**Exhibit C**

Fish Feedlot Impacts from Toxic Chemicals, Pollution and Escaped Invasive Fish

**Toxic Chemicals and Pollution**

Since a typical British Columbia salmon feedlot is holding from a half million to one million adult fish, significant fish wastes can accumulate under and around salmon feedlots and degrade habitat surrounding the feedlot, smothering portions of the ocean bottom, contaminating the marine ecosystem and depriving species of oxygen (Findlay and Watling 1997; Pohle et al. 2001; Lampadariou et al. 2005). Even if the bulk of the waste is carried away from the feedlot site by ocean currents, it is going somewhere and can cause localized pollution in other areas.

Salmon feedlots add drugs - such as antibiotics and therapeutants - to salmon feed, and chemicals - such as antifoulants and disinfectants - are also released into the environment by feedlots in an attempt to control unwanted organisms and diseases. Vaccines and antibiotics are used in salmon feedlots to control infections. Vaccines are given by inoculation but antibiotic treatments are typically done through medicated feed, which increases the chance that antibiotics will pass into the environment, either directly or through the feces, affecting wildlife and other organisms and remaining for long periods of time. Little is known about how these chemicals affect the marine ecosystems, however, studies investigating contaminants near British Columbia salmon feedlots found that rockfish near salmon feedlots had elevated levels of mercury compared with rockfish found elsewhere; parasites, tumors and lesions have been found on ground fish harvested near salmon feedlots; and clam beaches used by First Nations in the Broughton Archipelago have been destroyed by the accumulation of black muck and sludge that has been attributed to salmon feedlot waste (BCAFC 2004; DeBruyn et al. 2006).

Salmon feedlots can use a variety of methods to attempt to prevent and treat sea lice outbreaks and pathogen transmission, including closed containment aquaculture, proper site location, separating year classes, minimizing crowding, fallowing, feedlot maintenance and husbandry to help prevent outbreaks; and chemicals and drugs to treat feedlot salmon after an outbreak occurs (Costello 1993; SHC 2003). British Columbia salmon feedlots do not utilize some of the primary methods to prevent sea lice outbreaks, which are: using closed containment; proper site location, which maximizes the chances that feedlot salmon will be healthy by ensuring that feedlots are not located near potential sources of infection, such as salmon-bearing streams, migration routes and other salmon feedlots; and separating year classes, which prevents smolts (i.e. the lice-free, freshwater juveniles) from contacting the older and already lice-infested fish. Mapped locations of siting of salmon feedlots in British Columbia makes it clear there are no instream or estuarine locations for an industry this size to move to that do not include wild salmon migration routes.

Fallowing, which breaks the reproductive cycle of sea lice, appears to have only been used sparingly in British Columbia, and then only in response to severe crises. Fallowing is taking all of the salmon out of a feedlot and leaving it empty for one production cycle (two years) to allow the seabed below the feedlot to recover from damage caused by the feedlot and break the cycle of sea lice and other disease infestation in that feedlot. Fallowing is most effective if all the feedlots in an entire archipelago or channel are emptied; making it much less likely that feedlots will be reinfected by their neighbors. To be effective, fallowing must be done in conjunction with a separation of year classes to ensure that smolts are not infected by adult fish in the same feedlot. Morton et al. (2005) reported on a three-year study of sea lice infestation rates on wild juvenile pink and chum salmon in the Broughton Archipelago, following a 2003 British Columbia Ministry of Agriculture, Food and Fisheries (MAFF) order for fallowing along the presumed migration route of wild juvenile Pacific salmon in this area. Morton et al. (2005) assessed the effectiveness of fallowing by comparing sea louse infestation rates on wild juvenile salmon near three Atlantic salmon feedlot sites prior to, during, and after fallowing, and found that overall, *L. salmonis* levels were significantly reduced at the study sites during fallowing but returned to the original level after restocking.

