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NARRATIVE STORYTELLING IN CONJUNCTION WITH ENVIRONMENTAL
JOURNALISM

by

Abbey Grace Edmonson

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of
the requirements of the Sally McDonnell Barksdale Honors College.

Oxford
May 2021

Approved by

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DEDICATION PAGE

I would like to dedicate this work to my family, who has always loved and supported me through everything I do. I hope this makes y'all proud!

ACKNOWLEDGEMENTS

I want to thank the Sally McDonnell Barksdale Honors College and the School of Journalism and New Media for providing this amazing opportunity to me and several other students. Thank you, Dr. Charles Mitchell for advising me throughout this process. Thank you to Prof. Michael Fagans for accompanying and advising me on my trip to the Mississippi Gulf Coast in October 2020, and thank you to student photographer, Billy Schuerman, for capturing that trip with beautiful photographs. I also want to give a special thank you to everyone who opened their lives to me in order for this project to come to fruition: Clifford and Jason Lancon, Dawn Ross, Crystal Seas Oysters and the researchers at The University of Southern Mississippi Gulf Coast Research Laboratory.

This project could not have happened without all of you.

ABSTRACT

NARRATIVE STORYTELLING IN CONJUNCTION WITH ENVIRONMENTAL JOURNALISM

This thesis explores the effectiveness of long-form narrative storytelling in relation to environmental journalism. It particularly focuses on effectively communicating the seriousness of climate change on a local level through narrative storytelling. The bulk of the information was gathered through multiple interviews with people experiencing the effects of climate change on the Mississippi Gulf Coast. By using interviews with local people interspersed with scientific data, I hope to be able to show the average reader that climate change is real and it can dangerously affect people on a local level, even in rural states like Mississippi.

Through my research, I have found that climate change is largely overlooked by the general public because there are no set standards for environmental journalism. Because of this, important information regarding climate change is often misconstrued or communicated in a way that is not effective for general comprehension. I also found that scientific information is proven to be better understood when presented in a narrative format. Therefore, environmental journalism and the topic of climate change in general should adopt a narrative format in order to be most effective.

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Introduction

In the spring of 2020, I took the opportunity to enroll in a year-long journalism course through the Sally McDonnell Barksdale Honors College and the School of Journalism and New Media, which allowed me to help contribute to a group practicum and website centered on climate change in Mississippi. The goal of the practicum was to research and report on environmental changes happening in different facets across the state. We presented our information through various multimedia methods including written narrative, graphics, video and photographs. The practicum was not meant to place blame on the readers for enabling climate change or to strike fear into the audience. Rather, our storytelling was meant to call attention to the fact that climate change does happen, and it does need to be addressed and alleviated, whether the changes were caused by humans or not.

It is important to note that, before the emergence of the COVID-19 pandemic, participants in the practicum course were supposed to present their completed projects in a group panel. The University of Mississippi closed its campus to students and faculty March 2020, and it reopened with several social distancing rules and regulations August 2020. Both of the semesters in which this course fell were impacted by these changes. The students were supposed to participate in several other group events surrounding the project. Because we were not allowed to meet or travel together as a group, the group collaboration turned more into individualized study, and projects with collaboration were attempted where possible. My trip to the coast in October 2020, for example, was one of the opportunities that was luckily still able to happen, albeit socially-distant.

Each student in the course was assigned a geographic area or subject matter to cover. Most stories fit into four broad categories: ecosystems, health, food and energy. Students researched and wrote about topics including but not limited to river flooding, bee pollination and chicken farming. During the first semester, students were required to complete a minimum of three stories in their specified area. Students were encouraged to continue writing stories related to their field in the second semester. Before doing any reporting, students researched their topic in depth in order to gain a knowledgeable understanding of the scientific aspects. This research also assisted them in providing important historical, economic and cultural context within their stories. They then reached out to professionals in their respective fields and other important figures related to the stories for interviews. These interviews were conducted via phone call, video call, in person or e-mail.

