1989

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Abstract. Hempstead Plains, once encompassing 24,282 hectares, originally extended from western Suffolk County, to eastern Queens County, Long Island, New York. Hicks (1892), Harper (1918), Ferguson (1925), Cain *et al.* (1937), and Seyfert (1972), contended that Hempstead Plains was always devoid of arboreous growth, though Bailey (1949) maintained that shrubs and trees grew on the Plains. Those who have made important vegetation studies of the Plains included Hicks (1892), Harper (1918), Ferguson (1925), Conard (1935), Seyfert (1972), and Stalter and Lamont (1987). Stalter and Lamont (1987) studied a 8.5 ha remnant in the vicinity of Mitchell Field and found little bluestem (*Andropogon scoparius* Michx.) and broomsedge bluestem (*Andropogon virginicus* L.) to be the dominant species. Switchgrass (*Panicum virgatum* L.), indiangrass [*Sorghastrum nutans* (L.) Nash], and bird-foot violet (*Viola pedata* L.) are remnants of the prairie flora that dominated Hempstead Plains years ago. Invasion of alien species such as crabgrasses (*Digitaria* spp.), foxtail grass (*Setaria faberi* Herrm.), and purslane (*Portulaca oleracea* L.) on disturbed sites reflects the changing character of the Hempstead Plains flora. The small size of the Mitchell Field site, disturbance by vehicles and dumping may hasten the very slow process of old field succession at Mitchell Field.

Key Words. vegetation history, Hempstead Plains, Long Island, New York

INTRODUCTION

Hempstead Plains, once encompassing 24,282 hectares, is located on Long Island, New York. The goal of this review is to present the history of the land use of the Plains and then to interpret the floristic and vegetational changes that have occurred over the past 95 years, based on a comparison of several floristic studies. Those who have made important floristic studies of Hempstead Plains include: Hicks (1892), Harper (1918), Ferguson (1925), Seyfert (1972), and Stalter and Lamont (1987). Stalter (1981 and 1982) studied the ecology of the Plains from July 1980 through June 1981 and recorded the phenology and abundance of taxa found in 50 quadrats (m^2) at two study sites within the Hempstead Plains Nature Preserve.

Harper (1918) recognized Hempstead Plains as a genuine prairie on Long Island. Harper (1918) believed that the *Andropogon* which he found to be most abundant, little bluestem (*Andropogon scoparius* Michx.), was probably not the dominant grass in colonial times, but rather big bluestem (*Andropogon gerardii* Vitman), which is common on the prairies of western United States. Hempstead Plains is situated on outwash deposits of the last Wisconsin glacier. Two soil groups, the Haven Variant Association and Hoosic Variant Association were identified at the study sites. The Haven Variant Association occupies nearly level to gently sloping outwash plains, while Hoosic Variant soils are deep, very gravelly and well drained (Fuller 1914, Soil Conservation Service 1976).

METHODS

A comparison of native and introduced flora from 1892 through 1987 was obtained by examining species lists compiled by: Hicks (1892), Harper (1918), Ferguson (1925), Cain *et al.* (1937), Seyfert (1972), and Stalter and Lamont (1987). These data are presented in Table 1. A list of the flora identified by Stalter and Lamont (1987) appears in Table 2. Gleason and Cronquist (1963) was used as a reference to identify native and introduced species.

Table 1. A comparison of native and introduced flora, on Hempstead Plains, Long Island, New York, 1892 to 1987.

Collector	*Total Species*	*Native Species*	*Introduced Species*
Hicks (1892)	126	106 (84%)	20 (16%)
Harper (1918)	123	118 (96%)	5 (4%)
Ferguson (1925)	251	249 (99%)	2 (1%)
Cain *et al.* (1937)	69	67 (97%)	2 (3%)
Seyfert-Southeast (1972)	220	119 (54%)	102 (46%)
Seyfert-Central (1972)	185	103 (56%)	83 (44%)
Stalter and Lamont (1987)	171	106 (62%)	65 (35%)

OBSERVATIONS AND DISCUSSION

One of the earliest descriptions of Hempstead Plains was that by Denton (1670) which was reported by Seyfert (1972). Denton describes the plains as follows:

> "Toward the middle of Long-Island lyeth a plain sixteen miles long and four broad, upon which plain grows very fine grass, that makes exceeding good hay, and is very good pasture for sheep or other cattle; where you shall find neither stick nor stone to hinder the horse heels, or endanger them in their races . . ."

