

A photograph of a coastal dune landscape. The foreground is dominated by light-colored sand dunes with sparse green grasses. In the middle ground, a larger sand dune rises, partially covered with green vegetation. The background shows a dense line of green trees under a clear blue sky. The text is overlaid on the image in white, sans-serif font.

# Recent Research into the Geomorphic History of Lake Michigan Coastal Dunes.

Edward Hansen  
Hope College



# Special Acknowledgments To:

A scenic view of sand dunes with green grass and trees under a clear blue sky. The dunes are in the foreground and middle ground, with a dense line of trees in the background. The sky is a clear, light blue.

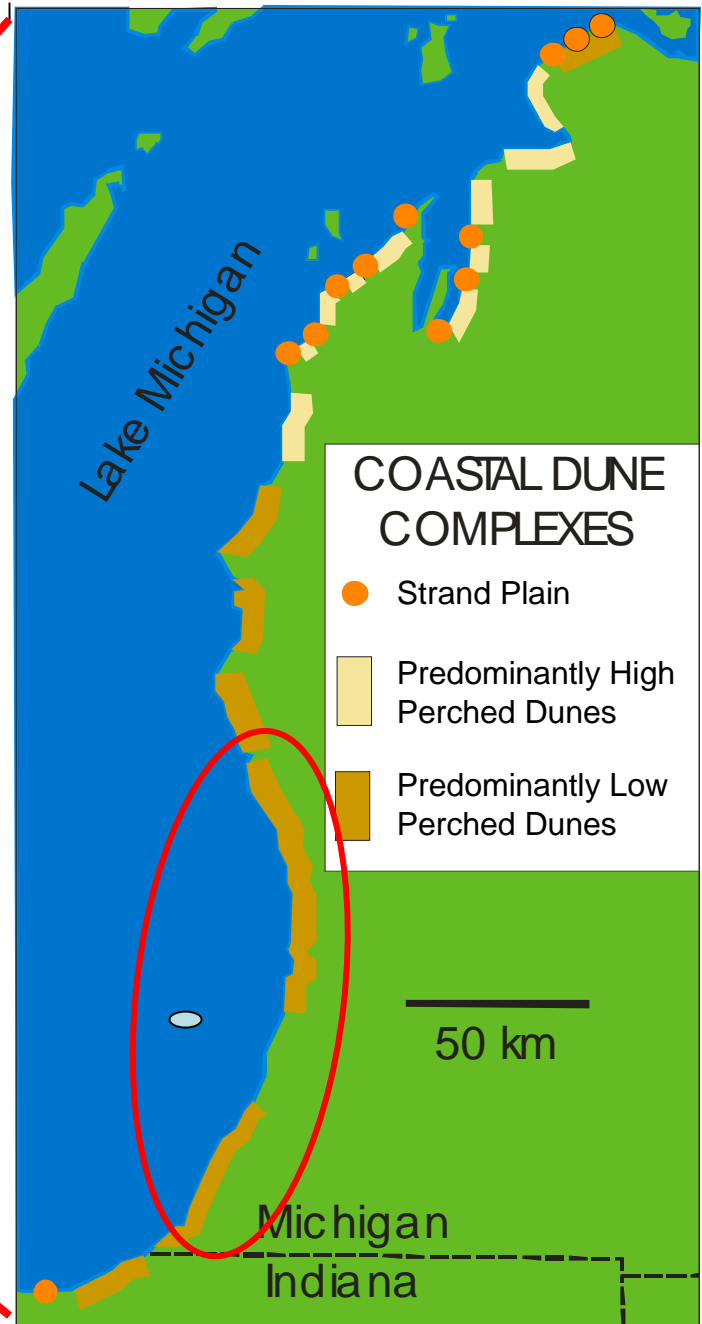
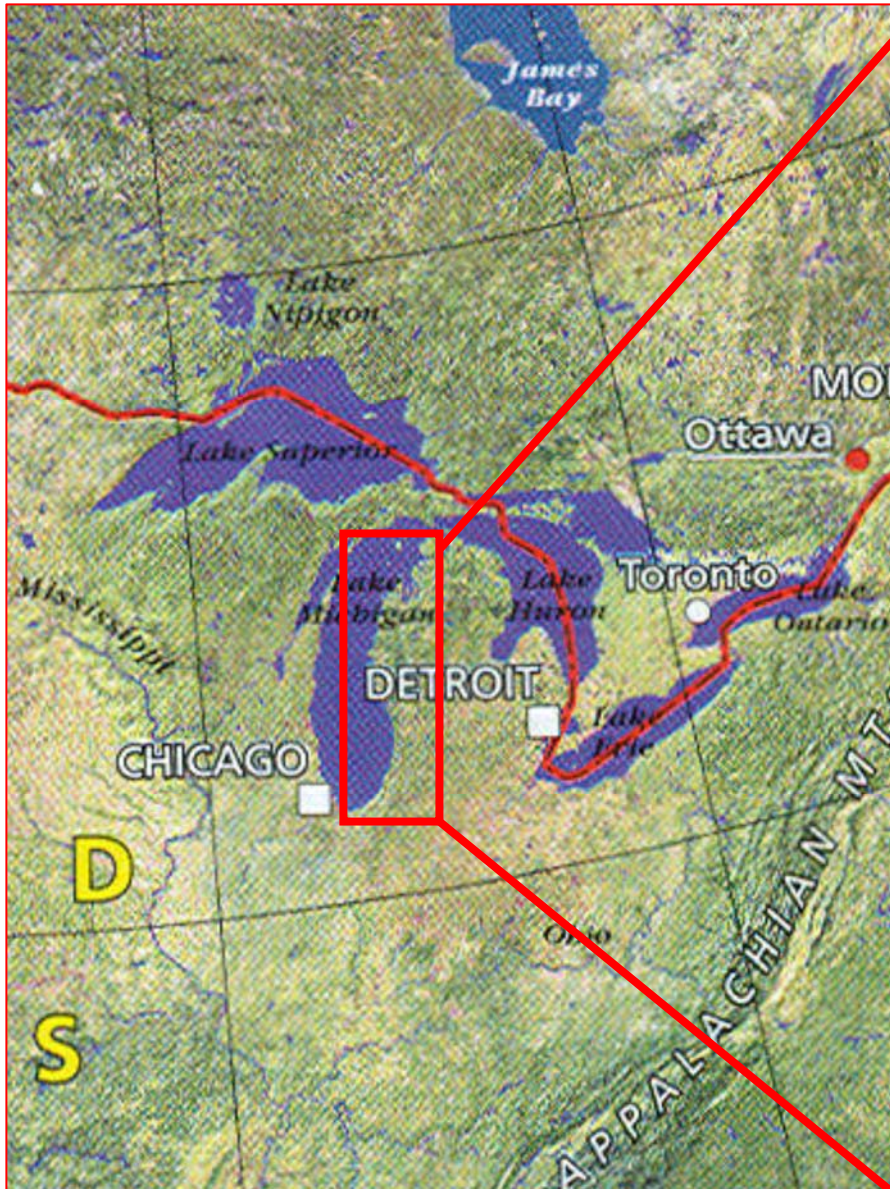
Alan Arbogast  
Michigan State University

Tim Fisher  
University of Toledo

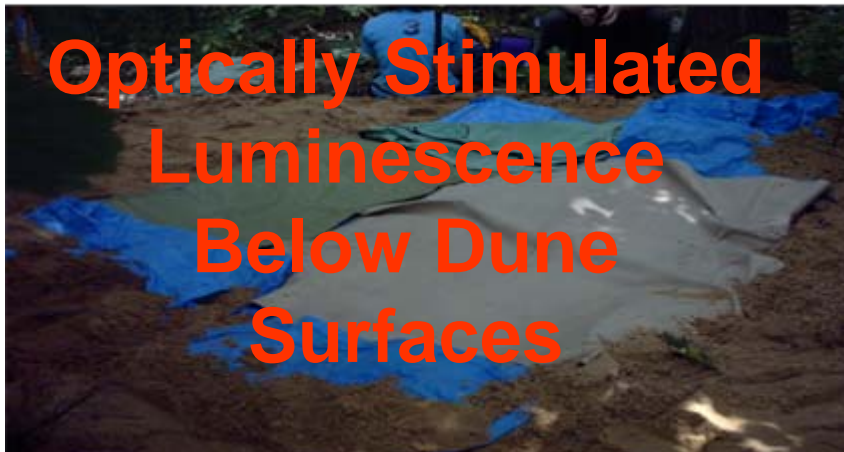
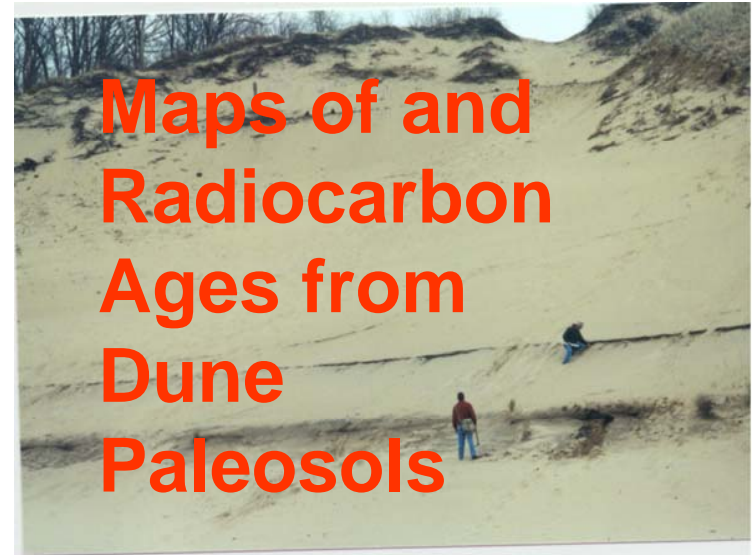
Walter Loope  
United States Geological Survey

