

## Appendix A: Citizen Scientist Historic Photos Protocol

# HISTORIC PHOTOS

We are looking for the oldest pictures of Lake Michigan's coastal dunes that you have, preferably ones that are 25 years old or older. Feel free to submit as many historic dune photographs as you can find.

Not sure where to start? Go dust off those old photo albums. Ask your parents, grandparents, friends or family if they have any historic photos of these landmarks that they'd be willing to share.

***Here is a step-by-step guide for this activity:***

- 1. Locate historic photos of Lake Michigan's coastal dunes that are at least 25 years old**
- 2. To the best of your ability, try to pinpoint the exact location of the pictures.** You can do this by identifying permanent landscape features nearby (e.g. docks, lighthouses etc) or by using GPS coordinates. Both Google and Apple Maps on your smartphone have the ability to easily show you the GPS coordinates of a location. Here's how you would go about that:
  - Open either Google or Apple maps on your smartphone device.
  - Type in the location of where the picture was taken into the search bar. For example, typing in "Silver Lake State Park" will take you over to the location of the park.
  - Then, to the best of your ability, press and hold on the map where your photo was taken.
  - Google and Apple maps will drop a pin and come up with the latitude and longitude position. It'll look something like this: (43.6727, -86.5215)
  - Need more help? Click here for [Google Maps](#) (Androids) or here for [Apple Maps](#) (iPhone).
- 3. Upload your historic photos with their location using the form below.** Your historical photo will likely be a physical copy, so please take a clean picture of it with a high-quality cell phone or scan it. [Click here if you need instructions on how to scan on Windows, Mac and even from your iPhone and Android!](#)

- 4. If you or your organization has more than 5 repeat photograph examples or if you just have followup questions, please email the project team at [dunes@environmentalcouncil.org](mailto:dunes@environmentalcouncil.org).**

It's that simple! By completing this process, not only will you be helping scientists study and preserve the dunes, but by submitting your historic photos you will also be entered in our photo contest with the chance to win a signed copy of the New York Times bestseller *What the Eyes Don't See: A Story of Crisis, Resistance, and Hope in an American City* by Dr. Mona Hanna-Attisha. You will also get a chance to win a free ticket to the dunes summit this fall and a framed copy of your photograph.

**[Click here to submit historic photographs of Lake Michigan's coastal dunes](#)**

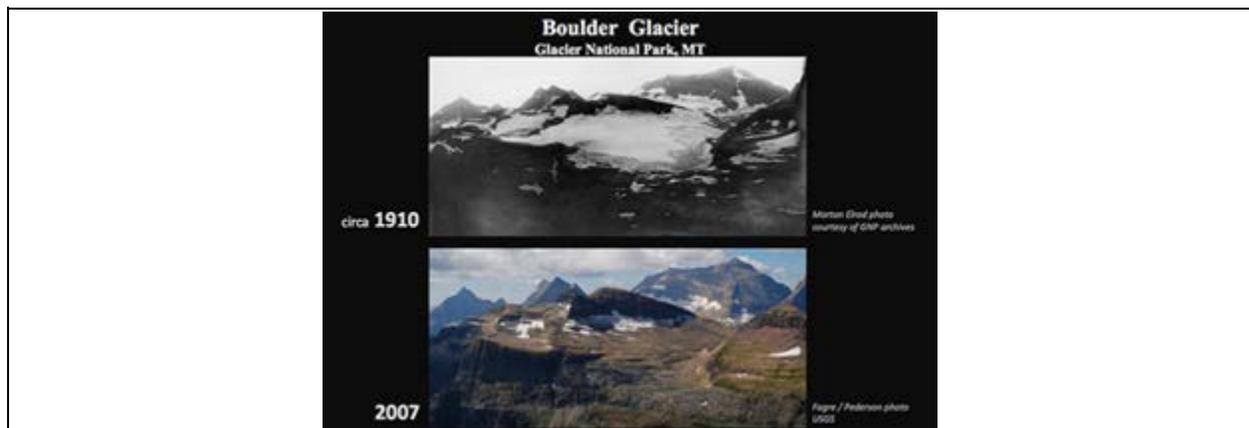
Financial assistance for this project was provided, in part, by the Coastal Management Program, Water Resources Division, Michigan Department of Environment, Great Lakes, and Energy, under the National Coastal Zone Management Program, through a grant from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

## Appendix B: Citizen Scientist Repeat Photography Protocol

### REPEAT PHOTOGRAPHY TO UNDERSTAND MICHIGAN'S COASTAL DUNES

As part of an ongoing study about historic changes to Michigan's coastal dunes, an active research team is recruiting citizen scientists to help document landscape change through the use of **repeat photography, which is the practice of taking multiple photographs of the same subject from the same location, at different times.**

Repeat photography is a common and effective method to assess the rate and characteristics of landscape change. For example, repeat photography is an excellent way to observe glacial retreat in western alpine settings resulting from climate change. Figure 1 provides an example from Glacier National Park illustrating this phenomenon. Without repeat photography, researchers may not have fully realized these examples of broad landscape change.



**Figure 1. Repeat photography of the Boulder Glacier in Glacier National Park. Top image: photograph of the Boulder Glacier in ~ 1910. Bottom image: photograph of the Boulder Glacier in 2007. Note the significant reduction in size of the glacier due to melting due to ongoing climate change (source: USGS).**

The coastal dunes of Lake Michigan provide an excellent opportunity to utilize repeat photography to evaluate landscape changes. The dunes are an ideal research location because: 1) the shoreline is relatively open and accessible; 2) coastal dunes are dynamic and change easily; and 3) vegetation coverage on dunes reflects relative dune stability at any given time.

Figure 2 illustrates the application and benefit of repeat photography within the context of dune morphology. Note the sequence of exposed organic (dark) layers which represents

prehistoric periods of stability and soil formation compared with the expanded vegetation in the repeat photograph. This photographic evidence indicates the dune is in the process of stabilizing due to expanded plant cover and demonstrates the sensitivity of this landscape.