By 1755, 6,800 ha of plains land were held as common lands by the Town of Hempstead. Thompson (1839) reported:

> "Except for the great plains, much of the common lands of the town was anciently enclosed in large fields for the pasturing of different kinds of stock, and denominated according to the use intended, as the ox-pasture, the cow-pasture, etc."

The aforementioned accounts indicate that Hempstead Plains was primarily used for cattle and sheep raising from 1670 to 1869. That Hempstead Plains was thought to be unsuited for crops can be seen by examining the account by Prime (1845) to explain the reason why the Plains were unsuited for farming. Prime (1845) states:

> "The main difficulty lies beneath the soil. The substratum is a coarse, smooth, clean gravel, that appears as if it had been screened and washed from every particle that was capable of retaining moisture, or any other vegetable nourishment, and its depth is unfathomable. The necessary consequence is, that except in few places, where there is a small mixture of loam, a coat of manure is leached off in the coarse of a year or two; and the work must be done over again."

Table 2. The vascular flora of Hempstead Plains, Long Island, New York. Non native plants are noted with an asterisk (*). Data from Stalter and Lamont (1987).

GYMNOSPERMAE

Cupressaceae
Juniperus virginiana L.

Pinaceae
Pinus strobus L.

ANGIOSPERMAE-DICOTYLEDONEAE

Amaranthaceae
Amaranthus retroflexus L.*
Froelichia gracilis (Hook.) Mog.

Anacardiaceae
Rhus copallina L.
Rhus radicans (L.) Kuntze

Apiaceae
Daucus carota L.*

Apocynaceae
Apocynum cannabinum L.

Asclepiadaceae
Asclepias syriaca L.
Asclepias tuberosa L.

Asteraceae
Achillea millefolium L.*
Ambrosia artemisiifolia L.
Antennaria plantaginifolia (L.) Richards.
Artemisia vulgaris L.*
Aster dumosus L.
Aster pilosus Willd.
Centaurea nigra L.*
Chrysanthemum leucanthemum L.*
Cichorium intybus L.*
Cirsium arvense (L.) Scop.*
Cirsium vulgare (Savi) Tenore*
Conyza canadensis (L.) Cronq.
Erechtites hieracifolia (L.) Raf. *ex* DC.
Erigeron strigosus Muhl. *ex* Willd.
Eupatorium hyssopifolium L.
Gnaphalium obtusifolium L.
Helenium flexuosum Raf.
Hieracium floribundum Wimmer & Grab*
Hieracium pilosella L.*
Hypochaeris radicata L.*
Krigia virginica (L.) Willd.
Lactuca serriola L.
Rudbeckia hirta L.
Solidago canadensis var. *scabra* (Muhl.) Torr. & Gray
Solidago graminifolia (L.) Salisb.
Solidago juncea Ait.
Solidago nemoralis Ait.
Solidago rugosa Ait.
Solidago tenuifolia Pursh
Taraxacum officinale Weber*
Tragopogon dubius Scop.*

Brassicaceae
Arabidopsis thaliana (L.) Heynh.*
Barbarea vulgaris R.Br.*
Draba verna L.*
Lepidium virginicum L.
Raphanus raphanistrum L.*

Caesalpiniaceae
Gleditsia triacanthos L.

Caprifoliaceae
Lonicera fragrantissima Lindl. & Paxton*
Lonicera japonica Thunb.*
Sambucus canadensis L.
Viburnum dentatum L.

Caryophyllaceae
Cerastium vulgatum L.*
Dianthus armeria L.*
Scleranthus annuus L.*
Silene alba (P. Mill.) Krause
Spergula arvensis L.*
Spergularia rubra (L.) J. & C. Presl.*

Celastraceae
Celastrus orbiculatus Thunb.*

Chenopodiaceae
Chenopodium album L.

Convolvulaceae
Convolvulus sepium L.

Cornaceae
Cornus florida L.

Cuscutaceae
Cuscuta pentagona Engelm.

Elaeagnaceae
Elaeagnus angustifolia L.*

Ericaceae
Lyonia mariana (L.) D. Don
Vaccinium atrococcum (Gray) Heller

Euphorbiaceae
Euphorbia cyparissias L.*
Euphorbia supina Raf.

Fabaceae
Baptisia tinctoria (L.) R.Br.
Lespedeza capitata Michx.
Lespedeza cuneata (Dum.-Cours.) G. Don*
Lespedeza intermedia (S. Wats.) Britt.
Melilotus alba Medic.*
Strophostyles helvola (L.) Ell.
Trifolium arvense L.*
Trifolium pratense L.*

Fagaceae
Quercus coccinea Muenchh.

