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LONG-TERM OBSERVATION OF THE ADIRONDACK ECOSYSTEM: DATA FROM THE SUNY ESF NEWCOMB CAMPUS

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INTRODUCTION

Field stations across the globe are treasure troves of knowledge about a particular place. These facilities store data as maps, lists, photos, databases, and oral and written histories. The SUNY ESF Anna and Archer Huntington Wildlife Forest (HWF) is a 15,000 acre (6,000 ha) biological research station in the central Adirondacks, in the towns of Newcomb and Long Lake (Essex and Hamilton Counties, respectively) (Figure 1). The land that constitutes HWF is part of the aboriginal territories of the Haudenosaunee and Abenaki people.

Held in trust by Syracuse University, HWF is private land with a public purpose: to engage and excite students and visitors about science and the Adirondacks. The mission of the Adirondack Ecological Center (AEC), the research arm of ESF Newcomb Campus on HWF, is to understand the Adirondack ecosystem through research and education; a key component to that mission is maintenance of historical archives. The information collected at the AEC (www.esf.edu/aec) over the past century exists in varying places and formats; here we will describe many of the available resources.

Records of past and present ecological communities are essential to understanding environmental change. With impacts to the Adirondack region from fragmentation, pollution and other phenomena, the data are essential to understanding how ecosystems respond and how people relate to system changes and dynamics. Archival data underpin environmental policy, conservation and management decisions; for instance, the national Clean Air Act amendments of 1990 were based on atmospheric and chemical data collected in the Arbutus watershed at HWF among other Adirondack lakes (Jenkins et al. 2007; Beier et al. 2021). Lake shorelines on HWF have minimal or no human development and can serve as a reference for lakes facing water quality issues from eutrophication, invasive species, motorized recreation and other impacts to aquatic systems. HWF watersheds are monitored for environmental trends and act as sentinels of change (Stager 2018) showing that even protected places in Adirondack Park are not static systems.

Archives help support training of future scientists and science-literate citizens. Direct engagement with collections can hone students' research skills, data literacy and capacity to collaborate (Cook et al. 2014). Because the data are place-based and disciplinarily relevant, archival studies occur at the interface of science and society (Kingsland 2017). And archives support opportunities for discovery: genetic analyses are reshaping what we know about species and relatedness of organisms. While most of the plants and vertebrates for the central Adirondacks have been described, it's likely invertebrates have been undersampled based on records of species new to science (Root et al. 2007) or records for New York State (Myers et al. 2011; AEC unpublished data). We know even less about microbes and fungi. Detailed records of where species are found, their associations with particular habitats, their trophic interactions and their sensitivity to loss and potential rarity are critical to ensuring a functional and resilient Adirondack ecosystem.

This paper provides a "road map" for researchers, students, historians and others on what resources exist at AEC and HWF and how to access them. The archives reflect decades of observations on unmanipulated forest stands and undeveloped water bodies that can be combined with on-site experimental plots for forest management and silviculture, predator-prey interactions, herbivore-plant relations and more, or compared to off-site locations on public or private land. The campus is operational all year and contains large areas of over 300-year-old unmanaged forest, experimental plots, and research laboratory, housing, dining and related infrastructure.

VERTEBRATE COLLECTION

Vertebrate specimens, skulls and skins make up a good portion of the physical archive; the herbarium comprises the other major component. The earliest specimen recorded in the collection is a skin and skull of a mink (*Neovison vison*) from June 1938. Over two hundred mammal skins and two dozen skulls and complete skeletons from HWF and the central Adirondacks are in the collection as well as over a hundred avian species and dozens of fish, reptiles and amphibians preserved in fluid. These are all part of the Roosevelt Wild Life Collections (RWLC) at SUNY ESF's main campus located in Syracuse.