Todd Thompson  
Indiana Geological Survey & Indiana University



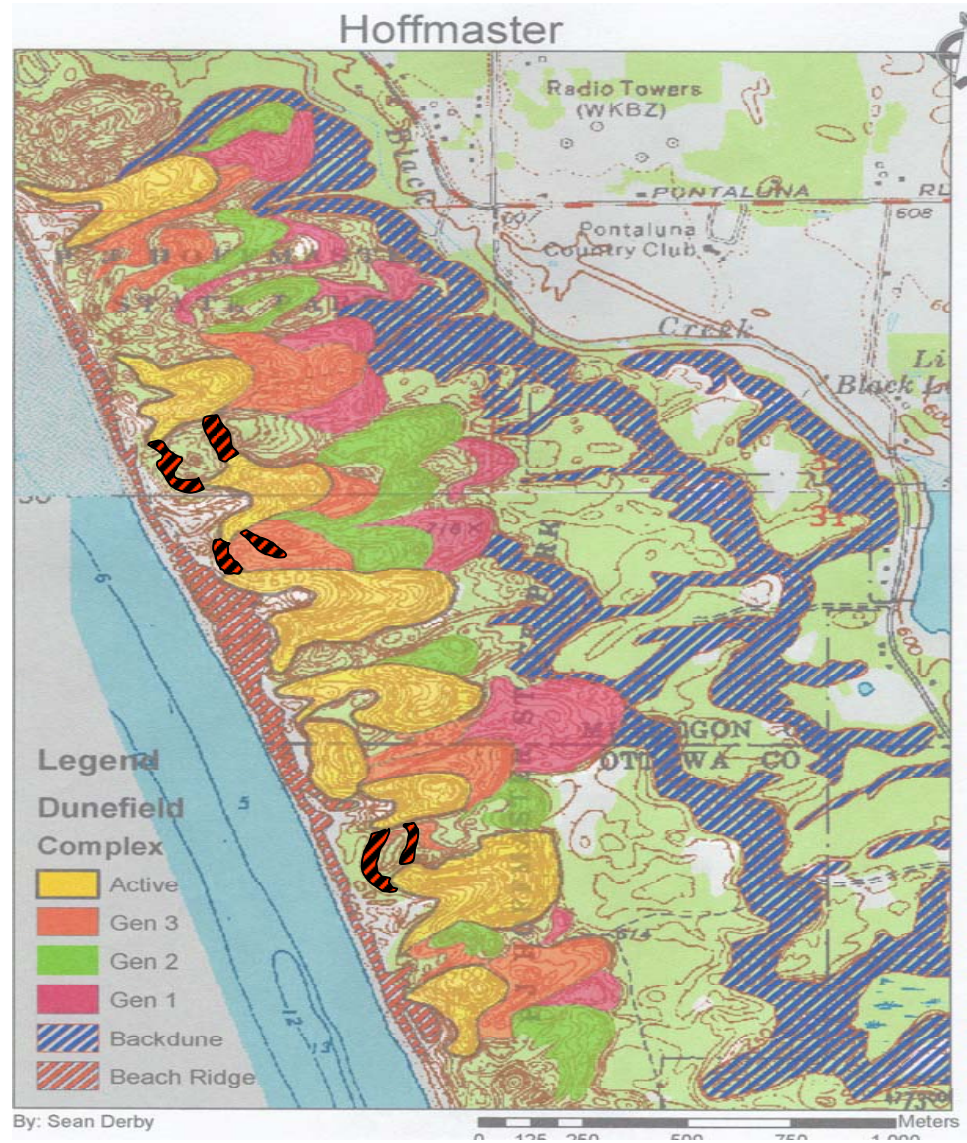
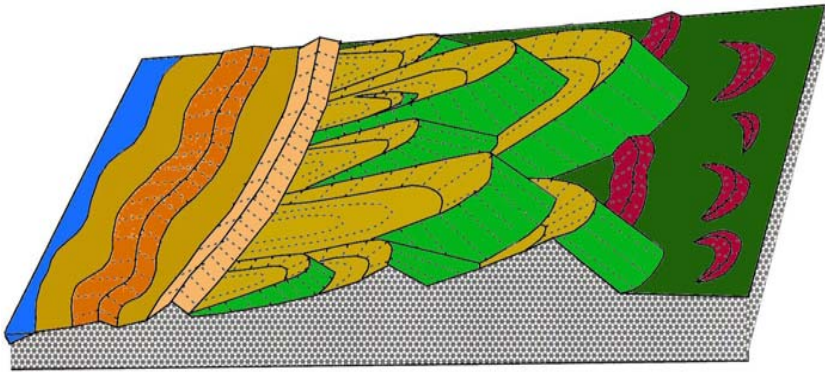


