National Park Service
U.S. Department of the Interior

Evaluation of Reference Conditions for Coastal Sand Habitats of Southern Lake Michigan at Indiana Dunes National Lakeshore

Charles C. Morris[1] and Thomas P. Simon[2]

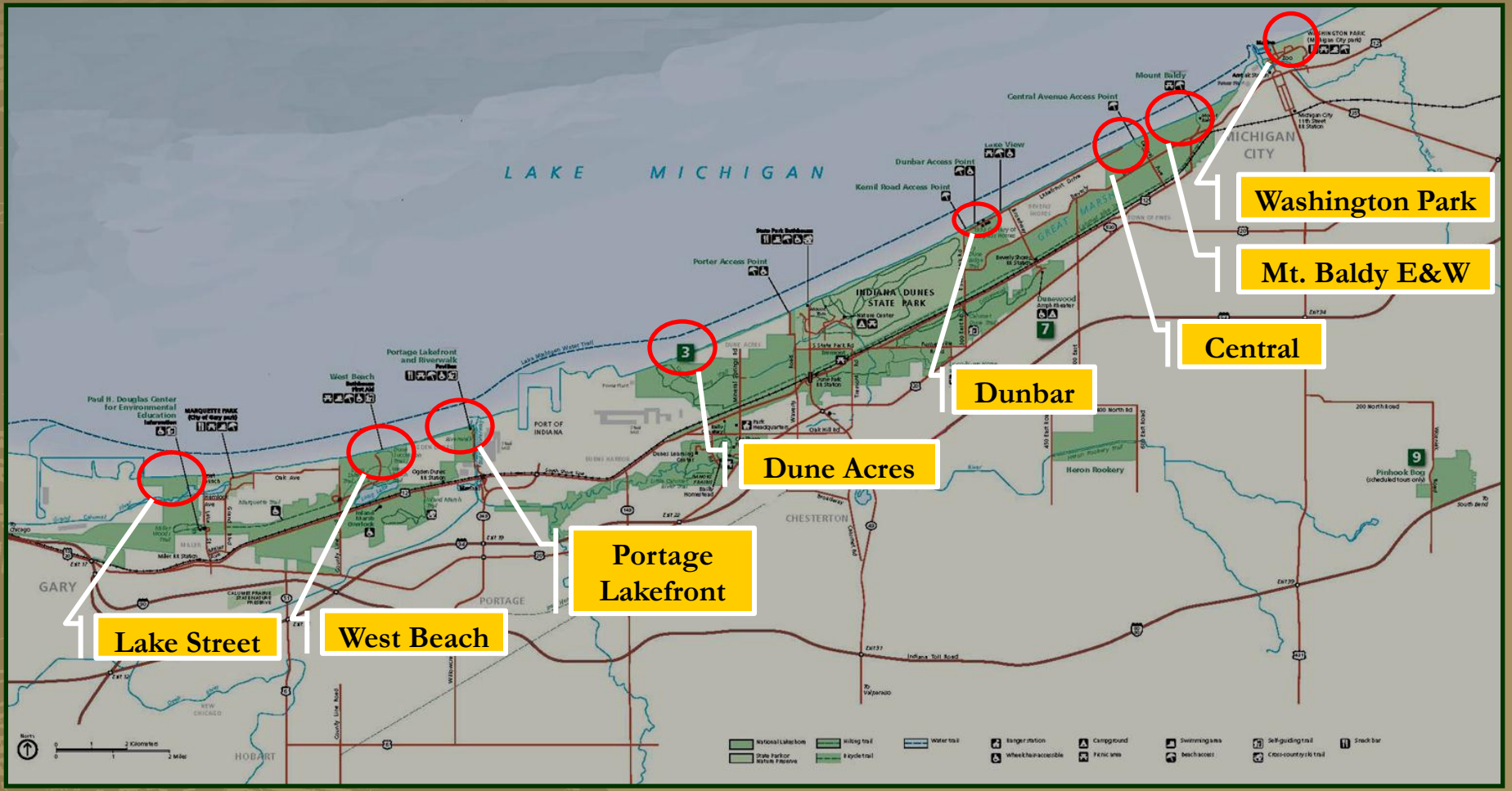
[1]National Park Service, Indiana Dunes National Lakeshore, 100 N. Mineral Springs Road, Porter, Indiana 47468

