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The Importance of and Need for Barrier Islands:

Investigation and Analysis of the Effects of Climate Change on Grand Isle

With Louisiana located along the Gulf of Mexico, to Louisiana residents, water is an integral part of their daily lives. As a Louisiana native, it is the primary source of income for our economy and culture. Our seafood and oil industries rely heavily upon water to benefit our economy, and our residents enjoy pastimes in recreational fishing, boating, and other outdoor activities. However, water is also a dangerous element that threatens the safety of island states and Louisiana coasts. The destructive effects of climate change on the Louisiana coast, ranging from flooding to receding coastlines, cause a greater need to protect our cultural ties to the land, which is highly threatened by barrier island erosion. Maintaining barrier islands is needed because they help reduce the damaging effects of natural disasters on coastal areas, protect the culture and infrastructure of coastal communities, and will help alleviate the financial costs in response to natural disasters.

Barrier islands are the coastal community's first line of defense against natural phenomena, shielding habitats and structures located further inland. They are narrow strips of offshore land formed by deposits of sand and sediment that protect eroding wetlands that house various species of fish, shellfish, and other wildlife that support our fishing industry. Since Louisiana coasts are already losing about a football field worth of coastline every 90 minutes,

losing barrier islands is an impending and damaging result that will accelerate wetland deterioration and put wildlife, communities, and cultures at risk. One of Louisiana's barrier islands, Grand Isle, is located southeast of Houma, Louisiana. Grand Isle's location on a river delta causes its residents to experience more "frequent hurricanes and storm surges" (Miller), putting them at a higher risk for flooding and other water-related damages. Barrier islands are in a constant state of fluctuation because major storm waves and storm surges "wash sediment landward" (Moore and Murray) and deposit sediment on the barrier. This constant cycle of environmental battering contributes to its vulnerability to the damaging effects of coastal erosion.

Utilitarians believe in maximizing pleasure and minimizing pain. For the overall good and happiness of coastal communities, maintaining barrier islands would relieve the residents' worries of flooding since the risk of flooding and storm damage would be less with these natural buffers in a stronger state. Using "high resolution orthorectified aerial images" (Aucoin) taken between 1998 and 2017, researchers discovered the shoreline position of Grand Isle and its coastal migration inward. In the study referenced in Aucoin's thesis paper, "water, vegetation, and bare earth" (Aucoin) land cover classes were compared to see the trends in Grand Isle's total area. From 1998 to 2012, the vegetated land was converted to another land class, whether it was bare earth or water, as the area trends for water and bare earth zones increased while vegetated zones decreased. The "combination of tides, storm surge, and wave action" (Moore and Murray) is a primary cause for barrier island erosion or the redistribution of sediment that contributes to their migration over time. This migration causes barrier islands to become thin as the shoreline moves "landward" (Moore and Murray) or recedes. Tidal inlet interactions in its tidal basin can cause barrier islands' inlets to "close or change size" (Nienhuis and Lorenzo-Trueba), which puts the area at a higher risk for the inlet's transgressive behavior that causes the sea to move

landward and the coast to recede. Once the barrier's width is "equivalent to the average extent of storm-driven overwash" (Morre and Murray) or the average redistribution of sediment, additional coastal erosion and migration occur. This chance of more erosion and sediment migration is a harmful and immediate threat to the state of coastal cities, which makes environmental reform critical to prevent future damages. Barrier islands are losing land quickly, which threatens coastal cities in the immediate future and put the communities living there at a higher risk from water damage due to the loss in the coastline.

Since barrier islands protect coastal communities, they also protect the communities' culture and infrastructure. This safeguard contributes to the preservation of a community's cultural traditions and historic land. As a natural buffer, barrier islands have a crucial role in the stability of our coast. Its erosion is an environmental consequence that contributes to the deterioration of our wetlands and coasts; these losses threaten our culture and our environmental stability. Our leading economic industries like fishing and shrimping rely heavily on species that reside in wetlands and other coastal bodies of water. Since our land and environment are closely associated with our cultural ties and economic success, losing our natural storm buffer risks the chance of losing our close connection to our land.

As stated earlier, utilitarians strive to maximize happiness and minimize pain. In this situation, a utilitarian would support maintaining barrier islands to protect communities' culture, traditions, and infrastructure because this would maximize the happiness of the community members because their culture would be preserved and minimize their worry about their environmental vulnerability. A Rawlsian would also support this assertion under the veil of ignorance. The veil of ignorance gives everyone an equal opportunity when coming to a consensus since no one wants to be in a disadvantaged group once the veil is lifted. If a

community's culture or tradition was threatened by sea-level rise due to flooding or coastal erosion, it would be in each group's best interest to support and protect the threatened community. Mitigation strategies like reducing carbon footprints and protecting natural buffers like wetlands, dunes, and barrier islands can support these communities by helping them adapt and be less vulnerable to storm damages. However, a libertarian might disagree, asserting that residents should either adapt or move away from flood-vulnerable, coastal areas. Adapting or moving to a new region might be an option for residents who have the "economic resources [like] income, retirement, [or] savings" (Miller) that allow them to adapt comfortably by purchasing flood insurance or moving to a new area. For many residents, the connection or "love for the island" (Miller) drives their decision to stay behind. Yet, most often, residents stay behind because other options are not as accessible due to certain socioeconomic levels in place. This concept is called environmental racism, which discriminates against lower-income households who are unable to financially handle the situation and are forced to endure its effects.