The primary treatment for sea lice infestations in British Columbia salmon feedlots is a reactive treatment of a chemotherapeutant given to feedlot fish in food after a sea lice infestation has occurred. Although diluted by surrounding water, the chemicals entering the marine environment via feces may affect non-target wild crustaceans and may remain in the environment from ten days to six months (Horsberg et al. 1987; Costello 1993; Roth and Richards 1993; Fraser 1995; Roth et al. 1996; Erdal et al. 1997; Hart et al. 1997; Ritchie et al. 1997; Treasurer and Grant 1997; Valles and Koehler 1997; Roth 2000). The ability of sea lice to develop resistances to chemical treatments is also a major issue (Hammell 2002) and has led to use of bath treatments, which release the drug directly into surrounding waters.

Even though the Canadian federal and provincial governments insist that sea lice are not a problem (Marty et al. 2010a), commercial salmon feedlots still find it necessary to deposit significant amounts of chemical neurotoxins into coastal waters in order to address the “non-problem.” Canadian federal rules require Atlantic salmon aquaculture to monitor the abundance of sea lice on their feedlots once a month, and take definite and rapid action in the form of chemical treatment if an average of three motile lice per fish are observed during juvenile March to July wild salmon out-migration times (DFO 2011a). The government’s treatment threshold of three lice per fish is not based on any science and is a purely arbitrary number. Lice loads which may not be a “problem” for large, commercially raised Atlantic salmon can easily cause problems for the much smaller wild salmon.

The chemical treatments for sea lice infestations of salmon feedlots have potential consequences as ecologically drastic as the sea lice themselves. The primary chemical weapon used on sea lice in British Columbia salmon feedlots is emamectin benzoate, sold under the trade name SLICE. Emamectin benzoate is in a class of chemicals called avermectins, axonic poisons which act by lethally interrupting the neurological processes sea lice feeding on the salmon’s treated tissue (Schulman et al. 1985; Valles and Koehler 1997). SLICE is added as a coating on commercial fish feed and is absorbed into the tissue of salmon, where it takes about a week to be eliminated (SPAHC 2002).

Emamectin benzoate use in British Columbia salmon feedlots began in 2000 and increased steadily through 2005: in 2003 0.1 gram of emamectin was used per metric ton of fish; that increased in 2004 to 0.17 g/mt; and to 0.27 g/mt in 2005; and use averaged just under 0.2 g/mt from 2006 to 2008 (BCMAL 2005, 2008). Use figures since 2005 translate to an annual average of 7,240 kilograms of SLICE used by salmon aquaculture in British Columbia to treat lice-infested fish. Although chemical industry and Canadian government agencies claim that SLICE is safe (SPAHC 2002; MAFF 2003), studies show that SLICE can have significant effects on species other than the targeted sea lice, including other crustaceans (such as copepods, shrimp, crab and lobsters). In fact, the label of the pesticide "Proclaim," in which emamectin benzoate is the only active ingredient, clearly warns that "[t]his pesticide is toxic to fish, birds, mammals, and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash water" (Novartis 1999). Documented effects of emamectin benzoate on other crustaceans range from disruption in molting and breeding behaviors to death (SEPA 1999; Haya et al. 2001; Brooks et al. 2002; Waddy et al. 2002; Bright and Dionne 2005). Because of its low solubility in water, SLICE is very likely to bioaccumulate in marine sediments, possibly to levels toxic to nearby marine animals (Brooks et al. 2002).

Despite these findings, the Canadian government has not been quick to seek an understanding of the negative effects SLICE has on the environment near treated feedlots, and describes its level of understanding as "extremely sparse" (Bright and Dionne 2005). Environment Canada acknowledges substantial knowledge gaps in data on chronic (as opposed to acute) toxicity; ecologically relevant effects other than mortality; endocrine disruption effects (e.g., altered moulting and reproduction); and toxicity data for benthic meiofauna such as nematodes, which are potentially sensitive and ecologically important indicator species (Bright and Dionne 2005).