The Roosevelt Wild Life Station, of which the RWLC is a part, was endorsed by President Theodore Roosevelt in 1916, and later written into New York State law in 1919. The RWLC cares for an enormous variety of "wild life," including plants, mosses, and fishes, and more than 10,000 bird and mammal specimens. ESF's collections support the education of the next generation of conservation and wildlife biologists, who also benefit from the many "-ology" and scientific natural history courses offered. ESF trains college student volunteers and offer periodic public educational programs in the collections. Researchers interested in accessing the RWLC in Syracuse should contact Head Curator Dr. Rebecca Rundell at rundell@esf.edu.

A smaller collection of bird and mammal specimens is available for on-site teaching and research at the AEC. This includes study skins, skulls, complete skeletons, and a few bird nests. The collection can be accessed with advance appointment (newcomb@esf.edu).

HERBARIUM

The plant collection at the Newcomb Campus came into existence in 1939, seven years after the donation of the property by Archer and Anna Huntington (Masters 1993). At that time Harold F. Heady, who later became a leading figure in range management, was a graduate assistant in the former Department of Forest Botany and Pathology at the New York State College of Forestry (now SUNY ESF). From May to September, Heady collected plants and with the help of experts, notably Homer D. House of the New York State Museum, identified and preserved specimens. During this original survey, 761 species were collected representing 328 genera (Heady 1940). Since then, additional specimens have been collected on HWF and the adjacent area, and the collection now has representative samples for 810 plant species. The herbarium at the Newcomb Campus is organized based on Heady's publication and was updated in 1962 by Cross and Krull.

The herbarium includes aquatic and terrestrial plants growing on the Huntington Wildlife Forest as well as species found in the upper Hudson River and Raquette River watersheds, a central Adirondack region from Long Lake east to the Opalescent River and south to Cheney Pond, Minerva (Hamilton and Essex Counties). Specimens are mounted on acid-free herbarium paper and show reproductive or other structures. Plants are listed phylogenetically by Family, by scientific name, and alphabetically by common name. Note that many names have changed over the decades; while current taxonomic names are included in the database, we have preserved the original classification of Heady (1940) for historical reasons.

Seed samples from all trees and many flowering plants are also part of the herbarium, 117 species in total. Preserved specimens include dry seeds with and without flesh, and some fruits are also wet-mounted in alcohol. This collection is useful for investigation of fruiting timing (phenology), wildlife food and other analyses (e.g., Costello 1992, LaMere et al. 2013, Jensen et al 2012).

FIELD NOTES

In 1938, the 4,063-acre "Check-Area" was created (King et al. 1941); it has been a foundational part of field research at HWF. The Check Area on the northern portion of HWF consisted of 54 miles of painted lines spaced at quarter-mile intervals running roughly north-south and east-west. These lines, marked on trees with bright orange paint, served as survey lines for strip transect censuses decades prior to the existence of the Global Positioning System in the US.

Check Area lines were periodically surveyed for Ruffed Grouse (*Bonasa umbellus*), white-tailed deer (*Odocoileus virginianus*) and other wildlife by faculty, staff and students until March 1948. Every wildlife observation along the lines, whether animal sighting, track or other sign, was recorded in a field notebook. Weather information and miscellaneous research activity was also recorded. This information was mapped as well as typed onto cards and comprises what are now referred to as historic field notes. We are in possession of both the original handwritten notebooks and the transcribed cards (Figure 2). The physical cards are sorted both chronologically and by species.

Besides organismal and weather information, these cards offer a glimpse into the daily life of a field biologist nearly a century ago, occasionally revealing quirky or fascinating anecdotes about decisions made during field experiments (see sidebar). The Field Notes also present a promising area of future study on the role of science in society, as mediated by technology, culture and other components. Science occurs in a social context, and the potential is high to explore how people interpret and define the region's natural systems in relation to the laws, institutions and other constituents that affect and interact with natural systems - what Jasanoff (2004) terms co-production of knowledge - and how we know what we know about the central Adirondacks.

