LONG ISLAND BOTANICAL SOCIETY

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Vol. 10, No.1 *The Quarterly Newsletter* *Jan-Mar. 2000*

On the Origin of Parabolic Dunes Near Friar's Head, Long Island, New York

Steven C. Englebright[1], Gilbert N. Hanson[2], Troy Rasbury[3], and Eric E. Lamont[4]

[1]Curator of Geology, Department of Geosciences, State University of New York at Stony Brook, Stony Brook, NY 11794
[2]Professor of Geology, Department of Geosciences, State University of New York at Stony Brook, Stony Brook, NY 11794
[3]Assistant Professor of Geology, Department of Geosciences, State University of New York, Stony Brook, NY 11794
[4]Research Associate, New York Botanical Garden, Bronx, New York 10458

Introduction

An analysis of the Grandifolia Sandhills (Long Island, New York) reveals that a series of duneforms and an associated endemic forest dominated by American Beech (*Fagus grandifolia*) located on and adjacent to Long Island Sound bluffs exceeding 100 feet in height are probable Late Pleistocene climatic relics. Information derived from both historic U.S. Coast and Geodetic Survey charts and U.S.Geological Survey digitial elevation maps demonstrates that the Sandhills are parabolic dunes that have been truncated by long term erosional recession of the Long Island north shore.

Extrapolation of original dunefield structure indicates that many individual dunes spanned a dunefield that was at least one mile in width and that all originated from a northwesterly sand source that appears to have been drowned by the post-glacial eustatic rise of sea level. Shoreface retreat has removed more than half of the initial length of many surviving Grandifolia dunes, a process that could only have occurred over thousands of years.

Large parabolic dunes similar to these occur in contemporary periglacial regions. The Grandifolia Sandhills apparently began to form approximately 18,000 years before present when the last periglacial climate effected coastal NewYork. Many of these dunes ascended the east-west trending spine of the Harbor Hill Moraine (Fuller, 1914) and were stranded in their present position when winds powerful and persistent enough to move them dissipated as the climate ameliorated.

Although tundra vegetation probaby helped trap and bind loose sand to (Continued on Page 3)

Audrey Watson Wigley

Dwarf **American Beech** *(Fagus grandifolia)* as found at Baiting Hollow, Long Island

Long Island Botanical Society
Founded: 1986 Incorporated: 1989

The Long Island Botanical Society is dedicated to the promotion of field botany and a greater understanding of the plants that grow wild on Long Island, New York.

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Annual Dues of $15 payable to:
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Mail to:
Lois Lindberg, Membership Chairperson
45 Sandy Hill Road
Oyster Bay, New York 11771-3111

Article & News Submissions
Long Island Botanical Society
P.O. Box 5001
Hauppauge, New York 11788
LIBS@nativeamerica.com

Society News

It is with great pleasure that I assume the position as the editor of the Long Island Botanical Society newsletter. The Society was founded in 1986 by an ambitious group of educated field botanists.
In 1991, Lois Lindberg initiated an informal mailing consisting of minutes from monthly meetings, field trip reports, and a few short articles.

Soon thereafter the accounts and diary of activities were somewhat formatted. Steve Clements became the first editor as the newsletter banner made its debut. He collected and packaged regional botanical news and delivered it in an early readable fashion.

Four years later, Eric Lamont succeeded as its second ambitious editor, continued to sort through noteworthy narratives and local botanical lore, did some tailoring to the layout, and added the logo of the Curly-grass Fern (*Schizaea pusila*).

And now I, too, have the privilege and opportunity to build upon the inspiring and informative productions of my predecessors as I assemble and arrange a third "edition" of the evolving newsletter.

This issue has the distinction of presenting a first printing of a significant geobotanical paper authored by a noted group of scientists including three geologists from the State University of New York at Stony Brook and botanist Eric Lamont.

The pages will still have the familiar flavoring of past issues. And, as always, Audrey Watson-Wigley will continue to charm us with her delightful and engaging botanical illustrations.

-John E. Potente

Plants in the News

In December, 1999 the journal "Nature" reported that a complete plant chromosome has been decoded for the first time. The simultaneous genetic mapping of two chromosomes of *Arabidopsis thaliana*, a member of the mustard family, has been achieved. Chromosome 2 was sequenced at the Institute of Genomic Research in Rockville, MD. And chromosome 4 was sequenced at the John Innes Center in Norwich, England.

John Rather, writer for the New York Times, said at a recent Sierra Club meeting that Suffolk County spending for land aquisitions is among the top ten environmental issues now facing Long Island. The Grandifolia Sandhills heads the list of sites as the top priorty.

On the Origin of Parabolic Dunes (continued)

create these parabolic dunes, when the climate warmed enough to support trees *Fagus grandifolia*--possibly in a dwarf form living at the edge of the range of the species--may have been the earliest tree to colonize. Once established, this species gradually modified surficial dune sand into a soil that promoted its domination and tall form.

As shoreface retreat undercut dune and forest over thousands of years the parent *Fagus grandifolia* population tenaciously evolved--or reverted to-- a unique dwarf morph that may have been the pioneer.