Want to participate? Here's how you can conduct your own repeat photography study:

## Protocol

[Click here to download and print these instructions](#)

### *Site Selection*

1) Select location – In order to achieve accurate repeat photography, the exact location of the original image must be known either through GPS coordinates or utilizing a permanent, fixed structure or landscape feature. Both Google and Apple Maps on your smartphone have the ability to easily show you the GPS coordinates of a location. With your map application open, simply press and hold on the location, and Google and Apple Maps will come up with the coordinates. For more detailed instructions, click here for [Google Maps](#) (Androids) or here for [Apple Maps](#) (iPhone).

2) Image antiquity – Ideally historic and repeat photos should span the greatest time period. Images acquired in the late 19th and early 20th centuries are especially useful for research efforts.

3) Focus on larger dune landscapes – While we are sure that your dog is adorable, for the purpose of this study, your picture's main focus should be the dune and not any figures that may or may not be present (see Figure 2).

### ***Acquisition of Modern Photograph***

If a suitable photograph (see Site Selection) is available, the following protocol should be followed when acquiring the modern photograph of the image couplet:

- 1) Make a copy of the original photo or take a picture of it with a high quality smartphone – You'll need to bring a copy of the original photograph to the site for comparative purposes.
- 2) Travel to site – Identify the location where the original photograph was taken and travel to it. Helpful tip – If you are able to obtain the GPS coordinates of the original photo using Google Earth or a smartphone application it may save time when you're out in the field. Record these coordinates and then find that location along the dune.
- 3) Find exact location – Attempt to find the exact location where the original photograph was acquired. In order to accomplish this task, attempt to align any modern landscape features, such as trees, bluffs, and built structures, visible in the original photograph with the modern view. See Figures 1 – 2 for examples of the desired similarities in view between the original and modern photo.
- 4) Equipment – Citizens scientists are encouraged to collect as high quality of a photo as possible. Photos may be collected using a tripod-mounted, large camera (4x5in sheet or 120 roll film), a high-quality digital camera, or by using a high-quality cellphone camera.
- 5) Tracking the location – Cataloging the location of the repeat photograph is important. For best results turn on the location/GPS coordinate feature on your camera (if available); or, activate the GPS feature on a cellphone or other device and record your position. If this is not feasible, record the description of the site as detailed as possible (i.e. approximately 100 ft east of the boat launch, facing SE).
- 6) Shooting the scene – To the best extent possible, scientists should attempt to match the field view of the original photograph with the repeat photo. To ensure as close of a match as possible, take several shots of the repeat image with subtle adjustments between each photo.
- 7) Send a copy of the repeat couplet, along with GPS coordinates, to the research team using the link below. Your historical photo will likely be a physical copy, so please take a clean picture of it with a high-quality cell phone or scan it. [Click here if you need instructions on how to scan on Windows, Mac and even from your iPhone and Android!](#) If you or your organization has more than 5 repeat photograph examples, please email the project team at [dunes@environmentalcouncil.org](mailto:dunes@environmentalcouncil.org).

**[Click here to submit repeat photography of Lake Michigan's coastal dunes](#)**

If you have any further questions, please email [dunes@environmentalcouncil.org](mailto:dunes@environmentalcouncil.org)  
or call 517-999-0411

### ***Minimizing Impact on the Dunes***

If you choose to visit a site within the dunes to acquire a repeat photograph, here some things to consider to minimize your impact on the landscape.

- 1) In order to avoid bringing invasive plant species into the dunes, clean your shoes before entering the landscape.
- 2) If the site is accessible from the beach, walk as far along the beach as possible before entering the dunes.
- 3) Follow established trails as much as possible to avoid damaging stabilizing vegetation.
- 4) Avoid endangered plant species such as Pitcher's Thistle, which require bare sand to thrive.



Financial assistance for this project was provided, in part, by the Coastal Management Program, Water Resources Division, Michigan Department of Environment, Great Lakes, and Energy, under the National Coastal Zone Management Program, through a grant from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

## Appendix C: Consent Form

### Coastal Dunes Modeling

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Research Participant Information and Consent Form

ID: S-1

1. Explanation of this research: The purpose of this study is to better understand the values and perceptions of Michigan's dunes by dune users and stakeholders. This will help inform the development of better coastal dune management by government agencies, conservation groups and university researchers.

2. Your participation is voluntary and all information you share will be anonymous. You may choose whether or not to participate in this activity. You may change your mind at any time. You can withdraw from the survey or workshop activity at any time with no penalty. Only researchers associated with this project and the MSU Human Research Protection Program (HRPP) may have access to information you provide in the survey and workshop activity. The responses to this survey will be anonymous and no identifying information will be linked to your survey responses after you complete the survey.

3. Risks and Benefits: There are no foreseeable risks to participating in this study. You will receive a \$20 gift card for participating.

#### 4. Contact Information for Questions and Concerns

If you have concerns or questions about this study, please contact Laura Young, E-mail: [youngla9@msu.edu](mailto:youngla9@msu.edu)

Lead researcher: Dr. Robert Richardson, Department of Community Sustainability, Michigan State University, Email: [rbr@msu.edu](mailto:rbr@msu.edu)

#### 5. Documentation of consent

Please indicate your agreement to participate by clicking continue to take the survey.

I agree to participate (1)

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## Appendix D: Workshop Survey

Coastal Dunes Literacy Workshop Survey

ID: S-1

1. How many trips did you make to coastal sand dune areas of Michigan in the last 12 months?

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2. What dune areas in Michigan have you visited the most? You may list more than one.

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3. What is the top benefit you derive from Michigan's coastal sand dunes?

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4. What is the top threat to Michigan's coastal sand dunes?

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5. What is your age? Please circle your age range.

