is a very narrow view of the pollution that fish farm waste represents. No attention has been given to regional benthic impacts or other long-term regional effects (i.e. nutrient pollution, blooms). Then there is the question of what effect the non-organic components of the waste, such as drugs, pesticides, feed additives and metals have. The… regulations largely ignore this latter problem.

[Ed. Note J. Werring: Levings et. al. (2002) examined the effectiveness of the Performance Based Standards (PBS) approach to monitoring the impacts on benthic fish habitats in the vicinity of fish farms (the approach currently being used by the BC government). **They could not find any scientific information that validated the use of Performance Based Standards to conserve the productive capacity of bottom fish habitat in BC**. They concluded that: "In our view PBS are not effective for integrated coastal management, which is the direction that DFO scientists have recommended for the Department. A system that allows discretionary use of a variety of sampling scales should be developed for B.C. coastal habitats and ecosystems supporting finfish farms and other industries."]

Comments on the… Standards

1) The use of sulphide to measure impact on the benthic community is an oversimplification for several reasons. Some of these reasons are;

1 Sulphide levels can tell you how select benthic communities are initially impacted, but it is not a good measure of recovery. There is usually a lag time between chemical and biological remediation. As sulphide levels begin to go down after a harvest, the point may be reached where it seems appropriate to begin a new production cycle even though little biological recovery may have occurred. This will lead to inappropriate fallow times.

- The biological response to sulphide may not be constant over a period of time. For example, how toxic sulphide is to an organism can depend on what stage of development it's in. Most organisms are more vulnerable to sulphide in their early stages of development (Knezovich, 1996). For many benthic organisms, larvae are produced in abundance during certain seasons (usually spring or summer). Sulphide may affect the benthic community more during these phases of peak reproduction.

- There are other chemicals that could be present in the fish farm waste, such as pesticides, feed additives, metals and drugs, which can affect the benthic community. Measuring sulphide will not account for this.

…[I]t is biological remediation that should concern us, not just chemical remediation. These two processes should not be equated, which is what the … regulations do.

2) The sulphide concentration values used to measure impact are much too high. The government will consider 1,300 micromoles to be a "trigger" and 4500 - 6000 micromoles to be the "standard". … The regional manger might impose penalties if sulphide levels between the trigger and standard values are found, but this is only discretionary.

Based on the available scientific evidence, it is unscientific and careless of the government to set 4500 - 6000 micromoles of sulphide as the acceptable standard. Using these levels of sulphide makes the regulation ineffective. Consider the following;

- Studies show that by 1,300 micromoles of sulphide, the benthic environment is already dominated by sulphide tolerant opportunistic organisms (Brooks, 2001). By this level, up to 90% of the benthic community is made up of only 6 opportunistic species, (i.e. a large reduction in biodiversity). This does not support the use of 1,300 micromoles of sulphide as a "trigger" to determine a level of concern.

- When the sulphide level reaches 4,500 - 6,000 micromoles, even the opportunistic species have begun to die off. The government standard is poisonous to most of the benthic organisms found on the BC coast, including many opportunistic, sulphide-tolerant ones. Such a government "standard" allows salmon farms to create extremely impoverished benthic communities.

3) Even if appropriate values of sulphide concentrations were to be used as the standard,
The BC government's approach is to use a single value for that standard. This fails to take into account the variability in the background sulphide levels that exist in the benthic environment along the BC coast. In the absence of fish farms, benthic sulphide concentrations can vary from as low as 1 micromole up to 1,000 micromoles (Bagarinao, 1993). Due to the wide variation in sulphide tolerance exhibited by different benthic species, the large range in background sulphide levels leads to different types of benthic communities along the BC coast. Increases in sulphide concentrations due to decomposing fish farm waste will have a very different effect on a community adapted to low background levels than it will for one adapted to naturally higher levels.

4) The use of sulphide concentration as a surrogate for biological impact cannot be applied at all to sites that have coarse sediments. For these sites, the government will rely on video surveys to assess impact to the benthic community, and is willing to accept a 50 to 75% reduction in biodiversity for these sites. This approach does not seem to be based on any solid scientific evidence. The use of video surveys to measure changes in benthic biodiversity has not been properly established. There is also no scientific evidence suggesting that a 50 to 75% reduction in benthic biodiversity is a reasonable risk level. Under the Canada Fisheries Act this impact would indeed be a harmful alteration of habitat and therefore a criminal violation of that legislation. … This is an important issue considering that coarse sediments are often used as spawning grounds for many species of bottom fish.