Although dwarfism today occurs on these dunes other than where the forest is undercut, the pygmy form appears to grow in particularly stressed micro-environments that are distal from water or where soil may be thin such as dune crests. Dwarf trees are most abundant where the fabric of the forest runs down the steep Sound shore bluff to be continually cut back by slumping and other effects of storm waves. This biogeologic phenomenon appears to be globally singular. Preservation for scientific research, study, and education is recommended.

History

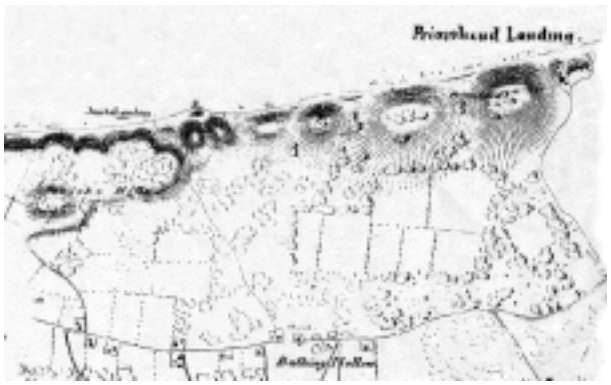
Previous reports on the possible geological origins of a series of sandy hills overlooking Long Island Sound near Friar's Head, Riverhead, New York have not provided interpretations that simultaneously explain both these hills and the apparently unique presence of a forest dominated by dwarf and other growth forms of the American beech (*Fagus grandifolia*).

Most workers, including Lewis (1876), Fuller (1914), and Black (1998), have concluded that these features are dunes.

Recent analysis by Terchunian and Sirkin (1999) suggest that the Grandifolia Sandhills have glaciofluvial cores that are merely veneered by locally derived wind-blown sediment which became mobile as a result of mid-19th century land clearing activities. This explanation does not reconcile with clearly observable geomorphic and bio-goeological phenomena.

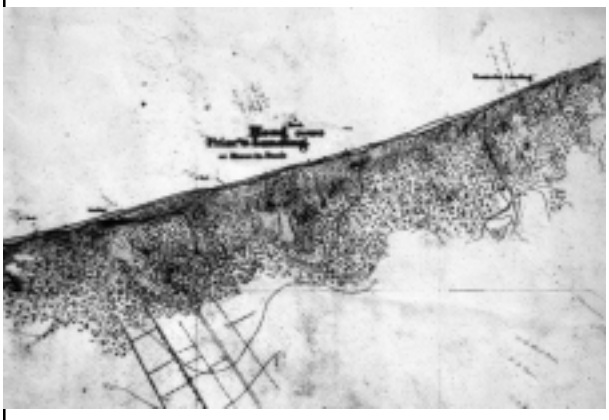
Discussion

An alternate interpretation, not previously reported, is that these features are the result of aeolian processes in a periglacial climate and that the population of *Fagus grandifolia* found here has for thousands of years trapped, bound, adapted to, and modified the sediment and soil chemistry of ancient parabolic duneforms (see addendum). Vegetationally detailed maps produced by the USCGS in, respectively, 1838 and 1885 demonstrate that the Grandifolia Sandhills remained largely vegetated during the mid-19th century.



USGS map circa 1838

The large dune called Friar's Head was so named when sailors saw a similarity to an elevated exposed dune area encircled by dwarf Beech Trees.



USGS map circa 1885

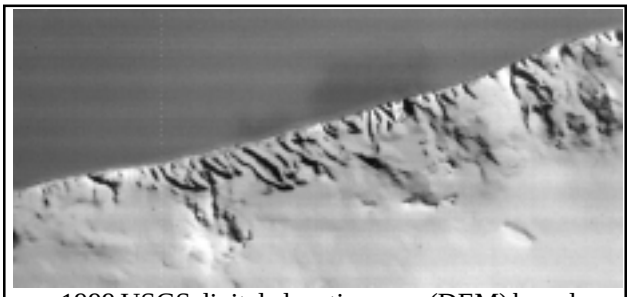
Note that on each of these historic maps mature trees were recorded for the dune area.

(Continued on page 4)

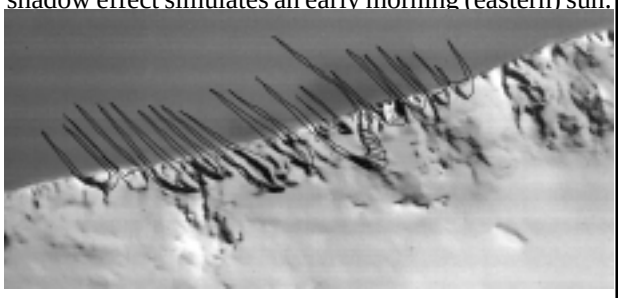
The idea that the Grandifolia Sandhills is no more than a thin veneer of sand resulting from wood harvesting activities south of the eroding bluffs during the time interval of the last hundred or so years (Terchunian and Sirken, 1999) is not supported by any evidence. Historic maps show cultivated fields adjacent to sandhills that appear to have been continuously vegetated. With the exception of laborious clearings for farm fields, the wood cutting activities of the ninteenth century typically did not injure or remove tree roots. Without root removal vigorous regrowth, not soil erosion or abundant loose sand, would have been the expected result of wood cutting. This conforms with the observations of Good and Good (1970) who concluded that "None of it (the Grandifolia Sandhills) was ever farmed, although timber was cut to supply firewood for New York City in the late 1800's".