18 - 24    25 - 34    35 - 44    45 - 54    65 - 74    75 - 84    85+

6. What is your gender? \_\_\_\_\_

7. In what zip code do you live? \_\_\_\_\_

8. What is your pre-tax yearly household income? Please circle your income range.

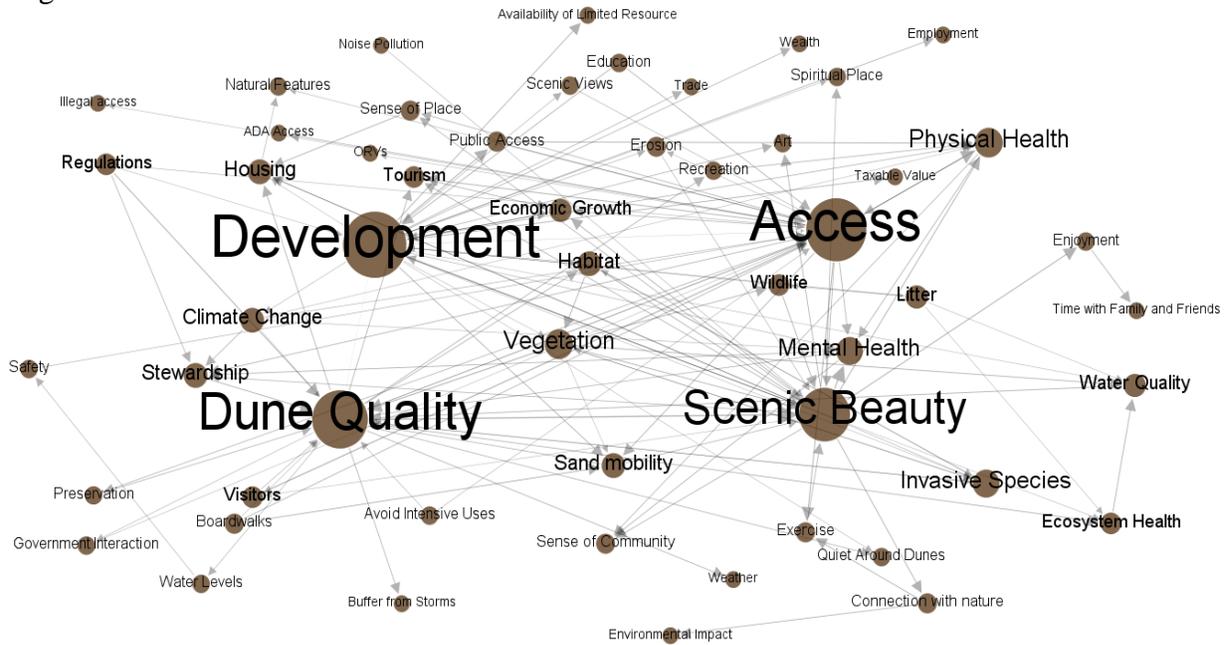
- Less than \$25,000
- \$25,000 - \$49,000
- \$50,000 - \$74,000
- \$75,000 - \$99,000
- \$100,000 - \$124,000
- \$125,000 - \$149,000
- \$150,000 - \$200,000
- \$200,000 or more

9. What is the highest level of education that you have attained? Please circle.

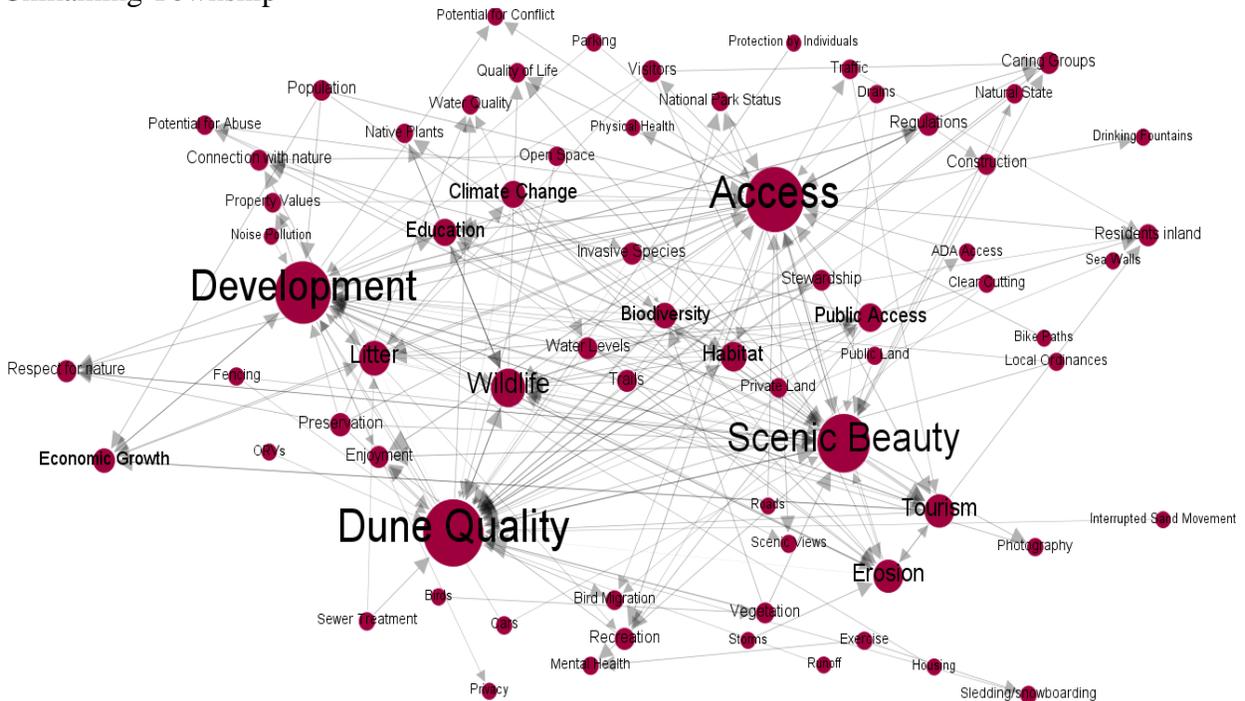
- Less than high school
- High school graduate/GED
- Some college
- Trade school
- Associate degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctoral degree

## Appendix E: Metamodels from five sub-groups

Douglas



Chikaming Township









## **Michigan Coastal Dunes Symposium 2019: Learning to Live in Dynamic Dunes**

**October 3, 2019 | Lansing**

- How have Michigan's coastal dunes changed in the last 100 years?
- What impact do our activities have on natural dune processes?
- How are dunes perceived by Michigan residents and communities?
- What criteria do local and state decision-makers use when making dunes planning and management decisions for their communities?