# Lake Michigan Dune Histories Based on:

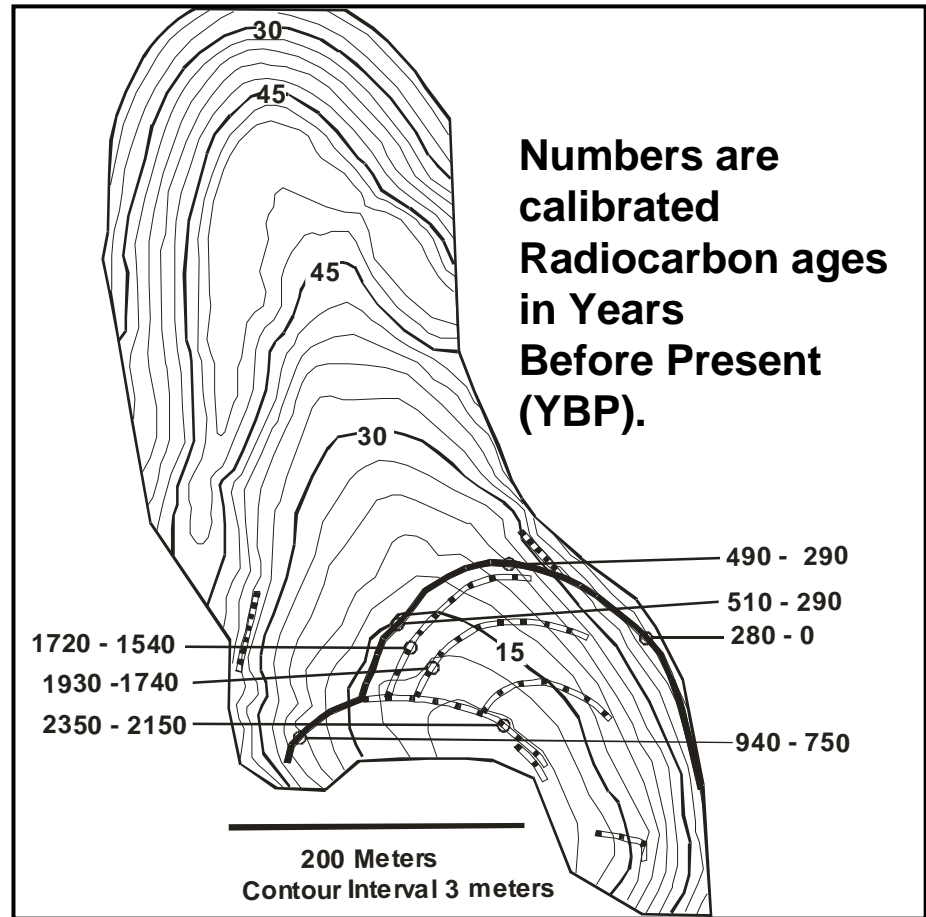




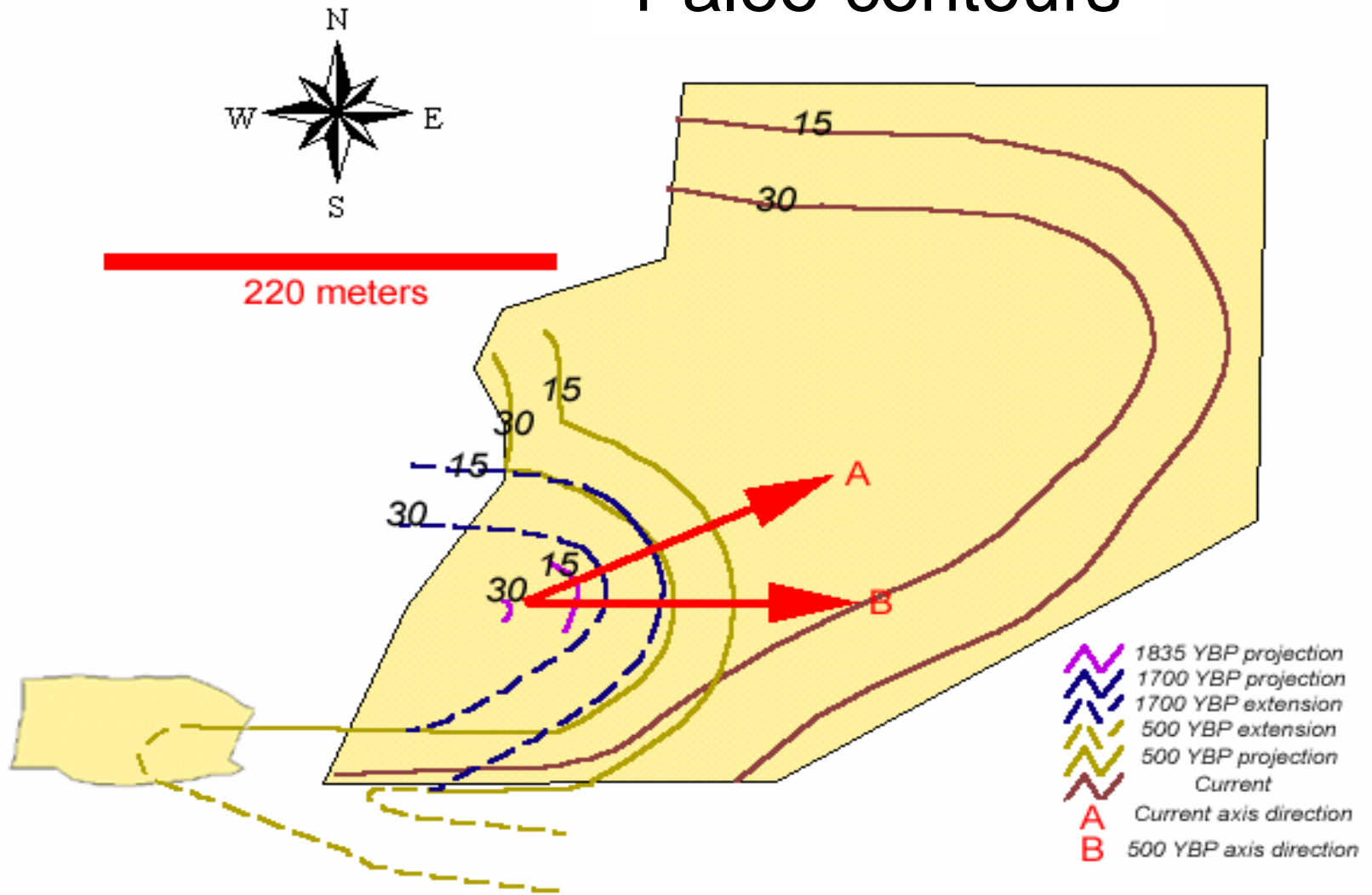
# Reconstructing Dune Histories Using Geomorphic Position



# Reconstructing Dune Histories Using Maps of and Radiocarbon Ages from Dune Paleosols

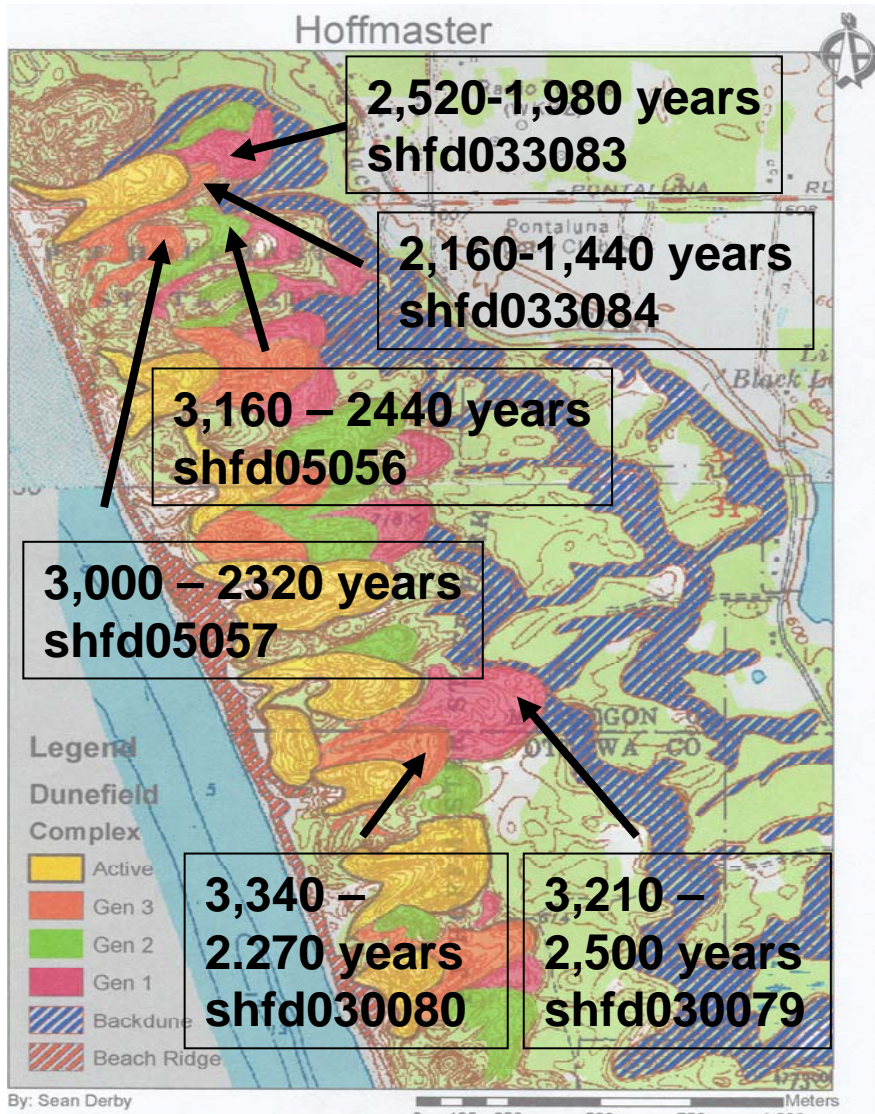


# Paleo-contours

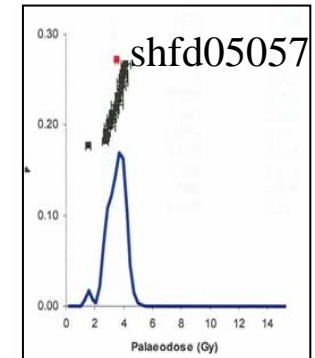
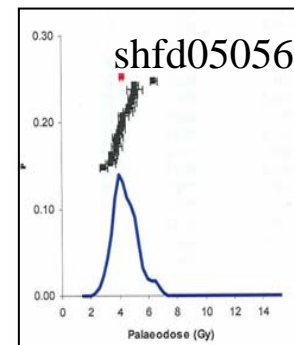
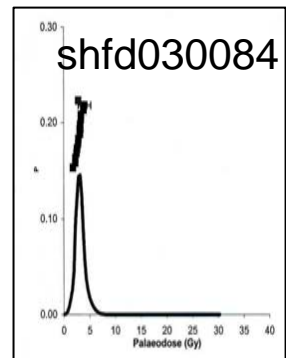
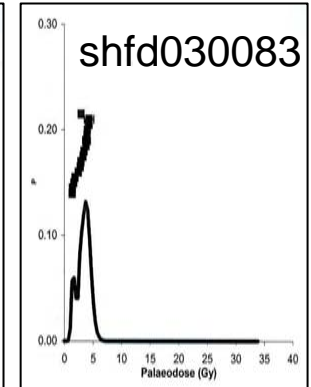
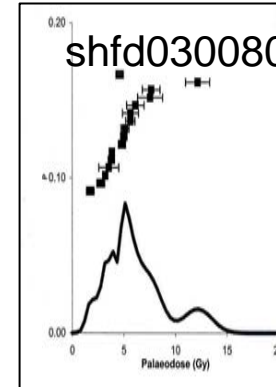
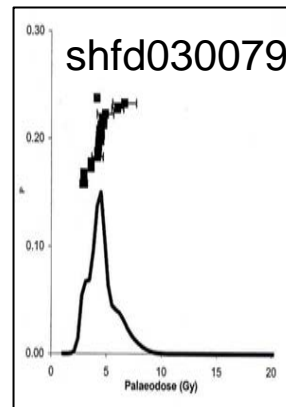