SPECIES LIST

AEC keeps lists of species identified on or adjacent to HWF. For vertebrates, there are at least 183 species of birds, 46 mammals, 18 amphibians (9 salamanders, 9 frogs and toads), 9 reptiles (7 snakes, 2 turtles; Johnson 1937), and 26 fish species (including game fish, minnows and introduced species; Dence 1937) belonging to 9 families and known to inhabit HWF.

Non-vertebrate Adirondack species known from the HWF include mosses and lichens, terrestrial and aquatic invertebrates, fungi and some microbes. Seventy-five Lepidoptera (moth and butterfly) species and approximately 40 Odonata (dragonflies and damselflies) are known to inhabit the HWF. For aquatic invertebrates, 145 genera or families have been identified from HWF streams and water bodies (Peckarsky 1986, Kennen 1989, Kruel 1969) and over seventy species of Ephemera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies) are known from the HWF (Myers et al. 2011; AEC unpublished data). These numbers are almost certainly underestimates of total biodiversity, given the rich variety of wetland, elevation, and other gradients found in this region.

GEOSPATIAL ARCHIVES

The ESF Forest Properties staff maintain a geospatial library for HWF that includes information ranging from soils, geology, hydrology, vegetation, elevation, continuous forest inventory (CFI) plots (https://portal.edirepository.org/nis/mapbrowse?packageid=edi.401.1), roads, trails, and other GIS data.

The forest stands spatial data layer is available for research planning, education and other needs. The data within the stand attributes table are extensive; some of the more significant features include:

- Cover type: includes forest type, wetlands, plantations, administrative use, etc. (Fig. 1) and unique site qualities
- Tree size class, age structure, and recent forest inventory data where applicable (includes basal area per acre; trees per acre; mean stand diameter; primary & secondary species based on percent of total basal area per acre)
- Past management activities: last harvest year and type for the last three harvest entries if applicable, last year the stand was inventoried, year planted

There is also a library of historic maps from more than a century of research and extensive forest inventory, experimental soil and vegetation treatments and timber harvesting records. There are aerial photos covering the following years: 1941, 1942, 1949, 1956, 1957, 1958, 1961, 1967, 1968, 1976, 1978, 1981 and 1985. Note aerial photos provide incomplete coverage of HWF in any given year. There are also remotely-sensed infrared and other data collected in the 1990s until New York State began its orthophoto program.

Requests for maps, GIS and other datasets should be submitted via this website: https://www.esf.edu/forestproperties/about/property-use-requests.htm. As digitization of archival materials proceeds, we encourage readers to consult the AEC website for updates www.esf.edu/aec/research/. The EDI dataset is found here: https://portal.edirepository.org/nis/mapbrowse?packageid=edi.232.2 and Bicknell's Thrush data here: https://vtecostudies.org/projects/mountains/mountain-birdwatch/.