SLICE is classified as a drug because it is fed to commercially raised fish rather than applied externally. Drugs are regulated by the Food and Drugs Act, whereas pesticides are regulated by the Pest Control Products Act (CFIA 2003). SLICE has yet to be tested for food safety by the Canadian Food Inspection Agency (CFIA 2001) or to be permitted for use through the Pesticide Control Act. Up until June 2009, salmon aquaculture in British Columbia used SLICE to control sea lice through the Emergency Drug Release Program (EDR), which allows the use of non-approved drugs when recommended by veterinarians for emergency situations (MAFF 2003). In June 2009, the Bureau of Veterinary Drugs (Health Canada) quietly approved the use of SLICE. Health Canada has refused to release the research supporting the approval, since it was conducted by the manufacturer, and is "proprietary information" not available to the public.

SLICE's commercial approval in 2009 was accompanied by the lifting of a prior mandatory withdrawal period of 68 days between the last use of SLICE and harvest of treated fish for human consumption. Yet SLICE's active ingredient emamectin benzoate can remain in the tissues of treated salmon for weeks or even months. The U.S. Food and Drug Administration has listed emamectin benzoate as an unapproved drug that should not be used on fish destined for consumption in the U.S. According to British Columbia Ministry of Environment information, on average, SLICE is used at least once during the production of every feedlot salmon from British Columbia (CAAR 2009). From 2001 to 2003, an annual average of 40 million Canadian feedlot salmon were treated with SLICE, according to Health Canada, Emergency Drug Release documents (Cox 2004). Canada exports the majority of its "farmed" salmon to the United States.

There is emerging evidence that SLICE is becoming ineffective in treating sea lice in some salmon feedlots (DFO 2009b). There are reports from Chile, Norway and Canada's east coast indicating that sea lice are showing signs of resistance to emamectin benzoate treatments, likely due to frequent and heavy applications (Lees et al. 2008). Since sea lice may have begun evolving a resistance, some fish feedlots outside of British Columbia are replacing

SLICE with deltamethrin, another neurotoxin marketed as Alphamax, for the treatment of sea lice. Alphamax is known to be relatively toxic to fish and invertebrates and acutely toxic to crustaceans (Bellona Foundation 2009). Alphamax is administered via a chemical bath: the net-cages are surrounded by tarps, fish soak in pesticide solution and then the tarps are opened and the chemical is released into the ecosystem. DFO has acknowledged concerns regarding Alphamax's "effect on other marine species and the eco-system in the vicinity of aquaculture cage sites" (DFO 2009b).

A salmon feedlot in New Brunswick, Canada was charged in November 2011 with violating the Canadian National Fisheries Act for illegal use of cypermethrin, an agricultural pesticide prohibited for use in marine environments. Illegal use of this pesticide in 2009 and 2010 killed hundreds of lobsters in the Bay of Fundy in at least three different sites near the fish feedlot. There are limited legal or environmentally acceptable options available to these companies to deal with sea lice as they become resistant to the less toxic drugs.

**Escaped Invasive Fish**

Salmon feedlots pose the risk of escape of non-native fish from pens. Feedlot salmon can and do escape into the natural environment, but the extent of the problem is not researched and unknown. Storms, equipment failure, attacks by marine mammal predators or human error can all result in significant release of feedlot salmon into the surrounding water. Over time, even more salmon can escape due to smaller accidental releases or escapes referred to as "leakage."

All aspects of the issue are debated—from the numbers of escaped fish to the impacts on the genetic, biological and ecological status of wild salmon. Escaped fish have the potential to spread disease and parasites, as well as compete with wild salmon for food and habitat. Although the majority of commercial raised salmon in British Columbia are Atlantic salmon, coho and chinook are also kept on feedlots, which poses the added risk of interbreeding with wild salmon and genetically affecting indigenous stocks, potentially decreasing wild salmon biodiversity.

The decision to raise alien Atlantic salmon in Pacific waters largely came from the entry of Norwegian companies into the British Columbia aquaculture industry. Atlantic salmon was the aquaculture species of choice in Norway, and for decades the companies invested in developing markets for this product. In the late 1980s, Norwegian companies were faced with strict environmental regulations and feedlot size restrictions in their own country, so they expanded into countries where regulations were less strict, such as Canada and Chile (Marshall 2003).