Our reports were mostly written in classic journalistic fashion, meaning the most important information was at the top of the page followed by important details and eventually other general information at the bottom. These stories included scientific fact, reputable sources and personal experiences. They were submitted to our respective advisors for several rounds of edits, and then the stories and additional media accompanying them were eventually uploaded to the practicum website.

My main area of focus was the Mississippi Gulf Coast and saltwater aquaculture. Through the course, I was able to travel to several cities along the coast and learn about the changes in the natural environment and the economic and interpersonal effects that followed. The trip left me both sad and hopeful for my home state.

I primarily learned a lot about the oyster industry and how people are working hard to revitalize it. I was surprised to learn that there were so many detrimental changes happening in that area that did not make it to larger media sources. Lives were completely changed, and Mississippi changed with them. I also thoroughly enjoyed learning about all of the people working to reverse the environmental damage that was done in Mississippi. My hope is that, through my research and efforts to highlight this corner of the world, people will begin to understand that climate change, no matter how small, is something to be taken gravely seriously.

My interest in environmental journalism primarily stems from my urge to represent the underrepresented. In this case, I found there were so many environmental changes going on along the coast that I had no idea about. This is part of what makes environmental reporting so important. Progress cannot be made if people are unaware of the problem in the first place. Learning more about those changes along the coast and speaking with people who experienced them firsthand were my first steps to sharing this information with the world.

Writing about complex, scientific subjects such as climate change is often difficult to clearly portray to a general audience. Because of this, it can also be a challenge to make the readers comprehend the threat of climate change on a personal level rather than global. If the information is not understood effectively, then it is highly unlikely there will be any motivation for positive change. I have found that the most effective strategy for relaying this sort of information in a way that is comprehensible to a general audience is to write in a narrative format in which anecdotes about real people are interspersed with scientific exposition.

I. Narrative Storytelling as a Vehicle for Environmental Journalism

Storytelling is how humanity has always connected with each other throughout our existence. While storytelling and journalism are not irrevocably synonymous, journalism is a developed form of storytelling. By publishing what is going on in their communities, journalists help foster those connections between other people within those communities.

Environmental journalism, which has steadily gained more attention in the world as climate conditions worsen, is current affairs journalism with a focus on nature and the environment, primarily in order to raise awareness about changes happening both locally and globally. Reporting on this subject also requires presenting a lot of scientific data in narrative form. Because scientific data is not often experienced directly, the general public depends on others to interpret it for them (Dahlstrom, 2014). By communicating scientific complexities in this way, environmental reporters help bridge the disconnect between readers and their understanding of climate change on all levels.

A. The Effectiveness of Storytelling

Telling stories is how humanity makes sense of the world. The institution of storytelling has evolved throughout history. The primary catalysts for its changing form are evolution and survival of cultures (Benjamin, 2006). From the hunter-gatherer days to the high-tech world that we live in today, the act of storytelling is constantly adjusting to changing needs in society. One thing remains the same: storytelling is how humanity grows together. We simply would not have progressed as a society without the spread of “threatening changes in the ambient world (Carey, 2007).”

Storytelling began as a way to ensure survival. Older generations told younger generations their knowledge from the past in order to prepare the younger generations for the future. Whether it was how to avoid a certain predator or where to migrate during certain times of the year, the gift of retelling experiences was how humans learned and continued to advance. Each generation progressed from the one before them. It is the oldest form of teaching. This also is the basis of how cultures formed (Benjamin, 2006). By passing down stories, humanity created a way of bettering themselves and preserving traditions.