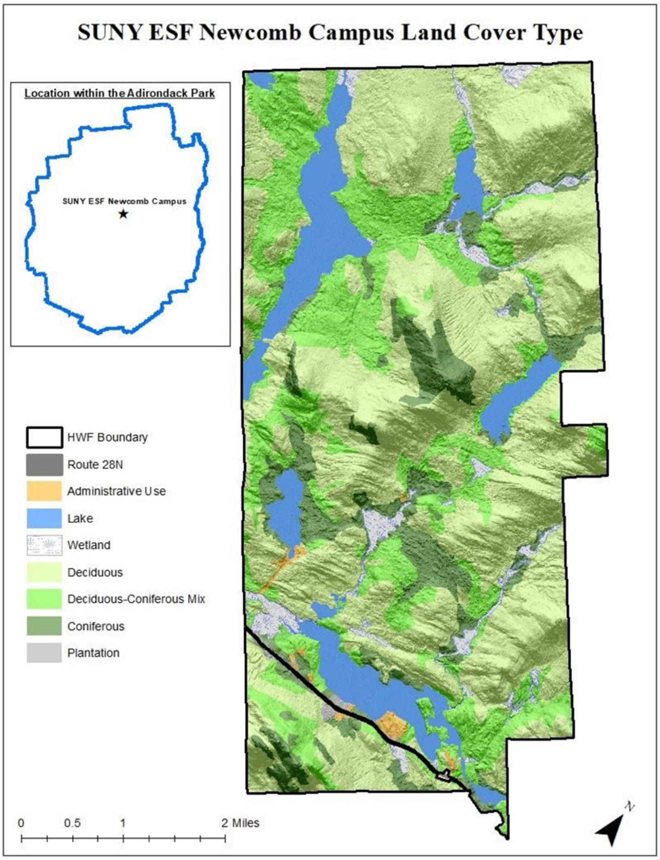

Fig. 1. Shaded relief map of Huntington Wildlife Forest showing location within Adirondack Park, major upland and wetland types, and administrative campus areas."

ADIRONDACK LONG-TERM ECOLOGICAL MONITORING PROGRAM

Monitoring an ecosystem requires consistent, repeated, high-quality observation. The AEC operates the Adirondack Long-Term Ecological Monitoring Program (ALTEMP) to record physical, chemical, and biological features over time at multiple scales at HWF using rigorous sampling procedures. ALTEMP provides the data necessary to detect changes and identify trends in species abundance and diversity, cycles, structure, composition and function in managed and unmanaged forested watersheds. The datasets underpin many of the experimental and observational studies undertaken by research teams.

AEC scientists and trained staff collect, organize and analyze data year-round. Over 30 monitoring efforts are included in ALTEMP; while not every study is operational today, currently we monitor dozens of environmental attributes. Select ALTEMP project objectives and data are described below; a full list is found in Table 1. Data and detailed sampling protocols are available online in some cases. Several datasets are located in the Environmental Data Initiative (EDI) repository at portal.edirepository.org/nis/home.jsp; search for keywords such as "AEC," "Huntington Wildlife Forest," "ALTEMP," or "SUNY ESF," along with the topic of interest.

Breeding Birds #2: The objectives for this project include documenting the relative abundance and species richness of breeding songbirds on HWF using unlimited-radius plots for annual point count data collected each June. The original project took place from 1952 to 1964 (Webb et al. 1977), and continued from 1984 to the present. The project includes breeding bird surveys in the Natural Area, an unmanaged (old-growth) primarily deciduous stand (*cf.* McNulty et al. 2008). Additional bird projects include a Bicknell's Thrush (*Catharus bicknelli*) project with the Vermont Center for Ecosystem Studies (2000-2016) and winter bird counts through Cornell Lab of Ornithology's community science Project FeederWatch (2004-present).

Loon Nesting #14: The project objectives for Common Loon (*Gavia immer*) nesting are to 1) document reproductive success of common loons for Arbutus, Catlin, Deer, Wolf, and Rich Lakes on HWF, 2) document cause of nest abandonment/mortality of eggs, chicks, and adult birds, and 3) document use of HWF lakes by banded loons via partnership with the Adirondack Center for Loon Conservation (ACLC). The data have been collected from 1987 to the present and are maintained by the AEC and ACLC.

Phenology, #8: The objective is to document changes and trends in timing of natural events. The following variables have been recorded since at least 1939: Lake ice in – ice out dates with the earliest record from 1874 (Beier et al. 2012); ice thickness; high water date on Rich Lake; first leaf, lilac; blossoming of *Trillium* and other spring ephemeral species, witch hobble (*Viburnum lantanoides*), and serviceberry (*Amelanchier* spp.); full leaf-out of sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*); first spring peepers (*Pseudacris crucifer*) and wood frogs (*Lithobates sylvaticus*) heard calling; first and last known date of presence of migratory bird species, especially American Robins (*Turdus migratorius*), Loons, Tree Swallows (*Tachycineta bicolor*) and Hooded Mergansers (*Lophodytes cucullatus*); sightings of rare or unusual animals such as accidentals from other parts of the globe; winter severity (number of days with >15 inches snow on ground; number days with minimum temp < 0^{o} F); notable weather events such as late spring snow, hail, damaging wind, ice, flooding etc.; frost occurrence between 15 May and 30 August, and estimated severity/plant damage; quantitative seed crop rating for masting and fruiting species (on a subjective scale of zero, poor, fair, good and excellent seed production; qualitative data are in ALTEMP