Hypericaceae
Hypericum gentianoides (L.) B.S.P.
Hypericum perforatum L.*

Lamiaceae
Hyssopus officinalis L.
Pycnanthemum flexuosum (Walt.) B.S.P.
Trichostema dichotomum L.

Mimosaceae
Albizia julibrissin Durz.*

Molluginaceae
Mollugo verticillata L.*

Myricaceae
Myrica asplenifolia L.

Oleaceae
Fraxinus americana L.

Onagraceae
Oenothera biennis L.

Oxalidaceae
Oxalis stricta L.

Phytolaccaceae
Phytolacca americana L.

Plantaginaceae
Plantago aristata Michx.
Plantago lanceolata L.*
Plantago major L.*
Plantago rugelii Dcne.

Table 2. Continued

Polygalaceae
Polygala nuttallii Torr. & Gray
Polygala polygama Walt.

Polygonaceae
Polygonum aviculare L.
Polygonum caespitosum Blume*
Polygonum scandens L.
Rumex acetosella L.*

Portulacaceae
Portulaca oleracea L.*

Primulaceae
Lysimachia quadrifolia L.

Rhamnaceae
Rhamnus frangula L.*

Rosaceae
Crataegus monogyna Jacq.
Potentilla argentea L.*
Potentilla canadensis L.
Potentilla recta L.*
*Potentilla simplex*Michx.
Prunus serotina Ehrh.
Pyrus coronaria L.*
Pyrus soulardii Bailey*
Rosa multiflora Thunb. *ex* Murr.*
Rosa virginiana P. Mill.
Rubus allegheniensis Porter *ex* Bailey
Rubus flagellaris Willd.
Rubus hispidus L.

Rubiaceae
Diodia terres Walt.

Scrophulariaceae
Agalinis acuta Pennell
Linaria canadensis (L.) Dum.-Cours.
Linaria vulgaris P. Mill.*
Verbascum blattaria L.*
Verbascum thapsus L.*
Veronica officinalis L.*

Simaroubaceae
Ailanthus altissima (P. Mill.) Swingle*

Solanaceae
Solanum dulcamara L.*

Verbenaceae
Verbena hastata L.

Violaceae
Viola fimbriatula Sm.
Viola lanceolata L.
Viola pedata L.
Viola sororia Willd.

ANGIOSPERMAE-MONOCOTYLEDONEAE

Amaryllidaceae
Hypoxis hirsuta (L.) Coville

Cyperaceae
Bulbostylis capillaris (L.) C.B. Clarke
Carex pensylvanica Lam.
Cyperus filiculmis Vahl

Iridaceae
Sisyrinchium albidum Raf.

Juncaceae
Juncus greenei Oakes & Tuckerman
Juncus secundus Beauv. *ex* Poir.
Juncus tenuis Willd.

Liliaceae
Allium vineale L.*

Poaceae
Agrostis hiemalis (Walt.) B.S.P.
Aira caryophyllea L.*
Andropogon gerardii Vitman
Andropogon scoparius Michx.
Andropogon virginicus L.
Anthoxanthum odoratum L.*
Aristida dichotoma Michx.
Aristida oligantha Michx.
Bromus japonicus Thunb. *ex* Murr.*
Dactylis glomerata L.*
Danthonia spicata (L.) Beauv. *ex* Roem. & Schult.
Digitaria ischaemum (Schreb. *ex* Scherig.) Schreb. *ex* Muhl.*
Digitaria sanguinalis (L.) Scop.*
Eragrostis spectabilis (Pursh) Steud.
Festuca elatior L.*
Festuca ovina L.*
Festuca rubra L.
Panicum auburne Ashe
Panicum capillare L.
Panicum commonsianum var. *addisonii* Stone
Panicum depauperatum Muhl.
Panicum dichotomiflorum Michx.
Panicum lanuginosum var. *fasciculatum* Fern.
Panicum lanuginosum var. *lindheimeri* Fern.
Panicum sphaerocarpon Ell.
Panicum virgatum L.
Paspalum setaceum Michx.
Poa pratensis L.*
Setaria faberi Herrm.*
Setaria geniculata (Lam.) Beauv.
Sorghastrum nutans (L.) Nash
Triodia flava (L.) Smyth
Triplasis purpurea (Walt.) Chapman

Poor soil as a detriment to cultivation is also clearly stated by Denton (1670):

> "From the first settlement of the country until within about the last thirty years it was universally believed that this great tract of land could never be cultivated-that if turned up by the plough, it was so porous, the water would at once run through it and leave the vegetation on the surface to perish from drought-that nothing would grow upon it except the tall grass which seems a native of that region."

