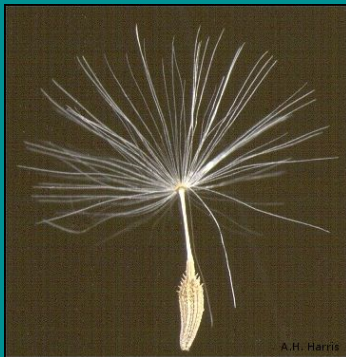
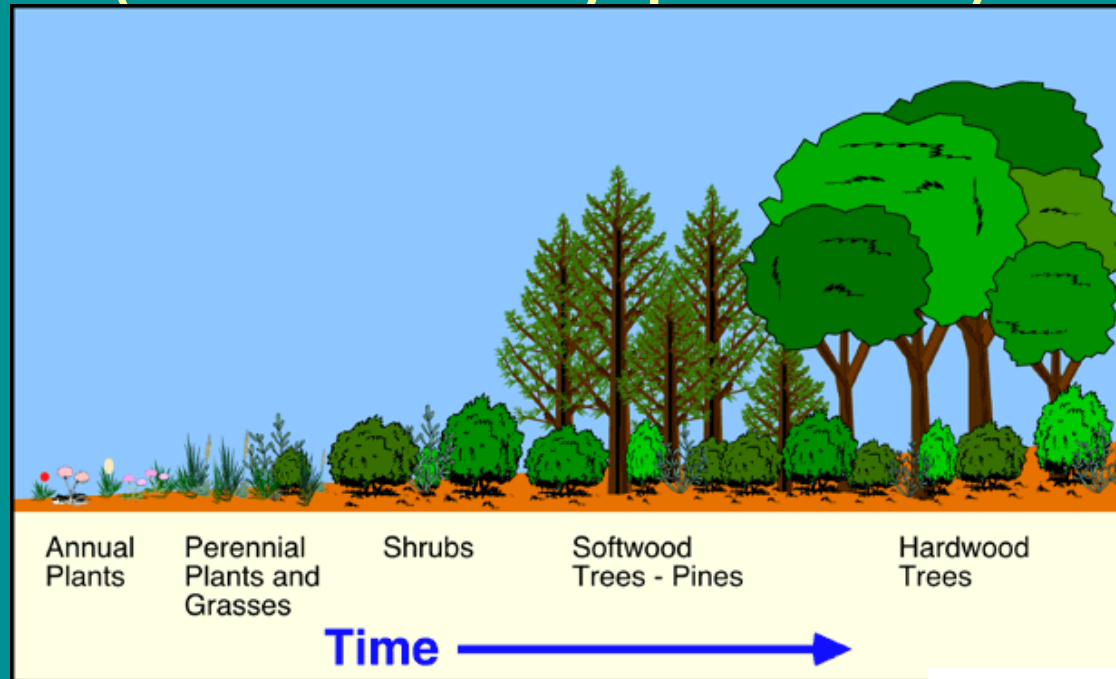


Secondary succession (soil already present)



<http://museum.utep.edu/archive/plants/>



http://pics.davesgarden.com/pics/melody_1097116107_252_tn.jpg



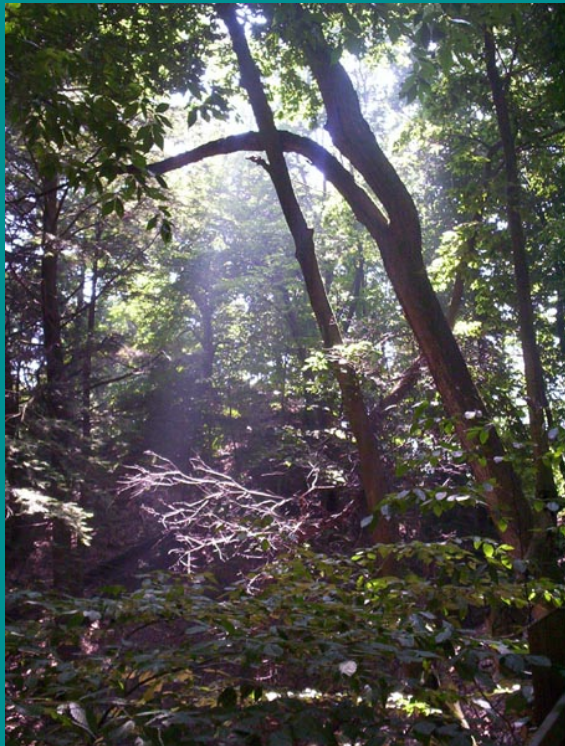
http://www.istockphoto.com/file_thumbview_approve/3943906/2/istockphoto_3943906-beech-and-acorn-seeds.jpg