The narrative is one of the most common forms of storytelling. Avraamidou and Osborne (2009) explore the different definitions of a narrative, or story, based on Chatman (1978), Toolan (2001), and Norris, Guilbert, Smith, Hakimelahi and Phillips (2005). For Chatman (1978) narratives are comprised of three elements: narrative: a) a story, described as chain of events; b) the existents that are the characters or items of setting; and c) a discourse, which refers to the means by which the content is communicated. Toolan (2001) states, “narrative is a perceived sequence of non-randomly

connected events, typically involving, as the experiencing agonist, humans or quasihumans, or other sentient beings, from whose experience we humans can learn” (p. 8). Norris et. Al (2005) suggests that narratives are comprised of eight elements: events, a narrator, narrative appetite, a time, structure, agency, purpose, and a reader.

A journal written by several psychology professors addresses the pedagogical strength of narrative storytelling (Landrum, Brakke, & McCarthy, 2019). Stories typically follow a protagonist along a journey attempting to resolve or confront a problem, and that eventually leads to the protagonist learning a lesson.

Stories are cause-and-effect situations that typically end with a resolution. People who are given these stories are supposed to obtain whatever that lesson or resolution is as well. By absorbing stories, humans are able to learn to build a shared meaning for varying experiences without ever physically leaving where they are (Landrum, Brakke, & McCarthy, 2019).

Stories become even more memorable when they are interesting and relevant to the audience. When there’s a problem to be figured out, humans inherently approach a story as if it is a puzzle (Landrum, Brakke, & McCarthy, 2019). The trickier the puzzle, the longer the audience remembers it after experiencing it. The ultimate benefit of storytelling and the reason it is so important to humankind is that it conveys lessons to the audience in a way that sticks with them after the experience.

Researchers have studied how stories can be a catalyst for change (Avraamidou & Osborne, 2009). Stories have the potential to influence people’s understandings and beliefs, and therefore lead to societal and cultural change. Situations presented in narratives are closely corresponded to everyday experiences, so it is naturally easier for

most people to comprehend that material rather than logical reasoning and scientific research (Avraamidou & Osborne, 2009). Because of this, stories can be incredibly powerful in instilling some sort of change within the person experiencing it.

Of course, it is important to note that journalism is not completely synonymous with narrative storytelling. Reporting and relaying information or news, also known as storytelling, is certainly an ancient practice. Otherwise, generations would have never progressed from the ones before them. While the modern institution of journalism was not officially introduced until the 18th century, storytelling is the core of journalism. In other words, journalism is storytelling, but storytelling is not always necessarily journalism (Carey, 2007).

B. Journalism as a Motivation for Change

The earliest example of journalism in history, the *Acta Diurna*, dates back to before 59 BCE (Brittanica, 2020). It was an Ancient Roman form of a daily official notice. Basically, it was the first daily gazette. China during the Tang Dynasty (618 C.E.-907 C.E.) issued a *bao* or “report” to its government officials. The *bao* continued until the end of the Qing Dynasty in 1911 (Brittanica, 2020). The first regularly published newspapers began forming in the 1600s. However, Journalism as an official institution did not start developing into the version we recognize today until around the 18th century.

The idea that journalists had a social responsibility to their readers came to fruition during the 19th and 20th centuries. Earlier newspapers argued that being partisan to their political affiliations was socially responsible, but as readership grew, newspapers grew with it. This new growth also welcomed more money, which allowed the newspapers to become more independent (Brittanica, 2020).

As I previously mentioned, storytelling and journalism in particular have proven to be catalysts for change. One of the more famous examples is Upton Sinclair’s *The Jungle*. Sinclair worked undercover in Chicago’s meatpacking district in order to expose the horrifyingly filthy conditions in which food was being processed at the time. Originally published as a novel, this story centers on a Lithuanian family finding work in Chicago’s slaughterhouses. The story drew a harsh light to the uncomfortable realities of the mostly immigrant workers (Sinclair, 1906). Sinclair also published his criticisms in a Socialist newspaper. Shortly after the story was released, the Pure Food and Drug Act and the Federal Meat Inspection Act were passed (Strieff, 2020). It is not definitively proven that *The Jungle* was a direct cause of the two acts being passed; however, journalistic stories

printed in response and in support of Sinclair's claims have been proven as contributors to the passing of the acts (Graf, 2020). Ultimately, Sinclair's novel, if anything, expedited a legal process that changed the way America processed and regulated food from that point onwards. The driving reason behind this success is the power of the narrative.

