An online tool to assess the health of local watersheds

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Today’s Presentation

• Land cover & watershed health
• Project data & methods
• A few results
• DEMO!
Project Partners

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Watersheds

Major basins
(10)

Drainage basins
(7000+)
and we know that...

 Oldest continuously operating cheesy 3D image
CLEAR’s “Changing Landscape” land cover
30-year period (1985 – 2015), 7 dates, 30m resolution

Connecticut (by town)

Lower LIS Watershed (by HUC-12 basin)
We live in an urbanizing state & region

2015 Land Cover

Land Cover Change, 1985-2015
(mi^2)

10 football fields per day

Graphics by CT Sea Grant
Everyone’s favorite land cover indicator: IC
More than just IC

The scientific literature points to the critical role that various land cover factors have in watershed health, including impervious cover, riparian cover, forest cover and core forest.

Generally, these indicators are more accurate at smaller watershed sizes.
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Project catalyst #1: a leap in land cover resolution

New 1m resolution NOAA C-CAP land cover dataset (2016 imagery) enables us to explore the land cover-watershed health relationship at a level of geographic resolution that was previously impossible.
Project Catalyst #2: a reminder of the importance of riparian land cover (2018)

Riparian services

- slow runoff
- protect shorelines from erosion
- aid in flood control
- filter or trap pollutants
- provide habitat and corridors for wildlife
- shade waters for fisheries enhancement

➢ first line of defense against the impacts of development
Project Objectives

• Compare 1m land cover to previous datasets
• Develop fine-grained watershed health index based on the relationship of land cover to CT DEEP’s Macroinvertebrate Multimetric Index (MMI)
• Relate this index to N loadings
• Create online application / decision support tool
Project data

✓ Land cover dataset?
✓ Watershed size/level?
✓ Width of riparian zone to use?
✓ Water quality/ecological condition?
Land cover dataset....1m (duh)
More accurate IC estimates

- NOAA C-CAP 1m
  Separate IC class

- CLEAR CL land cover
  ISAT Model \(\rightarrow\) watershed-wide estimate

- National land cover (NLCD), (C-CAP)
  % developed surface for each 30m pixel
Simplifying the land cover classes
Watershed size?

HUC-12 basins

- number: 244
- ave size: 21,056 ac

(modified) local basins

- number: 4,362
- ave size: 786 ac
Riparian Zone width: 100 ft

- Most common IWWC watercourse “upland review area” used in CT communities
- Most common width used in previous studies (e.g., Goetz et al.)
- Recommended in several studies as width that is protective of water quality
Macroinvertebrate Multi-Metric Index (MMI) is an integrative indicator of ecological health.

- MMI ranges from 0 - 100.
  - Higher MMI score indicates better water quality.
- CT DEEP has 200+ MMI sample sites to monitor stream and river water quality.
The Combined Condition Index (CCI)

A Biological Condition Gradient approach

- **Combined Condition Index** is a metric that describes the probable health of a watershed based on land cover within the watershed.

- CCI is calculated to have best fit with Macroinvertebrate Multi-metric Index (MMI)

- CCI ranges between 0 (poor) and 1 (excellent). Higher CCI score indicates better water quality.

- CCI is based on the land cover characteristics of riparian buffer and upland watershed.
How is CCI Calculated?

1. Divide a watershed into
   • upland watershed (everything outside the buffer)
   • 100’ riparian buffer

Pressures from watershed land use

Mitigative effects of buffer
How is CCI Calculated?

2. Compare percentage of natural land in the upland watershed vs natural land in the 100’ buffer.

- Natural (N)
- Impervious (IC)
- Agriculture-like (AL)
But all land cover classes are not alike!

Weighting factors based on best fit with MMI data but also are in line with the literature on the relative loading rates of different land covers.
How is CCI Calculated?

Watershed Condition Index (WCI)

Buffer Condition Index (BCI)

Pressures from watershed land use

Mitigative effects of buffer
Relating CCI to MMI

- Compare CCI with MMI (160 samples from 144 sites)
  - delineate upstream watershed
  - calculate CCI for each site
  - empirical regression analysis

\[
y = 0.6131x + 0.1972 \\
R^2 = 0.4951
\]
Nitrogen Enrichment Factor (EF)

- CCI was compared to loading estimates from USGS gauging station data, and the USGS SPARROW model.

- Relationship is normalized to Enrichment Factor, where 1 = “natural” condition.

- EF thus is a ratio of expected N load to a theoretical natural load, i.e., a measure of PROPORTIONAL DOSING.

✓ allows comparison between basins (vs loading)
✓ easier for non-technical people to understand?

Long Island Sound Study N Management Zones
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CCI map of CT

![CCI map of Connecticut with percentage bars for Mitigation, Recovery, and Conservation]
CCI Recovery Categories

Recovery Category indicates the state of, and suggested land use strategy for, a local basin, based on the current CCI value.

- **Conservation if CCI >= 0.75.** This means that the health of the watershed is likely to be good, and should be protected by land conservation and riparian protection strategies.

- **Recovery if 0.43 <= CCI < 0.75.** This means the health of the watershed is likely to be impaired but could be improved with conservation and reforesting of key area and riparian restoration.

- **Mitigation if CCI < 0.43.** This means that the health of the watershed is likely to be significantly impaired, but can be improved with an emphasis on restoration activities within the riparian zone and projects such as those designed to increase the urban tree canopy.
So where are we now?

✓ Finer resolution = more accurate land cover data
✓ Finer resolution = ability to better assess smaller landscape elements such as riparian corridors
✓ Finer scale = more reliable indicator
✓ Finer scale = information more suitable for local consideration/action
✓ CCI is tied directly to state wq/biocondition data (MMI)
✓ Project analysis and tools support more specific mitigation and protection strategies & targets
✓ New focus on riparian corridors
And where to go from here?

Riparian protection

Riparian restoration

IC Mitigation (LID)

Land conservation

Stormwater Runoff Reduction Plan

West Haven, Connecticut

Your Favorite Here
Demo time!!