# Reconstructing Dune Histories Using Optically Stimulated Luminescence Ages from Beneath Dune Surfaces



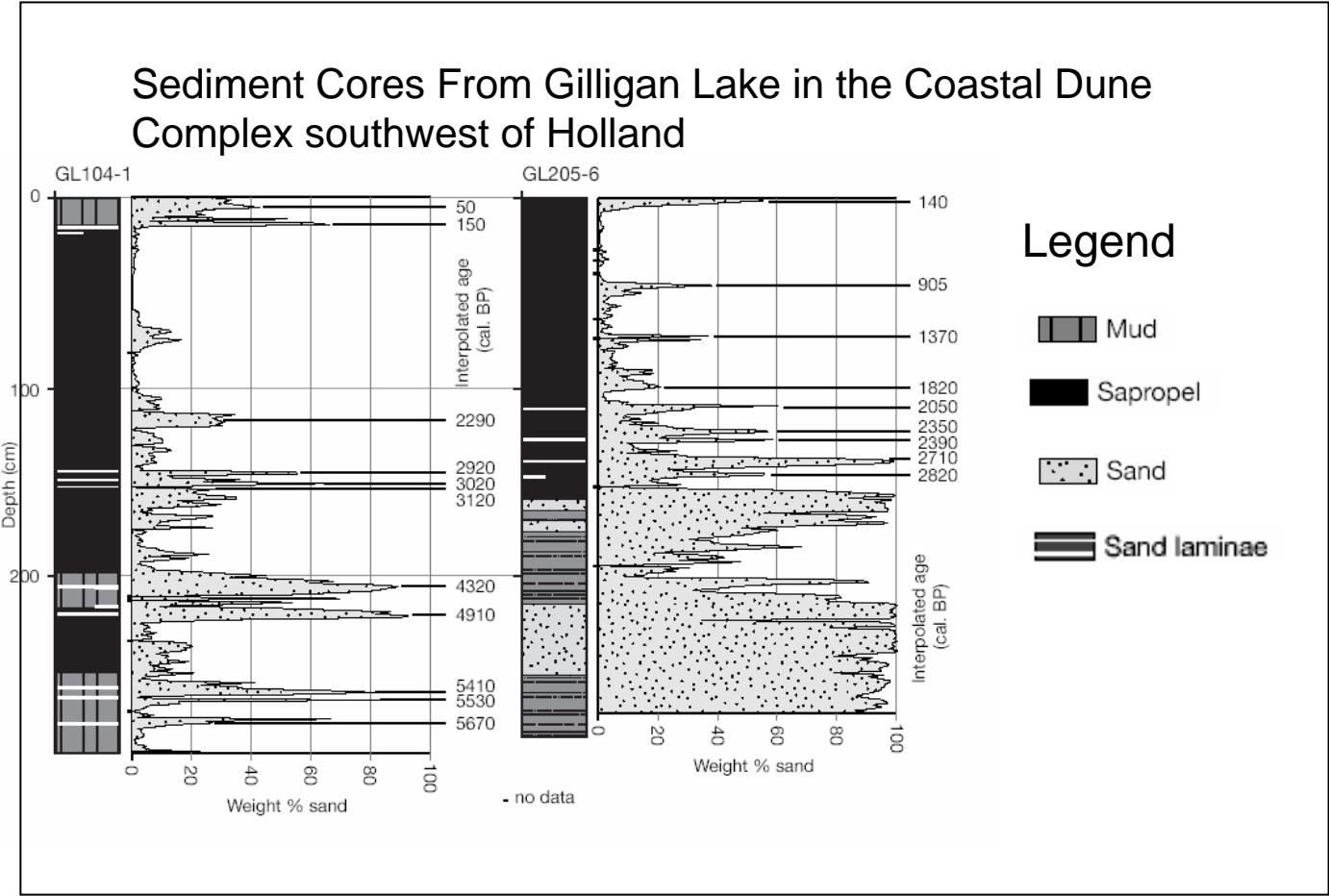
## P.J. Hoffmaster State Park



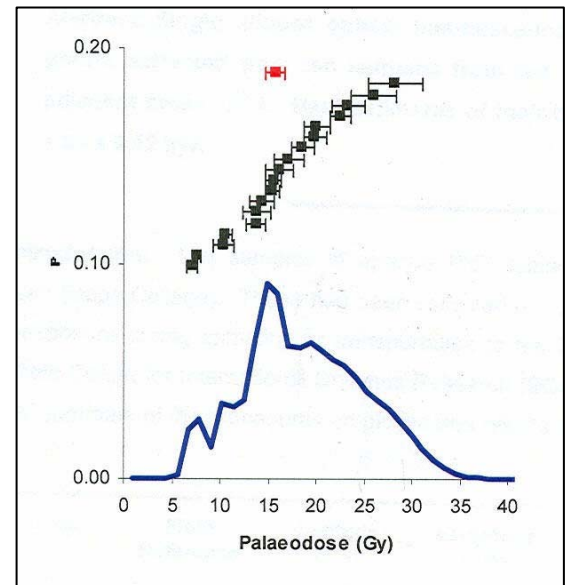
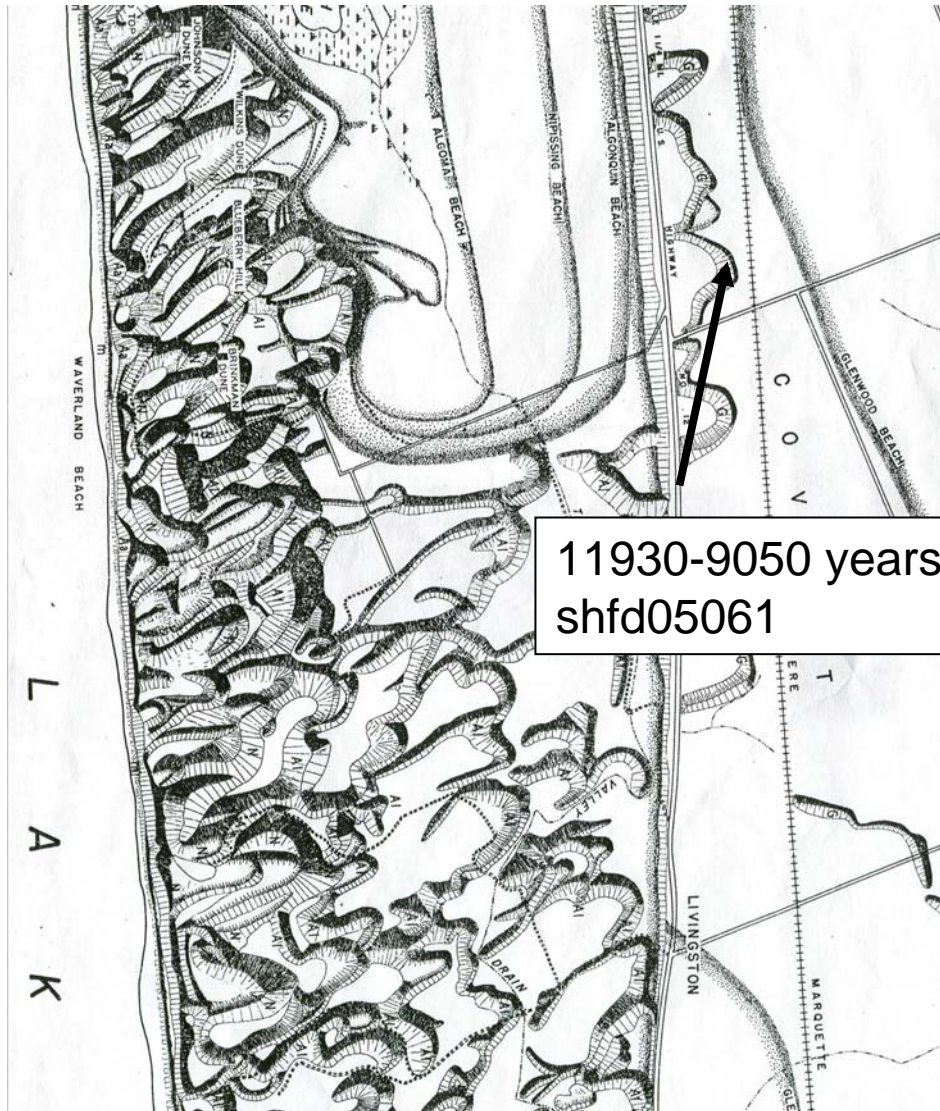