That was not the only time legal or social action has been taken as either a direct or indirect result of journalistic efforts. Another famous example is the beginning of the #MeToo women's empowerment movement. The movement initially sparked to life when Jodi Kantor and Megan Twohey broke the news in a *New York Times* article about Harvey Weinstein, a Hollywood mogul, and his multiple sexual assault allegations (Kantor & Twohey, 2017). Weinstein was notorious for sexually harassing women working with and around him, and it was swept under the rug within Hollywood society due to his high status. Ronan Farrow's *The New Yorker* article "From Aggressive Overtures to Sexual Assault: Harvey Weinstein's Accusers Tell Their Stories" was released shortly after, and all three reporters received a Pulitzer Prize for their work (Farrow, 2017). The breaking of this news catalyzed the growth of a historical movement. Those stories motivated other victims of sexual assault to speak up about their similar experiences, often involving other men with power in workplace environments (Hillstrom, 2019). With the simple hashtag #MeToo, victims of sexual assault around the world connected through their pain and called for an end to misogyny and toxic masculinity.

Several states such as California, New York and Illinois have passed new laws involving sexual assault training, softening the federal standard to make it less difficult to sue in state courts and banning nondisclosure agreements that predators have used to

silence their victims. (Christiansen, 2020). Without the #MeToo movement, these laws and regulations may have taken several more years to pass, or they may not have even been passed at all.

Journalists have a responsibility to enlighten the public on issues in order to instigate change. Whether that change is political, social or economic, the readers deserve to be presented with all facets of the issue in order to make an opinion for themselves. When executed correctly, journalism is an extremely powerful tool for change.

In the context of environmental journalism, catalyzing change through the narrative in this area seems viable as well. Well-known Swedish climate change activist, Greta Thunberg, is credited with mobilizing over 10 million climate change strikers (Strike Statistics, 2020).

A study analyzing Thunberg's ability to engage collective action from the public, or the "Greta Thunberg Effect" was conducted by the Journal of Applied Social Psychology (Sabherwal et al., 2021). The researchers used cross-sectional data from a nationally representative survey of U.S. adults. They hypothesized that familiarity with Thunberg would predict higher collective action intentions, and that collective efficacy beliefs would mediate that relationship (see Figure 1). The study found that people who are more familiar with Thunberg have higher intentions to take action against climate change than those who are less familiar. The study also found that, while Thunberg's influence was present across all age groups and the entire political spectrum, her efficacy was higher among individuals identifying as more liberal than conservative (see Figure 2). The results of this study suggest that Thunberg's message, publicized across most media outlets, directly influences action taken against climate change.

Figure 1 from (Sabherwal et al., 2021))