Join us at the Michigan Coastal Dunes Symposium 2019 to engage with researchers and decision-makers on answers to these questions and more, with the goal of learning how to live in Michigan's dynamic dunes. Participants will:

- Hear researchers share cutting edge science on how our coastal dunes developed over time, and how they respond to influences ranging from interactions with human beings to changes in lake levels and climate.
- Engage with state and local policymakers during a panel discussion reviewing current policies and recent dunes management examples.
- Discover the latest research on Michiganders' views of coastal dunes -- their benefits and the perceived threats to dunes.
- Access current resources for planners and community decision-makers.

### **Who Should Attend**

- Local and state planners and decision-makers for Michigan coastal dune communities;
- Coastal dunes advocates, scholars, and citizen scientists and interested residents.

**When:** October 3, 2019, 8:30am - 4pm

**Where:** The MTG Space, 4039 Legacy Pkwy, Lansing

**Cost:** \$35 -- includes a continental breakfast and lunch. Parking is free.

**REGISTER ONLINE:** <http://bit.ly/MICoastalDunes>

### **Presentations & Speakers Include**

- **Assessing Impacts on Michigan's Coastal Dune processes** with **Dr. Alan Arbogast**, Chairperson of the Department of Geography, Environment and Spatial Science in the College of Social Science at Michigan State University. Dr. Arbogast is one of the country's leading experts on the geomorphology and evolution of dunes, particularly the coastal sand dunes in the Great Lakes region.
- **Sands of Time** – New research using repeat photography to illustrate how Michigan's coastal dunes have changed over time, with **Kevin McKeehan**, MSU Dept. of Geography.
- **Mental Models: How Do People Perceive Coastal Dunes and How Does that Affect Local, State & Federal Decisionmaking?** with **Dr. Robert Richardson**, a natural resource economist and social scientist at Michigan State University, with extensive experience in the examination of values, preferences, and decision-making processes regarding natural resources and ecosystem services, including coastal resources.
- **Keynote: The Importance of Dunes to Michigan** with **Brad Garmon**, new director of Michigan's **Office of Outdoor Recreation Industry**.
- **Panel Discussion: Living in Dynamic Dunes: Who Decides & How?** State and local decision-makers discuss recent experiences around coastal dunes management – with **Marcy Hamilton, Southwest Michigan Planning Commission; Jennifer Howland, City of Grand Haven; Kate Lederle, Michigan Department of Environment, Great Lakes, & Energy; Richard Norton, University of Michigan**.
- **Strategies Coastal Communities Can Use to Reduce Future Invasive Species Introductions & Prevent Habitat Degradation**, recent work of **The Nature Conservancy in Michigan** with **Kaldis Grants**.

Space is limited and registration is required. We hope to see you there!

**REGISTER TODAY:** <http://bit.ly/MICoastalDunes>

*Financial assistance for this project was provided, in part, by the Coastal Zone Management Program, Michigan Department of Environment, Great Lakes, and Energy, and the National Oceanic and Atmospheric Administration.*



# Michigan Coastal Dunes Symposium

## *Living in Dynamic Dunes*

October 3, 2019 | Lansing





## WHO WE ARE

### Michigan Environmental Council

Michigan Environmental Council—a nonprofit charitable organization—is a coalition of more than 65 organizations formed in 1980 to lead Michigan’s environmental movement in achieving positive change through the political process. We bring a solutions-oriented approach to our work, combining deep environmental policy expertise with decades of experience in working with diverse stakeholders to achieve results. We work closely with our member organizations and partners in environmental, conservation, public health, and faith communities to protect our Great Lakes, promote healthy cities, safeguard our drinking water, and establish clean energy policies for a vibrant, sustainable future.

Since 2013, we have been engaging with ecologists, geologists and environmental economists to improve our understanding of Michigan’s dunes—how they came to be, how they change and evolve naturally and what they mean to Michigan’s people and environment. Our goal is to provide resources and information to help the State of Michigan and coastal communities engage in science-based management of dunes.

We gratefully acknowledge the support of the Michigan Coastal Management Program and our project partners:

- Michigan State University
- Heart of the Lakes
- The Stewardship Network
- The Nature Conservancy in Michigan

### Michigan Coastal Management Program

Established in 1978, the Michigan Coastal Management Program (MCMP) is committed to providing substantial technical assistance and strategic grant funding to assist in coastal communities’ ability to understand risks and options to mitigate coastal hazards; create healthy habitats that provide for human use and enjoyment; support coastal eco-tourism opportunities while ensuring for safe public access; and support resilient and sustainable coastal economies. As connectors and collaborators, the MCMP advances the research on a changing climate, resilient planning methods, and seeks balanced approaches to sustainable coastline.