Yet, 6,880 hectares of land in the southeastern portion of the Hempstead Plains were not plowed. By the 1840's, several influential individuals argued that this portion of plains land owned by the Town of Hempstead should be sold or cultivated. The chronology of those who argued for the cultivation of the Plains is presented by Seyfert (1972). In 1869, the Hempstead Town commissioners finally gave serious thought to selling their tracts of Hempstead Plains land. The commissioners were approached by Mr. Charles Harvey, who offered to purchase the land for $104/ha ($42/acre). Later that same year Mr. Alexander Stewart offered $136/ha ($55/acre) for a 3,035 ha tract of land. The offer was increased to $148/ha ($60/acre) by Col. Alfred Wood and Mr. C.B. Camp. After much bickering, the townspeople voted on the various offers and decided to sell 3,035 ha of land to Mr. Stewart for $394,350. On 23 November 1869, Mr. Stewart purchased an additional 809 ha of land. Additional tracts of land were sold by the Town of Hempstead in 1870, 1915, and 1927. In 1934, the last tract of Hempstead Plains was sold by the Town of Hempstead (Seyfert 1972).

Most investigators (Hicks 1892, Harper 1918, Ferguson 1925, Cain *et al.* 1937, and Seyfert 1972) were in agreement that Hempstead Plains were devoided of arboreous growth. Early descriptions of Hempstead Plains by Denton (1670) support the treeless condition of Hempstead Plains, yet Bailey (1949) maintained that shrubs and trees grew on the plains. Since the early accounts of the original flora of Hempstead Plains are contradictory, the status of the original flora is uncertain.

The first floristic study of Hempstead Plains was conducted by Hicks (1892), who reported that the most abundant plant was little bluestem. Hicks (1892) reported that big bluestem and indiangrass [*Sorghastrum nutans* (L.) Nash] might have been more abundant prior to his (1892) study.

The next serious study of the flora was published by Harper (1918). Harper reported that little bluestem was the most common component of the herbaceous vegetation. Harper stated that other important components of the flora were: big bluestem, plaintain-leaved pussy's-toes [*Antennaria plantaginifolia* (L.) Richards.], sedge (*Carex pensylvanica* Lam.), stargrass [*Hypoxis hirsuta* (L.) Coville], milkwort (*Polygala polygama* Walt.), winged sumac (*Rhus copallina* L.), indiangrass; goat's-rue [*Tephrosia virginiana* (L.) Pers.], and birdfoot violet (*Viola pedata* L.). Harper also noted that weeds were invading the once cultivated areas including: redtop (*Agrostis alba* L.), ragweed (*Ambrosia artemisiifolia* L.), heath aster, (*Aster ericoides* L.), Queen Anne's lace (*Daucus carota* L.), crab grass [*Digitaria sanguinalis* (L.) Scop.], and butter and eggs (*Linaria vulgaris* P. Mill.). Ferguson's (1925) floristic study of the Plains was one of the most complete studies of the area and included a list of 251 species (Table 1).

Conard (1935) indicated that several undisturbed tracts of 40 ha still remained within the original boundary of Hempstead Plains. Conard stated that stargrass, little bluestem, big bluestem, heath aster, wild indigo [*Baptisia tinctoria* (L.) R.Br.], Greene's rush (*Juncus greenei* Oakes & Tuckerman), grass-leaved goldenrod (*Solidago tenuifolia* Pursh), violet (*Viola fimbriatula* Sm.), and a number of other species were important components of the flora. Several of the species reported by Conard (1935) are also important components of the Plains flora today.

While Cain *et al.* 1937 did not conduct a floristic study of the Plains, his comments on the plant association "Andropogonetum Hempsteadii" are helpful in interpreting the ecology of the Plains. Cain wrote:

> "Trees, when present, usually are stunted and short-lived. The dominants included *Andropogon scoparius,* aster (*Aster linariifolius*), *Carex pensylvanica,* and *Aster ericoides* (= *Aster pilosus*). There are many other species present in the association, but they are not of high density, coverage or presence."

McManus (1968) wrote that the only remaining tracts of Hempstead Plains were located at Mitchell Field comprising approximately 243 ha of land. These small remnants have been reduced still further. Stalter (1982) noted that one site at Hofstra University that he examined in the summer of 1980 had been covered by fill in 1981. While small tracts of land supporting Plains vegetation remain, these tracts might eventually be developed.