[2]The School of Public and Environmental Affairs, 1315 E. Tenth Street, Room 341, Indiana University, Bloomington, Indiana 47405

Objective

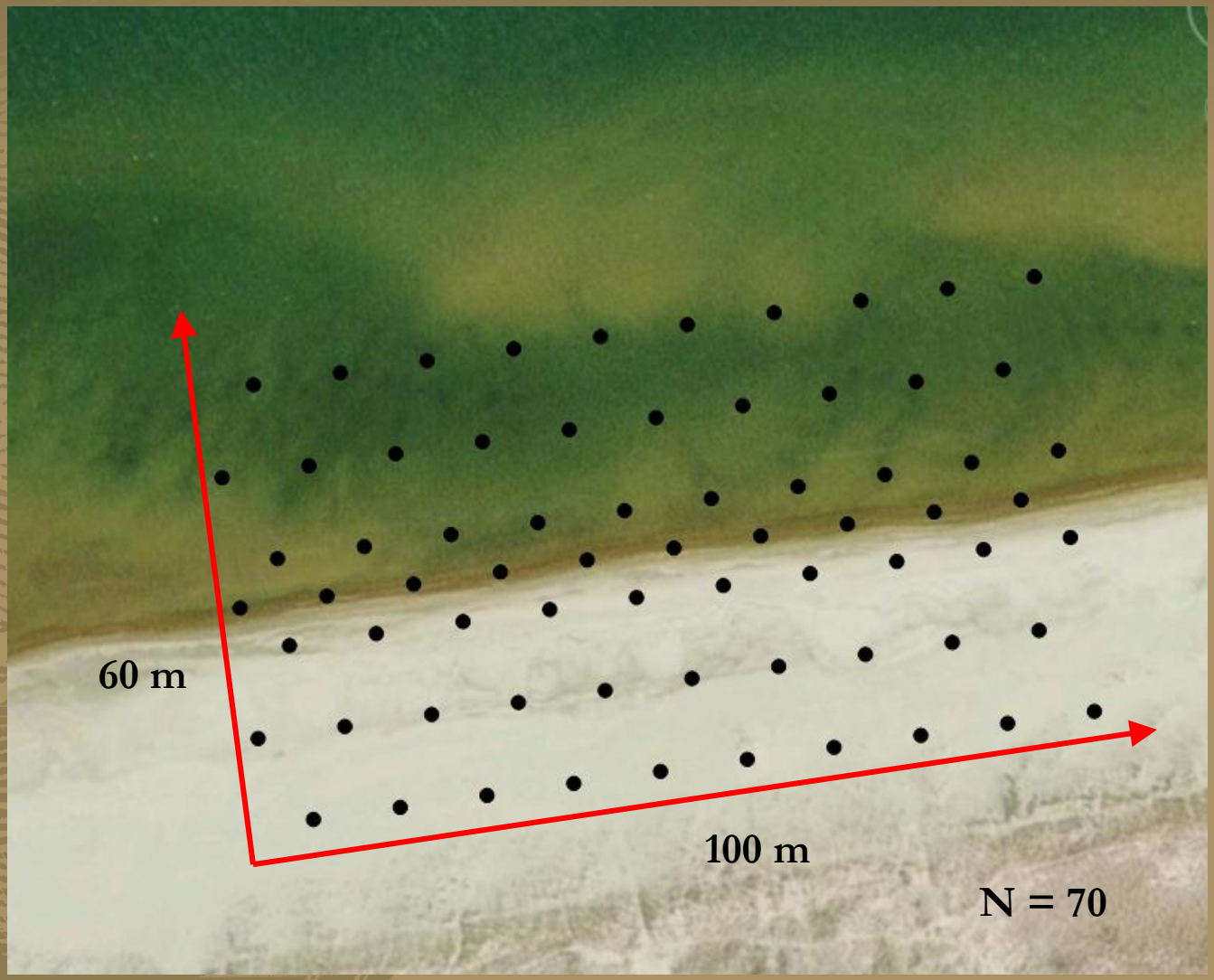
- **Understand the variability in coastal shoreline sand habitats to develop a method of quantitatively assessing site specific habitat suitability for fish assemblages.**