The results of historic influences like canals, flood control levees, and the development of the coastal petroleum industry caused the Louisiana coastline to become fragile. Yet, the Louisiana coastline was essential to the United States' economic success by producing large percentages of crude oil, natural gas, and fishing production in the nation (McKinney), which caused people to overlook the effect of its environmental damage. These industries' drainage system that supported almost half of the United States flowed along the Mississippi River, which directly affected the "Mississippi River Delta's delicate ecosystem, communities, and historic resources" (McKinney). There is no way to change the past; the only way to correct the damage is to create an effective plan. This plan should enforce preventative measures to preserve the

land, traditions, and community that is so dearly valued by residents and the industries' economic benefit by the government and other companies.

Maintaining barrier islands before natural disasters will help alleviate the financial stress on the United States government for the total cost for damage and storm repair. With the prevalence of long-term risks of flooding and erosion for coastal communities and barrier island areas, looking at long-term data is critical to predicting its future movement and adapting to its new state. Regarding cost-benefit analysis, the federal government's lack of concern to protect Grand Isle, referred to as a "forgotten rural community" (Miller) by several residents, when compared to New Orleans stems from the stability of New Orleans' tourism revenue. After Hurricane Katrina in 2005, the federal government realized the importance of New Orleans and the need to protect it. As "Grand Isle helps to buffer New Orleans and the state from hurricanes and storm surge" (Miller), it is interesting to see that the government continued to value the direct protection of New Orleans rather than the protection of Grand Isle that helps protect New Orleans. In this case, protecting New Orleans rather than Grand Isle is a matter of utilitarianism by maximizing the happiness of the richer rather than the residents of Grand Isle. The cost-benefit analysis determined that the pain of the Grand Isle residents did not outweigh the happiness of the government and the New Orleans residents whose properties and economies were better protected.

As stated in an earlier paragraph, utilitarians focus on the overall good of a group or community by maximizing the greatest amount of happiness and minimizing the amount of pain. By efficiently spending federal money, the people's overall happiness increases because there is a lesser struggle for funding. The excess funds can support better procedures and methods that protect coastal communities and barrier islands from adverse environmental effects. Reducing

“flood risks and their associated economic impacts” (Cigler) on environmental vulnerabilities is one technique that supports coastal communities, so they are at a lower risk of exposure to storm surges and other storm damages. A Rawlsian supporter would also agree with implementing timely mitigation processes because the veil of ignorance would allow individuals to be rational beings who have an equal advantage when deciding on policies. After all, each person knows nothing of each others’ socioeconomic class, abilities, or position in society. To ensure your possessions and family were safe, you would decide in an equal and rational way so that there would be no greater risk or vulnerability towards you as compared to another person.

While some believe that the constant maintenance of barrier islands is not worth the amount of money needed, sustaining barrier islands and practicing other preventative measures would reduce the total amount of federal money spent. A study by Stephen Farber, Robert Costanza, and Matthew Wilson determined and compared the economic and ecological benefits to help guide people's decisions to efficiently spend money and best enhance society in an environmentally-friendly manner. They analyzed the effects of storm damage with and without a barrier island present using a want-to-pay (WTP) versus a want-to-accept (WTA) comparison system. Farber, Costanza, and Wilson determined that there was little difference between storm damage with its presence without it. According to their calculations, they believed that maintaining the islands is equivalent to the “expected utility without the islands” (Farber et al), which discloses the unnecessary cost of sustaining the barrier islands. If the difference between the storm damage cost with and without the natural buffer, maintaining the barrier island would be more costly by a couple of hundred dollars without an “additive cultural or recreational” (Farber et al) benefit to the WTP value. With this source's publication day dating from 2002, new or better methods of conducting a cost-benefit analysis could have been developed and accepted

since then; this diminishes the validity and relevance of the source's information. Additionally, since Cigler published a more recent article from 2017 asserting that mitigation before a natural disaster event would save federal money, the validity of Farber, Costanza, and Wilson's claim decreases significantly.