The oblique "shadow effect" on a colored Digital Elevation Map (DEM) based upon a U.S. Geological Survey 7 1/2° quadrangle shows numerous northwest-southeast trending parabolic dunes both east and west of Friar's Head. Because the curvilinear shapes of these structures also define the boundaries of the Grandifolia Sandhills, it appears that these relief features of aeolian origin. The DEM clearly shows that this field of dunes is truncated by the erosional scarp that characterizes the eastern half of Long Island's north shore. This truncation not only demonstrates the pre-modern origin of the Grandifolia Sandhills, but suggests that the north fork of Long Island was a once much more extensive land surface across which these dunes migrated.

Aerial Photograph of the Grandifolia Sandhills. The feature in the lower left corner, the DeFriest Blowout, is the largest dune blowout on Long Island's north shore.



1999 USGS digital elevation map (DEM) based upon a 71/2° quadrangle. The computer generated shadow effect simulates an early morning (eastern) sun.

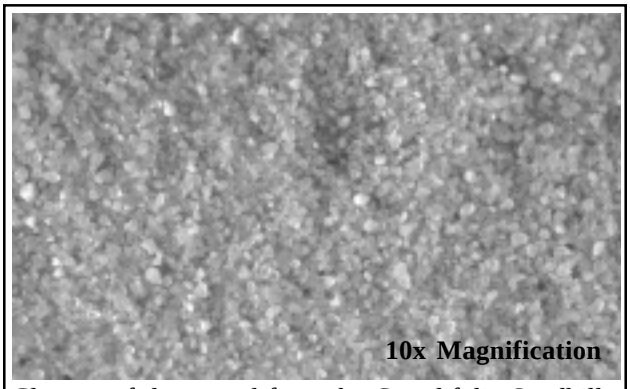


1999 USGS DEM with preliminary dune reconstruction extrapolated into the basin of the Long Island Sound. The extent to which dunes are eroded indicates the minimal extent of postglacial shoreface retreat for this coast.

The slip faces of upwards of ten large parabolic dunes are preserved where they collided with the north side of the Harbor Hill Moraine and each other. It appears that many climbed to its height before stranding occurred. Before encountering the moraine most of these dunes were apparently thirty to more than fifty feet high. Ground penetrating radar, coring, examination of primary bedding structures, detailed mineralogic analysis, and other research should determine the full extent to which the Grandifolia dunes are comparable to modern cold climate parabolic dunes of the high latitudes.

Retreat of the Late Wisconsinan glacier from southern New England is believed to have occurred between 20,000 to 15,000 years before present. This occurence inevitably caused a dramatic climate change; the region's previous wind and weather patterns adjusted. As the climate warmed, the dunes were trapped and bound by the subsequent colonization of *Fagus grandifolia.*

The prevailing wind that created these dunes came from the northwest and must have been both powerful and persistent. While the prevailing wind during Long Island's stormy winter season is today from the northwest, typical modern storms are relatively weak and have not created dunes



Closeup of dune sand from the Grandifolia Sandhills. Note the high degree of sorting. Preliminary examination of this sand including its narrow range of grain sizes and shapes, color, mineralogic composition, and other characteristics suggests that it may be a secondary depsit of Cretaceous sand. Based upon dune orientation it is inferred that the primary Creatceous deposit or source was in the north-central portion of what is now the Long Island Sound when sea level was lower and portions of this basin were subaerially exposed.

Glaciofluvial deposits typical of the study area. Exposure is in an excavation immmediately south of the Harbor Hill moraine near the DeFriest Blowout. Note the wide range of particle sizes.

Large re-exposed glacial erratics in the DeFreist Blowout. These rocks are part of the morainal landscape that was buried by parabolic dunes active in the periglacial climate that followed deglaciation.

like these anywhere along the Long Island Sound shore. Modern hurricanes, while potentially powerful enough to create parabolic dunes forms on Long Island, typically track from the south and are of limited frequency and duration. The Grandifolia Sandhills are, therefore, relics of a dramatically different glacial fringe regional climate. Within this context, the Grandifolia Sandhills exist despite, rather than because of, modern wind patterns.

