Impacts of dairy farming on water quality and biological communities of streams in Tararua District, New Zealand

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ABSTRACT

Water quality in dairy farming areas has increasingly been the focus of attention in New Zealand as more land is converted to dairying and the intensity of operations increases. Regional councils and the dairy industry have encouraged removal of existing treated dairy shed effluent discharges from waterways and the minimisation of diffuse sources of contaminants such as nutrients and bacteria.

There has been limited scientific data collected on the impacts of dairy shed effluent discharges on streams, nor on the overall water quality and biotic integrity in small sub-catchments with intensive dairy farming. This study aimed to address these issues, as well as investigating the scale influence (temporal and spatial) on the results.

Streams in two sub-catchments of the Manawatu River, Tararua District, New Zealand, were subject to regular monitoring over the summer low-flow period of 2001. Intensive dairy farming is the predominant land use in the catchments. Twenty-two sites were measured on seven occasions for bacteria, nutrients, turbidity, periphyton, temperature, conductivity, dissolved oxygen (DO) and pH. Macroinvertebrate samples were taken at 18 of the sites on one occasion. Twelve of the sites were paired above and below five dairyshed effluent discharges and one urban sewage treatment discharge.

The water quality in the small streams did not meet chemical or microbiological guidelines at most sites on most sampling occasions. While point-source discharges influenced some sites, other sites with no obvious contaminant discharges also did not meet guidelines. However, biological monitoring showed periphyton levels were always within guidelines and macroinvertebrate communities indicated only 'moderate' enrichment.

The discharges of treated dairyshed effluent into streams and drains had a significant impact on *Escherichia coli (E.coli)*, dissolved reactive phosphorus (DRP), nitrate, ammonia, turbidity and conductivity measures. However, periphyton levels generally decreased below discharges. Macroinvertebrate communities showed some change

below discharges to dominance by indicators of poor water quality, but this was not statistically significant. The variation between individual discharges indicates that there is a need to assess the impacts on a case-by-case basis.

Temporal trends below a dairy shed effluent discharge showed 24-hour cycles in temperature and DO but not in conductivity. In addition, there was a weak 12-hour cycle in temperature but this was unlikely to be due to pulses of effluent from twice-daily milking. Conductivity within the stream was affected by random events (for example pond desludging) influencing effluent discharges, indicating that individual variation in system management can have localised impacts on water quality. However, the proximity of cows at the time of sampling had no detectable effect on water quality measures. Rainfall affected *E.coli* levels in both streams, however the influence of rain on periphyton levels appeared to be subject to individual stream characteristics.

There was considerable spatial variation in water quality throughout the catchments. While some of this variation could be attributed to point-source discharges, much remains unexplained but is likely due to variation in overland runoff from grazed pastures and groundwater inputs. Data from State of the Environment (SoE) monitoring in the Manawatu catchment was also compared with results from this study to determine if the SoE monitoring is accurately reflecting water quality at these smaller scales. Larger waterways of the Manawatu catchment had similar levels of dissolved oxygen as the smaller streams, however there was a wide variation in nutrient levels in the different waterways.

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