Since Louisiana lies along the Gulf of Mexico, the duality of water is ever-present for Louisiana residents. Its beauty and threat are prominent in our daily lives. Our economic success and our unique culture stem from our location along the coast, but climate change creates adverse effects on our coastal communities. These effects range from flooding to receding coastlines, which causes a greater need to protect the cultural ties to the humid environment, which is highly threatened by barrier island erosion. The maintenance of barrier islands is crucial to preserve Louisiana culture and land that is so fondly cherished. They help alleviate storm damages on coastal areas, safeguard the culture and infrastructure of coastal communities, and will help mitigate the financial costs in response to natural disaster events.

Annotated Bibliography

Aucoin, Lindsey. "Detection and Analysis of Shoreline Changes Along Louisiana Barrier Islands: Grand Isle and Isle West Grand Terre." *Sam Houston State University*, Sam Houston State University, 2018, shsu-ir.tdl.org/handle/20.500.11875/2392.

In this source, Aucoin discusses and analyzes the shoreline changes for the Louisiana barrier islands Grand Isle and Isle West Grand Terre. Using "high resolution orthorectified aerial images" (33) dating between 1998 and 2017, researchers discovered the shoreline position and its migration inward between 1998 and 2013. The vegetated land was converted to another land class, whether it was bare earth or water. These transitions were thought to be more during periods of major hurricane activity, while vegetated land either remained stable or increased during a time frame with a "low rate of major hurricane activity" (34) from data between 1998 and 2017. While vegetation replacement occurred in the form of sediment deposits, the land to water transition still occurred.

Though this source was a scientific research thesis project, there was little bias since the experimental data supported the author's study and conclusions. There is a possibility for experimental errors, as referenced in Aucoin's paper, that included incomplete or inaccurate data, processing errors, or observation errors; the possibility of these errors were accounted for, and data were analyzed for error. For my paper, I plan to use this information as scientific evidence. This evidence will help support my claim that barrier islands are losing land quickly, which will damage coastal cities in the immediate future and put the communities living there at a higher risk from water damage due to the loss in the coastline.

Cigler, Beverly A. "U.S. Floods: The Necessity of Mitigation." *State and Local Government Review*, vol. 49, no. 2, June 2017, pp. 127–139, doi:10.1177/0160323X17731890.

In this source, Cigler discusses the government's response to the financial costs of flooding in the United States and why mitigation before natural disasters helps alleviate the economic stress on the national government. About fifty percent of the US population is within "50 miles of a coastline" (Cigler) and one half of Louisiana's population lives on the coast. These communities are at a greater risk for flooding and its effects that disrupt people's daily lives. In coastal areas, including barrier islands and marshes, there are various man-made structures like levees and elevated homes that help reduce a community's risk of exposure and damage from natural disasters.

Though this article was published in 2017, the information is still valid and important since it was recently published. Since this is an academic research article with evidence to support the assertions, there is little bias. The information from this article will help defend my claim that barrier islands are needed to protect coastal cities and communities. Government mitigation works if those measures are executed before a disastrous event, which reduces the amount of damage to a community and its inhabitants.

Farber, Stephen C. et al. "Economic and ecological concepts for valuing ecosystem services," *Ecological Economics*, vol. 41 no. 3, 2 May 2002, pp. 375 - 392, doi: 10.1016/S0921-8009(02)00088-5. [sciencedirect.com/science/article/pii/S0921800902000885](https://www.sciencedirect.com/science/article/pii/S0921800902000885).

In this source, authors Stephen Farber, Robert Costanza, and Matthew Wilson describe the economic and ecological benefits that help guide decisions to enhance

human society in a sustainable and environmentally-friendly manner. They set a \$100 monetary value of the barrier islands and compare the effects of storm damage with and without barrier islands present. Using predicted values, the willingness to pay to “maintain the barrier islands equals the expected utility without the islands” (Farber et al), which discloses the unnecessary cost of sustaining the barrier islands that can “conserve an ecosystem service” (Farber et al).

Though this article's published day dates back to 2002, this was the only article that refuted the need for maintaining natural buffers like barrier islands. This article was cited over 1500 times and in various languages since it was published. The wide use of this information contributes to the credibility of the information and the authors. I plan to use this information to allude to the refutation of sustaining barrier islands due to its neutral effect and condition as a result of coastal storm damage when compared with and without a barrier island present.

McKinney, Karen J. S. *Louisiana Coastal Vernacular: Grand Isle, 1780-1931*, University of Louisiana at Lafayette, Ann Arbor, 2018. *ProQuest*, <https://search.proquest.com/docview/2206748304?accountid=12154>.

In this source, McKinney discusses the preservation, history, and vernacular of Louisiana's coasts. She also talks about Grand Isle's formation and development. My main points for this research paper will include her discussion of the present and future endangerment of Grand Isle's historic resources. Barrier islands are one of the “natural buffer zones” (65) that protect the land from incoming storm surges.