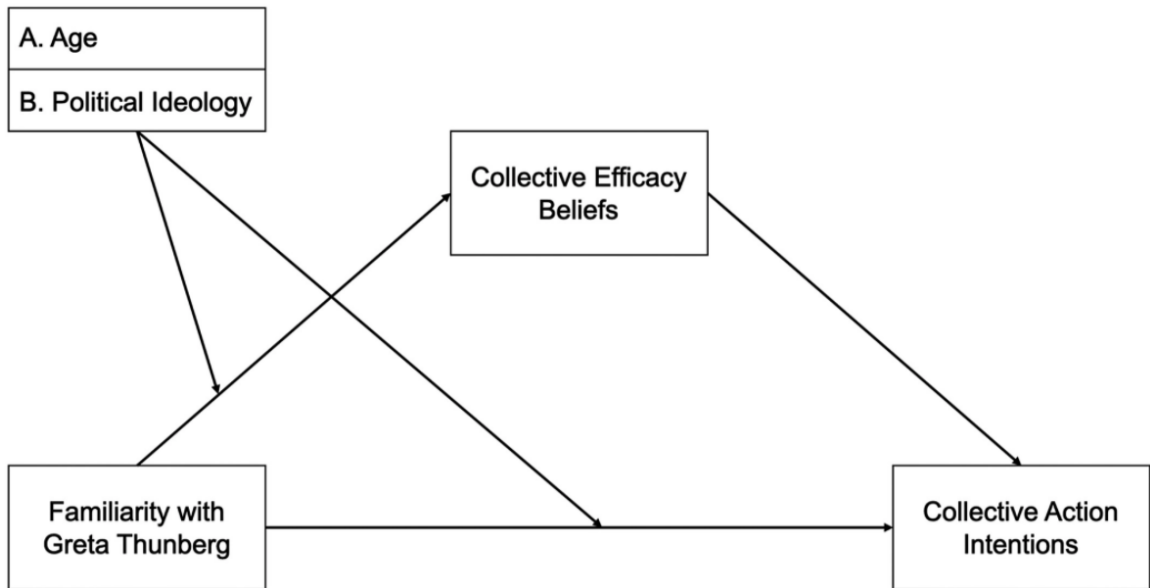
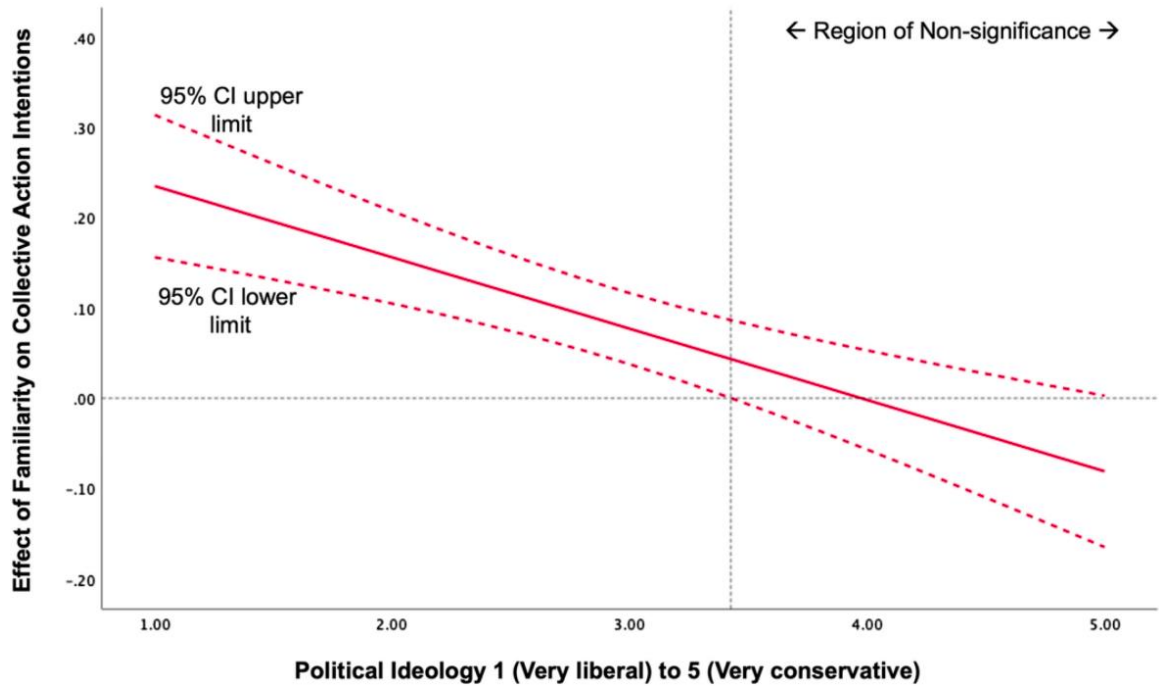


Figure 2 from (Sabherwal et al., 2021))



C. Scientific Knowledge Communicated Through Narrative

Mass media is the general public's primary source of scientific, health and environmental issues (Dahlstrom, 2014). According to Dahlstrom (2014), Americans receive information about science and technology primarily from television (34%) and the internet (33%) with print media coming in third. If an American is seeking a particular scientific or technological topic, the internet becomes the primary source (59%) with over half (52%) of the content originating from traditional journalism sources.

