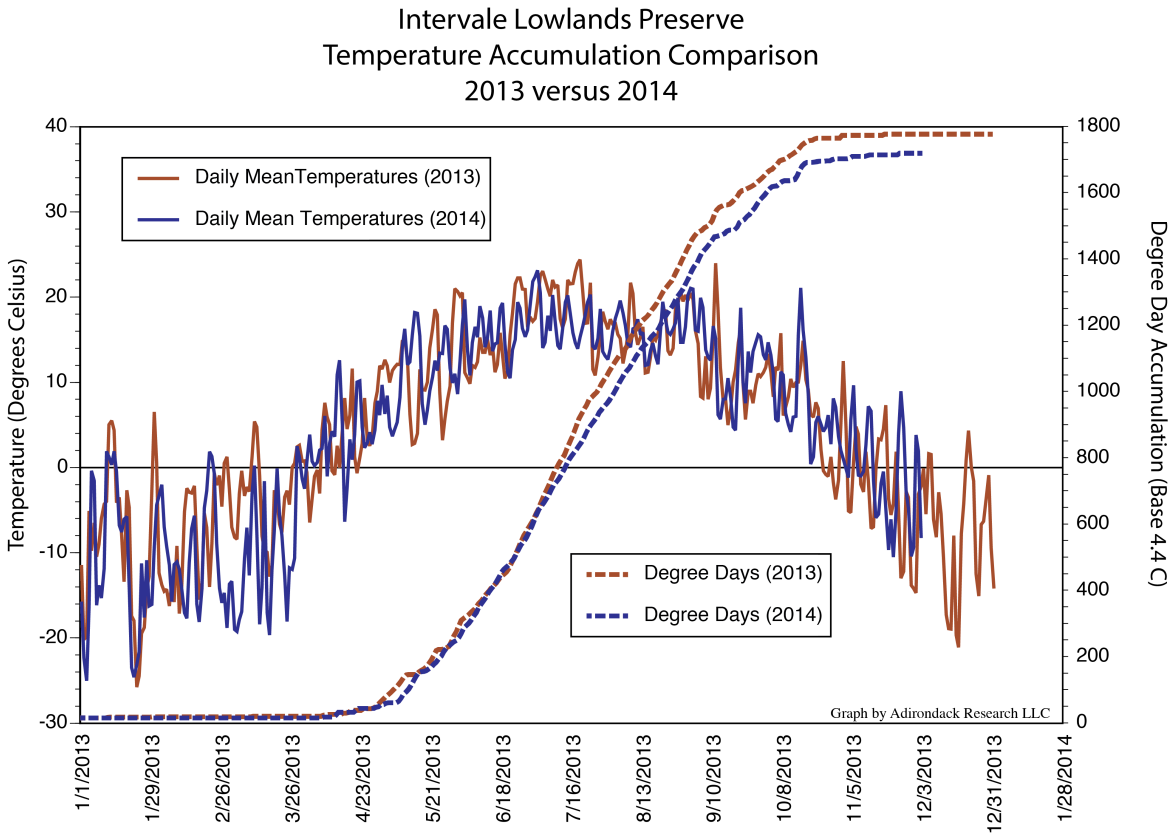
The Physical Environment

Biological Monitoring at Intervale Lowlands



Sampling Protocol, Revised March 15, 2015.
Intervale Lowlands Preserve
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Background

Intervale Lowlands Preserve monitors the ecological changes occurring on an ongoing basis. In addition to a baseline biological inventory and long-term monitoring of focal taxonomic groups, Intervale Lowlands Preserve also aims to monitor the physical environmental attributes that affect ecological change. These attributes of the environment are collectively referred to as "weather" in this protocol. Weather measurements include temperature, precipitation, snow-cover, solar radiation, stream temperature, river water height, and wind speed and direction.

Objectives

Monitoring temperature and other physical attributes of climate on the Intervale Lowlands Preserve will aid in making connections between changing climate and biotic attributes including biological interactions, distributions, phenology, and abundance. This protocol consists of a description of the abiotic measurements collected as part of the general long-term monitoring plan at Intervale Lowlands Preserve.