Indiana Dunes National Lakeshore



EXPERIENCE YOUR AMERICA

Methods



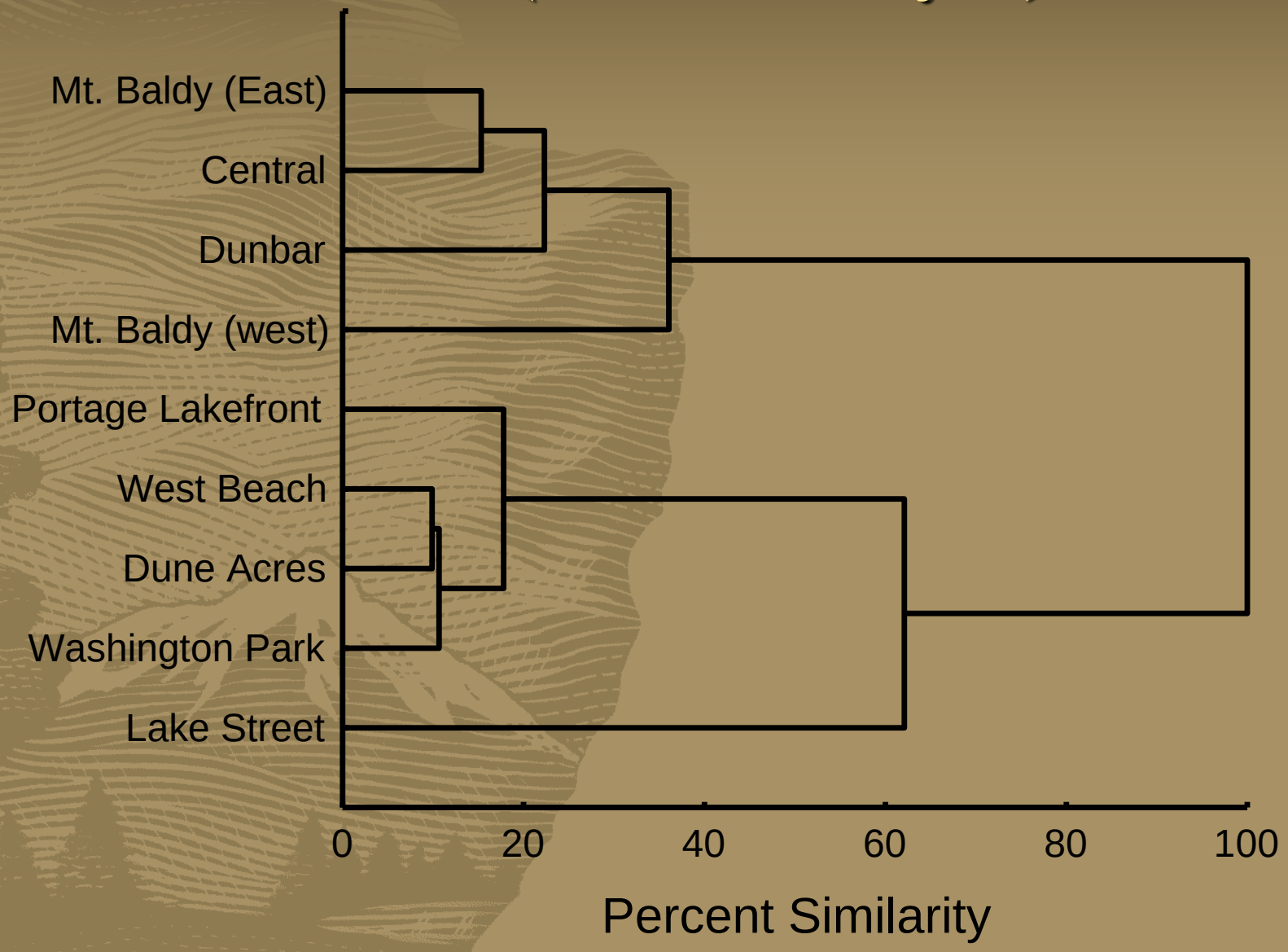
Methods

- Statistical Analysis
  - Numerical Classification Analysis (Cluster Analysis)
    - Identify between site similarity patterns using Ward's Method
  - Factor Analysis
    - Identify both within and between site factors explaining cumulative variation
  - Principal Components Analysis
    - Evaluate explained variance within cluster by row to determine physical location contacting the highest information content