# Reconstructing Dune Histories Using Lake Cores From Inland Dune Lakes

Sediment Cores From Gilligan Lake in the Coastal Dune Complex southwest of Holland



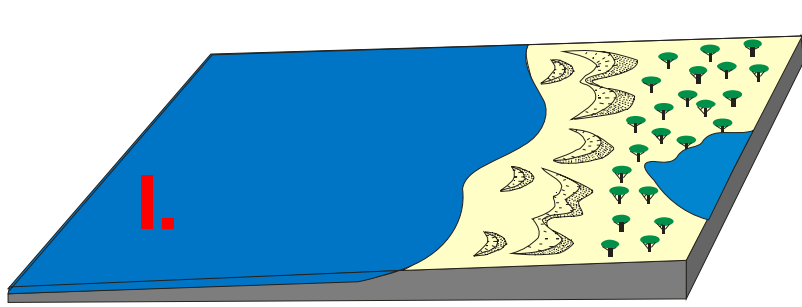
# Warren Dunes



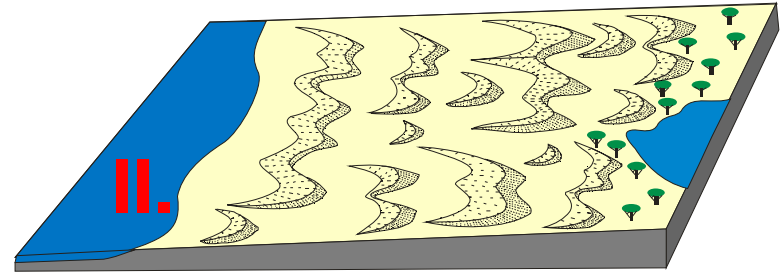
Map from Tague (1946)



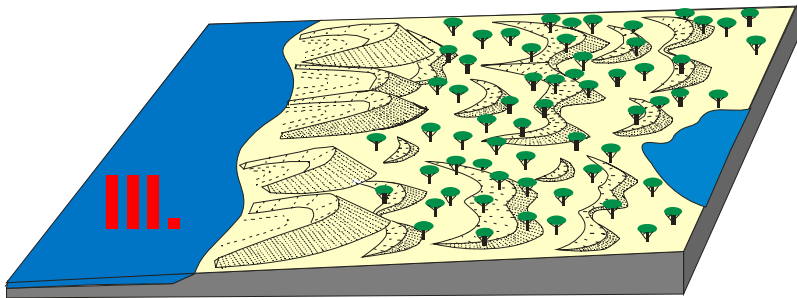
# History of Coastal Dune Complex near Holland, MI



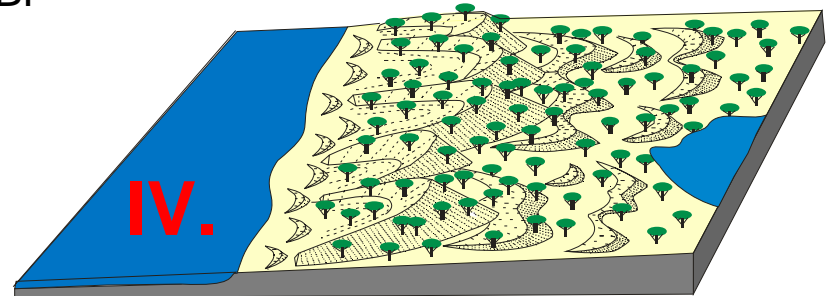
Initiation of dune growth during Nipissing Transgression ~ 5,500 YBP



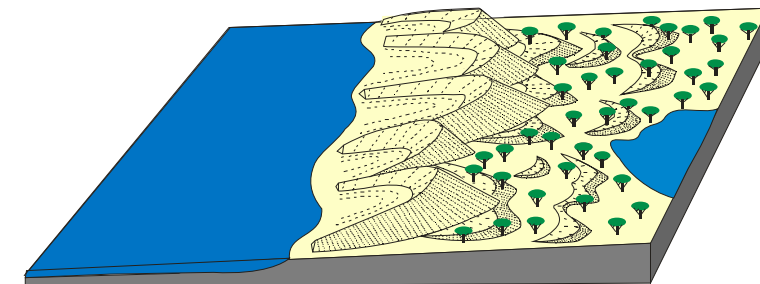
Formation of relatively low dunes over broad coastal zone during rise to and fall from Nipissing peak lake levels ~5500 – 4,000 YBP



Reworking of near shore dunes into massive parabolic dunes ~3,3000 – 2,000 YBP

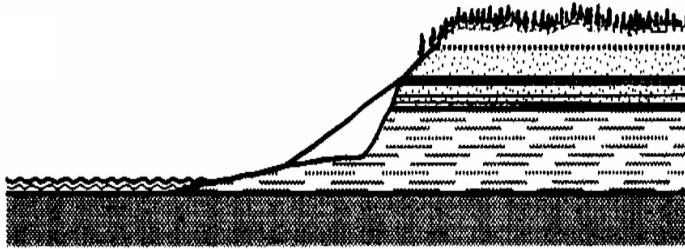


Prolonged period of dune stability ~ 2000 – 500 YBP

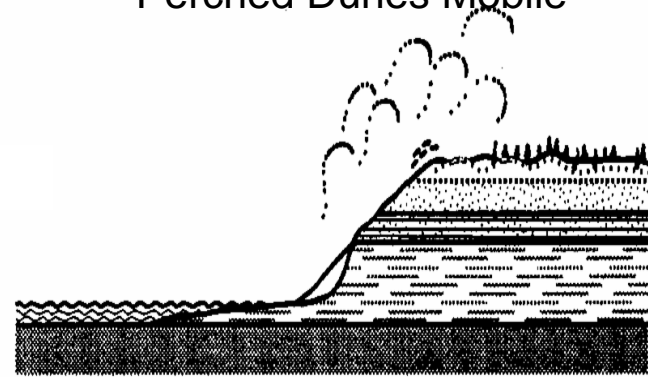


Renewed Dune Mobility ~500 – 0 YBP

Low Lake Levels:  
Perched Dunes Stable

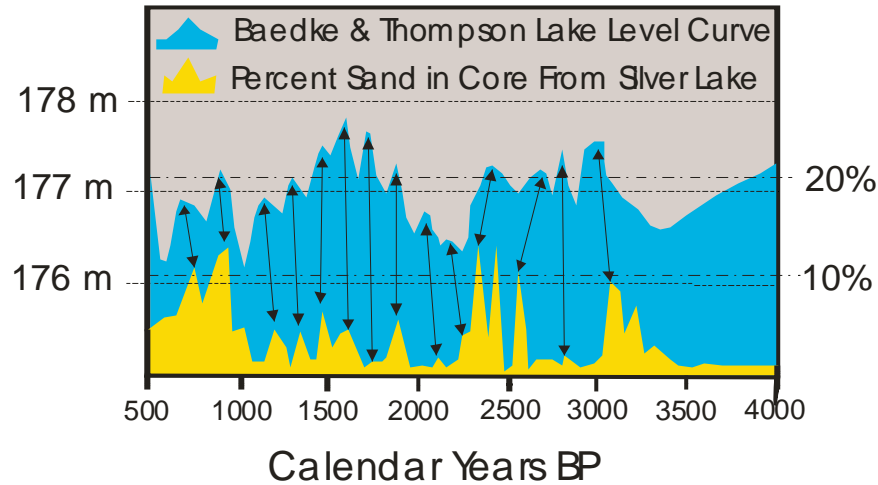


High Lake Levels:  
Perched Dunes Mobile



From Anderton and Loope (1995)

