Linking watershed nitrogen sources with nitrogen dynamics in rivers of western Oregon, USA

(3500 character limit)

Dan Sobota
National Research Council

Jana Compton
NHERRL, US EPA

Kara Goodwin
Independent contractor (I used the WED affiliation because the work was done while at EPA)

We constructed contemporary nitrogen (N) budgets for 25 river basins in the Willamette River Basin (WRB) of western Oregon, USA, to improve the understanding of how recent trends in human-driven N loading have influenced riverine N dynamics in the region. Nearly 20% of WRB stream length is currently in fair or poor condition because of high N concentrations. Additionally, nitrate contamination of drinking water affects at least 8,000 people in the WRB. We hypothesized that 1) the majority of N inputs in the WRB would originate from agricultural activities in lowland portions of watersheds, 2) annual riverine N yield (kg/ha/yr) would correspond to annual per area watershed N inputs, and 3) riverine N yields would be seasonal and highest during winter due to the region's Mediterranean climate. We calculated average annual N inputs for each study basin by summing newly available datasets describing spatially explicit N inputs of synthetic fertilizer, atmospheric deposition, crop biological N_2 fixation, biological N_2 fixation by red alder (*Alnus rubra* Bong.), livestock manure, and point sources for the period 1996 - 2007. Annual and seasonal riverine N exports were estimated with the USGS model LOADEST calibrated to N concentration data collected during the study period. We estimated that two-thirds of total N input to the WRB study basins in the 2000s came from synthetic fertilizer application. Nearly all fertilizer application occurred on the lowlands near watershed mouths. We found a wide range of riverine N yields from the study basins, ranging from one to 70 kg N/ha/yr. Across the study basins, N export was more strongly correlated to fertilizer application rates than percent of agricultural area in the watershed. Low watershed N yields reflected a high proportion of watershed area in the forested Cascade Mountain Range, which received low N inputs mainly from atmospheric deposition. N yields from study basins were strongly seasonal, with at least 50%, and often 75%, of annual N yield occurring in fall and winter months. Our results suggest that that spatially explicit data on specific crop types and crop practices are valuable for explaining spatial and temporal variation of nutrient concentrations in WRB rivers. This emphasizes the need for careful tracking of non-point N inputs to inform water quality monitoring and management.