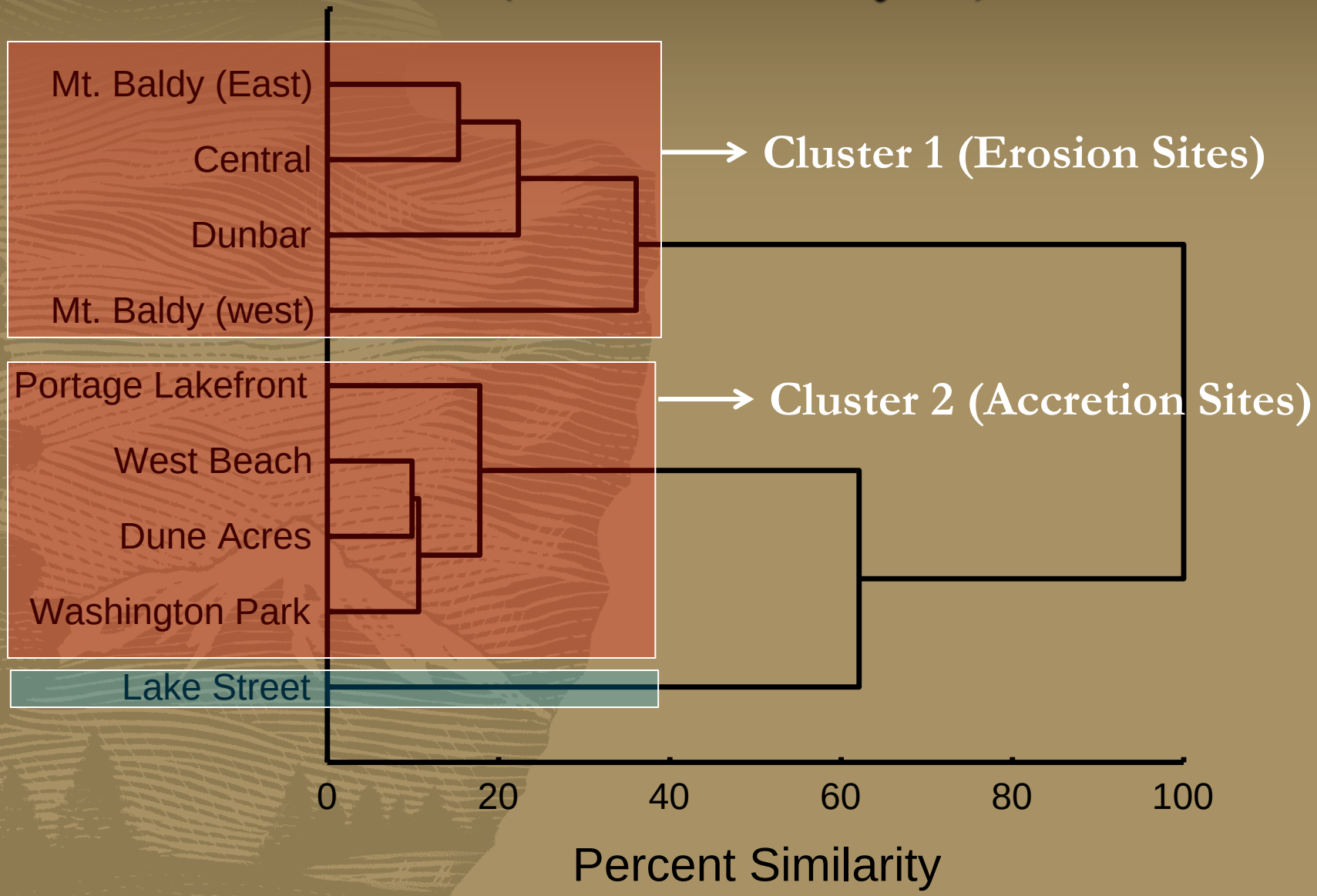
Methods

- Statistical Analysis
  - Numerical Classification Analysis (Cluster Analysis)
    - Identify between site similarity patterns using Ward's Method
  - Factor Analysis
    - Identify both within and between site factors explaining cumulative variation
  - Principal Components Analysis
    - Evaluate explained variance within cluster by row to determine physical location contacting the highest information content

Results (Cluster Analysis)



Results (Cluster Analysis)