#26); planted hybrid chestnut tree growth; and other variables as appropriate. Lake ice data are here: https://portal.edirepository.org/nis/mapbrowse?packageid=edi231.1

Ruffed Grouse Drumming #9: The objective is to document long-term population trends of Ruffed Grouse in a deciduous forest using male breeding counts. Each spring, observers travel specified routes listening for the characteristic drumming of males (beating of wings to attract a mate). Annual data were collected from 1984-present with additional observations available from 1939–1988. https://portal.edirepository.org/nis/mapbrowse?packageid=edi.220.1

Small Mammals #10 and #24: The project objectives include documenting abundance and population changes of mice, voles, shrews, squirrels and other small mammals in managed and unmanaged forests of HWF. From 1950-1968 and again from 1983 to 1988, lethal traps (snap and pit) were employed to document small mammal abundance in a variety of habitats (#10). It was determined that using snap traps did not adequately reflect the sciurid population, therefore an additional study was added using live trap methods (#24). Both projects ran concurrently for three years after which it was determined that the live trapping method provided similar population information to the lethal method. Changes in research ethics involving animal care and use also supported this switch to live trapping methods.

Continuous Forest Inventory #21: Project objectives include 1) documenting tree growth and mortality, species dominance, and other tree characteristics, and 2) documenting changes in forest conditions, generally every decade since 1971. This dataset contains thousands of individually-tagged trees and is often combined with remote sensing and geospatial technology to map forest structure, composition and change, assessment of forest carbon and other studies. See prior web link.

Amphibians #28: There are three separate amphibian projects. The objectives for the pitfall/drift-fence study are to 1) document composition, relative abundance and habitat preference of amphibians (frogs, toads and salamanders) within six aquatic and two forested habitats, 2) develop and test a population index system to determine annual fluctuations in abundance of selected amphibians, and 3) document species diversity, distribution and breeding season of amphibians. Objectives for the pool-breeding and amphibian reproductive success study include 1) assess reproductive success of wood frogs and spotted salamanders (*Ambystoma maculatum*) in vernal pools and beaver ponds and relative abundance of metamorphs, and 2) assess the phenology of breeding of wood frogs and spotted salamanders. Objectives for the third study of terrestrial salamander population trends and habitat use are to 1) assess relative abundance of terrestrial salamanders, 2) assess the relationship of salamander species to habitat features, and 3) assess changes in population demographics over time.

WATERSHED SCIENCE

HWF is the only site in the Adirondack Park with a full complement of atmospheric, aquatic and terrestrial system monitoring for air and water quality, climate effects and system responses (Mitchell et al. 2009). A detailed, multi-decadal dataset on meteorology, chemistry, nutrient cycling, hydrology, phenology and related parameters is available for the Arbutus Lake and the surrounding watershed. In 1978, HWF was one of the original sites in the nation sampled for acidic deposition (Beier et al. 2021). Many of the datasets can be downloaded or explored here: https://adk-ltm.org/. Much of the sensor data collected on HWF is remotely transmitted to ESF, state or national websites (see ALTEMP #15, Table 1). This includes:

- Dry and wet deposition of pollutants (SO_4, NO_3), base cations and nutrients in the National Atmospheric Deposition Program National Trends Network (NADP-NTN site NY-20) https://nadp.slh.wisc.edu/ and Clean Air Status and Trends Network (CASTNET) http://www.epa.gov/castnet national programs
- Atmospheric ammonia gas (NADP-AMON)
- Mercury Deposition Network (NADP-MDN) - wet deposition of Hg
- Litterfall Mercury Monitoring Initiative (NADP)
- Lake hydrology, groundwater depth and stream discharge, and snow depth
- Adirondack Lakes Survey Corporation - Arbutus Lake has been extensively sampled as part of the regional efforts www.adirondacklakessurvey.org/ and US EPA's Long-Term Monitoring program www.epa.gov/airmarkets/monitoring-surface-water-chemistry