Genetic risks to wild salmon are greatest with aquacultured Pacific salmon, almost all of which are now Chinook. The potential for interbreeding between feedlot and wild Chinook is high, whereas genetic differences make it unlikely that feedlot Atlantic salmon would breed with wild Pacific salmon (Allendorf and Thorgaard 1984). Because interbreeding decreases genetic diversity, disease resistance and adaptability, the genetic risks associated with escaped native feedlot salmon are serious (Gardner and Peterson 2003). The main ecological concern is how feedlot fish may impact wild fish. Escaped feedlot salmon—both Atlantic and Pacific—are capable of competing with wild salmon for food and habitat. Invertebrates and juvenile fish (including salmon) have been found in the stomachs of feedlot Atlantic salmon

(Black et al. 1991; Morton and Volpe 2002). Particularly worrisome are interactions between wild and feral feedlot salmon on the same spawning grounds (Gardner and Peterson 2003). Regardless of unsuccessful attempts to introduce Atlantic salmon to wild salmon rich British Columbia rivers from 1905 to 1934 (MacCrimmon and Gots 1979; Alverson and Ruggerone 1997), escaped Atlantic salmon have now been documented in some 80 British Columbia rivers and are known to have spawned in the Tsitika River on northern Vancouver Island (Volpe et al. 2000). Rivers or streams with diminished wild Pacific salmon have lower 'biotic resistance' to colonization by Atlantics (Volpe et al. 2001). The impact escaped feedlot Atlantic salmon have on wild Pacific salmon depends on how effectively the Atlantic salmon adapt after escaping. One European study indicates that feedlot Atlantic salmon can adapt very well, since escaped feedlot salmon are routinely caught by commercial fishermen seeking wild salmon. In the Faroe Islands, between 20 and 40% of all fish caught are escaped feedlot Atlantic salmon (Hansen et al. 1998).

Understandably, the number and magnitude of salmon escapes in British Columbia are difficult to determine. The British Columbia Ministry of Agriculture, Food and Fisheries (MAFF, now called BCMAL) reported a total of 500,000 feedlot salmon (mostly Atlantics) escaped from pens between 1992 and 2000 (MAFF 2003). According to BCMAL, over 1.5 million feedlot salmon escaped into British Columbia waters between 1987 and 2008 (BCMAL 2008). From 1995 to 2000, BCMAL reported losses of an average of 46,255 feedlot Atlantic salmon annually into British Columbia coastal waters. However, these figures likely grossly underestimate escapes. Morton and Volpe (2002) collected 10,826 Atlantic salmon caught by commercial fishers on British Columbia fishing grounds in 17 days of open fishing periods in 2000, 40% more than DFO's passive monitoring program reported caught over 8 weeks of the same fishing period. Research done in British Columbia estimates that 0.5 to 1 percent of juvenile Atlantic salmon in production "leak" from their pens each year (Alverson and Ruggerone 1997). One percent of the approximately 80,000 tons of feedlot salmon produced each year in British Columbia translates into approximately 160,000 additional feedlot salmon escaping into British Columbia's marine environment on a yearly basis. Other researchers have estimated continuous leakage of as high as 3% (Morton and Volpe 2002), which would translate into nearly half a million escaped feedlot salmon. Escaped feedlot salmon are usually recorded within 500 km of the escape site, but have been recorded up to 2,000 to 4,500 km from the escape/release site (Thorstad et al. 2008).

The Atlantic Salmon Watch Program is a joint initiative between DFO and BCMAL. Although there are questions whether this initiative is still functional, the program has in the past conducted monitoring and removal of escaped Atlantic salmon from streams and reported observations of escaped Atlantic salmon in over 80 British Columbia rivers. It also documented juvenile Atlantic salmon, indicating successful spawning, in three British Columbia rivers.