

**From:** Heinonen, John  
**Sent:** Tuesday, June 6, 2006 2:12 PM  
**To:** MacDonald, Steve <MacDonaldSt@pac.dfo-mpo.gc.ca>  
**Cc:** Nutton, Byron <NuttonB@pac.dfo-mpo.gc.ca>; Hwang, Jason <HwangJ@pac.dfo-mpo.gc.ca>; Morrison, John <MorrisonJo@pac.dfo-mpo.gc.ca>; Patterson, David <PattersonD@pac.dfo-mpo.gc.ca>  
**Subject:** RE: Nechako monitoring program

---

... see comments inserted in text below

John Heinonen

physical scientist  
Oceans, Habitat and Enhancement Branch  
Fisheries and Oceans Canada

Suite 200 - 401 Burrard Street  
Vancouver, BC V6C 3S4

Telephone: (604) 666-0126 (Téléphone)

Fax: (604) 666-0292 (Télécopieur)

E-mail: heinonenj@pac.dfo-mpo.gc.ca (Courriel)

cogito ergo sum

/ Direction des océans, de l'habitat et de la mise en valeur

/ Pêches et Océans Canada

/ 401, rue Burrard, bureau 200

/ Vancouver, (C.-B.) V6C 3S4

---

-----Original Message-----

**From:** MacDonald, Steve  
**Sent:** June 3, 2006 12:57 PM  
**To:** Hwang, Jason  
**Cc:** Patterson, David; Heinonen, John; Morrison, John  
**Subject:** Nechako monitoring program

Jason

Having had a fair bit of experience recently with the Nechako watershed flow and temperature database, I feel I can reliably point out the gaps and problems with our current data gathering procedures. Since the early 50's much data has been collected and through the efforts of John Heinonen, we now have most of the information in a single accessible database. However, allow me to point out some of the flaws and gaps in our approach to data collection in the past on my way to proposing a solution (which unfortunately will require some financial resources to correct).

1) Several sites need to be upgraded or added to the current monitoring design for flow and temperature. For instance, the lower Nechako and Stuart systems have been inadequately sampled in the past. Upgrades should also be considered at the Nautley confluence *In the Nechako? The Nautley (it is a very short river so I don't think so)? Upstream? Downstream?*. These sites, in addition to Irvine's, are required to operate and verify the IOSRTM model that we have used to assess the influence of the STMP and the CWR proposal at the Kenney Dam. If future temperature control policy is to consider temperature targets below the confluence of the Stuart, these data will be required - probably on a real-time basis. *Temperature targets should always be directly and rationally linked to "fish currency". Temperature targets should not be blindly fixed from year to year but need to be tied (if possible) to conditions experienced en route in the ocean and Fraser River. In high stress years, due to ocean and/or Fraser River conditions, lower Nechako River temperatures should be sought. Likewise, if ocean and Fraser River conditions have been particularly favourable, perhaps slightly higher Nechako River temperatures would be tolerable?*

DFO-166072

\\svbcvanfp01\Cohen-Comm\Personal\_Drives\David Pat  
terson\Email 01\Cohen - [David Patterson]\Incoming  
Mail\2006\

CAN084237\_0001

2) Questions exist as to the reliability and data relativity of several existing collection sites. There are three sites on the Stuart and three in the mid-Nechako reach (Vanderhoof area) that show unexpected disparity on some occasions. *These may be due to changes in channel morphology, wetted width and flow patterns at a site that render fixed sensor locations "non-ideal" at key times. When sensors such as Miniloggers are removed for downloading they are also not necessarily replaced in the same exact location. The transition from thalweg to river margin water temperatures may be abrupt. Sensors that do not require removal for downloading (such as thermistors connected to Starloggers) may shift in location due to sedimentation, debris impact, erosion, current, ice forces and vandalism/tampering. If sensor location is not checked regularly then data can gradually or suddenly become unreliable. Sensors, connections and cables can also deteriorate over time, giving "wonky" data output. The worst kind of poor data is only slightly different from good data and thus difficult to detect. QA/QC is not a simple task on such a project. Multiple back-ups are appropriate if premium quality data is desired.* Several years of careful data collection are required to better understand the dynamics of these sub-systems in order to assign levels of "quality" to past databases and to choose future collection sites with care.

3) To date, we have assumed that temperatures are homogeneous in river cross section, an assumption that is likely erroneous particularly directly downstream of major tributaries (e.g. the Stuart and the Nautley). This is not a critical problem from the standpoint of modeling temperatures in the entire watershed, but from a fisheries standpoint it must be understood. For example, if the cold water release were to be constructed, the accuracy of our assumptions about the effect of cold shock will depend on an accurate estimate of rate and distance required for two water bodies (with different temperatures and densities) to mix. The distance required for the Stuart and lower Nechako to mix will influence our estimates of exposure time to high water temperatures. Therefore, at selected sites a cross sectional analysis of the water column will be required several times thru the season. *River temperature variation across the Nechako River channel cross-section was the subject of a DFO technical report in the mid-80's, it isn't perfect but it does give an indication of the variability of water temperatures. Mixing dynamics are complex (time and space) and will no doubt depend on channel morphology around confluence areas, both upstream and downstream, as well as the relative discharges and temperatures of the joining rivers. The range of combining variables is great so the solution can be expected to also be complex (i.e. possibly also highly variable). The mixing length can be anywhere from zero (effectively, when both water in both channels are at the same temperature) to ???km ... when they are not. How is "mixing" or "mixed" to be defined, given that temperature is likely never uniform from bank to bank, or from riverbed to water surface? Is mixing important to fish, or do they "choose" what is best for them at a given time and location? Can fish "choose" what is the best temperature water for them if they are on the "wrong side" of an unmixed reach in a wide river such as the Nechako? In considering mixing, is it enough to have temperature measurements, or are parallel "at-site" (not extrapolated from some distant station) discharge/velocity measurements also required to accurately analyse each scenario?*

4) The existing monitoring program as it pertains to the needs of DFO and other fisheries interests suffers from lack of leadership and therefore our data consistency and quality is in question and uncontrolled. Some support for a P/Y to oversee the collection methods and resulting databases is required. Ideally this person should be based in the area as even with today's automated collection methods frequent site visits are the only guarantee to high quality data. If possible we intend on seeking assistance from water survey of Canada in monitoring some of the sites. *Temperature has been measured by various means since 1950 and each of these need to be clearly documented to qualify the level(s) of uncertainty "baked into" the various component parts of the temperature database. Location of the temperature sensor(s) within the channel cross-section may be as important as sensor accuracy, perhaps even more so. It may be impossible to document sensor location for the historic data. When I modified the temperature logger set-up in 1996 we put three thermistors on the end of the cable and added Miniloggers as a back-up. We placed sensors in the thalweg (as best we could), weighted on the bottom. I think that all temperature monitoring in support of watershed scale modelling should focus on the thalweg temperature, if there is a "river water temperature" the thalweg temperature would be it.*

5) We intend on seeking matching funds from a variety of agencies because I expect the continuous collection of these data are of interest to a variety of disciplines. The Province will likely use these data for fisheries and agriculture interests as well as the analysis of the effect of forest losses to beetle kill. Environment Canada can use these data to consider climate change, and of course there is Alcan.

We anticipate start-up costs for equipment that may approach 50K for the first year (more if real-time equipment is required) and another 50K a year to run the program. *I think these are under-estimates.*

Any ideas how we could put this together.

S.

\\svbcvanfp01\Cohen-Comm\Personal\_Drives\David Patterson\Email 01\Cohen - [David Patterson]\Incoming Mail\2006\

CAN084237\_0003