In addition to the intensive sampling in Arbutus Lake and watershed, weather, climate signals, and other data have been collected for HWF including:

- Lake chemistry data for the five major lakes collected monthly from June to August since 1999 as part of the Adirondack Lakes Assessment Program www.adklakes.org/
- Meteorology: a National Weather Service station operated from 1942-present (see ALTEMP #15). Since 2016, detailed daily meteorological data are also collected as part of the statewide MESONET network www.nysmesonet.org/weather/local#network=nysm&stid=newc
- Phenocam: a webcam collected daily data since 2008 showing Rich Lake conditions, current daytime weather, and vegetation green-up and leaf color/senescence www.esf.edu/hss/em/huntington/goodnowCam.html
- Carbon cycle sampling via an eddy-covariance flux tower in the Arbutus Watershed to understand carbon exchange and the forest's metabolism.

DOCUMENT COLLECTION

There are close to one thousand publications originating from studies on HWF or involving data from the AEC, including nearly 200 theses and dissertations. Citations and many abstracts can be found online: www.esf.edu/aec/publications/. Books on Adirondack and related topics, theses, dissertations and other materials in the AEC collection are part of the ESF Library holdings www.esf.edu/moonlib/. Full issues of Roosevelt Wild Life Bulletins, many containing early studies of the Adirondack ecosystem, are online here: www.archive.org/details/sunycollegeofenvironmentalscienceandforestry?tab=collection.

CONCLUSION

In her celebrated book *Braiding Sweetgrass*, indigenous scientist, ESF professor and writer Robin Wall Kimmerer speaks of learning to speak the language of a place (Kimmerer 2013). Archives provide one way to pay attention, to understand the world in which we live, and to be introduced to the beings and phenomena that occurred before. Archives help us see and celebrate the diversity of life that surrounds all who live, work and study the Adirondack region.

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SIDEBAR: A SKUNK CABBAGE DISCOVERY

Skunk cabbages (*Symplocarpus foetidus*) emerging from a blanket of snow provide a burst of purple or chartreuse against the brown and white of late winter. This plant is one of the first to flower and leaf out, having the capacity for thermogenesis (internal heat production[1]), but they are not common in the central Adirondacks (https://www.inaturalist.org/observations/109953993). In mid-April 2021, we realized we had a decades-old mystery on our hands.

Two expert Adirondack botanists visited the Newcomb Campus to examine patches of flowering skunk cabbage near Arbutus Lake. There are few other known locations (https://newyork.plantatlas.usf.edu/plant.aspx?id=131), perhaps due to the species' association with moist, often calcium-rich soils. And there they were, blooming annually alongside streams.

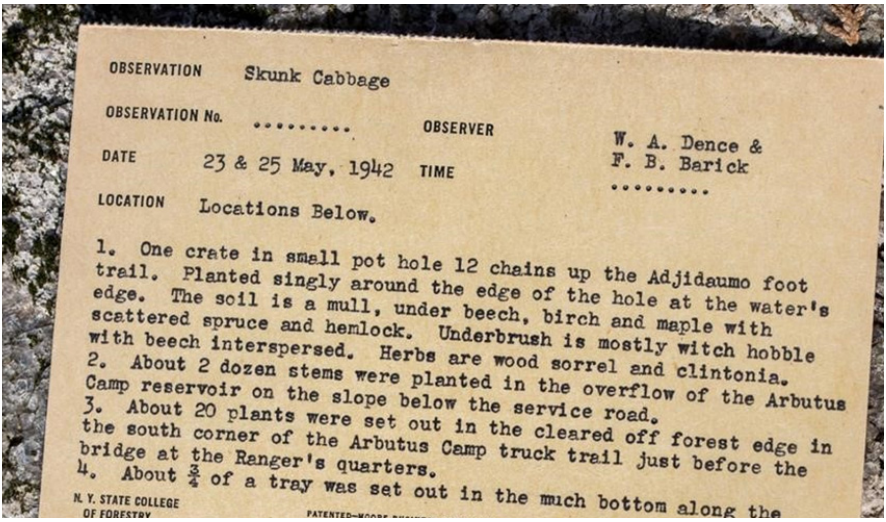
One day, while perusing through the collection of Field Notes, a card with the title "Skunk Cabbage" immediately caught the eye of Graduate Teaching Assistant Carrick Palmer (Figure 2). In the early 1940s, researchers at the College planted skunk cabbage on the property. The sites they chose are within a rich vein of calcium-containing rock in the upper Hudson River watershed. The plants have been successful at this site for eighty years.