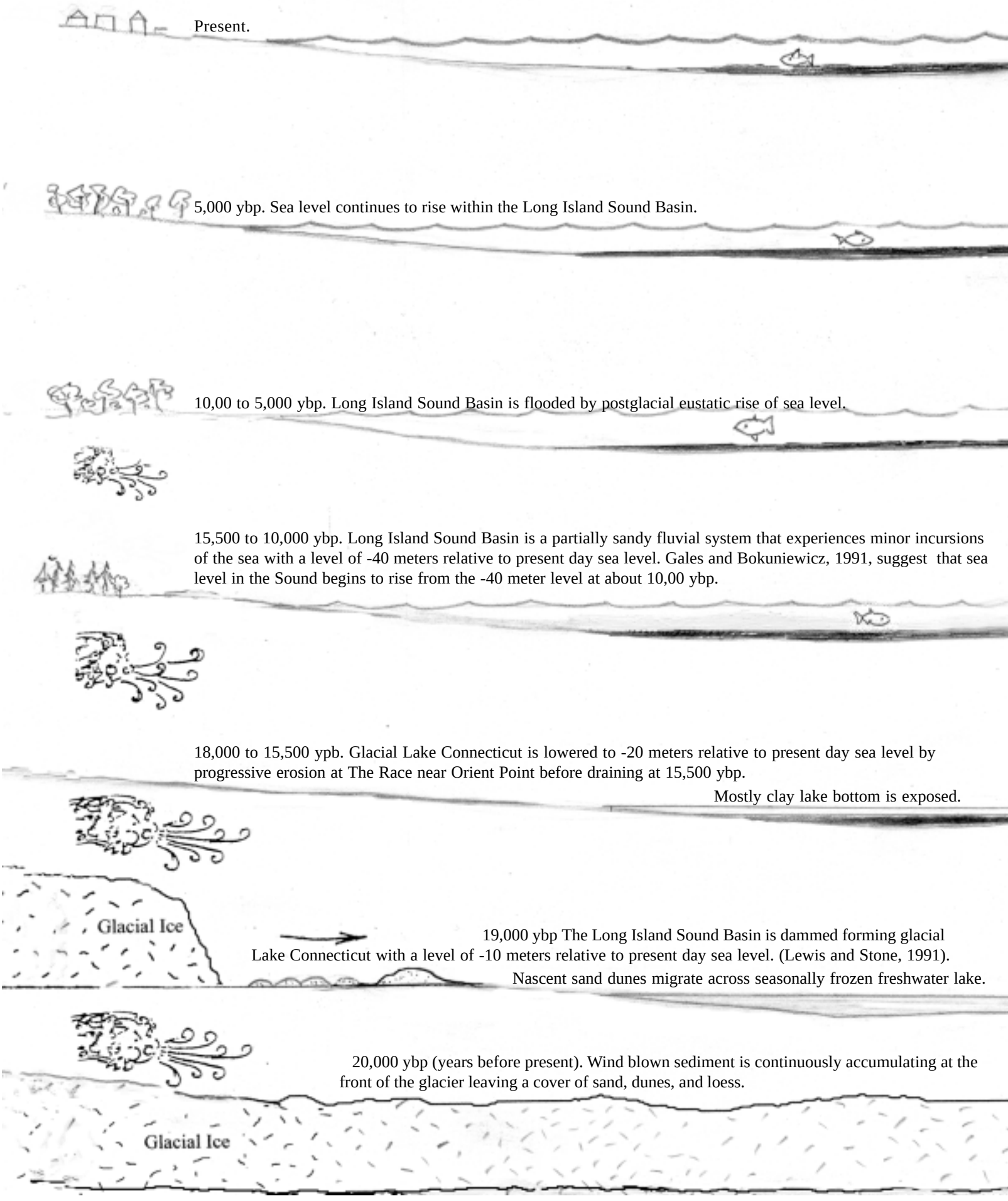
Dunes that are similar to the Grandifolia Sandhills in size, shape, relief, and orientation are found at Hither Hills State Park near the eastern edge of Napeague Bay in East Hampton Town on Long Island's south fork. As with the Grandifolia Sandhills, no modern source of sediment has been convincingly identified for the Napeague Dunes. Expansive growth of *Fagus grandifolia* is not evident at the Napeague Dunes where an oak-pine forest performs a similar function. While this and other vegetational differences distinguish these two dune fields, the comparable size and shape of the dunes, their northwest-southeast orientation and other geomorphic similarities are striking. Further investigation is needed to determine whether the Napeague Dunes are of mixed ages or if they may all have been created when sea level was low and a common tundra landscape connected what is now the North and South Forks of eastern Long Island to sand sources in the Long Island Sound Basin.

