BEFORE THE MANAWATU WANGANUI REGIONAL COUNCIL

IN THE MATTER OF The Resource Management Act 1991

AND

IN THE MATTER OF Hearing on Submissions Concerning the Proposed Horizons Regional Council One Plan for the Manawatu Wanganui region.

Speaking Notes & Supplementary Statement of Evidence of Dr Mike Joy on behalf of Wellington Fish and Game & The New Zealand Royal Forest and Bird Protection Society

---

SPEAKING NOTES & SUPPLEMENTARY STATEMENT OF EVIDENCE OF Dr MIKE JOY

1. Introduction

1.1 My name is Dr Mike Joy, and I have the qualifications and experience described in my evidence in chief.

1.2 I have read the Environmental Court's Code of Conduct for Expert Witnesses (Section 5 of the Environment Court Consolidated Practice Note 2006), and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

1.3 I am a Freshwater Ecologist and Senior Lecturer at Massey University in Palmerston North. I have researched freshwater ecosystem health, especially in relation to what it is and how to measure it, mainly using native fish for the past 16 years. I have published about 16 peer reviewed scientific articles on this area of research, mostly in international publications and have done around 100 scientific reports and presentations for regional councils and government departments and NGO groups. I am giving this submission on behalf of Forest and Bird and Fish and Game New Zealand.

2. Speaking Notes

2.1 From what I have seen there has been a lot of very confusing evidence presented at this hearing about the ecological health of rivers in this region particularly the Manawatu River and how the condition has changed over time. The confusion stems from two sources: 1) the fact that much of the scientific data comes from one-off grab samples which very poorly represent the actual condition of a flowing water system. This is simply because these snapshot samples of attributes vary enormously daily even hourly, and 2) additional confusion comes from the intentional obfuscation of these measures by some submitters with a vested interest in maintaining the status quo.

2.2 Measures of the functional responses of rivers, and the resulting effects of the functional processes on the distribution and structure of fish and macroinvertebrate communities, are the best way to truly and accurately measure the health of freshwater ecosystems. Functional measures and biomonitoring has been recognised globally to be far superior to snapshot water quality (WQ) samples by environmental managers in Europe (EU Water Framework) and the USA (USEPA). The whole idea of "water-quality" is very abstract; river water doesn't exist in a test tube - the life of the river can't exist without suitable habitat. For Example, you can have great habitat but if the water is devoid of O_2 then nothing can live in it. In other words you can't have one without the other and neither can be considered in isolation.

2.3 The reasons that functional and biomonitoring measures are superior are simple and understandable. The reason we take the snapshot WQ samples (apart from being a leftover from a time when freshwaters were seen to have little value so little effort was made, and limited technology was available) is to try to estimate what levels will indicate or lead to a negative impact on the river ecosystem. Without doubt it is much more rational to go directly to measuring how the river responds functionally and biologically to those inputs. The functional responses are measures like ecosystem metabolism, which drive the changes in invertebrate and fish communities by altering their distribution.

2.4 The best example of the difference between snapshot WQ samples and functional and biological measures is dissolved oxygen levels. The GPP and ER work done by Roger Young showed the massive swings that dissolved oxygen (DO) go through over a 24 hr period in a degraded system. If you were to take a snapshot WQ sample of DO levels (the way NIWA does in the morning or when the technician gets there) they would change by an order of magnitude in a few hours, from levels that are lethal to almost all life (< 40% O_2 saturation) to levels that look about right for a healthy system, then later in the day to super saturation levels.

2.5 Roger Young's GPP and ER results are a perfect example of the rivers functional response and the effects on stream life. The river is responding to excessive nutrient levels the only way it can, by trying to assimilate them. But because it can't we see the massive swings and oscillations in O_2 levels - the ecosystem is going out of control. The resulting effects on fish and invertebrates are completely in agreement with these functional responses; the fish and invertebrates can't handle these fluctuations and thus, they are no longer present either by death or avoidance. I will go into fish distribution in more detail later.

2.6 The nutrient concentration data have also formed the basis of many of the technical arguments about statistical reliability and whether temporal trends were significant or not. I have to again emphasise that they are snapshots and these concentrations of nutrients vary over time, along even short lengths of the river. Obviously if you collect enough snapshots you can begin to form a picture but what we need is a movie to understand the river as a whole, and while snap shot samples do undoubtedly have some limited use to set limits, as have been proposed by horizons in the one plan, they do not tell the whole picture in regards to the health of aquatic ecosystems spatially and temporally. Continuous monitoring, even over 24 hours, of nutrient levels shows just how variable these concentrations are as key nutrients are taken up and released through biological activity and changes in contaminant loadings from both point and non point source discharges.

2.7 Fish are excellent bio-indicators of the state of rivers because they integrate all important impacts on the river over long time periods and they can tell us much

about its condition. Unfortunately, we don't have the same long term dataset, per region, to analyse as we do for the WQ samples to show statistical trends over time. Nobody was out doing comprehensive fish samples 50 or even 20 years ago, and there are very few sites that have been sampled regularly over time. However, because we do have a large database of information on fish distribution nationally it was possible to look at time and landuse trends in relation to fish populations, using that database, to predict changes in regional populations, which I will describe in more detail.

2.8 So the solution for the lack of long-term fish distribution data in the Manawatu catchment was to use a surrogate for time, that is; where fish are found now compared to where they should be. In the case of fish there is little point comparing the distribution now with what it was pre-human as that would obviously be unattainable, but what we can do is compare the present distribution of fish in the Manawatu catchment with what is present elsewhere in New Zealand at sites with similar climate, geology, hydrology, and landcover.