But the card contained no information to explain why the biologists planted skunk cabbage. There is a history of humans using it for medicine, but no commercial use. Most herbivores avoid eating the leaves which contain sharp calcium oxalate crystals that cause burning and pain in an animal's mouth.

By mid-May, most skunk cabbage were chewed down to the stalk (Figure 3). Luckily, the culprit left a not-so-subtle clue - a large pile of scat. Black bears (*Ursus americanus*) looking for forage after extended food restriction of winter might overlook – or be adapted to– the crystals in the plant.

With our story unfurled like a new skunk cabbage leaf, the botanical mystery has come to a probable resolution. ESF scientists likely planted it as food for black bears and other wildlife. We never would have known if not for the Field Note.

1 Takahashi, K., T. Ito, Y. Onda, T. Endo, S. Chiba, K. Ito, and H. Osada. 007. Modeling of the thermoregulation system in the skunk cabbage: *Symplocarpus foetidus*. *Physical Review* E 76:031918.



OBSERVATION Skunk Cabbage

OBSERVATION No. ....

OBSERVER W. A. Dence & F. B. Barick

DATE 23 & 25 May, 1942

TIME ....

LOCATION Locations Below.

1. One crate in small pot hole 12 chains up the Adjidaumo foot trail. Planted singly around the edge of the hole at the water's edge. The soil is a mull, under beech, birch and maple with scattered spruce and hemlock. Underbrush is mostly witch hobble with beech interspersed. Herbs are wood sorrel and clintonia.
2. About 2 dozen stems were planted in the overflow of the Arbutus Camp reservoir on the slope below the service road.
3. About 20 plants were set out in the cleared off forest edge in the south corner of the Arbutus Camp truck trail just before the bridge at the Ranger's quarters.
4. About $\frac{3}{4}$ of a tray was set out in the mnch bottom along the

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PATENTED—MOORE ...

Figure 2. Field Note describing skunk cabbage planting date, location and details, 1942.

Figure 3. Skunk cabbage chewed by black bear, 2021.

PROJECT TITLE	OBJECTIVE	COLLECTION PERIOD
#1 Beaver Colony	Survey of the number of active beaver colonies on HWF	1951-19571974 1974 1979-present
#2 Breeding Birds	Document relative abundance and species diversity of breeding birds on HWF	1983-present
#2A Breeding Birds, Natural Area	Document relative abundance and species diversity of breeding birds in the Natural Area, an unmanaged (old-growth) hardwood stand	1952-1963 1991- present
#2B Bicknell's Thrush	Survey for Bicknell's Thrush in surrounding high elevation areas	2000-2016
#2C Project FeederWatch	Bird counts at feeders at the Interpretive Center	2004- present
#3 Winter Birds	Winter bird counts on HWF	1987-1989 (all areas) 1990-2006 (Natural Area only)
#4 Scent Stations	Determine trends in coyote populations on HWF and provide baseline data of numerical response to fluctuations in prey abundance	1987-1990; 2001
#5 Creel/Fish Management	Use angler-reported data to collect fishing data on lakes	1971- present
#6 Limnology	Generate and record baseline data on HWF lakes	1950-1959 1987-1989
#6B Limnology II	Adirondack Watershed Institute Adirondack Lake Assessment Program	2001- present
#7 Loon Nesting	Document loon nesting success on HWF lakes and use of lakes by banded Loons	1986- present
#8 Phenology (Lake ice, animals, plants, weather)	Document changes and trends in species phenology and events	1932- present
#9 Ruffed Grouse Drumming	Document population trends of ruffed grouse in a northern hardwood ecosystem	1984-1992 1995, 1996 2001- present
#10 Small Mammals	Document small mammal abundance and population changes in managed and unmanaged forests *see project #24 for data	1950-1968 1983-1988 1990- present