It is no secret that a story becomes more interesting when it is relatable to the audience. Because of this, scientific knowledge is often misconstrued, misunderstood or completely avoided by readers. This also is why some people might not have a concrete understanding of climate change and the gravity of the situation. By communicating information about climate change in a narrative form with context, environmental journalists can relay important news to people who can comprehend its importance.

According to Bruner (1986), humans have two modes in which we process the world: the *paradigmatic* or *logico-scientific* mode and the narrative mode. The *paradigmatic* mode works by abstracting itself from everyday life by cutting out emotions and interconnections with people. It is a very logical, scientific approach to understanding things. The narrative mode also tries to make sense of the world, but it does so by putting other people into context. The narrative mode uses stories and anecdotes to build a better comprehension. Bruner (1986) states that all normally-developed people learn best in the narrative mode and that the two modes are completely separate and distinct from one another. Mutonyi (2015) argues that if that is the case, and one mode develops before the other, then a person could use each mode to develop the other one. Meaning, using a

narrative format to explain scientific knowledge could help people who operate under the narrative mode understand those complex scientific ideas better.

A study conducted in a sensation and perception course reported that students in the course sections who read nonfiction books based on the material they were learning scored slightly higher than the students in the sections that read the traditional textbook (Gunther, 2011). This further proves Mutonyi's (2015) theory that narrative formats tend to help people understand complex scientific ideas better than a formal, calculated explanation.

Other studies have shown that, contrary to popular belief, today's media-soaked millennials prefer digital longform journalism (Dowling, 2019). Dowling (2019) argues that, instead of the fast-paced, concise journalism that was anticipated to suit millennials' "short attention spans," Journalism is developing into a hybridized version of nonfiction and the novel in reportage. This is because it allows readers to absorb information in an interesting and captivating way without distractions.

Narrative storytelling is the origin of journalism, and it is intrinsically persuasive (Dahlstrom, 2014). They tell a particular experience rather than a general truth, which, in being itself, demonstrates a claim to be made. Because narratives present cause-and-effect relationships with real-world objects without argument, it is difficult to argue against its claims. Several studies have shown how audiences are more likely to accept normative views when they are presented in the narrative (Dahlstrom, 2014).

Researchers in the School of Marine and Environmental Affairs at the University of Washington have derived metrics of narrativity from psychology and literary theory, and they used those metrics to test the hypothesis that narrative climate change writing is

more likely to be influential. The narrative elements they used to gauge each scientific abstract in the sampling were setting, narrative perspective, sensory language, conjunctions, connectivity and appeal to reader. They used the citation frequency as a proxy for the amount of influence determined. After sampling 732 scientific abstracts drawn from climate change literature, they found that narrative abstracts are cited more often, independent of year of publication, number of authors or abstract length (See Figure 2). This suggests that writing in a narrative style likely increases the influence of articles in climate change literature (Hillier, Kelly, & Klinger, 2016). They suggest that appeal is positively associated with narrativity because, in the context of climate science, authors are likely to offer a recommendation that is understood to the reader (Hillier, Kelly, & Klinger, 2016).