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MICHIGAN DEPARTMENT OF  
ENVIRONMENT, GREAT LAKES, AND ENERGY



Cover photo credits, clockwise from top left:

- North Manitou Island, 1910, manitouslandsarchives.org, Doreen (Simmon) Pavlick Collection;
- North Manitou Island, 2019 repeat photograph, Kevin McKeehan, Michigan State University;
- Macatawa Beach, Holland, 1962, Archives of Michigan;
- Manistee, 2018, Elizabeth Fedorchuk

# Michigan Coastal Dunes Symposium

## AGENDA

- 8:30 am **Registration**, Continental Breakfast, The MTG Space, Lansing
- 9:00 am **Opening Remarks**  
Karen Rae Boase, Michigan Coastal Management Program
- 9:05 am **Keynote: The Importance of Dunes to Michigan**  
Brad Garmon, Michigan Office of Outdoor Recreation Industry
- 9:30 am **Overview: What Do You Hope to Learn Today?**  
Tom Zimnicki, Michigan Environmental Council
- 9:45 am **Mental Models: How Do People Perceive Coastal Dunes & How Does That Affect Decision-making? Results from Summer 2019 Dunes Workshops**  
Dr. Robert Richardson, Michigan State University Department of Community Sustainability
- 10:45 am **Break**
- 11:00 am **Assessing Impacts on Michigan’s Coastal Dune Processes: Research Findings & Sands of Time Repeat Photography**  
Dr. Alan Arbogast & Kevin McKeehan, Michigan State University Department of Geography, Environment, & Spatial Sciences
- 12:00 pm **Lunch & Networking**
- 1:00 pm **Recent Work: Strategies Coastal Communities Can Use to Reduce Future Invasive Species Introductions & Prevent Habitat Degradation**  
Kaldis Grants, The Nature Conservancy in Michigan & Julia Gehring, Sleeping Bear Dunes National Lakeshore
- 2:00 pm **Panel Discussion: Living in Dynamic Dunes: Who Decides & How?**  
Marcy Hamilton, Southwest Michigan Planning Commission  
Jennifer Howland, City of Grand Haven  
Kate Lederle, Michigan Department of Environment, Great Lakes, & Energy  
Richard Norton, University of Michigan Taubman College of Architecture and Urban Planning
- 3:30 pm **Pulling It All Together: What Have We Learned About Michigan Dunes Management & Perceptions**  
Tom Zimnicki, Michigan Environmental Council
- 3:50 pm **Closing Remarks: What’s Next? Role of Symposium Participants**
- 4:00 pm Safe Travels!

## SPEAKERS

### Alan F. Arbogast

Michigan State University

Dr. Alan F. Arbogast is currently the Chairperson of the Department of Geography, Environment, and Spatial Sciences at Michigan State University (MSU). Arbogast received his Ph.D. from the University of Kansas in 1995 and has held a faculty appointment at MSU since that time. Arbogast's research focuses primarily on the evolution and geography of coastal sand dunes in the Great Lakes region. This work has revolutionized the way that these dune fields are viewed in historical and societal contexts and has contributed to new management paradigms. These projects have been funded by the National Science Foundation and the Michigan Departments of Natural Resources and Environmental Quality. Arbogast teaches a variety of courses at MSU, with the majority related to physical geography and geomorphology, and is the author of *Introductory Physical Geography*, which is now in its 4th edition.



She provides technical assistance and collaborates with partners and coastal communities to help advance habitat preservation, restoration, and protection activities for coastal areas.

Boase has held several positions within EGLE, WRD related to permitting, pollution prevention, compliance assistance, and enforcement programs. Prior to her position in the Coastal Program, Boase was an Enforcement Specialist for EGLE, WRD. She also held two positions with the Southeast Michigan District Office dealing with the soil and sedimentation control program and wetlands, inland lakes and streams. Boase has completed her graduate course work with an emphasis in Botany at Eastern Illinois University, and earned a B.S. in Botany from Eastern Illinois University.

### Brad Garmon

Michigan Office of Outdoor Recreation Industry

Brad Garmon was named director of the Michigan Department of Natural Resources (DNR) Office of Outdoor Recreation Industry in September 2019. He has spent the last 18 years focused on improving Michigan public policy to better protect the Great Lakes and natural areas, while also forging stronger connections between resource conservation, job growth, talent attraction and economic development. Most recently, Garmon served as the interim CEO of the Michigan Environmental Council in Lansing. Prior to that, he was MEC's director of Conservation and Emerging Issues—a role created in 2011 specifically to support and build stronger alliances between outdoor recreation, economic development and natural resource stewardship.



Garmon was appointed by Governor Snyder to the Michigan State Parks and Recreation Blue Ribbon Panel in 2011, and also served on the DNR Public Land Strategy Steering Committee in 2012 and the Office of the Great Lakes' Water Strategy Cabinet in 2013. He was appointed to the DNR's Pigeon River Country Advisory Council in 2013. Garmon also is a member of the

### Karen Rae Boase

Michigan Department of Environment, Great Lakes, and Energy

Karen Rae Boase has 19 years of work experience in the Michigan Department of Environment, Great Lakes, and Energy (EGLE). She currently serves as the Coastal Habitat Coordinator for EGLE, Water Resources Division (WRD), Coastal Zone Management Program (Coastal Program) and is responsible for managing coastal grants unique to the coastal habitat focus area.



Michigan Heritage Leadership Council, and previously served on the Michigan State Parks Advisory Council's Finance Subcommittee. He is a past board member of the Community Economic Development Association of Michigan and the Michigan Trails and Greenways Alliance. Garmon currently sits on the board of directors of the Michigan Mountain Biking Association. He holds undergraduate degrees in Earth Science and Geospatial Analysis, and an M.A. in English.

## Julia Gehring

Sleeping Bear Dunes National Lakeshore

Julia Gehring is currently the Plant Biologist at Sleeping Bear Dunes National Lakeshore. In her role at the park, she supervises the vegetation branch including the invasive plants, rare plants, restoration, prescribed fire, forest health, and GIS programs. Prior to working with the National Park Service, she worked with a variety of nonprofit and academic institutions including The Nature Conservancy. As Conservation Coordinator, she assisted in protecting, maintaining, and restoring the Western Lake Erie Basin and Oak Openings regions. Gehring's graduate studies and over a decade of work experience span the floras of the Great Lakes, Florida, and Southwest. Her research interests lie in demography, plant-animal interactions, fire ecology, landscape ecology, land management, and botany.