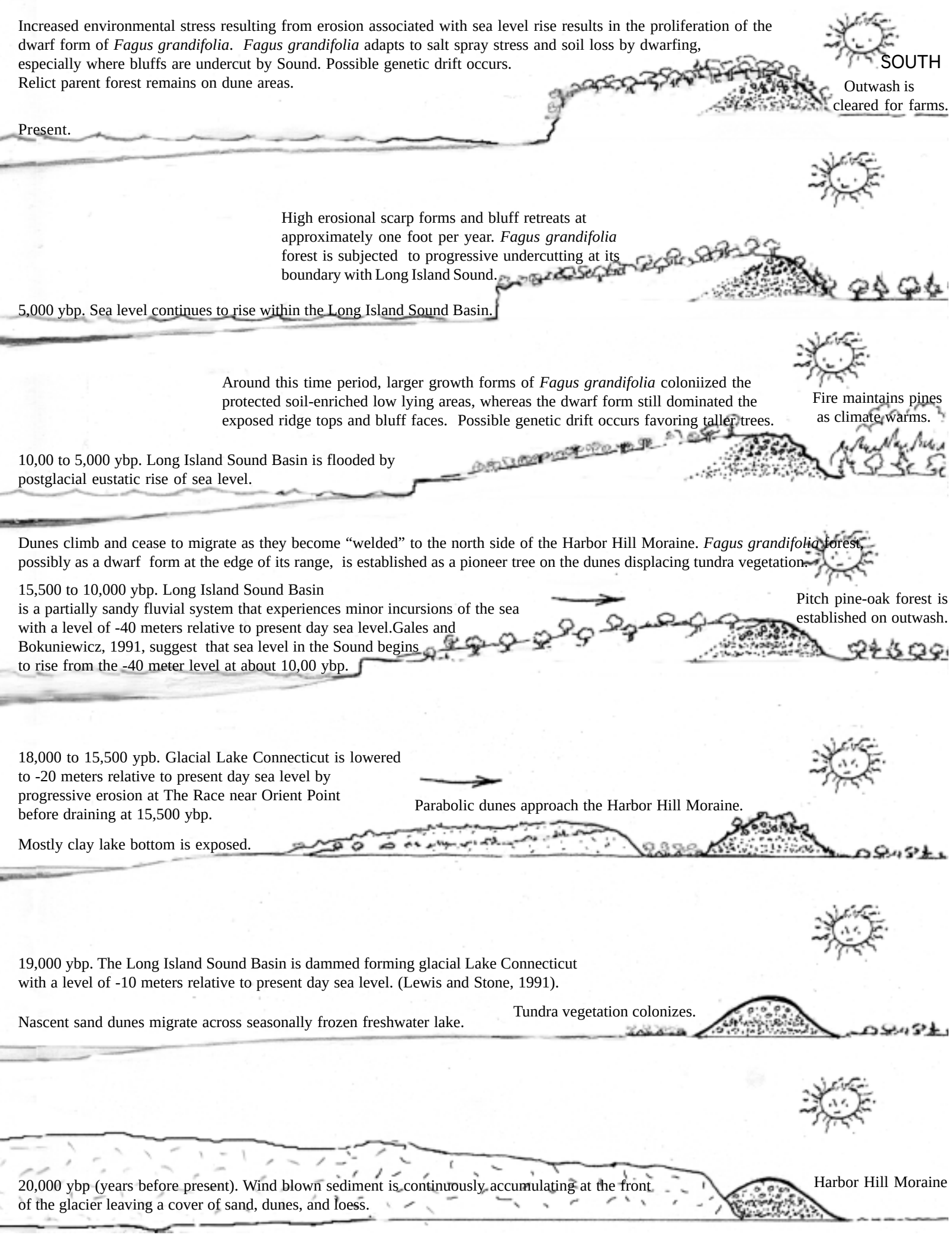
Conclusion

The relic vegetation and parabolic dunes at and near Friar's Head are unique. They appear to be among the rarest of landforms still extant from a now vanished climate and time when Long Island's landscape was both exceedingly cold and vegetationally primitive. The globally singular association of *Fagus grandifolia* with this ancient climatic relic duneform offers an exceptional opportunity for scientific research and study. Preservation of the Grandifolia Sandhills would be consistent with the wise decision previously made that created preservation of the Napeague Dunes. Such preservation would provide opportunity for the public to appreciate and enjoy an important and remarkable part of their natural history heritage. (Continued on Page 6)

INFERRED ORIGIN AND DEVELOPMENT OF PARABOLIC DUNES AND CLIMATIC RELICT FOREST LOCATED IN RIVERHEAD, SUFFOLK COUNTY, NEW YORK.