Target abiotic sampling methods

We aim to measure as much of the abiotic physical environment at Intervale Lowlands as possible, given financial constraints. Our monitoring is limited to the list below. We may increase the range of abiotic attribute measured in the future to include atmospheric gas measurements, soil chemical and physical properties, stream gauge, etc.

Methods

Three primary physical environment measurements are collected at regularity at Intervale Lowland Preserve. These include weather, water, and some geomorphology. In the future, we may record chemical measurements of water, air, and soil. Our primary tools for recording these parameters include a weather station, stream and air temperature probes, a snow gauge, a crowd-sourced water level gauge, and historic and current aerial photography. As a measure of simplification for this protocol, we have broken measurement descriptions into three categories: weather, water, and geomorphology.

Protocols

Weather Station: Adapted use of equipment, tools, and partnerships developed by Rainwise, Inc. Weather Underground, and Cornell's Network for Environment and Weather Applications (NEWA).

Site placement

Intervale Lowlands Preserve has one primary weather station located near the main house next to the garden. In addition to this main weather station, we have a light, humidity, and temperature probe (HOBO) placed at the east end of East Field where the Upper Loop Trail enters East Field. The main weather station collects temperature, humidity, dew point, barometric pressure, wind speed and direction, leaf wetness, solar radiation, and precipitation.

Data collection procedure

All data collected from the weather station is automatically sent via radio signal to a receiver located in the main house. The receiver is connected via Ethernet cable to the internet and data is uploaded in real time to Rainwise.net for storage and password-protected download access. Weather station data is concurrently sent to several other data collection and analysis centers, including Cornell's Network for Environment and Weather Applications (NEWA), Weather Underground, Wind Alert, AWEKAS, and Personal Weather Stations (PWS).

An auxiliary temperature logger is located where the Upper Loop trail enters East Field. This temperature, light, and humidity probe is placed here as a weather station back-up and as a secondary sight to confirm weather station accuracy as well as to document seasonal fluctuations in temperature consistency across the preserve.

Collection interval

The Intervale Lowlands Preserve weather station collects and uploads weather data in fifteen-minute intervals. The HOBO temperature loggers collect in 15 minute increments as well, but can be lengthened to one-hour increments to save memory. Because these loggers have finite data storage, their data need to be manually uploaded before their memory fills. Capacity can be calculated to determine how often they need to be cleaned of data.

Photographic records: Including snow gauge time lapse photos, porch time-lapse, and historic and current aerial photography.

Site placement

Snow cover is measured at a separate location on the Upper Loop Trail. This specific location has been chosen because it is sheltered from wind, yet open enough to allow unobstructed snowfall. A second time-lapse camera is set up on the upper deck of the main house facing east across the Upper and Lower Fields.

Data collection procedure

Time lapse cameras are set for intervals corresponding to what they are measuring. The snow gauge camera is placed roughly four feet from a meter stick anchored in the ground with zero inches at the soil line. The camera faces the meter stick and collects images once per day at 12:00 noon. This data collection method measures snow depth rather than snowfall. Snowfall measurements would be collected at 10:00 AM each morning after a snowfall on a previously swept snow board. For ease of measurement, and because snow cover is more of a predictor of spring phenology than cumulative snow fall, we have elected to collect in this manner.

A second time-lapse camera faces east from the main house and collects images every ten minutes. The purpose of this camera is to record snow cover at the local landscape scale, to document weather events, and for educational and promotional purposes. Image data from cameras are downloaded manually.

Collection interval

The rate of image capture and size of images affects the storage capacity of the camera. We collect snow depth images in one-day intervals and the camera facing east from the main house collects images in 10-minute intervals.

Lotic water measurements: Including water temperature and river channel height.

Site placement

Water temperature is collected from the west branch of the Ausable river along the banks of Intervale Lowlands Preserve. A HOBO submersible temperature logger is attached to tree roots and is weighted down by a cement brick, roughly 15 feet from the river's north bank adjacent to Lower Field.

A crowd-sourced water level meter is located at the Midriver Bridge on River Road as part of a larger crowd-sourced hydrology program called Crowd Hydrology.

Data collection procedure

Water temperature is downloaded from the HOBO temperature logger device manually approximately once per year.

The crowd-sourced water level meter located at the Midriver Bridge is manually measured as passerby's record water level on their phones by sending a text to 616-951-3218 with an included site code.