Methods

- Statistical Analysis
  - Numerical Classification Analysis (Cluster Analysis)
    - Identify between site similarity patterns using Ward's Method
  - Factor Analysis
    - Identify both within and between site factors explaining cumulative variation
  - Principal Components Analysis
    - Evaluate explained variance within cluster by row to determine physical location contacting the highest information content

Results (Factor Analysis)

Grain size by sieve	All Sites		(Erosion) Cluster 1		(Accretion) Cluster 2
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1
Sieve #4 (%) > 4.75 mm	-0.865099		-0.799078		0.794382
Sieve #20 (%) 1.99 - 0.85 mm				0.932562	0.878178
Sieve #60 (%) 0.424 - 0.250 mm	0.91827		0.879637		-0.837306
Sieve #100 (%) 0.249 - 0.150 mm			0.829912		-0.748882
Sieve #200 (%) 0.105 - 0.075 mm		-0.817944			-0.825859
Explained Variance	35%	30%	43%	22%	61%
Cumulative Variance	35%	65%	43%	65%	

Results (Factor Analysis)

Grain size by sieve	All Sites		(Erosion) Cluster 1		(Accretion) Cluster 2
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1
Sieve #4 (%) > 4.75 mm	-0.865099		-0.799078		0.794382
Sieve #20 (%) 1.99 - 0.85 mm				0.932562	0.878178
Sieve #60 (%) 0.424 - 0.250 mm	0.91827		0.879637		-0.837306
Sieve #100 (%) 0.249 - 0.150 mm			0.829912		-0.748882
Sieve #200 (%) 0.105 - 0.075 mm		-0.817944			-0.825859
Explained Variance	35%	30%	43%	22%	61%
Cumulative Variance	35%	65%	43%	65%	

Results (Factor Analysis)

Grain size by sieve	All Sites		(Erosion) Cluster 1		(Accretion) Cluster 2
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1
Sieve #4 (%) > 4.75 mm	-0.865099		-0.799078		0.794382
Sieve #20 (%) 1.99 - 0.85 mm				0.932562	0.878178
Sieve #60 (%) 0.424 - 0.250 mm	0.91827		0.879637		-0.837306
Sieve #100 (%) 0.249 - 0.150 mm			0.829912		-0.748882
Sieve #200 (%) 0.105 - 0.075 mm		-0.817944			-0.825859
Explained Variance	35%	30%	43%	22%	61%
Cumulative Variance	35%	65%	43%	65%	

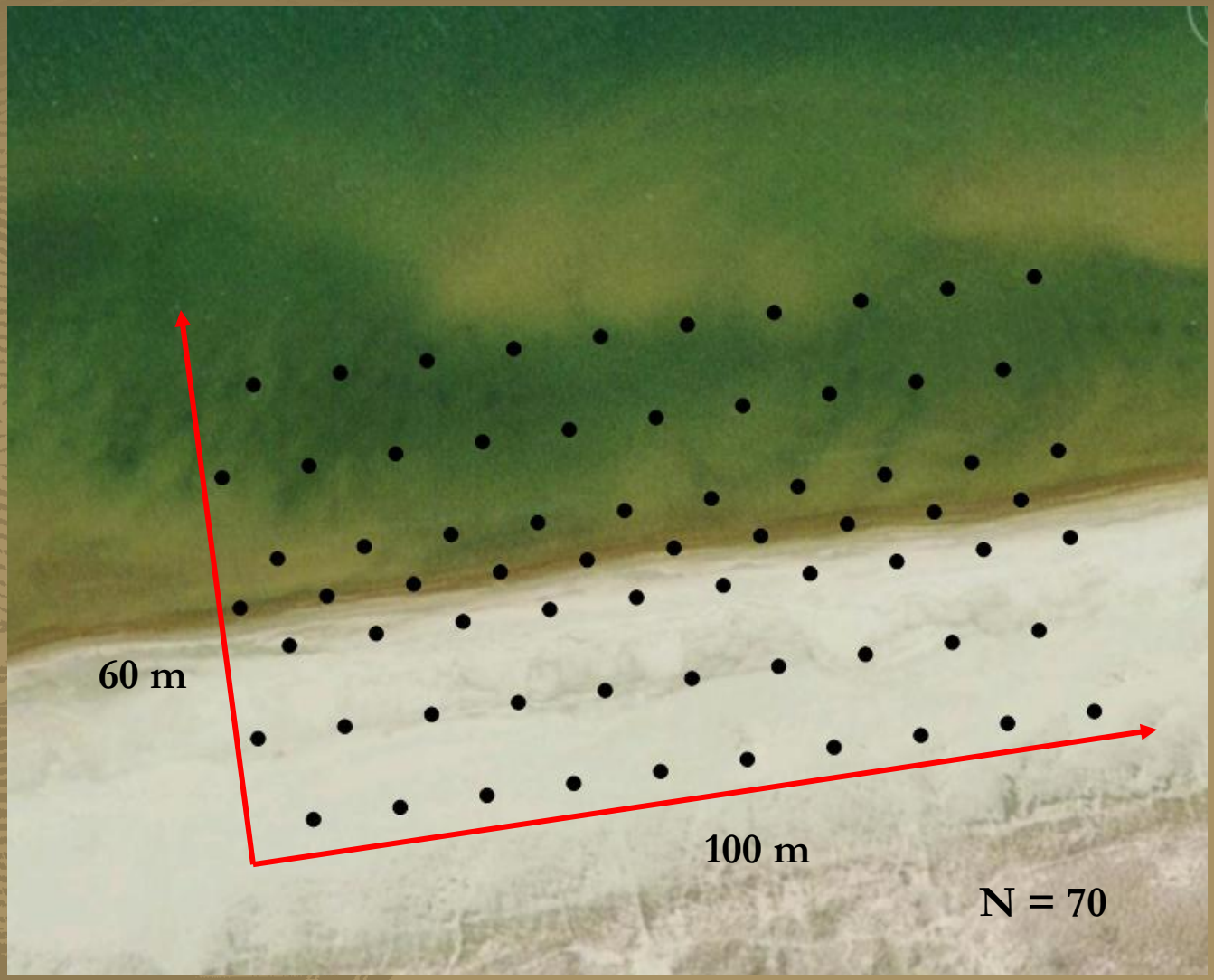
Results (Factor Analysis)

