Paleoecology – Incomplete Notes[1]

Questions and Myths:

- Great plains and other landscapes were dominated by pine before European settlement; cut down and regenerated to oak
- Large portions of the Vineyard were open – grasslands, savannahs, openings maintained by Indian burning, firewood cutting and forest management around villages or other settlements
- MV is pitch pine-oak as suggested by most regional vegetation maps

Focus on MV-Naushon-Falmouth. Reference ACK, CC and region to globe

Hemispheric – LIS progressive decline 10-7; June insolation Peak 12K, declining to 0KFormation N Atlatic Deep Water, Current by 6K; Big increase Atlantic SST 6K; Most rapid change around 6-5.5K (coincides with elm, hemlock)

GISP plus sand – sharp T and erosion swings 6K to 1K

Elm decline – centered on 5780 (6175-5480)
Hemlock decline – 5460 (5900-5046)

Crooked Pond lake level – Rising 10-7 peak nadir 5.2-3.5 then rising; Rising Temp 10-3.5 then decline. Precip high before 5.5 then low then back up.

So, rising temperatures and water levels as progressively wetter to 6 K then decline in both. Then decline water levels, drought sand cooling temperatures. Cool the slightly warmer and rising water levels form 3000.

Beech prevails during cooler period on coast (warmer inland). Oak back on coast as temperatures come back up then steady.

Harlock fits this perfectly – beech 5.5 to 3.5K. Plus has sand layers at 5.6 - 4.2. 3.5 Harlock+Black have 20% Myrica. Deep+Blaney's on Beech. Uncle Seth's the oak and beech more variablewith oak-beech trading off as beech increases form 5.5 then oak dropping at 4K. But Deep. Blaney's and Harlock beech to 30-40%.

Duarte little beech but gradual shift to pine from 3.5K.

LOI – Duarte: Big increase at 8K; smaller at 5.5K; big at 2K;
Seth's: VLittle; constant decline form 10K, slight increasing after 3.5K
Black: Mineral then drop + StepUp at 6.2; drop 5K; consistently higher from 3.5
Harlock: vlittle change other than sand. Possibly higher at 3.5K
Blaneys: consistent rise with infilling form 11K; Blip down at 7.0, 6.2K
Deep step up 7-8; blips at 5K; consistent form 3.5K

[1] Additional handwritten notes, notecards, and source material are in the Harvard Forest Archive

Notes on Pollen Diagrams – MV to Woods Hole
1-10-2013

Replot these species with whatever scales but similar for each taxon at all sites.

Some dating questions (chronology) across sites. Seth's no chronology.

Pine – Declines fairly steadily from perhaps 12000 to 6-7000. Has a minor peak with corresponding decline in oak around 8000. Stays at lower levels throughout rest of Holocene. Higher on outwash (Duarte) or near outwash (Seth's) than on moraine and towards Falmouth.

Oak – Fairly steady rise form ~11,000 to 6000 with short-lived decline around 8000. Peak at 60% (Deep, Blaney's, Harlock, Black, Seth's, ~ Harlock). Decline at 5500 seen in pronounced way at Deep, Blaney's Harlock, Seth's. Gradual at Black and non-existent at Duarte. So oak constant on plain.

Beech – Appears pretty consistently at 8000 (Black 6500?). Remains low but rising at variable rates until 5500 when increases abruptly at Deep, Blaney's, Harlock, Seth's. Never increases at Duarte. Peak of 30-40% (Deep, Blaney's, Harlock), 20% at Black and Seth's, 5-10% at Duarte.

Hickory – Clearly present from 6500 with ~5+% being maximum – Seth's, Black, Harlock, Blaney's, Deep.

Alder – Peak around 12,000 (Blaney's, Deep) but sizable extended peak at Black (see influx for Deep) around the peak of oak.

Beetlebung – No apparent story. Not plotted in all diagrams.

Bayberry – Early (10-12000) peak at Deep and Duarte. Consistently present at Duarte, Seth's, and Black, less so at Blaney's and Deep; not plotted at Harlock. Rises and stay high around 3-3500 at Black, Harlock, Blaney's, Deep. Not at Duarte or Seth's.