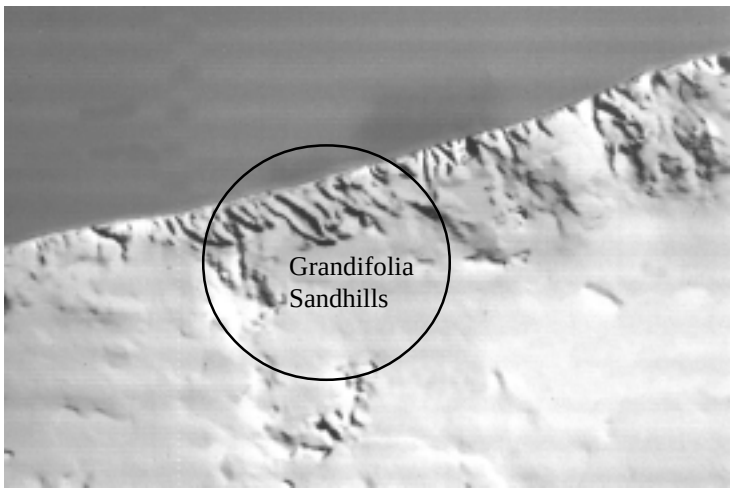
NORTH



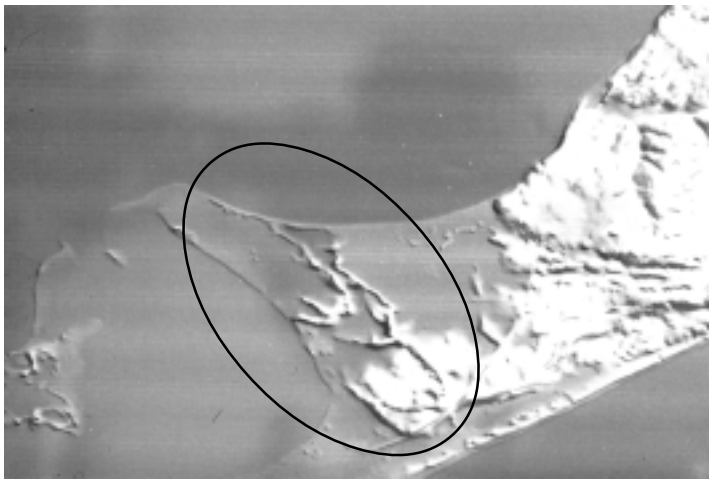

SOUTH
Outwash is cleared for farms.
Present.
High erosional scarp forms and bluff retreats at approximately one foot per year. *Fagus grandifolia* forest is subjected to progressive undercutting at its boundary with Long Island Sound.
5,000 ybp. Sea level continues to rise within the Long Island Sound Basin.
Around this time period, larger growth forms of *Fagus grandifolia* coloniized the protected soil-enriched low lying areas, whereas the dwarf form still dominated the exposed ridge tops and bluff faces. Possible genetic drift occurs favoring taller trees.
Fire maintains pines as climate warms.
10,00 to 5,000 ybp. Long Island Sound Basin is flooded by postglacial eustatic rise of sea level.
Dunes climb and cease to migrate as they become "welded" to the north side of the Harbor Hill Moraine. *Fagus grandifolia* forest, possibly as a dwarf form at the edge of its range, is established as a pioneer tree on the dunes displacing tundra vegetation.
15,500 to 10,000 ybp. Long Island Sound Basin is a partially sandy fluvial system that experiences minor incursions of the sea with a level of -40 meters relative to present day sea level.Gales and Bokuniewicz, 1991, suggest that sea level in the Sound begins to rise from the -40 meter level at about 10,00 ybp.
Pitch pine-oak forest is established on outwash.
18,000 to 15,500 ypb. Glacial Lake Connecticut is lowered to -20 meters relative to present day sea level by progressive erosion at The Race near Orient Point before draining at 15,500 ybp.
Parabolic dunes approach the Harbor Hill Moraine.
Mostly clay lake bottom is exposed.
19,000 ybp. The Long Island Sound Basin is dammed forming glacial Lake Connecticut with a level of -10 meters relative to present day sea level. (Lewis and Stone, 1991).
Tundra vegetation colonizes.
Nascent sand dunes migrate across seasonally frozen freshwater lake.
20,000 ybp (years before present). Wind blown sediment is continuously accumulating at the front of the glacier leaving a cover of sand, dunes, and loess.
Harbor Hill Moraine

Comparison of Parabolic Duneforms depicted on 1999 United States Geological Survey Digital Elevation Maps for Eastern Long Island

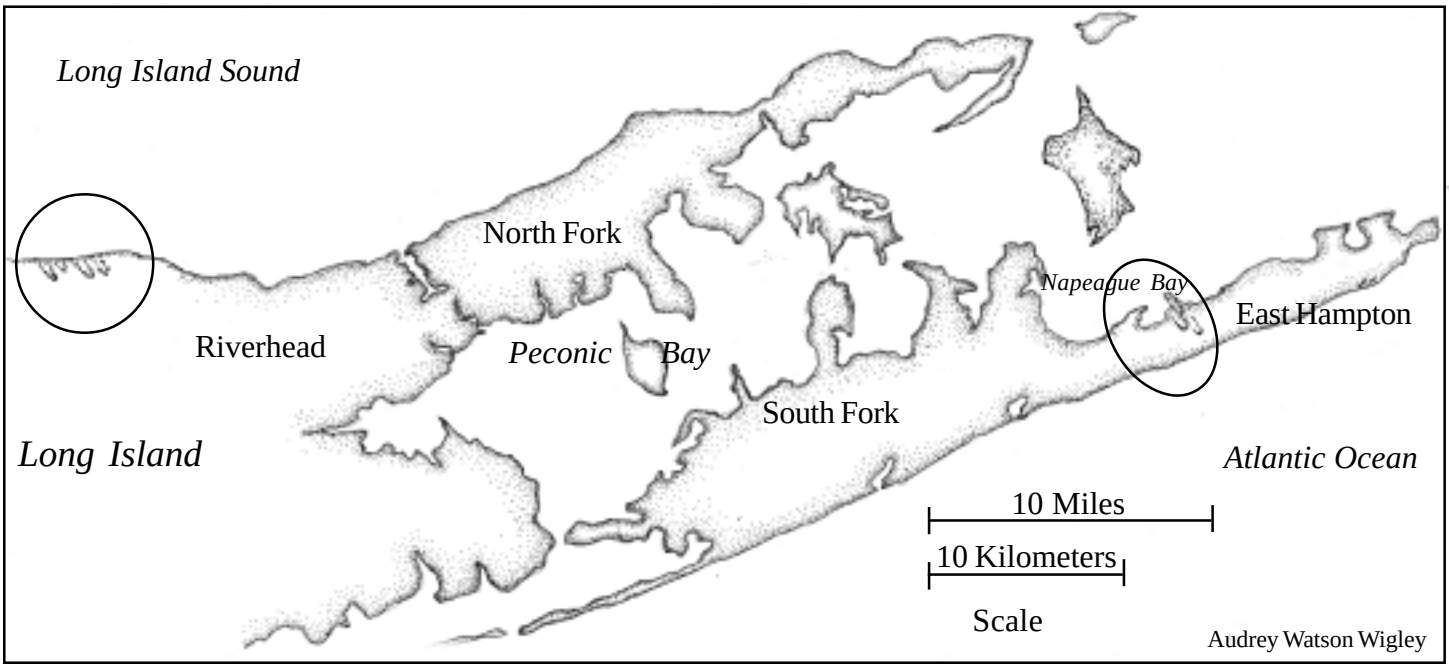
These digital maps, derived from photographs, show relative ground elevations.
An oblique shadow is cast through computer enhancement to afford dimensional contrast.