Changes in biotic environment

Presence of insects, birds, and mammals (pollinators, dispersers, fertilizers)

Shade and litterfall from trees

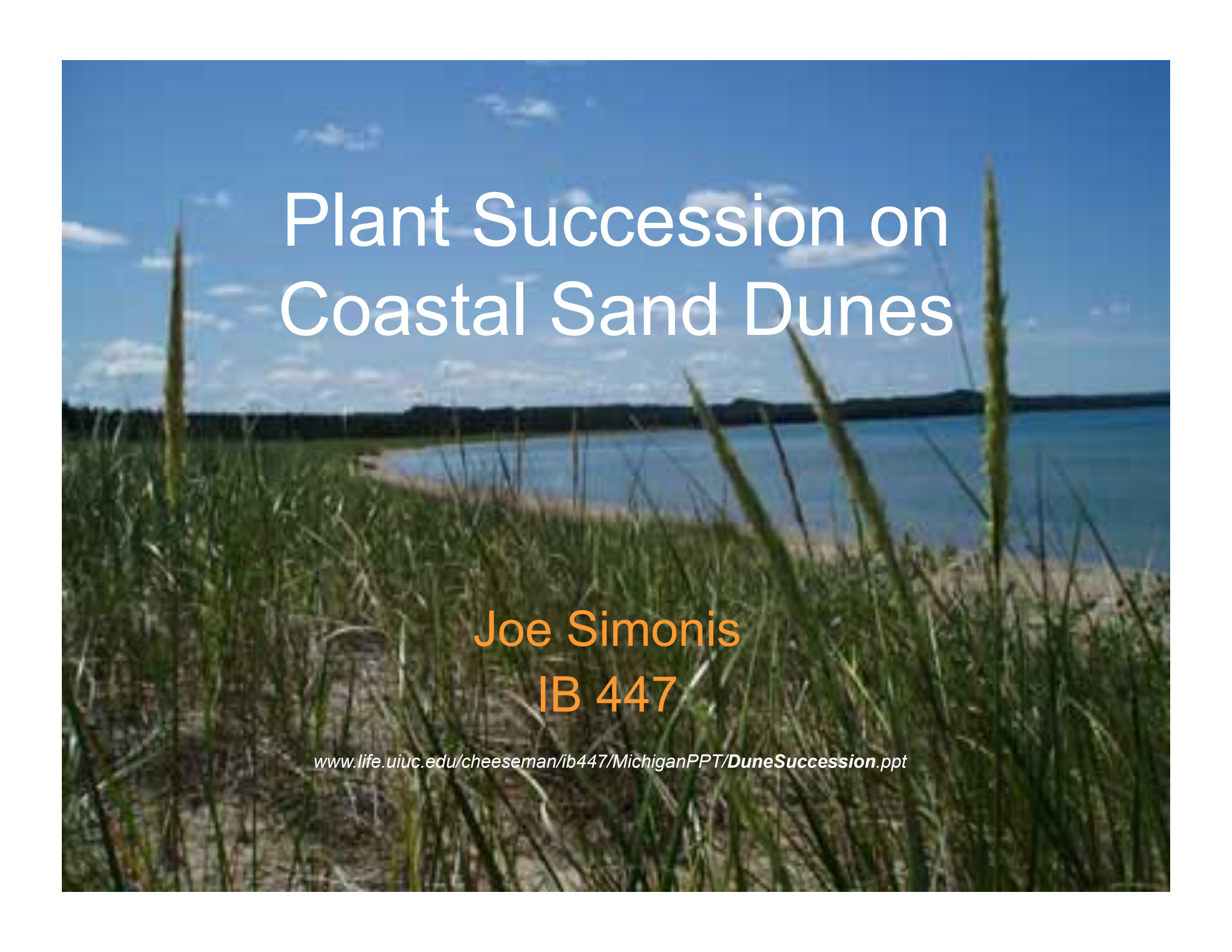
www.birderblog.com



www.airninja.com



www.ent.iastate.edu

A photograph of a coastal sand dune. In the foreground, there is a dense field of tall, green grass with long, thin seed heads. The grass is slightly out of focus. In the background, a calm body of water, likely a lake, stretches across the horizon. The sky is a clear, bright blue with a few small, white clouds. The overall scene is peaceful and natural.