Grain size by sieve	All Sites		(Erosion) Cluster 1		(Accretion) Cluster 2
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1
Sieve #4 (%) > 4.75 mm	-0.865099		-0.799078		0.794382
Sieve #20 (%) 1.99 - 0.85 mm				0.932562	0.878178
Sieve #60 (%) 0.424 - 0.250 mm	0.91827		0.879637		-0.837306
Sieve #100 (%) 0.249 - 0.150 mm			0.829912		-0.748882
Sieve #200 (%) 0.105 - 0.075 mm		-0.817944			-0.825859
Explained Variance	35%	30%	43%	22%	61%
Cumulative Variance	35%	65%	43%	65%	

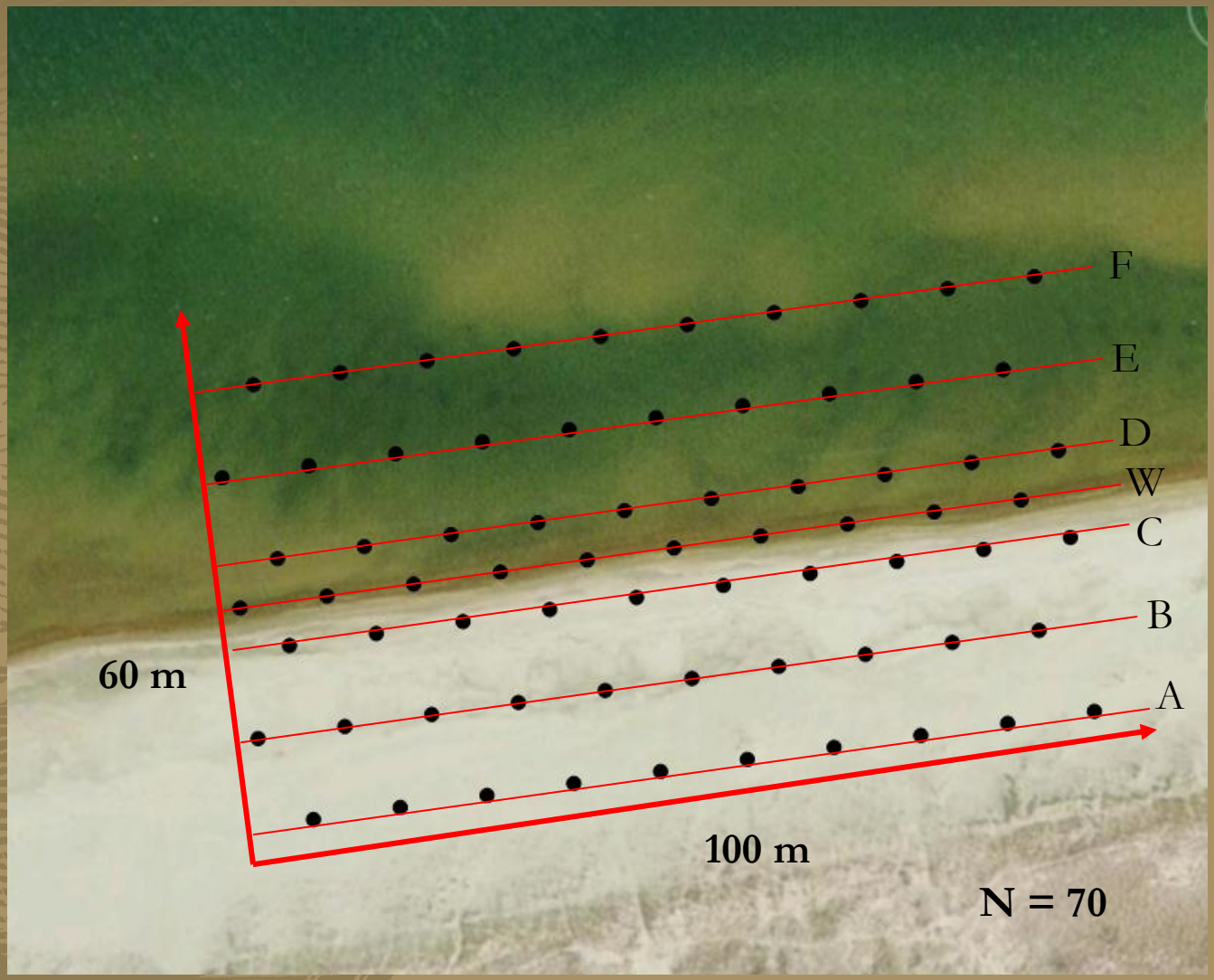
Methods

- Statistical Analysis
  - Numerical Classification Analysis (Cluster Analyses)
    - Identify between site similarity patterns using Ward's Method
  - Factor Analysis
    - Identify both within and between site factors explaining cumulative variation
  - Principal Components Analysis
    - Evaluate explained variance within cluster by row to determine physical location contacting the highest information content