Area of Baiting Hollow, Town of Riverhead, showing large parabolic dunes that have been significantly truncated by erosion associated with long term shoreface retreat. Diameter of circle is approximately one mile.



Area of Napeague, East Hampton, showing parabolic duneforms similar in sizeand orientation to those of the Grandifolia Sandhills. Unlike the dunes near Baiting Hollow these appear to have been preserved with most of their overall length.Long axis of oval is approximately one mile.



Eastern Long Island showing the location of all known parabolic dunes in coastal New York. Note that these dunes, found only at Riverhead and East Hampton, are similarly oriented. The Riverhead dunes appear to have been climbing the north side of the Harbor Hill Moraine when a changing climate stranded them. Still undetermined is whether the dunes at Napeague also originated from a now submerged sediment source in the Long Island Sound Basin.If so, they could have advanced to their present position after moving through one of the gaps in the easternmost Harbor Hill Moraine.The subsequent rise of sea level has flooded both the Long Island Sound and Peconic Bay estuaries. On each fork it has also constructed connecting beaches across morainal gaps to form tombolo complexes. On the South Fork, rising sea level has elevated the water table, created extensive freshwater wetlands, and apparently begun to drown the Napeague Dunes.

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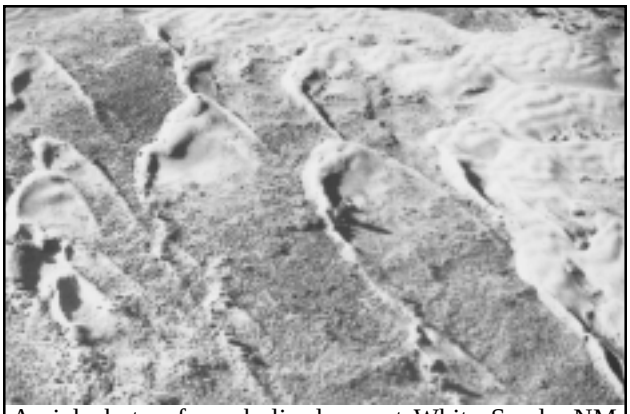
U.S.Geological. Survey, 1999, DEM based on 7$^{1/2^{o}}$ quadrangles, Riverhead and Gardiners Island East sheets

Addendum

Typical Parabolic Dune

Parabolic dunes are formed when wind causes loose sand to coalesce into a mobile, crescentic-shaped landform as above. Vegetation typically anchors the out lying perimeter causing "trailing tails". Parabolic dunes are unique among the known range of duneforms in that the relationship between vegetation and dune appears to be causal. The importance of plants to the formation of parabolic dunes can be inferred by their complete absence on the otherwise dune-rich Desert Planet, Mars--where there are no plants.



Aerial photo of parabolic dunes at White Sands, NM. Wind direction is from lower right to upper left. Note how parabolic symmetry is dependant upon presence of vegetation. Conversely, see how other duneforms are present where vegetation is absent.

Typical growth form of American Beech, Blydenburgh County Park, Smithtown, L.I.

Growth form of dwarf American Beech, Grandifolia Sandhills, Baiting Hollow, L.I.

American Beech

(Fagus grandifolia)

Fagus: derived form the greek word "to eat"
referring to the provisional beechnuts

"Beech nuts, of which there are good crops only every few years, are an important food for wildlife as well as for the patient human."

-- Edward G. Voss
from "Michigan Flora"

Larry Decker

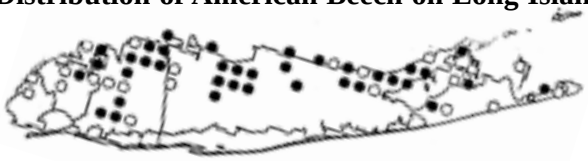
"... taken in all seasons and judged by all that makes a tree noble--strength combined with grace, balance, longevity, hardiness, health--the Beech is all that we want a tree to be."