5) For fine sediments, the … waste regulations do not define any biodiversity standard. The reduction in biodiversity allowed for fine sediment sites will be at the discretion of a local manager. The manger will base the decision on biological sampling, done only if the sulphide level goes above 1,300 micromoles. As we saw above, there is already a great deal of impact to benthic biodiversity at this level of sulphide. Any scientific criteria that the regional manager might use to assess what represents an appropriate impact to biodiversity for fine sediments hasn't been made clear. By treating biodiversity impact in such a discretionary manner, the BC government has created a regulation that relies more on value judgment rather scientific evidence. …

6) There is also a problem with how the government measures a reduction in
biodiversity. For example, the government seems to define a 50% reduction in biodiversity simply as the point when 50% of the species are left, without looking at the relative abundance of the species. They read this reduction in diversity from a graph that plots the number of species found under a fish farm as a function of sulphide concentration. This is too simplistic, and it tends to underestimate the amount of impact. What if many of the species left are only represented by a few individuals? As noted above, by 1,300 micromoles of sulphide, up to 90% of the benthic community is made up of only 6 species. At 200 micromoles, those same 6 opportunistic species make up about 10 to 20% of the community on average. The remaining 10% at 1,300 micromoles may consist of many species, but their role in the community has been greatly impacted by their reduced numbers. To properly assess reductions in biodiversity, one must not only count the species but also look at their relative abundance in comparison to what they were before any impact occurred.

7) …the… regulations … completely ignore the impact to the benthos directly beneath the fish farm. The impact is often much higher under the farm than beyond its perimeter.
…

Regulation Omissions.

…One type of regional impact from salmon farm waste is the impact on the benthos beyond the tenure boundary. Studies in the Bay of Fundy have shown that salmon farms can impact the benthic community on a regional basis (Pohle, 2001)

Another type of regional impact is the link between nutrients released from decaying waste and plankton blooms. As the salmon farm sewage decays it releases nutrients such as nitrogen and phosphorous into the water. Changes in nutrient levels can alter the plankton community, since the different plankton species have varying degrees of response to changes in nutrient levels. Evidence from outside of BC shows that the excess nutrients added to water by fish farms can result in higher incidences of plankton blooms. Some of the key findings include:

- Increased growth of attached filamentous algae near fish cages in Baltic archipelagos (Ruokalathi,1988; Ronnberg,1992)

- The establishment of a link between blooms of the toxic plankton algae *Prymnesium parvum* , which killed 750 tonnes of salmon and rainbow trout in fish farms in a Norwegian fjord, and the nutrient loading from the fish farms (Kaartvedt,1991).

- A monitoring program between 1988 and 1997 looked at 4 sites in the Quody Region of the Bay of Fundy. Two sites were located near fish farms whereas the other two were located away from fish farms. The waters near the fish farms had higher levels of a diatom known to cause blooms in the area (Smith, 2001).

- In hybrid striped bass aquaculture ponds, dinoflagellate blooms were found on 10 of 14 occasions to co-occur with concentrations of urea (caused by sewage decomposition) in excess of1.5 mM nitrogen. When urea levels were <1.5 mM nitrogen, on seven occasions, no evidence of dinoflagellate blooms was observed in these ponds (Gilbert, 1999).

Of course plankton blooms are naturally occurring events that can be influenced by many physicochemical factors. One of these factors is nutrient concentrations and ratios. The nutrient loading caused by fish farm sewage must be taken into account and should be part of any program that proposes to monitor and regulate fish farm impacts.

Other impacts from salmon farm waste that are not covered by the BC … regulations are.

- The impact of chemicals such as persistent organic contaminants, metals, feed additives, pesticides and other drugs is being ignored. With metals, there will be a small amount of monitoring, but the method used for monitoring is not appropriate. Zinc and copper concentrations are measured by taking a sediment sample and then homogenizing it before concentrations are measured. This is not the best way to conduct these measurements unless you are trying to average out the high values. As chemicals are deposited by the sewage, one would expect a vertical concentration gradient. The chemical would be more concentrated on top of the sediment and diminish as one digs into the sediment. By homogenizing the sediment, the vertical chemical gradient is destroyed. This could underestimate the concentration of the chemical on or very near the surface of the sediment. This would especially be important to consider for impact to the epifauna.

- In measuring zinc and copper, there is an added problem. These metals are most toxic when they are in their dissolved, ionic forms (i.e. Cu^{2+}, Zn^{2+}). But this is not what is being measured. The metal concentrations are being measured as weight of copper or zinc per gram of dry sediment, after the sample was homogenized. This doesn't tell us the concentration of the metal ions in the water found in the sediment pores, which is a more appropriate measure of toxicity (Peterson, 1996).

- Disease organisms can be present in the waste from farms that are experiencing a disease outbreak. For example, the IHN virus, which has been causing problems recently on several farms in BC, is found at high concentrations in the feces of infected fish (Kent, 1998).

- Genetic pollution from antibiotic resistant bacteria found in the waste from salmon farms using antibiotics. The genes that give the bacteria the ability to resist antibiotics is often found on plasmids, which can be transferred between most bacteria. The use of antibiotics selects for these resistant forms of bacteria. A salmon farm using antibiotics puts out resistant bacteria and therefore puts more of the plasmids that contain the resistant genes into the environment.