Assessing the impact of harmful algal blooms on wild salmon populations in BC: planning for a HAB monitoring program

Nicky Haigh, Harmful Algae Monitoring Program, Vancouver Island University, Nanaimo

The past years' poor returns of Fraser sockeye stocks, and eyewitness accounts of wild salmon mortalities due to harmful algal blooms (HABs) in BC (coho / *Pseudochattonella* in Quatsino Sound, Sept 2008, Dave Guhl, Marine Harvest Canada; chum and pinks / *Heterosigma* near Klemtu, August 2009, Andy Haslam, Marine Harvest Canada, pers. comm.) suggest that the past position of "HABs do not affect wild salmon in BC" has been, at best, a little optimistic. The tendency of dead fish to sink in temperate waters, and the expanse of the little-visited coastline of BC, have perhaps made this a problem that was less likely to be perceived. However, with the past eleven years of HAB monitoring by the salmon aquaculture industry with the Harmful Algae Monitoring Program (HAMP), we have a better understanding of the extent of the HAB problem in BC, and the presence of the salmon farmers have increased the environmental monitoring in these remote regions. It seems imperative now that we increase HAB monitoring in BC to try to assess the effects of harmful algae on wild salmon populations.

In order to assess the effect of HABs on salmon we need to either monitor where the fish are, or where the blooms are, to measure the impact when they intersect. Unfortunately, there is still a lot we don't know about where the salmon are, and where the HABs occur in BC. Like salmon, HABs move around, may be found in different areas at different times of the year, and are affected by many different environmental parameters. Below is a short summary of some of the things we do know about the harmful algae of BC.

There are several species of algae known to cause mortalities in finfish in BC. The harmful diatoms *Chaetoceros convolutus* and *C. concavicorne* kill fish by a process of mechanical irritation of the gills, which eventually causes the fish to suffocate due to mucus build-up. These species, which usually bloom in the spring and the fall, are accepted as less likely to affect wild salmon, as the blooms are often patchy, cause a sub-lethal irritation, and the fish are usually able to swim away from, or below, the bloom. Of greater concern are the toxin-producing algae: *Heterosigma akashiwo, Chattonella* cf*. marina, Pseudochattonella* cf*. verruculosa, Cochlodinium fulvescens, Chrysochromulina* species*, Dictyocha* species, and *Alexandrium catenella* and *A. tamarense*.

Of the toxic algae species known in BC, *Heterosigma akashiwo* is of the greatest concern; every year this species of algae causes mortalities to farmed salmon somewhere on the coast of BC. *Heterosigma* is also well-known to bloom in Georgia Strait every year in the early summer, and also, frequently, in September. *Heterosigma* blooms are usually reported in Vancouver Harbour from early June, and then appear to progress northward in the Strait of Georgia through June and July. *Heterosigma* is usually first seen in Departure Bay in mid to late June; however, in late May 2007 there was an anomalously early, very thick bloom of *Heterosigma* in Departure Bay. This 2007 bloom was also reported to kill fish in Washington State fish farms. It should be noted that *Heterosigma* is not always toxic to fish, but the environmental or other trigger that causes this species to become toxic is not known. *Heterosigma* also frequently blooms on the west side of Vancouver Island, and in the Central Coast area. In these areas

the blooms usually happen in late August through September, although blooms in July and October are sometimes seen.

Other toxic algae species, while less common, are also of concern with respect to effects on wild salmon stocks. *Pseudochattonella* cf. *verruculosa*, a species that was just recently identified in Quatsino Sound, killed farmed salmon, and also wild coho salmon, in the area. *Cochlodinium fulvescens* (previously called *C. polykrikoides*) formed thick blooms in the west coast inlets of Vancouver Island in August and September 1999, and it was reported by the locals that the thick bloom in Quatsino Sound and Holberg Inlet (which killed farmed salmon) delayed the return of chum salmon to spawn in local rivers. *Chrysochromulina* species have been reported to bloom in BC waters from April through to September. These species have not been reported to kill wild salmon in our area, but they have caused mortalities in farmed fish, and have been responsible for large wild and farmed fish kills in Europe.

The extent of the HAB problem in BC and its effect on the wild salmon has been largely overlooked in the past. In order to effectively assess it now we need to do several things:

- monitor areas away from salmon aquaculture operations, where there is little or no HAB data
- monitor areas known to be important to juvenile and returning salmon stocks
- isolate and culture harmful algae species from known fish-killing blooms in BC, in order to fully identify these species, assess harmful levels, and develop non-microscopic methods of HAB detection

Monitoring of harmful algae is still primarily done by microscopic analysis of water samples. This allows us to identify and quantify species, which is necessary to determine whether they are likely to impact fish. Non-microscopic methods are in development (HPLC, genetic probes), but there does not yet appear to be a good method for routine monitoring. Again, for these methods it is necessary to know exactly what species of algae one is monitoring for, and unfortunately we are not yet at that point in BC.

I propose that an effective monitoring of the possible impacts of HABs on wild salmon stocks in BC would include several sites in the Georgia Strait area and in Barkley Sound, monitored weekly throughout the plankton season; co-ordination with the salmon aquaculture industry to share the information that they have on HABs in other areas; and, also in cooperation with the salmon aquaculture industry, isolation and culturing of harmful algae species from known fish-killing blooms.