Plant Succession on Coastal Sand Dunes

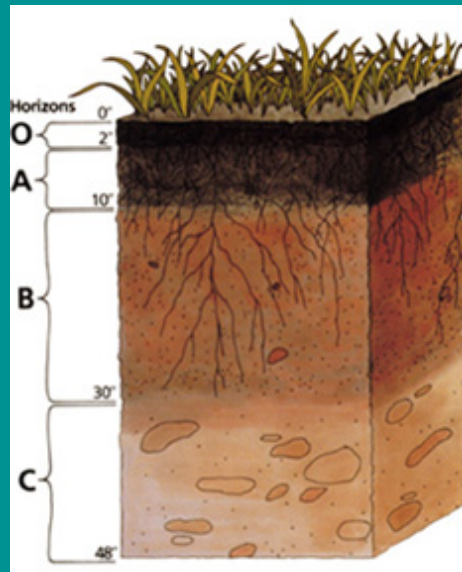
Joe Simonis
IB 447

www.life.uiuc.edu/cheeseman/ib447/MichiganPPT/DuneSuccession.ppt

Primary succession: soil development

Soil organic material

WITHOUT EARTHWORMS



http://en.wikipedia.org/wiki/Soil_profile

WITH EARTHWORMS



Changes in abiotic environment

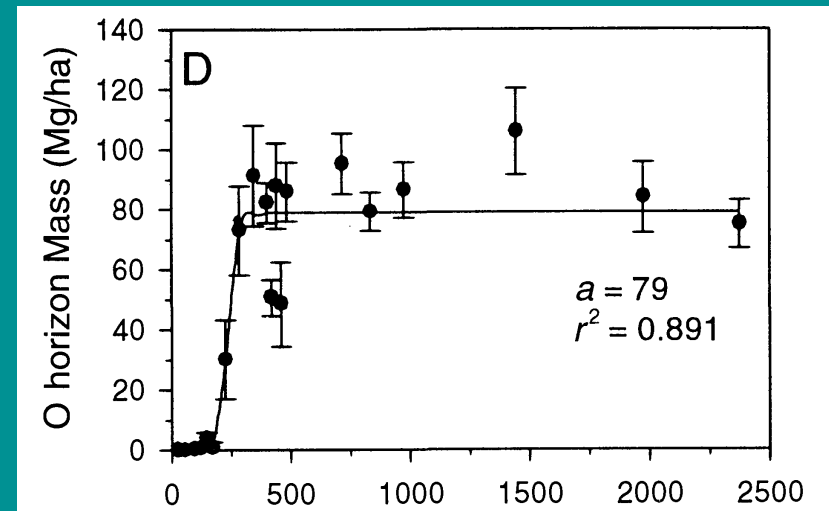
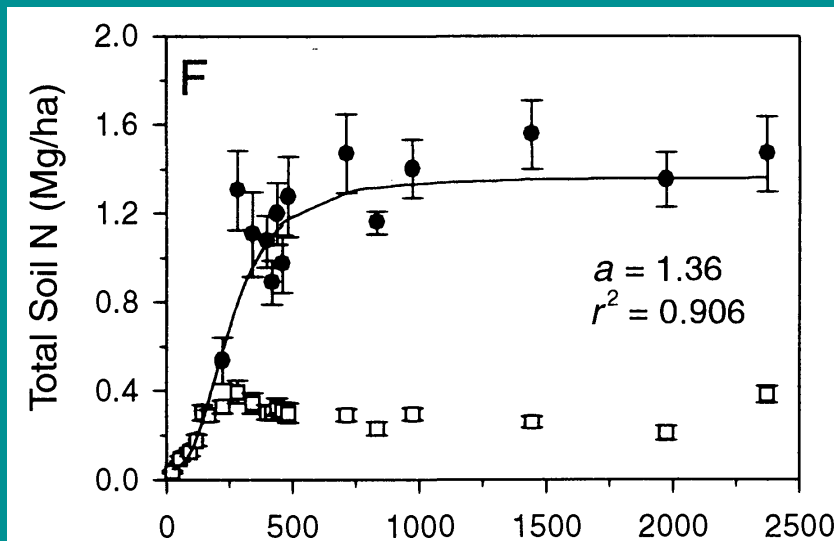
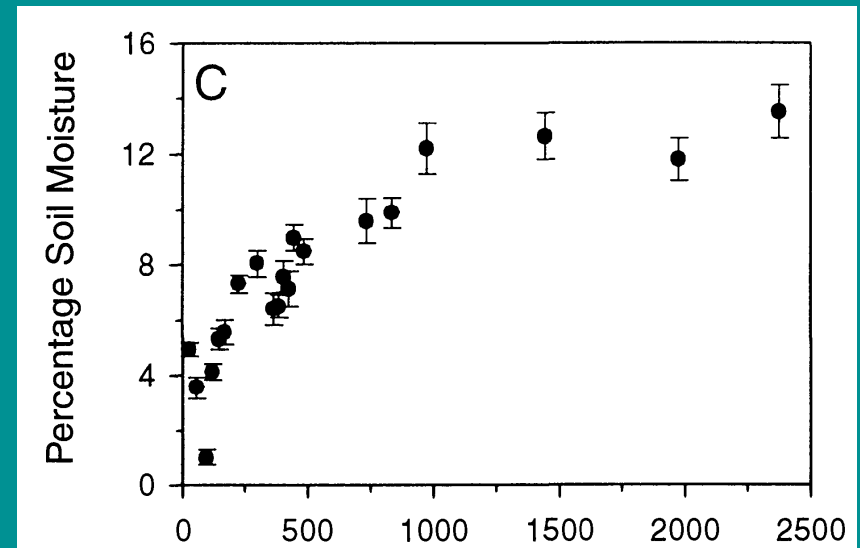
Stabilization of sands