## Kaldis Grants

The Nature Conservancy in Michigan

Kaldis Grants is a Restoration Associate with The Nature Conservancy (TNC). Utilizing his knowledge of terrestrial invasive plant management, Grants coordinates restoration activities along 500 miles of Eastern Lake Michigan's coastal ecosystems. He serves as preserve manager for three TNC preserves. Grants



graduated from Michigan State University earning a degree in Fisheries and Wildlife Management with a concentration in conservation biology. In his personal time, he is an active member of the Latvian community, and enjoys traveling, hiking, camping and various team sports.

## Marcy Hamilton

Southwest Michigan Planning Commission

Marcy Hamilton is an experienced senior planner with a track record of implementing successful projects for a variety of clients around the Southwest Michigan region. She has a wealth of experience writing master and recreation plans, facilitating planning processes, and developing grants and implementing projects in watershed planning, economic development, and recreation. In 2017 she was promoted to also serve as deputy executive director.



Hamilton was the project director for the Dowagiac River Watershed Project with the Cass County Conservation District from 1999-2002. She holds a bachelor's degree in Biology and Environmental Studies from Ohio Northern University and a Master of Environmental Science Degree from Miami University, Ohio.

## Jennifer Howland

City of Grand Haven

Jennifer Howland has been the Community Development Manager for the City of Grand Haven and the contract planner for the Village of Spring Lake for more than six years. Originally from Rochester, Michigan, she graduated from Albion College with a bachelor's degree in Earth Sciences and German and then went on to earn a master's degree in Urban and Regional Planning from the University of Illinois. Howland and her family



moved to Grand Haven in 2013 from the St. Louis metro area. Howland's experience working in city, county, and regional governments over the past 14 years has given her the skills necessary to help developers and residents navigate the regulatory process and turn their plans into reality.

### **Kate Lederle**

Michigan Department of Environment, Great Lakes, and Energy

Kate Lederle is the specialist for the Critical Dune Area and High Risk Erosion Area programs for the Michigan Department of Environment, Great Lakes, and Energy. A native Minnesotan, she began her career on the shores of Lake Superior working with local landowners to stabilize moving sand on Park Point in Duluth. Between then and now she has worked with plants, mammals, and birds before coming to Lansing. Lederle has lived in northern Minnesota, the western UP, Las Vegas, and New Zealand—all equally wild. For the past seven years she has worked the CDA and HREA programs for the State of Michigan.



### **Kevin McKeenan**

Michigan State University

Kevin McKeenan is a graduate student at Michigan State University and his research focuses on aeolian environments, whether arid dune fields or coastal sand dunes. These landforms and environments are sensitive to changes in climate and from human impacts. Consequently, he hopes to understand how these environments have evolved in the past and how they will change in the future. Such research is not merely academic but could prove valuable as climates change globally and locally. For example, research has shown that the Nebraska Sand Hills, the largest stabilized grassland dune field system in North America, was at times in the last 25,000 years active during megadroughts, depositing dust downwind. Here,



too, in Michigan sand dunes are an important part of our landscape, and there is evidence that coastal Lake Michigan dunes have evolved in fascinating ways in the last 25,000 years and continue to change.

McKeenan's research aims to understand these aeolian landscapes, particularly on the Great Plains and in Michigan. He is also interested in the related questions as to why stable grassland sand dunes reactivate and why mobile dunes stabilize, how soil develops in dunes, how to measure surface roughness, and what human impacts affect these aeolian environments. These are the research questions he is pursuing in doctoral studies at Michigan State University and that he examined while obtaining his M.S. degree in Geography from the University of Wisconsin-Madison.

### **Richard Norton**

University of Michigan

Richard (Dick) Norton is a professor with the Urban and Regional Planning Program and the Program in the Environment at the University of Michigan. He teaches and conducts research in the areas of planning law, sustainable development, land use and environmental planning, and coastal area management. His most recent research has focused on the challenges of managing shorelands along the Laurentian Great Lakes.



Norton contributes actively to public service through community-engaged research and teaching, by serving as chair of the board of directors of the Huron River Watershed Council, and by serving on the planning law committee of the Michigan Association of Planning. Prior to joining UM, he earned his Ph.D. in city and regional planning and his J.D. at the University of North Carolina at Chapel Hill, along with master degrees in public policy studies and environmental management from Duke University. Prior to completing his graduate studies, he worked in professional practice as a consulting environmental policy analyst and planner in Washington, D.C., and San Francisco, California.

## Robert Richardson

Michigan State University

Dr. Robert Richardson is an environmental economist and Associate Professor in the Department of Community Sustainability at Michigan State University. His research, teaching, and outreach program focuses primarily on sustainable development and the contribution of ecosystem services to socioeconomic well-being. He uses a variety of methods from the behavioral and social sciences to study decision-making about the use of natural resources and the values of ecosystem services.



Richardson has conducted research related to the economic benefits of wilderness areas in the western United States, and the impacts of climate change on public lands and protected areas. He has also conducted research related to the valuation of ecosystem services and tradeoffs in decision-making about environmental management in southern and eastern Africa, Central America, and Southeast Asia. His work has been published in *Ecological Economics*, *Environment and Development Economics*, and *World Development*, as well as in other journals. Richardson is a member of the Board of Scientific Counselors of the U.S. Environmental Protection Agency, and chairperson of the subcommittee on Sustainable and Healthy Communities.

## Tom Zimnicki

Michigan Environmental Council

As Program Director for Agriculture, Groundwater and Surface Water, Tom Zimnicki leads Michigan Environmental Council's efforts in advancing a policy agenda focused on innovative and pragmatic ideas that encourage environmentally sustainable agriculture and water conservation throughout Michigan. In this capacity he serves as project lead for the Michigan Coastal Zone Management Program grant, "Learning to Live in Dynamic Dunes." Zimnicki was appointed to serve on Michigan's Water Use Advisory Council, and represents environmental organizations on the Michigan Agriculture Environmental Assurance Program Advisory Council and the Pesticide Advisory Committee. He also serves on several committees of Michigan's Generally Accepted Agricultural Management Practices Task Force.