--Donald Culross Peattie
from "A Natural History of Trees"

Distribution Range of American Beech

from "Trees of the Southeastern United States"
by Wilbur H. Duncan and Marion B. Duncan

Distribution of American Beech on Long Island



Key: a specimen is known from the county or town prior to 1980
a specimen is known from the town since 1980

from "New York Metropolitan Flora"
Brooklyn Botanic Garden

While American Beech is plentiful throughout the eastern deciduous forest and along the central and northern portions of Long Island, the dwarf form occuring as a forest community is globally rare and the best remnant of this in New York State occurs at Baiting Hollow in the Town of Riverhead.

"Maritime Beech Forest NYNHP considers the large, high quality, globally-rare maritime beech forest at Friar's Head Forest the most important element of biodiversity, and the primary target for conservation, at the site. The occurence... ...makes this a site of very high biodivesity significance at the state and global level.

Coastal Oak-Beech Forest ...the most important contribution of this forest to the biodiversity of Long Island is that it provides a large, relatively intact buffer for the maritime beech forest.

This hardwood forest is dominated by beech and usually occurs on north-facing exposed bluffs and th back portions of rolling dunes in well-drained sands"

--New York Natural Heritage Program

Audrey Watson Wigley

Historical Accounts of the Grandifolia Sandhills

1876 Elias Lewis, Jr. (Geologist)

"At this point is the great dune known on the Coast Survey charts (1838) as Friar's Head. The sand blown from this spot and from the flanks of the dune constitute the semicircular wall..."

--Published in "The Popular Science Monthly", January Issue

1914 Myron L Fuller (Geologist, Department of the Interior)

"In fact, it is not unlikely that considerable areas of the ridges mapped as moraines are only pseudomoraines composed of dune sand, although they may contain a core of morainal drift."

--"The Geology of Long Island", US Geological Survey, Professional Paper 82

1938 Roy Latham (Long Island's premier naturalist)

"...very high sand dunes there and fine heavy woods. Polypodium vulgare Fern: the most of the species I ever saw - beds 40 by 100 feet thickly green with it." --March 9th entry in his Journal

1970 Ralph E. Good and Norma F. Good (Department of Biology, Rutgers University, New Jersey)

"All of the vegetation studied is developed on dune sand deposits which form sea cliffs and uplands."

--"Bulletin of the Torrey Botanical Society", Volume 97, July 1970

1989 George Bartunek (Geologist, Chairman of the Town of Riverhead Conservation Advisory Council)

"According to the 'Soil Survey of Suffolk County' (USDA 1975) the area is classified as dune sand."

--In a letter (July 10, 1989) to the Town Board and Planning Board of Riverhead

1998 John Black (Geologist, Professor Emeritus, Suffolk Community College)

"...examination of the area revealed that the Sandhills consist of... ... parabolic dunes perched atop a high bluff fronting on the Long Island Sound."

-- "Long Island Botanical Society Newsletter", September Issue

Until this point there was no question as to the uniqueness of this site or the fact that dunes existed there.
Then a private firm began looking to develop the area.
To do so the firm needed to produce an environmental impact statement (EIS).
The firm then looked to find consultants to write them the EIS. (Contributors to the EIS are listed below).*

The following account is New York State's response to this final environmental impact statement (FEIS).

1999 NYS Natural Heritage Program (A state biodiversity inventory; NYS Department of Env. Conservation)
Gregory J. Edinger (Community Ecologist) and Kathryn J. Schneider (Ph.D. Zoologist)

"throughout the FEIS the authors...criticize and make false statements... to refute well-documented information about important natural areas at the project site... They have used data to confuse decision-makers... The FEIS concedes that there are 'wind blown soils' at the site, but later contradicts that view by stating 'no maritime sand dunes exist' at the site."

--NYNHP Response to Final Environmental Impact Statement

*(Terchunian and Sirken, 1999, see References on Page 9)

Long Island Botanical Society
Muttontown Preserve
Muttontown Lane
East Norwich, New York 11732

Programs

January 11, 2000 Tuesday, 7:30 PM

Members night: Members are welcome to bring slides, stories, specimens, and tales of secular sightings of your favorite plants. A great opportunity to show what you have found while exploring and crawling on Long Island.

Muttontown Preserve, East Norwich*

February 8, 2000 Tuesday, 7:30 PM

Andrew Greller: Professor Emeritus of CUNY, past president of the Torrey Botanical Society, and expeditionist extraordinaire will speak on the **"Mediterranean Woodlands"**. Andrew, who has worn through more leather soles than a great many will surely captivate us with his findings.

Muttontown Preserve, East Norwich*

March 14, 2000 Tuesday, 7:30 PM

Herb Mills: Herb Mills, Director of the Natural History Bureau of Nassau County Museum, has chosen to show us a collection of slides revealing **"The Flora of Argentina"**.

Location: Bill Patterson Nature Center, Muttontown Preserve, East Norwich*

*Refreshments and informal talk begins at 7:30. Formal meeting starts at 8:00 PM. For directions call: 516-571-8500

New Members

The Long Island Botanical Society is pleased to welcome the following new members:

Catherine Attanasio, Amityville
Virginia L. Barath, Sayville
Tom Fiore, NYC
Mary Ellen McLoughlin, Flanders
Lance Mion, East Quogue
Bianca Rice, Flanders