PROJECT TITLE	OBJECTIVE	COLLECTION PERIOD
#11 Snowshoe Hare Tracks	Assess trends in hare populations in a sprucefir forest; compare trends with relative abundance of selected predators	1969-72 1987- 2001
#12 Water Level	Observe the water level fluctuations within selected within selected watersheds	1985-1999 staff gauge readings 1999-present Arbutus outlet
#12A Arbutus Lake pH	Monitor daily and year-round pH of Arbutus Lake	1983-2007
#13 Wildlife Observation Survey	Document wildlife seen near roadsides	1962-1984 1985- present
#14 Migratory Waterfowl	Determine abundance of waterfowl during spring and autumn migrations	1986, 1987, 1988
#15 Atmospheric/Meteorological	Daily weather information NOAA NADP MESONET	1940-2016 2016- present 1978- present_ 2016- present
#16 White-tailed Deer Tracks and Pellets	Access relative abundance and habitat use on HWF	1984-1986 Pellets 1974-1999 Tracks
#17 Winter Tracks	Determine relative abundance of select mammals in winter and determine factors impacting predator populations	1986- present
#18 Nest Boxes	Document use of nest boxes, nesting chronology, hatching success, and whether nest box placement use is correlated with location characteristics by Wood Ducks and Hooded Mergansers	1931-1970 1987- present
#19 Woodcock Singing Survey	With the US Fish and Wildlife Service, measure relative abundance of Woodcock in the central Adirondacks	1968- present
#20 Snapping Turtle	Document observations of marked snapping turtles during nesting	1970- present Observations

PROJECT TITLE	OBJECTIVE	COLLECTION PERIOD
#21 Continuous Forest Inventory	Document tree growth and mortality, species dominance, and other tree characteristics; document changes in forest conditions (1986 new plots established)	1970, 1976, 1981, 1982, 1984, 1991, 2001, 2011, 2021
#22 Exclosures	Document location, history of deer herbivory via fencing experiments	1979-1985, 1990, 1995, 2000, 2013, 2018
#23 Aquatic Invertebrates	Inventory aquatic invertebrates	On-going
#24 Chipmunk/ Red Squirrel	Evaluate annual population of red squirrels on HWF. In 1991 this expanded to include live-trapping of all small mammals.	1989-1991 Calls *1991- present Trapping
#25 Habitat Inventory	Assess structural vegetation characteristics and floristics at small mammal and songbird stations and sampling units; detect changes in vegetation over time; relate changes in habitat to changes in mammal, bird and amphibian populations	1988-1989, 2002-03, 2021
#26 Seed Production	Document seed production of seven tree species annually. Fall and spring.	1988- present
#27 Great Blue Heron Nesting	Document Great Blue Heron nesting activity and success	1939-1999
#28 Amphibians	Pitfall/drift fence study; pool-breeding amphibian reproductive success; terrestrial salamander population trends and habitat use	1990-1991 1994- present
#29 Deer Hunts	Maintain deer density of Northern Unit of HWF at or below 12 deer/mi^2	1966-1970 1978-1984
#30 Raptor Nest Locations	Document raptor nest locations	1950s- present
#31 Deer Population Study	Document population demographics, social organization and genetics and seasonal movement behavior and home ranges	1962-2008

Table 1. Adirondack Long-Term Ecological Monitoring Program Datasets, Objectives, and Collection periods.