Prior to joining MEC in October 2016, Zimnicki worked as an environmental consultant in Kalamazoo where he specialized in the use of market-based solutions to incentivize nonpoint source runoff controls for municipal and agricultural entities. A native of Allen Park, Tom earned a B.S. in Biology from Adrian College and holds a M.S. in Environmental Science and a Master of Public Affairs from Indiana University's School of Public and Environmental Affairs.



**Alan F. Arbogast, Ph.D.**

Professor and Chair  
 Michigan State University  
 Department of Geography, Environment, and  
 Spatial Sciences  
 Geography Building  
 673 Auditorium Rd, Room 116  
 East Lansing, MI 48824  
 517-355-5262  
 dunes@msu.edu  
 geo.msu.edu

**Karen Rae Boase**

Coastal Habitat Coordinator  
 Coastal Management Unit  
 Water Resources Division  
 Michigan Department of Environment, Great Lakes,  
 and Energy  
 525 W. Allegan Street  
 Lansing, MI 48909  
 517-897-2060  
 boasek@michigan.gov  
 www.michigan.gov/coastalmanagement

**Brad Garmon**

Director  
 Michigan Office of Outdoor Recreation Industry  
 525 W. Allegan Street  
 Lansing, MI 48909  
 517-284-6240  
 GarmonB@michigan.gov

**Julia Gehring**

Natural Resources - Plant Biologist  
 Sleeping Bear Dunes National Lakeshore  
 9922 Front Street  
 Empire, MI 49630  
 231-326-4752  
 julia\_gehring@nps.gov  
 https://www.nps.gov/slbe

**Kaldis Grants**

Restoration Associate  
 The Nature Conservancy in Michigan  
 101 E César E. Chávez Ave  
 Lansing, MI 48906  
 517-316-0300  
 kaldis.grants@tnc.org  
 https://www.nature.org/en-us/about-us/where-  
 we-work/united-states/michigan/

**Marcy Hamilton**

Senior Planner  
 Southwest Michigan Planning Commission  
 376 W Main St, Ste 130  
 Benton Harbor, MI 49022  
 269-925-1137 x1525  
 hamiltonm@swmpc.org  
 www.swmpc.org

**Jennifer Howland, AICP**

Community Development Manager  
 City of Grand Haven  
 519 Washington Avenue  
 Grand Haven, MI 49417  
 616-847-3490  
 jhowland@grandhaven.org  
 www.grandhaven.org

**Kate Lederle**

Environmental Quality Specialist  
 Great Lakes Shorelands  
 Water Resources Division  
 Michigan Department of Environment, Great Lakes,  
 and Energy  
 517-290-2757  
 lederlek@michigan.gov  
 High Risk Erosion Areas:  
 www.mi.gov/shorelands  
 Critical Dune Areas:  
 www.mi.gov/criticaldunes

**Kevin McKeenan**

Research Assistant  
Michigan State University  
Department of Geography, Environment, and  
Spatial Sciences  
Geography Building  
673 Auditorium Rd, Room 15  
East Lansing, MI 48824  
mckeeha2@msu.edu  
geo.msu.edu

**Richard Norton, Ph.D., J.D.**

Professor  
University of Michigan  
Urban and Regional Planning Program  
Program in the Environment  
Taubman College of Architecture and Urban  
Planning  
2000 Bonisteel Boulevard  
Ann Arbor, MI 48109-2069  
734-936-0197  
rknorton@umich.edu  
<https://sites.google.com/a/umich.edu/rknorton/>

**Robert B. Richardson, Ph.D.**

Associate Professor  
Michigan State University  
Department of Community Sustainability  
480 Wilson Road, Room 305  
East Lansing, MI 48824-1222  
517-355-9533  
rbr@msu.edu  
[www.canr.msu.edu/csus/](http://www.canr.msu.edu/csus/)

**Tom Zimnicki**

Program Director, Agriculture, Groundwater  
and Surface Water  
Michigan Environmental Council  
602 W. Ionia Street  
Lansing, MI 48933  
517-999-0411  
tom@environmentalcouncil.org  
environmentalcouncil.org



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## Appendix H: Symposium Q&A Notes

### Michigan Coastal Dunes Symposium 2019 – Discussion Notes

#### **Mental Models: How Do People Perceive Coastal Dunes and How Does That Affect Decision-making? Results from Summer 2019 Dunes Workshop - Dr. Robert Richardson**

Q: Does the mental model indicate a positive or negative relationship between the nodes?

RR: No, but the size of the node indicates the number of times the word was mentioned and relative magnitude of arrow. Bear in mind, larger communities have larger models, more audience content.

Q: What were the demographics of each mental model developed?

RR: Douglas/Chikaming → higher median age (meetings at 9am); Ann Arbor/Lansing → greater participation, greater mix of ages (meeting at 6pm); both had majority white attendees.

Q: Was sand mobility mostly perceived as a positive or negative attribute of the dunes?

RR: See as positive as it was associated with dune quality but negative in regards to private development i.e. moving sand for housing.

Q: What's the differentiation between the terms "economic growth" and "tourism?"

As they are inherently connected in Michigan's coastal communities.

RR: Mental models show only preliminary results and demonstrate how people use words in their own ways.

Q: How did you determine where to collect data for your mental models?

RR: Our first two locations were chosen because we wanted to go where people live near dunes (Douglas/Chikaming). The two inland locations (Ann Arbor/Lansing) were chosen due to convenience and who responded to our initial survey.

Q: Is 75 people a big enough sample size?

RR: Our online survey has a much bigger sample size but you still can't say that's significant so we can't draw conclusions. Mostly looking for shared and collective understanding at this stage.

Question to audience; What do you think drives differences in dunes?

- Water levels
- Human impact
- Wind
- Mining
- Armoring shoreline
- Vegetation cover

### **Assessing Impacts on Michigan's Coastal Dune Processes: Researching Findings & Sands of Time Repeat Photography - Dr. Alan Arbogast (AA) and Kevin McKeehan (KM)**

Q: What's the role of dunes in fire suppression?