Collection interval

Water temperature is collected in one-hour intervals and the water level is recorded intermittently. We attempt to collect water level 3-5 times per week during summer and at least once per week at other times of the year. We make special effort to record water level during drought or storm events, and during ice out in spring.

Sample processing and preliminary data recording

All weather related measurements are automated. The data uploads for these measurements, however, are manual in most cases. The weather station is the only truly automated recording and reporting device. Data from the weather station is automatically updated to the Rainwise.net servers in 15-minute intervals. From Rainwise, data are automatically pushed to other data compilation and display websites like NEWA and Weather Underground. The automated weather station also performs initial calculations on weather data for display, in real time, on the Rainwise website and user interface. These initial calculations of weather-related data include daily high and low temperatures, averages over 15-minute intervals, cumulative solar irradiance, and cumulative daily rainfall.

Auxiliary temperature probes also need to be uploaded manually using the HOBO data up-loader connection and a laptop computer. HOBOs need to be uploaded periodically and backed up. Their battery and memory capacity is limited and can only run for part of a year when collecting multiple recordings per hour. Memory capacity can be calculated from the HOBO user guide.

The cameras that record seasonal changes from the main house and snow cover on the Upper Loop Trail need to be uploaded periodically and backed up. Special notice needs to be made when using the time-lapse cameras. Their battery and memory capacity is limited and can only run for part of a year when collecting multiple frames per hour or day. Memory capacity can be calculated from the camera user guide.

Stream temperature measurements are also automated, however they need to be uploaded periodically, stored, and backed up. Stream water level is not automated and relies on periodic hand measurements using a water level meter installed at the Midriver bridge on Intervale Way. Once measurements are made, they can be texted to Crowd Hydrology. Once submitted, data are available from http://crowdhydrology.geology.buffalo.edu/.

Identification procedure and Additional data analysis

Physical data often needs to be sorted and analyzed in a way to make data presentable. Mean daily lows and highs are graphed each season to show daily temperature fluctuations and seasonal trends. Degree day calculations are done to show temperature accumulation differences among years. Snow recordings need to be entered from video by hand into an Excel datasheet to determine dates of first and last snowcover for each year. Data from Rainwise can be sorted and analyzed to calculate yearly irradiance. Yearly irradiance is useful for calculating solar panel efficiency and for comparing solar energy production estimates to those calculated using regional solar monitoring stations.

Aerial photographs dating back to the 1940s have been compiled to describe changes in the landscape at Intervale Lowlands Preserve. As more images are taken as time goes on, there will be additional opportunities to measure stream channel variation, insect herbivory and other forest disturbances, land-use changes, and regional changes.

Data compilation, analysis and publication

Yearly degree day calculations can be compared to insect emergence and flowering time to model how relationships between species of different taxonomic groups are responding phenologically to variations in temperature from year to year. These calculations and detailed analysis should be completed every three to five years.

Every spring, the previous year's temperature accumulation, high and low daily temperatures, and snow cover should be calculated and added to the year in review. Water level can be used to calculate stream flow.

Temperature data is automatically published to Weather Underground as well as several other websites. The NEWA site calculates degree days for the Intervale Lowlands weather station for various models that correspond to metabolic responses of several important agricultural crop pests.

Materials and costs list

Many of the weather measurements require an up front equipment cost. Below is a list of some of the measuring devices currently operating at Intervale Lowlands Preserve.

Device	Measurements	Cost	Website
Rainwise MK-III Long Range Package Weather Station	Weather	$1,500	http://www.rainwise.com/products/detail.php?ID=6895&Category=Popular_Packages_&pageNum_cart=/products/index.php
HOBO Temperature Logger	Temperature	$50	http://www.onsetcomp.com/products/data-loggers/ua-002-08
HOBO Steam Temperature Logger	Stream Temperature	$130	http://www.onsetcomp.com/products/data-loggers/u22-001
River Gauge Meter	River stage	Free	crowdhydrology.org
Brinno Time-lapse Cameras	Snow-cover, phenology	$270	http://www.bhphotovideo.com/
Pheno-cam	Phenology	$400	http://www.bhphotovideo.com/c/product/1043210-REG/star_dot_netcam_sc_series_sd130b.html