## Lake plain complex near Silver Lake, Mi

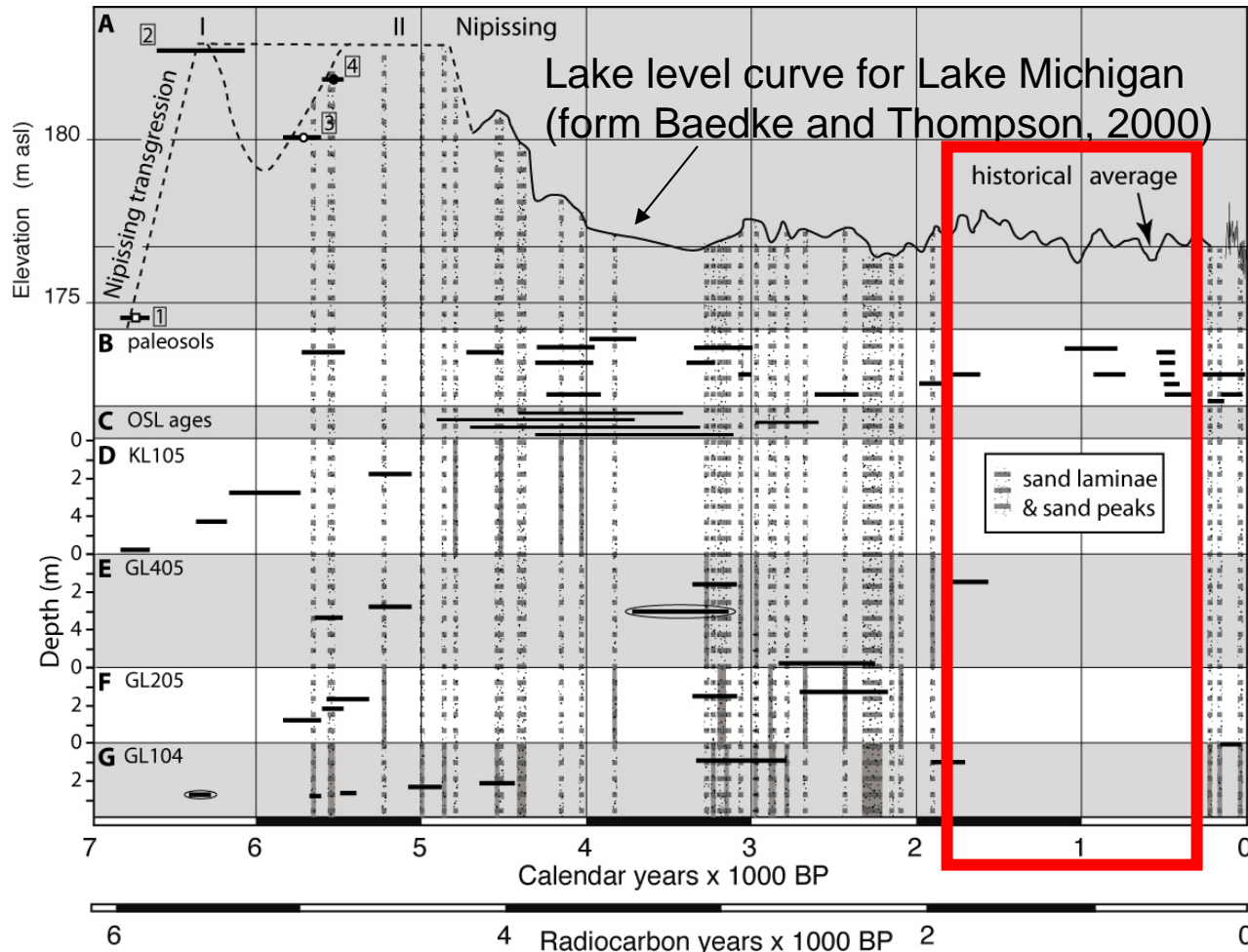


Modified from Fisher and Loope (2005)



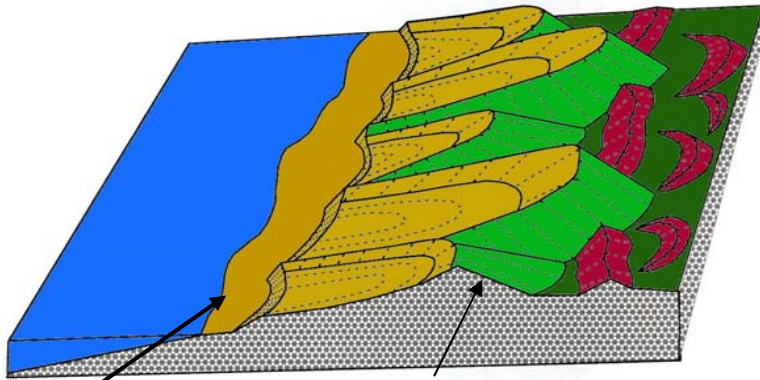
# Chronological Data For Coastal Dune Complex Near Holland, Michigan

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Period of dune mobility indicated by peak in sand concentration in small lakes within dune complex.



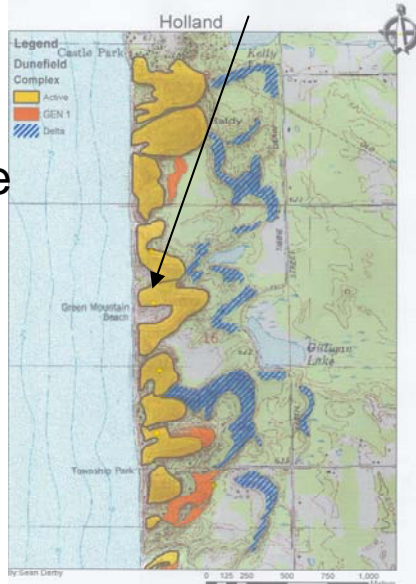
# Low-Perched Coastal Dune Complexes

## Holland Style (Simple Complex)

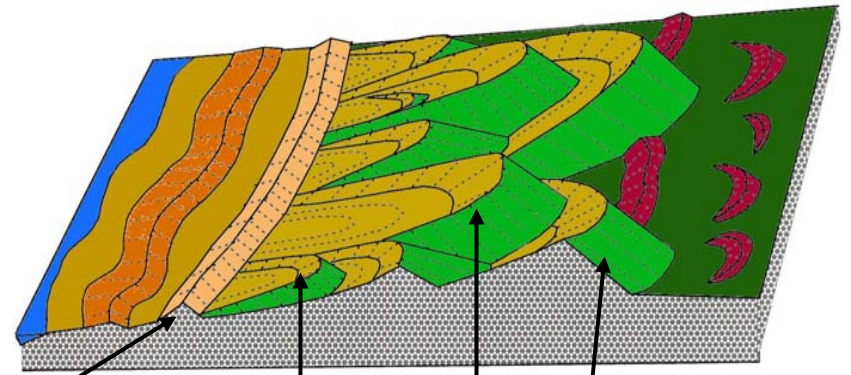


One set of massive parabolic dunes

No high coastal dune ridge

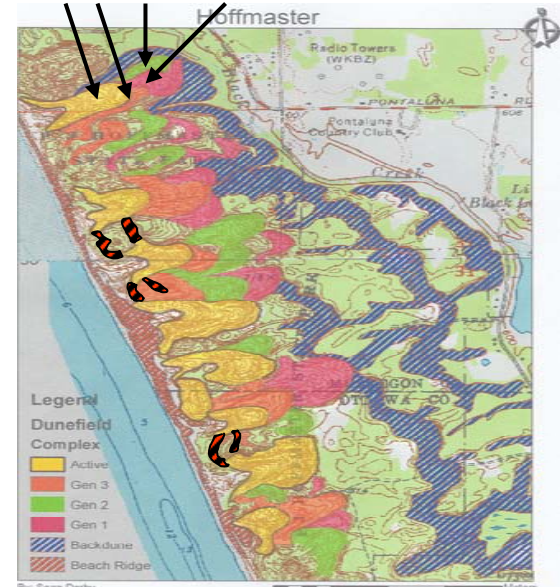


## Hoffmaster Style (Compound Complex)



Several generations of overlapping and nested massive parabolic dunes.

