

Hydrology Histories: Barry Fahey and the Glendhu study

I graduated from Otago in 1961 with a Bachelor's degree, a double major in geography and geology, and worked briefly for the Green Island office of the New Zealand Hydrological Survey. At the suggestions of Kees Toebe (chief scientific hydrologist with the Water and Soil division of the Ministry of Works, and President of the New Zealand Hydrological Society for its first 12 years), I undertook an investigation of rainfall interception by tussock, manuka and radiata pine in the Silverstream catchment, west of Dunedin, which was completed in 1964.

Events took a different course over the next 20 years. I completed a PhD at the University of Colorado with the Institute of Arctic and Alpine Research, and spent the next 15 years teaching geomorphology at the University of Guelph in Ontario, Canada.

In 1985, I returned to New Zealand and joined the Protection Forestry Division of the Forest Research Institute in Christchurch, to establish a research programme on forest road erosion in steep-land forests.

When that was nearing completion, I turned my attention back to tussock grassland hydrology and in the early 1990s teamed up with Dave Murray at the University of Otago. We investigated the potential role of snow tussock in supplementing stream flow through fog interception, using a large weighing lysimeter relocated to Swampy Summit, just west of Dunedin, from the Glendhu experimental catchments in the uplands of east Otago.

This was somewhat fortuitous, because in 1992 I was entrusted with the operation of the Glendhu paired-catchment study. At the time, the Forest Research Institute was seeking interest from staff to assume responsibility for operating all their catchment programmes in the South Island, including the Maimai near Reefton and Donald Creek in northwest Nelson. Based on my previous interest in tussocks, I jumped at the chance to take leadership of the Glendhu study.

The Glendhu study was originally established by the New Zealand Forest Service in 1979 to assess the potential hydrological impacts of converting indigenous snow tussock to pine plantation. As well as demonstrating that replacing tussock with pines could reduce water yield by up to 50%, a comparison of storm flood peaks showed that as the magnitude of the event increases, the existing land cover becomes less significant in determining the peak flow response.

This information was subsequently added to a worldwide study undertaken by colleagues from the UK, the US, and Chile, that investigated the extent to which forests could mitigate flood events compared with shorter vegetation types.

The planted catchment was harvested between 2014 and early 2018, and replanted in pines in 2020.

Investigations at Glendhu have helped demonstrate that the retention of a tussock cover is essential to sustain water yields, especially during prolonged dry spells. This has been attributed to some combination of low evaporation and fog interception, with their relative importance being the subject of controversy. Regardless, any further large-scale conversion of tussock grasslands to plantation forests is highly unlikely.

I firmly believe there is value in retaining long-term catchment studies like that at Glendhu, even if they appear to have outlasted the reasons for setting them up in the first place. For example, studies conducted in the Glendhu catchments have led to a better understanding of runoff and flow-generating mechanisms

in the prevailing schist terrain. In particular, we now know that hillslopes are more important in sustaining baseflow than headwater wetlands, and the bulk of the water comprising runoff is quite young.

The Glendhu catchments have also served as a natural laboratory for the investigation of evapotranspiration processes in tussock grasslands and the potential for fog interception to augment stream flow. Results from the large weighing lysimeter, originally located at Glendhu, showed that fog interception by the tussock cover is minimal.

More recently, the Glendhu catchments have been the venue for numerous studies by Sarah Mager and her students at the University of Otago. In a collaborative effort with Rayonier NZ (the forest owners) and the Otago Regional Council, turbidity and suspended sediment data have been collected and used to assess the effects of harvesting on water quality.



Figure 1 (left). The planted catchment (GH2) with the weir at Glendhu 2012.

Figure 2 (right). Barry Fahey in Glendhu 2018.

The catchments have also been an important source of information used in the resolution of resource management issues. For example, runoff and rainfall data were used to calibrate and validate the WATYIELD water balance model, originally developed by Rick Jackson at Manaaki Whenua – Landcare Research in spreadsheet form, later made more user-friendly through the addition of an interactive graphical interface.

The WATYIELD model has enabled the prediction of water yields at the catchment scale in a variety of circumstances relating to water resource issues in Otago, and elsewhere. The model predicted the detrimental effect of tussock conversion to pasture in the adjacent Deep Stream and Deep Creek catchments, which supply up to 50% of Dunedin’s water supply, and confirmed that fog is unlikely to be a major contributor to tussock water yield at the catchment scale in the uplands of east Otago.

Throughout the study, my colleague John Payne provided valuable technical support. Financial and moral support was provided by Rayonier NZ’s Invercargill office in recent years.

The research effort at Glendhu has recently been scaled back. It now comprises a basic monitoring programme led by Sarah Mager at the University of Otago.

The Glendhu study is unique in New Zealand. First, because of its longevity and second, because of the size of the catchments. I consider these compelling reasons for retaining the monitoring programme in its present form, as water yields respond to the second forest rotation. As a colleague once told me, “Well-maintained data appreciate in value like a vintage car”.

Barry Fahey’s recollections are part of a New Zealand Hydrological Society [series](#) that documents the times and memories of New Zealand’s senior hydrologists.