Methods



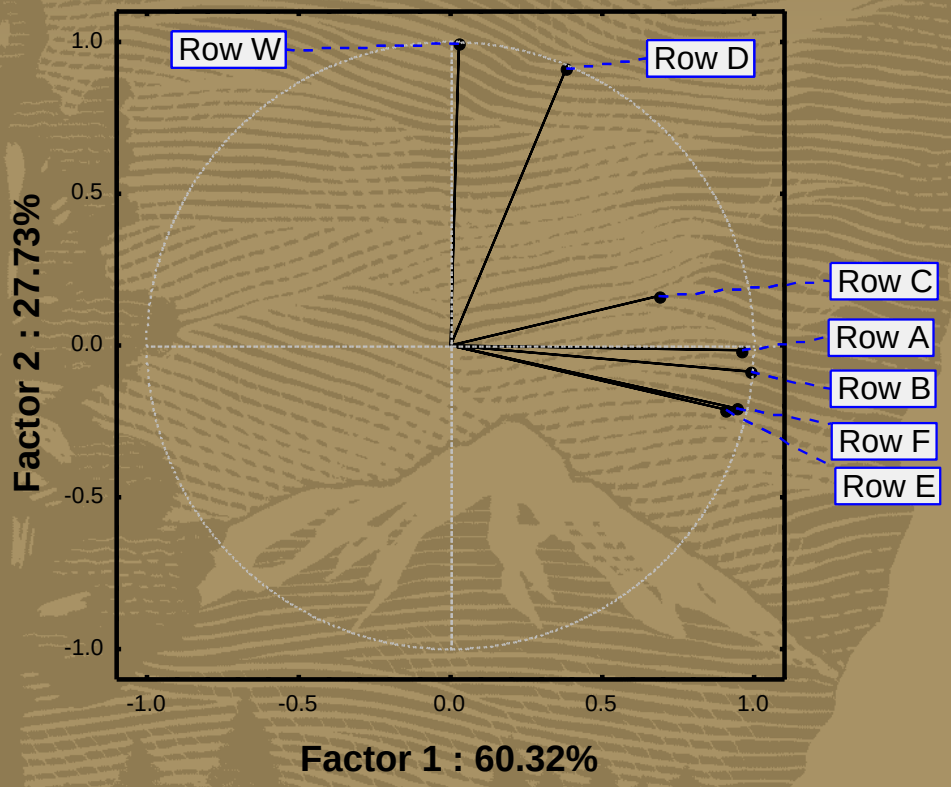
Methods



Results (PCA)

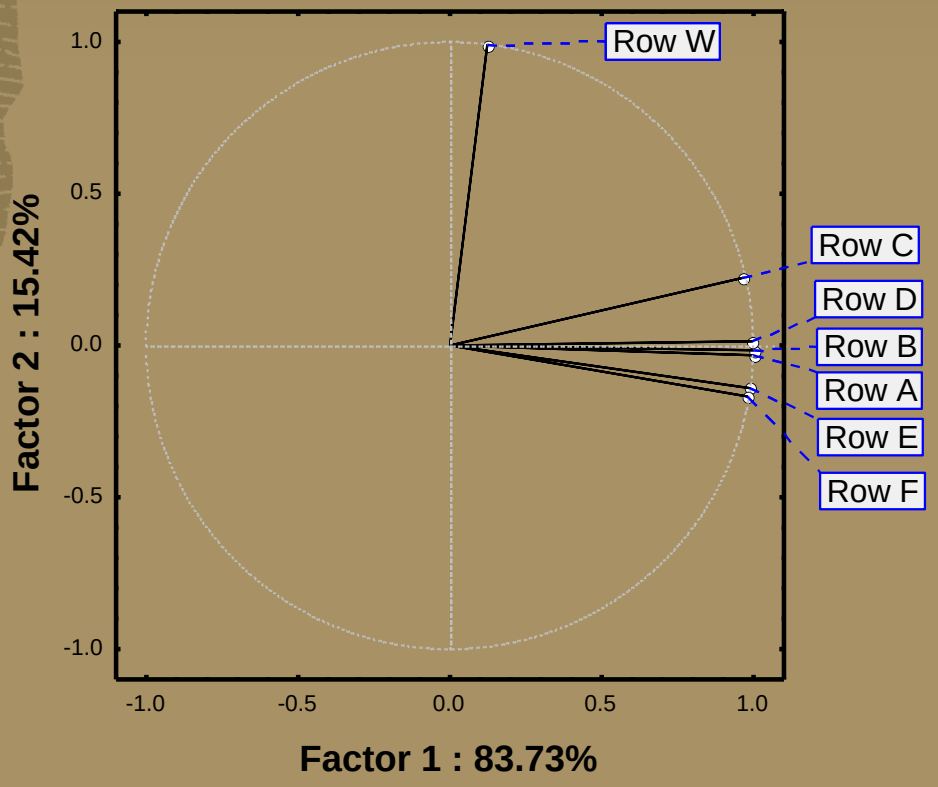
Cluster 1(Erosion)

Mt. Baldy E, Mt. Baldy W., Central, Dunbar



Cluster 2 (Accretion)

Portage Lakefront, West Beach, Dune Acres, Washington Park



Conclusions

- Sand derived habitats are not homogeneous across the shoreline within the Indiana Dunes National Lakeshore
  - Principal habitat types segregate into “erosional” and “accretion” zones
- Between site variance within each zone type can be explained by the relative percent contribution of coarse materials and varying compositions of fine material
  - Factor loadings between erosion and accretion sites demonstrated an inverse relationship
- Within site variance is best explained by samples collected within the wash zone and/or a zone extending lake-ward five meters from the wash zone

Thomas P. Simon, PhD
tsimon@indiana.edu

Charles C. Morris, PhD
charles_morris@nps.gov

INDIANA UNIVERSITY
BLOOMINGTON

GLRI #94 Task Agreement #J 6300100405

Great Lakes RESTORATION

NATIONAL PARK SERVICE

National Park Service
U.S. Department of the Interior

EXPERIENCE YOUR AMERICA