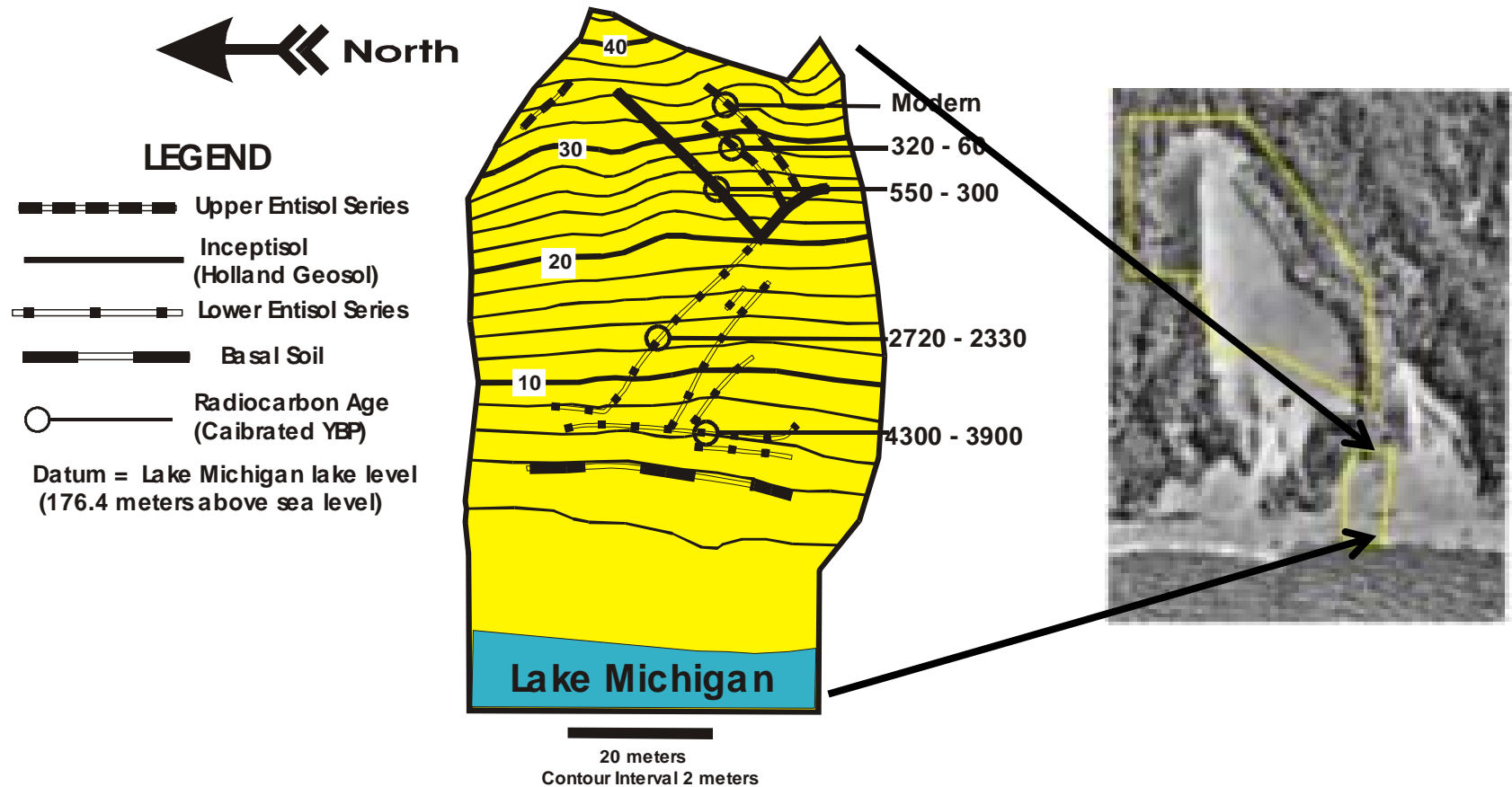
High coastal dune ridge





# Simple Low Perched Dune Complexes

Soils formed on the depositional lobes of parabolic dunes are now exposed along the lakeshore, implying net shoreline recession.



net sediment loss > net sediment supply

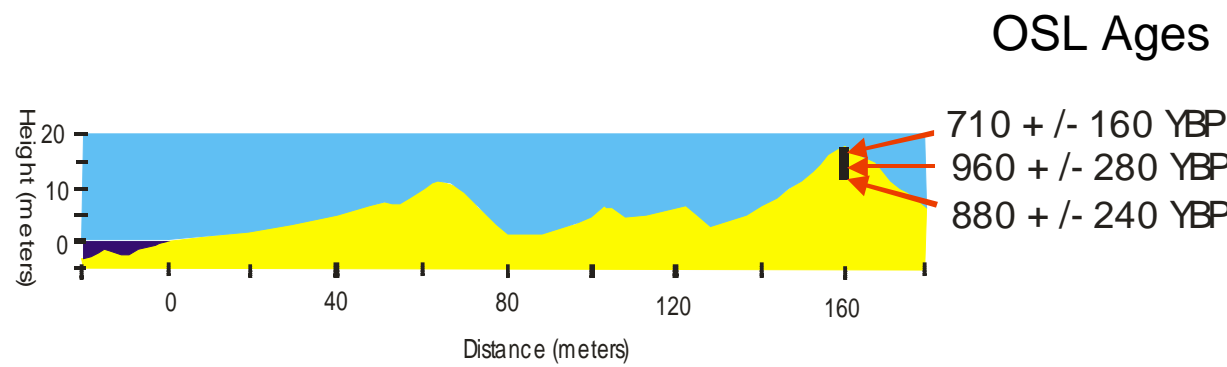
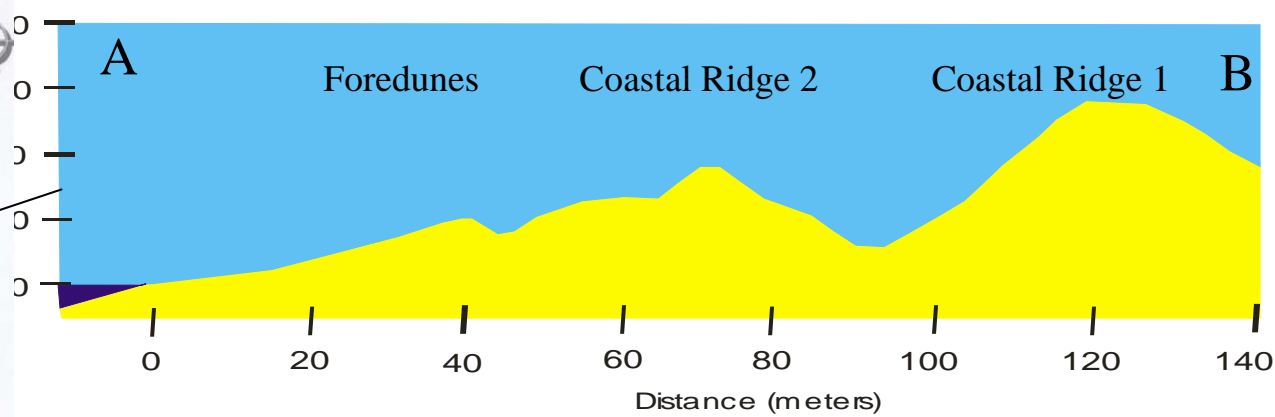
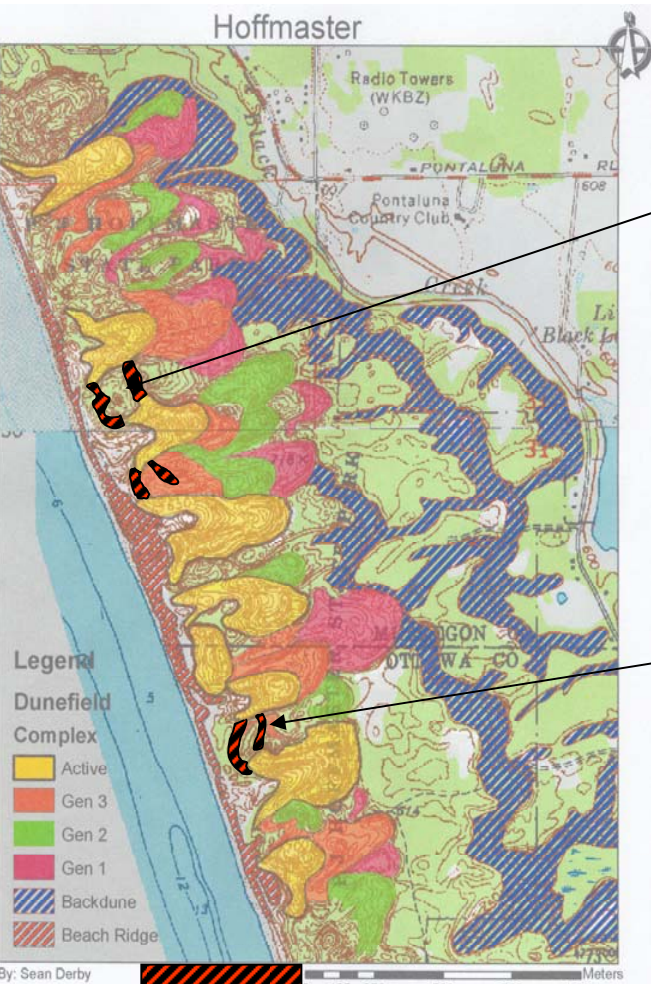
# High Perched Dunes Also Form in Areas of Net Negative Sediment Budget and Retreating Shorelines



