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## QUESTIONS

*Eugenie Sage, Green MP:* Thank you, they have all been very interesting presentations. In terms of climate change and intense storm events, it seems that we have to really lift our game with erosion control and ensuring that sediment does not get into lakes. What thinking has been done about significantly stepping up our work in this area?

*Max Gibbs, NIWA:* The work that Bay of Plenty Regional Council are doing using detention bunds, traps and other actions in the catchment is designed to reduce the impact of fine sediment or any sediment coming down. There is nothing you can do about a weather bomb, it will come through, but it is vital to employ good farming practices and such things as the timing of bare ground. Our climate change seems to have given us a wet season and a dry season, so these things need to be considered when managing farms and developing farm plans. Knowing that the rainy season is coming, you would not harvest your corn crop and leave it bare, you would want the paddock covered fairly quickly.

*Ian McLean, LWQS:* I would like to ask the speakers who described processes that have gone on since the Tarawera eruption, with change taking place in the soil and forest, why is the water quality in Lake Okataina getting worse? What is making the change? Why is something changing right now when these processes have been happening for many decades?

*Theodore Kpodonu, Waikato University:* If you look at the chlorophyll *a* data of the lake it seems to be stable. However in calculating the TLI, we use other indexes like total phosphorus and total nitrogen and there is an increase in both. However if you look at the productivity of chlorophyll *a*, the lake data does not change in quality per se. Going back to a thesis from the 1950s and research in the 1970s there was gradual change from the 1950s through the 1970s. But from the 1990s until now there has been stability in the water quality. But because we use various indexes in the calculation of the TLI it shows the quality of the water going up and down.

*Don Atkinson, LWQS:* Is the suggestion of moas' grazing in earlier pre-European occupation comparable to the current grazing from our introduced species of mammals?

*Rob Allen, Landcare Research:* You raise an ongoing discussion there, probably the most recent statement is from the Feathers to Fur Symposium, run by the New Zealand Ecological Society in 2010, in which one of the papers presented compares the diet of moa and deer, and there is huge overlap.<sup>1</sup>

*David Hamilton, Waikato University:* Part of the significance of Lake Okataina is that it is a reference lake. The concept of a reference lake is that it is an un-impacted lake. In terms of the National Policy Statement for Fresh Water Management we want these reference lakes because there are impacted lakes around the country that we are trying to return to the condition that approximates somewhere between where it is now and a reference lake. I wondered if Willie, Rob and Theodore would comment on the concept of 'reference state' and with so much variability when should we consider things to be in a reference state? Here is a lake that has 89% of its vegetation in indigenous forest and for us in the Rotorua Lakes that would be the reference state almost.

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<sup>1</sup> David M. Forsyth, Janet M. Wilmshurst, Robert B. Allen and David A. Coomes, 2009. *Impacts of introduced deer and extinct moa on New Zealand Ecosystems*, <http://newzealandecology.org/nzje/2913.pdf>

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*Rob Allen, Landcare Research:* I do not support the notion of a stable reference point, it should be a changing reference point. In many respects I agree with what you are saying, it is a lake that is operating without a dominating human influence driving those changes. But we have to be careful to partition out the fact that humans are not the driving force. One of the aspects I talked about was the even aged nature of the forests and that drives nutrient dynamics in the systems. Those forests to some degree have not even aged as an artefact of past human activity. So you have to keep an open mind and think what the lake is like and what are the driving factors and are they different from a set of factors in another lake. I have not had much to do with the Rotorua Lakes but I look at 13 lakes and think – hmm, a pity they did not have a few more to partition out the variants.

*Willie Shaw, Wildland Consultants:* It is fine to use the concept of reference lakes but you have to understand what is going on with them and their catchments in particular. For Okataina we do not understand the variation over time of what appears to be a very natural system. All the preparation on my presentation did for me was raise question after question about what IS going on. The session this morning has added another level of complexity because there are not only erosional processes carrying core sediment into the lake, but as we heard from Max, the fine sediment processes as well. Look at the steepness level increases and we can relate that to simple measures like bank collapse or landslide occurrence, but what about the fine sediment carried through all those high rainfall events. There has certainly been some accumulation of high rain events which have led to those spikes and the related effects around the shoreline. So the concept is fine but we have to understand what is going on in the system as a whole.

*Theodore Kpodonu, Waikato University:* The concept of reference used in restoration; restoring the lake to pre-disturbance period. What is the definition of pre-disturbance? Is it pre-human disturbance? Is it pre-climatic disturbance? Pre-what disturbance? I look to what Rob is saying that there should be an evolving concept. I looked at a 10 year window of Lake Okataina water quality data in terms of climate change and how much control climate has. We have about 50% variability in the data explained by climate alone which is quite high, compared to many lakes in other places.

We could see that climate plays a major role and so, what is pre-disturbance? We need to look at our 3 year TLI concept again and the reference conditions for restoration. Maybe it needs a bigger forum to look at what we should do with lakes' restoration or we will be taken by surprise one day. We think we are doing all the right things with no dairy farming, no this and that, but the lake is still deteriorating. We should look at reference conditions in terms of climate, natural drivers and anthropogenic drivers of ecosystem change and then we can set good conditions for our lakes.