INTERPRETING COLIFORM COUNTS IN NORTHEAST OREGON RANGELAND STREAMS

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Because mammals may transmit pathogenic organisms through water supplies, the sanitary status of a stream is of great interest. For several decades, Escherichia coli have been used to indicate fecal contamination of water. The coliform organisms themselves are benign and some can be found in soil and vegetation. However, the fecal coliform group is directly related to the feces of warm-blooded animals. State and federal water quality regulations rely on total and fecal coliform sampling to indicate the probability of pathogenic organisms from fecal contamination.

The Meadow Creek study is concerned with the level of fecal contamination from cattle grazing. Meadow Creek is a second order, wildland stream on the Starkey Experimental Forest in northeastern Oregon. Streamflow ranges from 2 cfs (cubic feet per second) in late summer to 170 cfs in spring. Average stream gradient through the study area drops 50 feet/mile and the channel bottom is mostly gravelly or cobbled. Cattle have good access to the water. Douglas-fir, ponderosa pine, and meadow communities characterize the area. Small pastures along the stream have been moderately stocked since 1976 to test the effects of several grazing systems on instream coliform counts. The variable sampling results have pointed out a number of factors which should be considered to correctly interpret the impacts and trends from grazing. Examples can be drawn from the rest-rotation, deferred rotation, and season-long pastures.

Coliform concentrations are cyclic. Generally, the counts at controls were highest when sampling began July 1, although some sites peaked as late as August 7. Counts declined through the summer, reached a low by the end of August, and peaked again late in September, after fall rains and leaf-fall began. Following the pattern demonstrated in other studies, the concentration would be quite low in the winter, if sampled. (Diurnal cycles also are evident, constraining the daily sampling period for comparative samples).

Some contamination results directly from cattle standing in or adjacent to the water. However, coliform counts also relate to hydrologic events on the watershed. The events that should be considered when interpreting the data are most dramatically demonstrated by storm responses. Coliform curves at Meadow Creek peak with the hydrograph and begin to decline. Late on the hydrograph recession limb, coliform will quite often briefly increase and then drop off to original levels. Occasionally, counts at some sampling sites decrease while flow increases, possibly related to dilution. Apparently, some factor associated with the volume of flow raises the coliform count. Bottom sediment disturbances, bank flushing or runoff are all possibilities. It is generally believed that coliform bind to sediment and maintain steady-state populations. In 1970, Kunkle demonstrated the storage capacity of bottom sediments with a series of wading experiments. Although the data is not available for Meadow Creek, it is reasonable to expect coliforms to correlate with storm-associated turbidity, and slow stream segments with silty substrates to yield more coliform when disturbed than riffle areas. In fact, riffles may purify the water through aeration and increased contact with bacteria predators. Kunkle also conducted experiments which imply banks store coliform. Although it was not possible to test this on Meadow Creek, the rate of coliform increase should relate to the rate of change of wetted perimeter.

Runoff is most commonly implicated as the source of coliform during storms. Infiltration studies along Meadow Creek indicate that this storm was insufficient to produce significant runoff anywhere on the research area; in this example, overland transport simply could not have occurred on the pastures adjacent to the stream. Had runoff occurred, its contribution of coliform would depend on the coliform storage capacity of the pasture--the number of organisms produced and their survival curve--and the percent normally transported. Buckhouse and Gifford (1976) and Clemm (1977) demonstrated that fecal coliform can survive in feces for at least one year, but only 2-3 percent of them may be transported (Kunkle, 1970). Studies on overland transport are planned for Meadow Creek this summer.

Because fecal coliforms are associated with all warm-blooded animals, big game as well as cattle may impact the quality of Meadow Creek. To sort out the role of big game, a game-proof fence encloses one set of grazing systems. Preliminary analysis shows mixed results, suggesting that during the grazing season, the wildlife raise coliform counts, but after the cattle are removed, counts are comparable regardless of wildlife access. Likewise, different grazing systems do not offer clearly different responses yet.

Some other patterns are emerging from Meadow Creek, however. Overall, grazed areas have the highest counts and controls have the lowest; stream segments in pastures rested one month had counts similar to one year of rest. Ungrazed segments tend to reduce or dilute coliform concentrations, but may be more sensitive to hydrologic events than grazed stretches. Perhaps that is because ungrazed stretches have a lower baseline input and so bottom storage produces a relatively larger source. Season-long grazing has the greatest impact, but the status of deferred rotation and the rest-rotation pasture in use is not yet clear. Overall, counts seem to have increased somewhat since 1976, but the analysis is incomplete.

For monitoring trends and comparing treatments, relative coliform concentrations and factors affecting them are sufficient. Health standards, however, are not determined by relative associations but by real presence of organisms. In Oregon, standards are tailored to the expected use of each major drainage basin. As part of the Grande Ronde basin, all experimental areas of Meadow Creek have continually met recreational standards. Drinking water must be treated even in ungrazed portions.

LITERATURE CITED

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INFILTRATION, RUNOFF, AND SEDIMENT YIELD IN RELATION TO MOUNT ST. HELENS ASH DEPOSITION

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On May 18, 1980, Mount St. Helens shattered a 120 year-dormant interval with an explosive eruption that devastated most of the immediate area in a 160 degree sector north of the mountain, killing people, triggering numerous mudslides and destructive floods, and blanketing much of eastern Washington, northern Idaho, and western Montana with volcanic ash.

A joint investigation involving U.S.D.A.-SEA and Oregon State University was undertaken through the leadership of Forrest Sneva. A number of aspects of ash-related situations were examined. Physical and chemical components of the ash, dietary effects of ash ingested by rumenants, seedling emergence and plant production aspects, and watershed characteristics (sediment production and water infiltration) were evaluated.

The hydrologic portion of this effort was conducted during the late summer months. The ash had been distributed on the crested wheatgrass seeding in three replications of five treatments. The treatments were Moses Lake Ash at 89,000 pounds/acre, Moses Lake Ash at 178,000 pounds/acre, Yakima Ash at 89,000 pounds/acre, Yakima Ash at 178,000 pounds/acre, and an ash-free control.

A Rocky Mountain infiltrometer provided a simulated rainstorm. The equipment consists of a 500-gallon water storage tank, a pump and motor apparatus, which pumps water into a sprinkler and then to a series of three infiltration/runoff plots. The plots are constructed so precipitation and runoff waters can be captured and measured.