Since the preservation of a culture and way of life is a more personal topic, there is an increased possibility of bias since McKinney also resided in Louisiana while completing her research thesis. However, McKinney is also very credible in this topic since she is an adjunct instructor at the University of Louisiana Lafayette's School of Architecture and Design. With these credentials, she should be well-informed of Louisiana's vernacular or its domestic architecture of coastal areas. I plan to use this information to support my claim that maintaining barrier islands will help protect communities and their cultures that have been traced back for centuries. This information also complements Beverly Cigler's article "U.S. Floods: The Necessity of Mitigation" because it gives an outside viewpoint that still supports the need for maintaining barrier islands that do not only focus on the damaging environmental effects of climate change like coastal erosion.

Miller, Lauren, "Perceptions of Vulnerability to Flooding, Hurricanes, and Climate Change on Grand Isle, Louisiana's Only Inhabited Barrier Island" (2019). Graduate Student Theses, Dissertations, & Professional Papers. 11286. <https://scholarworks.umt.edu/etd/11286>

In this source, Miller discusses the findings of her research, including the Grand Isle community's use of structural and non-structural methods to reduce risks and effects of climate change. Miller also includes some historical and environmental factors that contribute to Grand Isle's vulnerability as well as community thoughts on their vulnerability to natural disasters and climate change. The Grand Isle community depends so much on industries like gas, oil, and commercial fishing for their economic stability. Their coastal location caused their industries to be successful, though Grand Isle's

location, being on a river delta, causes it to experience more “frequent hurricanes and storm surges” (Miller) and contribute to the damaging effects of coastal erosion.

Since this is a scientific research thesis and a primary source, there is bias because the experimental data is supported by the author’s study. However, with the comments from community members, there might be a little bias towards those structures or topics. This information would help support my argument that barrier islands are necessary to contribute to the safety of coastal Louisiana communities, validating the need for their maintenance.

Moore, Laura J., and A. Brad. Murray. Springer International Publishing, 2018, Barrier Dynamics and Response to Changing Climate, link.springer.com/book/10.1007%2F978-3-319-68086-6#about.

In this source, editors Laura Moore and Brad Murray discuss the barrier islands’ response to climate change through observations and conceptual models. The state of barrier islands is always in constant fluctuation because major storm waves and storm surges “wash sediment landward” (ix) and deposit the sediment on the barrier. Dunes help barrier islands by lessening the effect of storm damage. If dunes are higher than the “combination of tides, storm surge, and wave action” (ix), they prevent overwash or the redistribution of sediment that enables barrier islands to move over time. As the shoreline moves “landward in the long term” (ix), barrier narrowing occurs often; once the barrier’s width is “equivalent to the average extent of storm-driven overwash” (ix), additional coastal erosion and migration of the barrier island occur.

Since this article has a wide range of observations and evidence from multiple studies, there is little room for bias since the evidence supports the trend of the barrier islands' response to climate change. This trend is negative due to the continuous effect of climate change on the coastal areas, including storm surges and hurricanes, that reduce the size and effectiveness of the barrier islands and other landforms that help protect coastal areas. For my research paper, this information will highlight the need for maintaining barrier islands because they help protect coastal cities and are in danger of being eliminated due to the changing climate.

Nienhuis, Jaap H., and Jorge Lorenzo-Trueba. "Simulating Barrier Island Response to Sea Level Rise with the Barrier Island and Inlet Environment (BRIE) Model v1.0." *Geoscientific Model Development*, vol. 12, no. 9, 12 Sept. 2019, doi:<https://gmd.copernicus.org/articles/12/4013/2019/gmd-12-4013-2019.html>.

In this source, authors Jaap Nienhuis and Jorge Lorenzo-Trueba describe terms like barrier overwash and inlets that contribute to the barrier islands' reaction to "coastal change and sea-level rise" (Nienhuis and Lorenzo-Trueba). Nienhuis and Lorenzo-Trueba study the barrier islands' reaction using the Barrier Inlet Environment model that follows two main operations: the overwash sedimentation and flood-tidal delta deposition. Tidal inlet behaviors are dependent on the "deposition of flood-tidal deltas" (2), whether it be the speed it approaches equilibrium volume of inlet migration. Tidal inlet interactions in its tidal basin can cause inlets to "close or change size" (3), which puts the area at a higher risk for the inlet's transgressive behavior that causes the sea to move landward and the coast to recede.

Since this source is an academic model description paper, there is little room for bias since the claims are based on and follow experimental data from their BRIE model. This model helps investigate “long-term risks of flooding and erosion” (1) in coastal areas by tracking the tidal inlet behaviors. In my research paper, this information will assert that barrier islands are affected by their inlet behaviors, which can put the island at a higher risk of flooding and erosion since the amount of flood-tidal delta deposits correlate with the inlet size (2).