The data in Table 1 indicate that over 80% of the species identified by Hicks (1892) were native to North America. Harper (1918), Ferguson (1925) and Cain *et al.* (1937) found over 95% of the species at Hempstead Plains were native species. Seyfert's (1972) study revealed that approximately 45% of the Plains flora were introduced while Stalter and Lamont (1987) found 38% of 171 species on a 8.5 ha tract were introduced (Table 2). The high percentage of introduced flora in the studies of Seyfert (1972) and Stalter and Lamont (1987) suggest that the areas studied by Seyfert and Stalter and Lamont were disturbed.

No accurate account of the flora of Hempstead Plains was known until the study by Hicks (1892). The flora observed by Hicks in 1892 was a product of over 150 years of intensive grazing; and, therefore, might have been different from the flora that existed when the region was first settled by Europeans. Hicks (1892) quotes early Dutch writers, "Hempstead is superior to all settlements on the Island, for it is very rich in cattle." A quotation by Thompson (1839) that appears in the Introduction section of this paper, notes the use of Hempstead Plains for the sustenance of livestock.

Little bluestem and broomsedge bluestem are the dominant vegetation at Hempstead Plains (Stalter and Lamont 1987). Poverty grass [*Danthonia spicata* (L.) Beauv. *ex* R. & S.], fescues (*Festuca* spp.), orchard grass (*Dactylis glomerata* L.), indiangrass, Kentucky bluegrass (*Poa pratensis* L.), and switchgrass (*Panicum virgatum* L.) are common the year round and are conspicuous when in flower and fruit. Important herbs are wild indigo, heath aster, grass-leaved goldenrod [*Solidago graminifolia* (Nash) Fern.], common St. John's-wort (*Hypericum perforatum* L.), hawk weeds (*Hieracium* spp.), and Queen Ann's lace (Stalter and Lamont 1987).

Harper (1918) recognizing the significance of Hempstead Plains as genuine prairie, speculated about its origin. Harper (1918) considered a number of factors (e.g., soil, fire, climate, etc.) but found each of these factors alone insufficient to explain the origin and perpetuation of the flora.

Investigators have suggested that many factors might have been important in perpetuating the vegetation. Fire (Cain *et al.* 1937, Seyfert 1972), topography (Cain *et al.* 1937), the presence of the sod producing little bluestem (Svenson 1936), the role of small mammals (Johnson 1972), soils (Svenson 1936, Stalter 1981), allelopathy (Stalter 1981), and a combination of the above factors (Stalter 1981) have been suggested to explain the presence and maintenance of the vegetation.

It is apparent that all of these factors act alone, together, or perhaps synergistically, to perpetuate the flora of Hempstead Plains. Additional work has not clarified the importance of each factor listed above although more work on the soil might provide greater insight to understanding the complexity of the flora. Of all the factors mentioned, soils are probably the most important. Permeability is moderate in the top soil and very high in the underlying sand and gravel. During years of low rainfall, or during periods of prolonged drought, the vegetation would be under severe water stress. Within the past 25 years, Hempstead Plains has experienced two dry periods. The first, the most severe of the 20th century, occurred in 1964 and 1965. In 1965, only 660 mm of rain were recorded in New York City, breaking the previous record set in 1964 by almost 150 mm. A second severe drought during the summer and early fall of 1981 killed approximately 30% of the shrubs at the study sites examined by Stalter (1981), though grasses were unaffected by the 1981 drought.

The original 24,282 ha of Hempstead Plains vegetation has now been reduced to 243 ha. Almost all of the remaining land has been altered by plowing, roads, pipelines, and mini-bike trails. Little or no portion of the original Hempstead Plains could be defined as in its "natural condition," although many of the species found on the original area still thrive there today. The presence of a high percentage of introduced species in the vegetation studies of Seyfert (1972) and Stalter and Lamont (1987) suggest that the plains remnants are highly disturbed (Table 1). While many taxa of the original flora still exist at Hempstead Plains, the composition of the vegetation today is drastically different than the vegetation that existed when Long Island was first settled by Europeans. The presence of shrubs, such as blackberry (*Rubus allegheniensis* Porter *ex* Bailey), and trees such as black cherry (*Prunus serotina* Ehrh.), crab apples (*Pyrus* spp.), and eastern redcedar (*Juniperus virginiana* L.) indicate that Hempstead Plains is undergoing very slow plant succession.

ACKNOWLEDGEMENTS

This paper is dedicated to Dr. Hugh Loveland, C.W. Post - Long Island University. The authors appreciate the contributions and assistance of Dr. Loveland toward the understanding of the flora and ecology of Long Island's plant associations. We thank Dr. Dwight T. Kincaid for helpful comments on the manuscript.

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