The Forest Health Indicators Dashboard:

Assessing the condition of forested ecosystems in real time

Jennifer Pontius , James Duncan, John Truong and Mim Pendleton

University of Vermont RSENR, USFS Northern Research Station and Forest Ecosystem Monitoring Cooperative

Summary: Many organizations are moving towards an ecological indicators based approach to **describe and monitor the status of complex ecosystems in simple terms** that can provide a more **holistic view of the structure, function, and services provided** by ecosystems. Many stakeholders in Vermont have also cited the need for a comprehensive, dynamic assessment of the condition of the regions forests, leading to a working group convened in 2015 to identify key metrics and data aggregation approach for a systems-based ecological assessment for forests.

FEMC has led the development of the data aggregation and synthesis tool that resulted from this design effort, **The Forest Indicators Dashboard**. This tool is a dynamic, online, quantitative, systems-based assessment of the current status and long-term trends of Vermont's forested ecosystems.

What makes this Forest Indicators Dashboard Unique is:

1) Its use of a **systems approach** to ecosystem assessment, including metrics that capture forest structure, condition, stress agents and services provided,
2) Identification of long-term baselines or **ecologically meaningful** thresholds for each metric to inform interpretation of current conditions and trends,
3) Inclusion of data sets with ongoing data collection to enable **regular updates** of forest ecosystem condition.
4) Ability to **explore and visualize current conditions** for a **suite of relevant metrics** and examine **long-term trends** while linking directly to data for **easy download.**

	Structure	Condition	Services	Stressors
Phase I	Hardwood Regeneration (FIA P2 Plots - seedline density)	Mapped Mortality *(ADS acres)*	*Economies (Timber Extraction Volume - FPR)*	Growing Season Anomoly *(Duration - MODIS)*
	Softwood Regeneration (FIA P2 Plots - seedling density)	Mapped Disturbance *(ADS acres)*	*Economies (Maple Syrup Production - MSA)*	Acid Deposition *(NDN Total Wet - NADP)*
	Forest Species Diversity *(Shannon Weiner - FIA P2 Plots)*	Canopy Greeness *(MODIS Cumulative NDVI)*	Hunting *(Hunting licenses - ANR)*	Mercury Deposition *(NADP)*
		Crown Condition *(FEMC Inventory Dieback)*		Surface Ozone *(Concentration - PFR)*
Phase II	Forest Cover *(Landsat Total Forest Acreage)*	Productivity *(Biomass accumulation - FIA P2 Plots)*	Water Quality *(Lake pH)*	Temperature Anomoly *(Max/Min - PRISM)*
	Forest Patch Size *(Landsat Mean Patch Size)*	Invasive Plants *(FIA P2 Plots % invaded)*	Carbon Storage *(FIA P2 plots)*	Precipitation Anomoly (Total - PRISM)
	Fragmentation *(Landsat Connectivity Index)*		Recreation Rates *(Visitor records - FPR)*	Snow Cover Anomoly (Duration - NOAA)

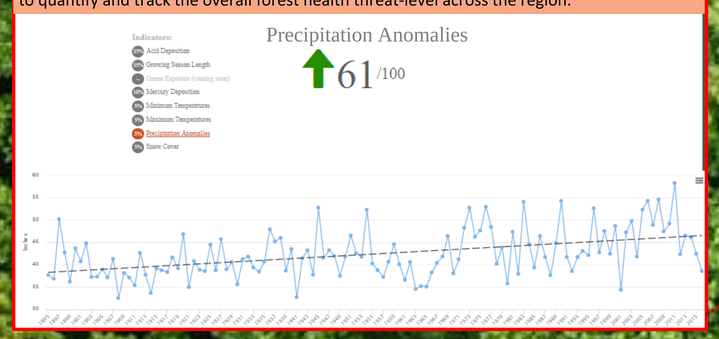
Forest metrics used in the Forest Indicators Dashboard.

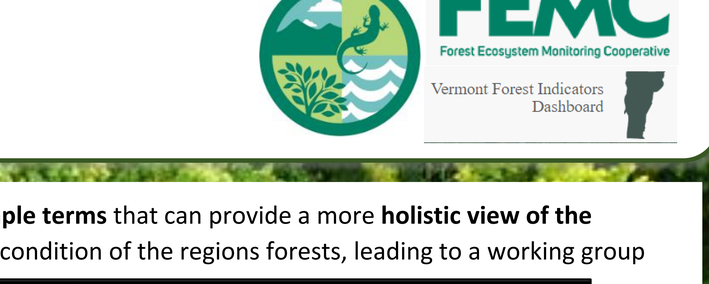
Current Conditions: Yearly values for each metric are averaged based on a stakeholder defined weighting, producing a current condition score for **each metric**, aggregated **by category** or summarized over all metrics **combined** into one **Overall Score** with a scale of ***0 (impaired function)*** to ***100 (optimum function).***

Long-term Trends: The **trend slope** of the long-term data (30+ years for most metrics) indicates if conditions are improving ↑ or declining ↓. This can be visualized compared to long-term **means or baseline values** for **each metric**, aggregated **by category** or over all metrics **combined**.

Structure: Forest structure is typically characterized by the diversity of tree species, size, density and arrangement of trees in the forest. Here we also include landscape-scale structural metrics to capture the geographic extent and continuity of the region's forests.

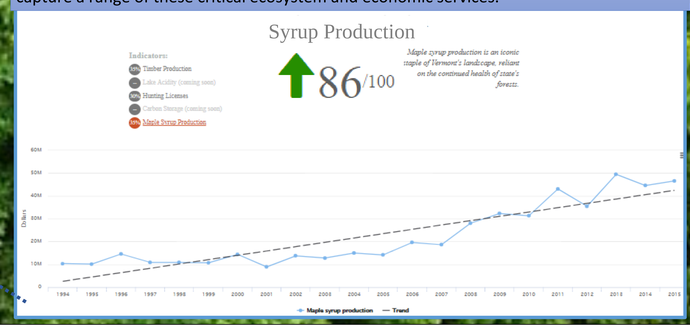
Stressors: Many biotic and abiotic stress agents act simultaneously on our forests, impacting growth, regeneration and survivorship. Here we capture some of the most prolific stressors to quantify and track the overall forest health threat-level across the region.





Condition: Forest condition characterizes the overall health of the trees within the forest and the forest canopy across the landscape. There are many different ways to quantify the health of trees, from ground-based inventories to satellite analyses. Here we include metrics from a range of assessment methods to best represent the overall condition of the region's forests.

Services: Forest ecosystems are valuable for the many ecological, economic, social and aesthetic services they provide. This is particularly true for a forest dominated region with a thriving tourism and forest products-based economy. Here we include several metrics that capture a range of these critical ecosystem and economic services.



The Phase 1 dashboard presented here represents an initial subset of potentially important ecological indicators to more comprehensively assess the condition of Vermont's forested ecosystems. Based on these inputs, the current overall score for Vermont's Forests is a 85/100, indicating a relatively healthy, functioning ecosystem compared to historic conditions and baseline thresholds. However, an overall declining long-term trend indicates that there is need for management to sustain the resource and the services it provides. Examination of the individual indicator categories indicates that this declining trend is primarily driven by reductions in hardwood regeneration and timber production, and increases in mapped mortality and canopy dieback .

Ongoing scientific review panels will continue to modify and improve the data sets included in this dashboard, as well as their interpretation relative to historical or baseline "norms". If you want to be involved please contact us at James.Duncan@uvm.edu.

To test drive this prototype online, visit https://www.uvm.edu/femc/indicator_dashboard/round3/intro.html