Grass – Heterogeneous
Duarte - Consistently 15-20 Duarte declining after 300 to settlement when rises.
Seth's – 5%, lower after ~3000, rising greatly with settlement
Black - 1-2% until settlement when rises greatly
Harlock – Very low until settlement
Blaneys+Deep – 2-3% until 8000 then low until settlement

Cyperaceae – Duarte – 10-20% until settlement when low

Ambrosia – Low until settlement

Organic matter – Highly variable
Duarte – low until 8000, consistent at 30% until 2000 when rises to 40-75%
Seth's – Pretty consistent at 20% , rising before settlement then dropping.
Black – Low until 600 when consistent at 60%, rising to 70-75% until settlement
Harlock – Consistent at 70%
Blaney's – Rising form 10,000; consistent at 85% other than mid-Holocene blips
Deep – Rising form 10,000; Consistent and rising form 8000 at 60-70%

Charcoal – Heterogeneous; varied scales
Duarte – Early peak; low until 8000 when consistent at 500 until drop at 2000
Seth's – Sustained peak in pine to oak transition at 600; low for Holocene
Black – Peak with pine to oak at 200; very low through Holocene
Harlock – Very low through Holocene
Blaney's – Higher during pine to oak; Low through Holocene; modest rise 2000
Deep – Very low with variation through Holocene

NOTES ON ANDREA STEVENS' THESIS (2001)

Many of her levels have 15-20% unknowns/unidentified
Excluded ag taxa from pollen sum

Andrea regresses the percentage of grass, pine and oak pollen in surface samples against percentages of these taxa in vegetation within 500m of the sites and indicates that "*there is a significant relationship between surface grass pollen and grasslands (r^2=0.4, p=0.04), although the slope of the regression line is very low (0.2), and indicates only subtle differences in grass pollen percentages between sites with very different area of grasslands*". This is a very optimistic assessment (see attached figure) as the line does not go through the origin, the plot is a ball of points, and one outlier provides the significant relationship. Interestingly her line intercepts the Y-axis at 7.2% suggesting that with 0% of grassland within 500m one would still expect to get 7% grass pollen. In fact for <5% grassland with 500m she gets grass pollen percentages ranging from 4-12.5%. Andrea attributes this to: (1) grass in the groundcover of shrub and forest vegetation and in patches not seen or sampled in releves, (2) grass in areas beyond 500m, including grasslands on distant shorelines, and (3) wetland taxa like *Panicum virgatum* and *Spartina pectinata* on the margins of ponds. So, grass pollen percentages overestimate the amount of grassland at low values an underestimates the amount of grassland at high values.

states that *Andropogon* and *Spartina* overlap completely in major characteristics). A number of her sites do have 5-10% grass below the Ambrosia rise, however most of these sites also have a tail of *Ambrosia* (which might suggest mixing?) and fairly consistent and abundant Cyperaceae, *Myrica* (which she interprets as *M. gale*), and monolete spore (all of which may indicate a substantial wetland component). A number of her sites are described as having bordering wetland fringes with

Spartina, Juncus, Myrica, Thelypteris, etc. (e.g. Black Point Pond, Wtacha Pond, Long Cove Pond).

Take-Home Messages

"The presettlement pollen record of coring sites across the island suggest a largely forested landscape on Martha's Vineyard prior to settlement, with localized grassy clearings near coastal ponds on the mid- and eastern outwash plain."

"communities with a grassland component were also a part of the prehistoric landscape".

"Prior to European settlement, localized but persistent areas of grassland vegetation types (e.g., grasslands, savannas, open woodlands) occurred on the island, particularly on the outwash plain. Prehistoric grassland types were probably maintained by fire ignited by Indians occupying areas along coastal pond shorelines."

"Many modern grassland sites represent relicts of recent and historical agricultural practices, although certain fragments of these grasslands were likely present before the expanded agricultural economy of the Europeans. These sites were probably maintained by disturbance regimes and ecological pathways that are uncommon on the modern landscape."

"greater amounts of charcoal were found in presettlement sediments than in postsettlement sediments at most study sites across the island….These fires must have sustained some early successional, probably grassland vegetation types."

