Identifying and quantifying key sources of nutrient pollution from irrigated agriculture

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Abstract: Nutrient (nitrogen and phosphorus) pollution from intensive agriculture can have substantial negative impacts on the cultural, ecological, and economic values of fresh and estuarine waters. Understanding the sources of nutrients contributing to waterway pollution is important for effectively mitigating this pollution. Waterway nutrient pollution may arise from a variety of sources, including fresh faecal material, dairy shed wastes, and inorganic fertilisers. Here, we present some pilot work as part of a larger project that aims to identify and quantify the key sources of nutrients exported from an intensively irrigated agricultural region, by combining microbial, chemical and isotopic source tracking approaches. In our pilot study, we tested the suitability of a Monte-Carlo Markov-chain source apportionment model, SourceTracker (Knights et al. 2016) for quantifying the contribution of cattle faecal material (a potentially important organic source of nutrient pollution) to waterways of an irrigated agricultural region.

Samples of water (farm-scale irrigation water re-use ponds, irrigation drains, major rivers upstream and downstream of the irrigated region), soil (soil from grazed paddocks) and faeces (cow manure) were taken across the irrigated agricultural region. The proportional contribution of different faecal sources to the microbial community in each sample category was then modelled using SourceTracker. We used a library of faecal sources, including cattle, collated by the Environmental and Public Health Microbiology Laboratory (Monash University).

Results indicate that on-farm sources (faeces, soil and irrigation water re-use ponds) exhibit high contributions (up to 90%) of cattle faeces to the total microbial community, suggesting that SourceTracker can be used to detect the presence of runoff water from irrigated farms. Irrigation drains also display detectable contributions from cattle faeces. Major rivers downstream of the irrigation region displayed larger cattle contributions to the total microbial community than rivers upstream of the region, suggesting that direct export of cattle faecal material may contribute to nutrient exports from the irrigation region. Future work will combine microbial source apportionment with chemical and isotopic mixing models to better understand observed nutrient concentrations. This will enable estimations of pollutant contributions from both organic (e.g. cattle faeces) and inorganic (e.g. fertiliser) pollutant sources, so that we can better design effective management strategies for controlling nutrient export from farms

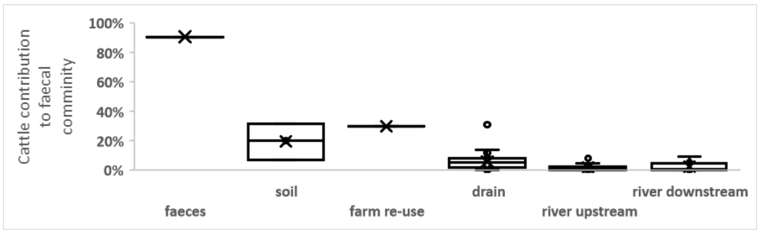

Figure 1. Contribution of cattle faeces to the total faecal community in cattle faeces, soil, irrigation water re-use systems ('farm re-use'), irrigation ('drain'), and major rivers upstream ('river upstream') and downstream ('river downstream') of the irrigation district

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