New windward dunes (windbreaks)

Water!!!

Organic horizon development

Nutrients: nitrogen, phosphorus,
potassium



Early species

Characterize primary dunes (ages 0 - 50 years)

Beach grass and sand reed grass are crucial early colonizers of coastal dunes



<http://tecalive.mtu.edu/meec/module09/>



www.dnr.state.wi.us

Middle species

Characterize open secondary dunes (55-175 years old)

The environment is still harsh as water and nutrient levels are not very high

Evergreen shrubs (common bearberry and juniper) and bunchgrasses (little bluestem) become the dominant species



www.savedunes.org



botit.botany.wisc.edu



en.wikipedia.org

Late species



Mixed pine forests dominate dunes 200 years old and older

Common species: white and red pine, white spruce, balsam fir, white cedar, and paper birch



Hardwood trees

Red maple and red oak are present by 225 years, but aren't important components until after 440 years

Eastern hemlock, sugar maple, and beech are only really present and abundant on undisturbed old (1445+ years) dunes

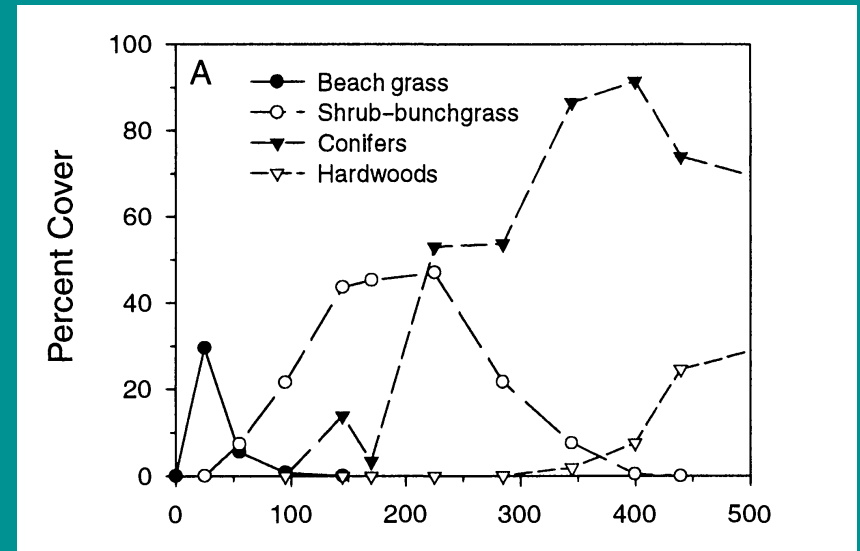


Photo by Lee Frelich.



Textual Sources

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Gurevitch, J., S. M. Scheiner and G. A. Fox. 2006. *The Ecology of Plants*. Sinauer Associates.

Lichter, J. 1998. Primary succession and forest development on coastal Lake Michigan sand dunes. *Ecological Monographs* 68: 487-510.

Terrestrial Ecosystems: Coastal Dunes. www.techalive.mtu.edu

Sleeping Bear Bay ~ August 2004
photo by leelanau.com