Figure 2 from (Hillier, Kelly, & Klinger, 2016)

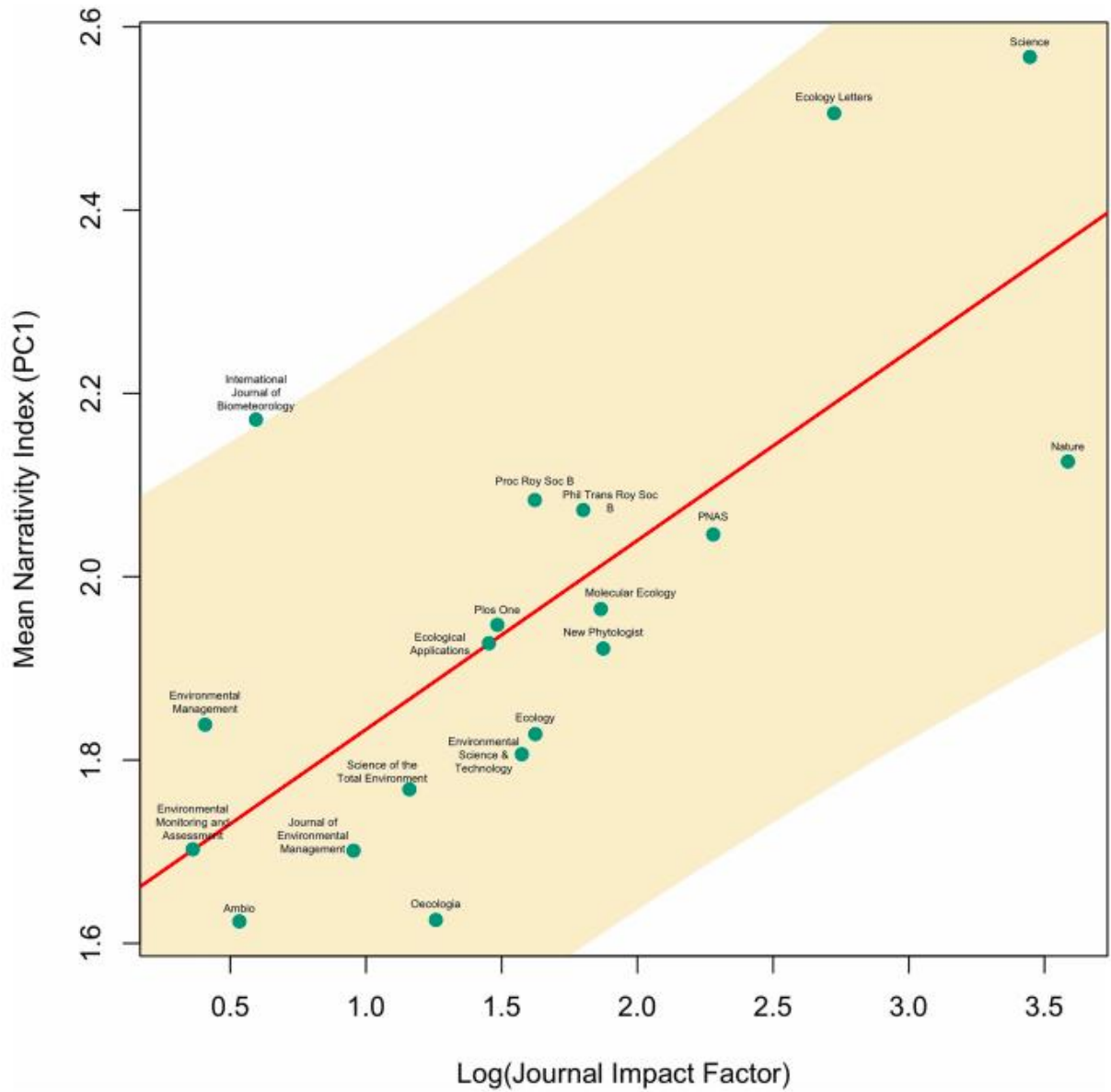


Fig 2. The relationship between the narrativity index (PC1) and journal impact factor. Response variables reflect journal means for articles in our dataset (N = 732); shaded area represents the 95% confidence interval for the best-fit line. Linear regression $R^2 = 0.62$, $p = 6 \times 10^{-20}$.