2.9 Effectively what I did was to compare what is now in the Manawatu with what should be there if it had the average amount of impairment found in the rest of the North Island to quantify what has been lost over time. To do this I used a predictive model of fish distribution for all the North Island except the Manawatu River. The predictive model links spatially explicit GIS maps of climatic, geological, hydrological and landuse/landcover mathematically to where the fish species are found. The predictive model is extremely accurate and similar models, referred to as fish maps are used by most North island Regional Councils and they have been published in international journals and are often cited as the most accurate globally due to the quality of the available GIS habitat data in New Zealand, the large number of sites in the NZFFDB.

2.10 Using these maps I found that 75% of the catchment no longer has the migratory galaxiid and gobiomorphus (adult whitebait and bully species) that should be present. But each species has a specific natural distribution that can be less than that. So I looked at them on a species by species basis. For example the koaro (adult white bait) is missing from > 80% of its expected range. They should occur at 975 km of river length in the Manawatu but now are only found in 156 km so are missing from 819 km. To give you some idea of the magnitude of this loss a very conservative estimate of the number of adult fish missing would at least a million fish. If this had happened over night I think we can all manage the uproar with a million dead fish washed up on the banks of the river.

2.11 Almost all of the native fish in this region initially migrate upstream to get to their chosen habitat so they must make a series of choices at each river tributary junction, and my modelling shows they make these choices based on the condition of the river choosing the least of the two sediment and nutrient levels upstream.

2.12 To confirm this I set up an experiment to see if the fish could chose between tributaries using a blind choice test. The experiment was set up on the banks of the Manawatu River taking 500 litres from the Mangaore River which has clean mountain water diverted to it from the Mangahao River via a hydro dam and the lower Manawatu River and I let the fish make the choice. When given the choice significantly more fish chose the Mangaore over the Manawatu River. The same experiment using the Oroua River significantly more fish chose the Manawatu River over the Oroua River.

2.13 Sediment deposited on the stream bed is another major impact for fish and invertebrates, especially in New Zealand because our native fish are mostly benthic. To quantify the effects of deposited sediment we ran an experiment in a section of a stream by putting radio tags in fish to see where they spend the majority of their time. The study followed 139 native fish of 5 species in 75 m of stream for a year. The study showed that deposited sediment had a major impact on fish communities by removing habitat. We found that they spend about 80% of their time deep down in the substrate in the spaces between rocks and boulders. When deposited sediment fills these gaps and the substrate is buried in sediment then this entire habitat is lost. To give you an idea of the magnitude of this change where these spaces are still available we estimated there were approximately 400 fish in the studied 75 m of stream. An identical stream with sediment filling all spaces would support only about 20 fish because they have virtually nowhere to hide/live.

2.14 As I mentioned before while there were not enough data on fish distribution over time in the Manawatu River we do have a huge national database with 22,500 sites sampled for fish over the last 40 years. I analysed this database for temporal and land cover trends first in native fish in a report I did for the Ministry for the environment, and then in a similar analysis on trout in a report for Fish and Game NZ. The details are in my EIC but to summarise the results all native fish communities and trout showed significant declines over the last 40 years especially the last 10 years. This is reflected in the fact that 60% of native fish species as well as the freshwater mussel and crayfish are now on the threatened species list. The analysis of landcover patterns showed that significantly fewer native fish and trout are found in pastoral catchments, while more are found in native forest.

2.15 There has been some suggestion from submitters that trout are the culprits of reducing native fish populations and that they cause ecosystem changes. I totally reject this assertion. As I mentioned above trout as well as native fish are being severely impacted by farming intensification, point source discharges and landuse change. Furthermore, the economic value of the trout fishery and the advocacy role played by Fish and Game New Zealand means that I have no doubt that New Zealands Rivers and native fish populations would be in much worse shape were it not for their presence.

2.16 All the evidence I have presented highlights the continuing decline of rivers in New Zealand and especially in the Manawatu Region. The ecosystem level bio-monitoring measures are totally unanimous and unequivocal in this conclusion. This is in contrast to the snap shot WQ measures that as we have seen could be argued forever. The GPP and ER measures presented by Roger Young are in total agreement with biomonitoring results and undeniable, although some non scientists have attempted to down play this.

2.17 The solutions for this situation are simple: reducing nutrient and sediment inputs to the rivers. This reduction must be catchment based, and the management practices required to achieve this have advantages over and above simply river improvements. Planting of catchments and riparian areas reduce sediment and nutrient inputs and capture carbon, but this must occur in small even ephemeral streams, that is where the most advantage can be gained. These small/ephemeral streams have been left out of accords and regulation to date but they are of crucial importance to restoring rivers. The area of riparian land in relation to water volume is much higher in small streams so this is where the best ratio of nutrient and sediment reduction per volume of water can occur. As streams become larger this ratio reduces and consequently the gains from planting diminish. Thus it is crucial for any restoration protect effort to start in headwater and small feeder streams.

2.18 I have presented little evidence of the impact of point source discharges, this is not because they are of lesser importance it's just that I don't have available data on them or biological data at the scale necessary to make the connections. They undoubtedly however play a major role in river ecosystems and must be part of total catchment management necessary to halt the declines in river health.

Dr Michael K Joy - 28 February 2010