"The increasing importance of sands towards the eastern outwash coupled with the slightly higher percentages of grass pollen in presettlement sediments from the eastern outwash sites Mashacket Cove and Slough Cove, and particularly Jane's Cove, suggest soil texture may have influenced the distribution of grassland vegetation types at least on the outwash plain. However, coarse sands also characterize upland areas near the two northern moraine sites, Lagoon Pond and Lake Tashmoo, both sites with pollen records suggesting that grasslands did not occur prior to settlement in this area of the island. Fire was therefore probably a more important influence than soil texture on the occurrence of grasslands prior to settlement" [But Lagoon Pond has among the highest presettlement C:P, as well as many archaeological sites]

"Any association between soil texture and the modern vegetation of the island has been obscured by the intensive disturbance associated with agricultural land uses during the past 350 years." [Broadly speaking this is absolutely untrue]

"Certain oak forests on the eastern outwash plain (e.g., west of Mashacket Cove and east of Jane's Cove) are characterized by a more open canopy with a groundcover of grasses and sedges, suggestive of a relict savanna community, and a possible history of fire."

She interprets the two western outwash sites (Muddy Cove and Deep Bottom Pond) and three morainal sites as supporting extensive forest with oak dominant except at Lake Tashmoo where pine was important. There is one archaeological site 6m above the water table at the head of Lagoon Pond near where she took her core and many others around the head of the pond. The excavated one is 1000 BC to 1500 AD with abundant shellfish and no evidence of agricultural activity. Interestingly she interprets the presettlement vegetation pattern around Lagoon Pond independently of (and in contradiction to the) pollen diagram. *"Prehistoric pollen assemblages from Lagoon Pond offer no indication of the grassland vegetation types occurring near this site at that time".* [What is the source of the information of grassland vegetation around Lagoon Pond come from?]

Black Point Pond has presettlement corn pollen (it is the only site) as well as abundant Ambrosia (>10%) in some samples, which is interpreted as strongly indicative of Indian occupation and agricultural activity. Other sites have elevated Ambrosia before settlement, which is also interpreted as due to Indian clearings. [It is difficult to know how to interpret this diagram. It does have a C-14 date of 690 BP, but there are few changes in the pollen percentages, with Ambrosia being high throughout. *Rumex* and *Plantago* do show a rise and fall, but most other taxa are fairly flat.]

"at least on the moraine, beech was more common before settlement (particularly before 1500 years ago) than it is today."

"on the outwash plain of Martha's Vineyard, beech (and possibly hickory) may have been more common prior to settlement than today, although still very much subdominant to oak and pine".

After settlement maize pollen appears at Black Point Pond, Muddy Cove, Deep Bottom Cove, Long Cove, Lagoon Pond, and Lake Tashmoo. Interpreted as a local source, nearby cornfields.

Fire. All but Lagoon Pond exhibit a decrease in charcoal after settlement. Trend is especially pronounced on outwash sites. This is in contrast to almost all other NE sites, except Duck Pond, Marconi AWC Swamp, and Donut Pond Bog. So she describes CC, MV and Nantucket as coastal region displaying a different trend. More than 60% of presettlement samples have C:P >400, which is the indicator for local fires (!). Highest mean values come from Jane's Cove, Black Point Pond, and Lagoon Pond. One very high value at Cedar Tree Neck Bog is due to fire across bog surface.

"Management Implications"

The results of this study suggest that the prehistoric landscape on Martha's Vineyard was characterized by forests and woodlands dominated by oak or mixed oak-pine, and occasional pine-dominated stands, interrupted by localized grassy clearings associated with Indian land uses along the shorelines of coastal ponds. Grassy openings may also have persisted in other parts of the island, outside the pollen source

area of study sites, in areas of Indian settlement somewhat removed from coastal ponds or along near coastal margins. Furthermore, the spatial dynamics of grassland sites prior to settlement may have been influenced by Indian settlement patterns which shifted in response to available resources…Fire was likely an important factor in allowing open areas to persist as localized fragments in the landscape mosaic of the time.

…In the case of coastal sandplain grasslands on Martha's Vineyard, the results of this study suggest that these vegetation types may not have occupied large areas on the prehistoric landscape, but rather, were more limited in area, existing as fragments within forests (savannas) or as small continuous areas bordering the more widespread forests. As such, management efforts directed at emulating some sense of a precolonial landscape should focus on maintaining a diversity of communities, with open grassland associations representing a successional gradient which, prior to settlement, may have resulted from changing Indian settlement patterns and accompanying agricultural and fire activity."