Long-term water quality trend analysis in the Lone Tree Creek watershed and surrounding marine waters

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Background

- Analyses focused on Lone Tree Creek watershed and the associated nearshore environment (Figs. 1-2).
- Lone Tree Creek flows ~1.5 miles before discharging into Lone Tree Pocket Estuary and Lone Tree Lagoon. These areas provide important habitat for juvenile Chinook salmon, and 30 other fish species.
- The nearshore environment is a historic and active fishing and shellfishing area.
- Lone Tree Creek is an intermittent, run-off dominated stream. The creek consistently flows November through April each year.

Water Quality Monitoring

- Monitoring began in the late 1990s at some sites.
  - Upper basin: LON2 and LON3 are not monitored frequently enough for long-term trend analysis, but are used for comparison to the lower basin sites.
  - Pocket estuary (LONPE) monitoring began in 2007.
- Marine water sites: Lone Tree Lagoon (KIK2) and Kikut Bay.
- Analyses were run on pH, dissolved oxygen (DO), temperature, salinity, turbidity, and fecal coliform bacteria.

Results

- Temperature increases after 2010 in the pocket estuary and at KIK1; could be from deforestation or climate stressors.
- pH decreases at KIK3 after 2011, which could be informative of potential future climate stressors (ocean acidification).
- Salinity increases in the pocket estuary and decreases in the lagoon could indicate more exchange between the creek and the bay.
- Results for dissolved oxygen, turbidity, and fecal coliform were more interesting and complicated as shown in Figs. 5-10.

Nonparametric Analyses

- Seasonal Mann-Kendall for long-term trend analysis and individual analysis by season for Lone Tree Creek.
- Locally Weighted Smoothing (LOESS) lines were used for trend visualization.
- Pettit’s homogeneity test was used to determine breaks in homogeneity and data were analyzed over the identified shortened time periods, in addition to the entire dataset.
- Kruskal-Wallis test and post-hoc Conover-Iman test for comparisons between sites.

Discussion

Forestry:

- ~95% of watershed is zoned for forestry.
- Logged areas (Fig. 11) overlap with wetlands that provide primary hydraulic support for Lone Tree Creek.
- Forestry practices during these years may have had cumulative negative effects on stream flow and water quality producing the observed increases in turbidity (Fig. 6) and fecal coliform (Fig. 8).

Campground Management:

- Wastewater, stormwater, and road management could influence bacteria (Figs. 9-10) and pH and turbidity (Figs. 7-8) concentrations.
- Wastewater sprayfields effects (between LON2 and LON3 ) are likely diluted moving downstream. However, lower basin sites in the watershed have higher fecal coliform than in the upper basin (Fig. 10) because of additional sources of contamination within the campground.
- Possible sources include septic failure, run-off and spills at the dump station. Stormwater inputs at Snee-Oosh road could increase fecal coliform in the lower basin while also diluting the more turbid water from the upper basin.

Climate stressors:

- Heavy run-off influence in watershed could affect discharge in the creek and water quality (e.g. temperature, pH, DO).

Restoration of lower basin 2006-2007:

- Significantly improved DO and likely contributed to the positive trends in DO prior to 2010/2011 (Fig. 5).
- LON1 has the most variability in DO (Fig. 6) possibly due to the restoration having the greatest effect at this site. Generally, DO varies more in the creek and pocket estuary than the marine sites.

Conclusions

- Overall shift toward poorer water quality in 2010/2011, possibly due to forestry practices, campground management practices, climate stressors.
- Next: Regression models to determine most influential parameters. Air quality and flume discharge data will help determine potential climate influences.

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References