AA: There is evidence of fires but not on shoreline but we don't know this for sure.

Julia Gehring: There are fires approximately every 17 years.

Alan: My friends doesn't think fire has an impact on dune mobility. Perhaps logging played a role, we may be seeing slow recovering from logging.

Comment: Increased access over time to dunes so they should be more eroded and more vegetated.

Q: Have you tried to look at the vegetation composition in photos?

A: Not yet, we see a mix of greens and woody plants and nothing has jumped out in terms of invasive species.

Comment: Perhaps you could look at when vegetation was purposefully planted in photos.

AA: Vegetation is spreading across dune fields.

KM: Vegetation is a trend.

AA: Impact of climate change, more precipitation but more variability.

Dick (UM): Why is your work important? So what?

AA: High passion, bring the latest science to management in a holistic package. Brits have started pulling grasses so dunes move again, do we want that to happen?

Tom: By understanding how dunes change, the hope is that this information will inform master plans and policies.

Eli: We need to look at preserving the process of the dunes along with understanding it.

**AA: Takeaway is dunes are dynamic and this should influence policy and management decisions.**

### **Recent Work: Strategies Coastal Communities Can use to Reduce Future Invasive Species Introductions & Prevent Habitat Degradation - Kaldis Grants (KG) and Julia Gehring (JG)**

JG: Question to audience, what makes the dunes special for you? What do you seek at the dunes?

- Horizon line
- Solitude
- Sand, miles of it
- Forest
- Family memories
- Crinoids

Comment woman from IN: People on dunes affect erosion, need to develop messaging campaigns across shoreline to tell people impact of being on dunes, teach people to stay on trails.

JG: Important to review condition of national resources over time, more paths means more changes for invasive species to enter.

Q: What's the visitor growth rate of Sleeping Bear Dunes?

Answer from main SBD guy: We saw a spike after our feature on GMA. 1.6 million visitors this year but the beaches were quiet due to high water levels so the majority of people were hiking. We love social media but also hate it because bed space around SBD is limited and so coming to us can be perceived as expensive and is during high season. Had ½ million visitors July 1- August 1 and we are projecting our season will be elongated with climate change.

Q: What's the length of your management plan?

A: Our general management plan is flexible, we make decisions based on changing conditions and we are also very data driven. The GMP for the NPS is roughly 20 years and we are 10 years into the current one, likely last GMP because they are costly. Management zones will live on in perpetuity and the challenge is to get visitors to less frequented areas of the park.

**Panel Discussion: Living in Dynamic Dunes: Who Decides & How? - Marcy Hamilton (MH), Jennifer Howland (JH), Kate Lederle (KL), and Richard Norton (RN)**

TZ: Discuss tools and resources pertaining to dunes you deal with

JH: Created a master plan or resiliency plan with an entire section about climate change along with a homeowners guide for sensitive overlap districts, helps with protection with private development.

RN: We need to plan to lay out threats dunes face but it's difficult as dunes change but we have to let them change to keep them natural. Hard to understand dunes legally as people support private property rights until it involves sand moving to or from their property. Need a lot of dialogue and to work in good faith.

MH: We need more resources for communities for dune management, we can't leave everything up to the state but we have nothing in our regional ordinances to successfully protect dunes, need to partner with other organizations to preserve dunes.

TZ: There are some misconceptions regarding the state's authority to manage dunes.

KL: Critical dunes only constitute 30% of MI's dunes. High risk erosion is issue with dunes. Critical dunes were declared in 1989 in an atlas of maps by the DNR. 3 criteria 1. Barrier dunes 2. Exemplary plant communities 3. 20 feet high, 1.5 miles long, on-shore.

Q: Isn't it time to redraw critical dune map?

KL: Yes! We'd love to but we struggle with the dune atlas and we tried back in 1996 to redraw with a lot of opposition.

Hat lady: Local government is tough, differing opinions about climate change and the fact that there is no enforcement in dune management.

Eli: Overlay districts should be used as a means to build consensus.

MH: Updated master plan that allowed people to build, sensitive overlay district.

Q: Have you seen any success in communities? Which ones and what tools did you use?

MH: Success in Chikaming where we made strict setbacks that were close to 100 feet.

RN: People always look to state for dunes management issues but local governments normally have control, environmental groups should go to local governments, may be more effective. The reality is dunes and shores move, what are we going to do?

KL: The local arena is where change comes from, stat has statute and uses it for decisions.

Q: Sand mining is a hot topic, does it fall under local or state jurisdiction?

KL: We would need to amend the critical dune act and local governments can't be more stringent than the state.

RN: If you have dunes that don't fall under the critical dune act then locals can regulate them.

Hat lady: Hard to find the will to fight when there isn't much "gain" to being on local town council.

IN woman: Public trust issue, when there is high water armors are approved, bad optics.

RR: Need more education and awareness, statewide educational campaign from EGLE for example.

Rhonda: MSU Communications Dept. is working with EGLE on statewide marketing for coastal management and on how to become more resilient.

JG: What is the panel's perspective on what's changed in MI in the last 20-30 years in regard to public engagement?

JH: Important to pick a topic and use language that not divisive.

RN: When lake levels fall people forget about the problems we face when the levels are high, indicates the importance of local government.

MH: Issue with lack of awareness.

Comment: Need to keep next generation in mind, there is no solution to erosion so we need to educate people that their coastal properties will eventually disappear.

RN: Educate everyone, everyone has a vested interest in shorelines in MI.

### **Quick takeaways from panel discussion**

JH: Need to look at a sensitive overlay districts.

MH: Good to hear what Grand Haven did, need to keep momentum moving forward.

KL: My work at EGLE is dictated by statute but I want to be involved at local level.

RN: If we want to protect dunes, if need to make our cities appealing so people move there instead of our shorelines when migrating to MI.