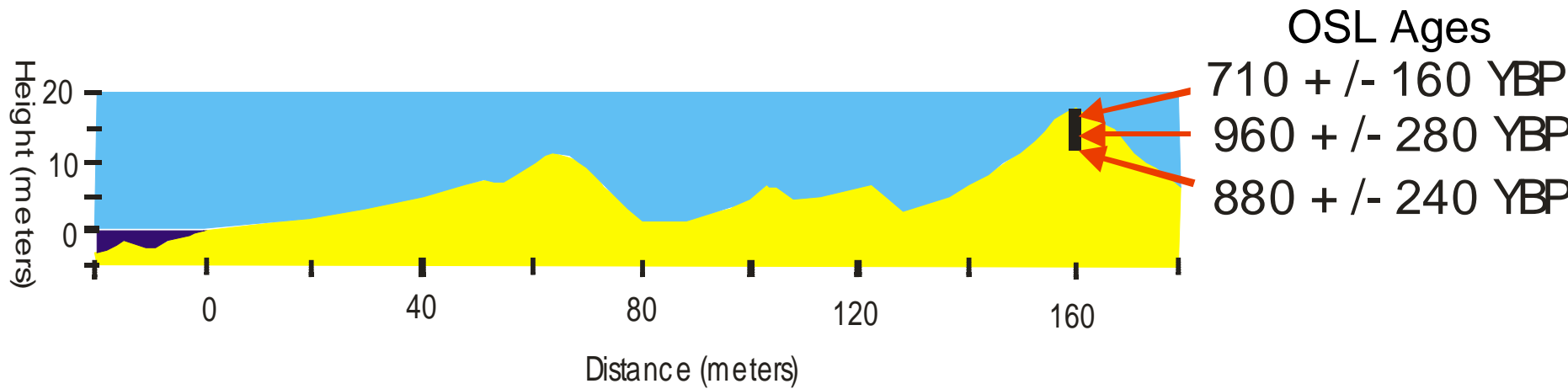
Photo Courtesy of Walter Loope



# Compound Lake Plain Complex At Hoffmaster State Park, South of Muskegon, Michigan



Fragments of Earlier High Coastal Dune Ridges



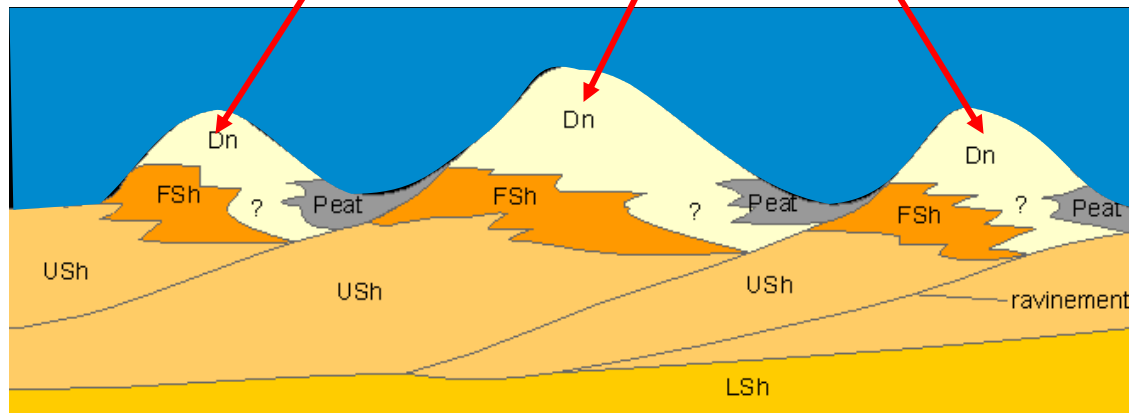
Olson (1958) showed that high coastal dune ridges formed by coalescence of successive generations of foredunes.

Implication the shoreline at Hoffmaster has been moving lakeward.

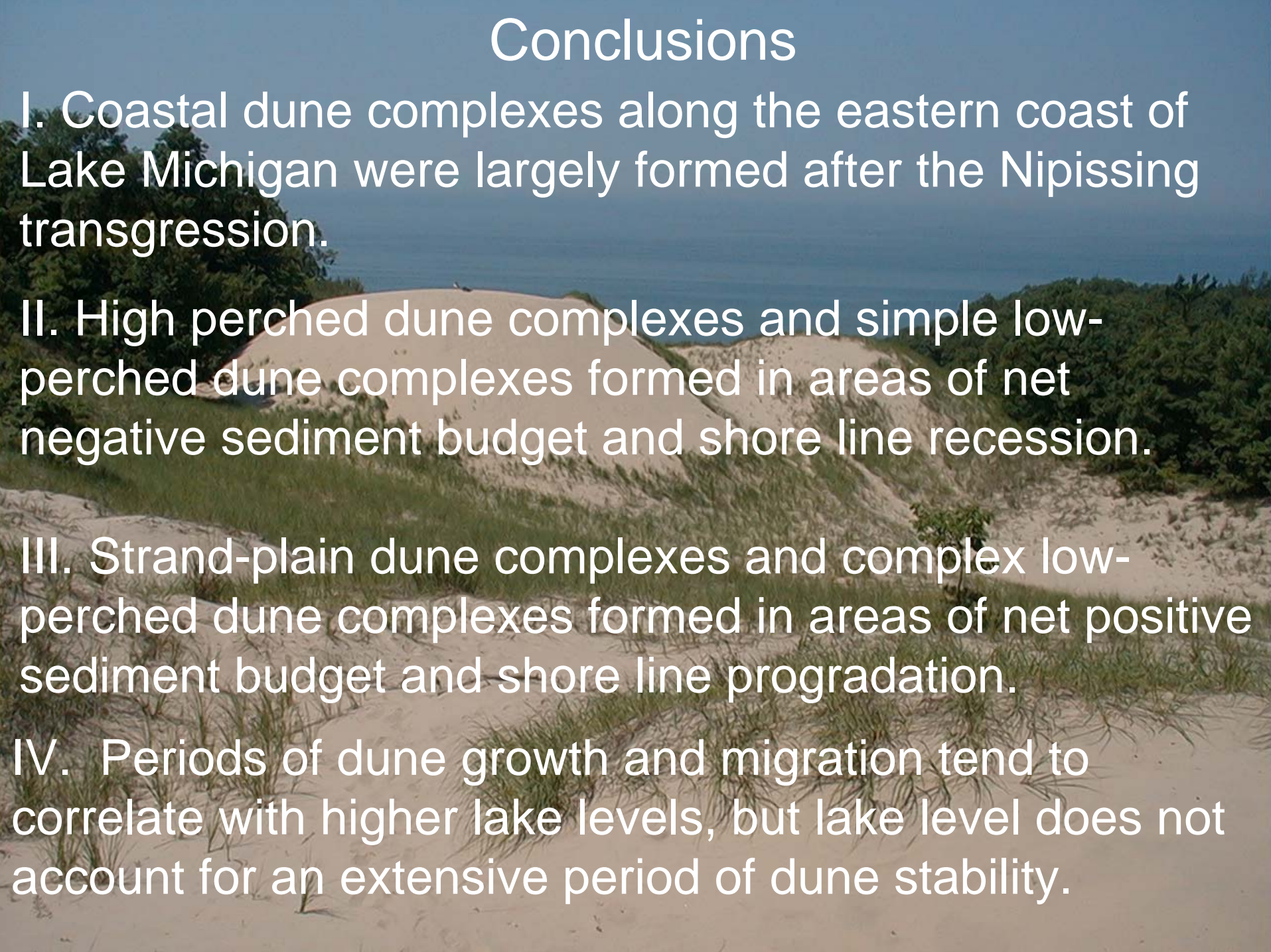
net sediment loss < net sediment supply



# Strand plain dune complexes also form in areas of net positive sediment budget and prograding shorelines



# Conclusions

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- I. Coastal dune complexes along the eastern coast of Lake Michigan were largely formed after the Nipissing transgression.
- II. High perched dune complexes and simple low-perched dune complexes formed in areas of net negative sediment budget and shore line recession.
- III. Strand-plain dune complexes and complex low-perched dune complexes formed in areas of net positive sediment budget and shore line progradation.
- IV. Periods of dune growth and migration tend to correlate with higher lake levels, but lake level does not account for an extensive period of dune stability.