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D. Standards of Environmental Journalism

Because popularity in environmental journalism is relatively new, there is no official collection of standards yet. However, journalists should always adhere to certain criteria to ensure their story is accurate and enlightening to the reader. For example, the Society of Professional Journalists (SPJ) published a code of ethics that they believe all journalists should follow. The four principles listed are seek truth and report it, minimize harm, act independently and be accountable and transparent (S., 2014). While SPJ's code of ethics is not specific to environmental reporting, it is relevant to any journalist reporting on any story. The goal of a journalist is to relay information truthfully and with purpose.

The Society of Environmental Journalists (SEJ) was founded in 1990, and it grew to become a national organization by 1998. Their objectives include but are not limited to educating the public on emerging issues, protecting freedom of information on environment-related issues, and building bridges between scientists and journalists. However, they do not have a published set of standards (S., 2019).

A recent study comprised of both professional and student environmental journalists was conducted in an attempt to establish criteria for environmental reporting (Rogener & Wormer, 2015). The goal was to create a set of standards for higher-quality environmental reporting. Ten total criteria were formed (See Figure 3). After creating the criteria, the students and professional reporters were asked to analyze and rank a collection of 50 environmental stories based on their new criteria. The reviews concluded that the area in which most stories were lacking was context. This means that most of the stories, 42 out of the 50 to be exact, failed to put details such as economic effects and

political or cultural aspects into context when writing about climate change. This helps show why there is a disconnect between a general audience and their understanding of climate change on a local level.

Cognitive and brain sciences conclude that humans think in terms of unconscious structures called frames (Lakoff, 2010). According to Lakoff (2010), “Frames include semantic roles, relations between roles, and relations to other frames.” The example he used is a hospital frame. The roles within a hospital frame are Doctor, Nurse, Patient, Visitor, Receptionist, and more. The relationships between those characters such as operations and visitations are physically realized by association in neural circuits in the brain. Because frames come in systems, a single word can activate a defining frame.

There can also be negative framing. Lakoff (2010) argues that there is a massive hypocognition, or lack of ideas, in the case of the environment, largely due to the absence of frames and the unproductive way in which the environment is currently framed. Environmental issues do not just concern the environment. They also involve conversations around economics, energy, food, health, trade and security. Currently, the Environment Frame sees the environment as something other than us. We separate ourselves from nature when we should be recognizing that we are part of nature. Lakoff (2010) calls for a complete reframing of how journalists, politicians and climate change advocates frame the environment. By doing so, the general public will associate stories involving climate change and the environment with roles such as the economy, energy, food, and more.

Ultimately, environmental journalism has room for growth, and it is because of this weakness that readers fail to comprehend the urgency and necessity for this type of reporting.

Figure 3 from (Rogner, Wormer, 2015)

Table I. Criteria in environmental journalism and general criteria in journalism.

Criteria in environmental journalism	
1	No scaremongering/no trivialisation Risks and opportunities are neither exaggerated nor minimised.
2	Documentation/evidence The presentation of studies, facts and figures on environmental issues elucidates the evidence.
3	Experts/transparency of Sources/conflicts of interest The sources of factual claims and assessments are named; their degree of independence and objectivity is elucidated and core statements are backed up by at least two sources.
4	For and against The essential, relevant views are presented appropriately.
5	Press release The information contained in the report and the presentation go well beyond that of a press release/press material
6	Novelty The report makes it clear whether it deals with a new or newly discovered issue, an innovative environmental technology or a novel potential solution/regulation or similar, or whether this has been in existence for some time.
7	Potential solutions and paths of action / no greenwashing The piece outlines ways of solving or avoiding the environmental issue, if and where appropriate.
8	Geographical dimension (local – regional – global) The geographical scale of an environmental problem and the connection between local and global perspectives are presented.
9	Temporal dimension (sustainability) The temporal scale of an environmental problem or phenomenon is presented
10	Context/costs In addition to scientific, health and technical aspects, political, social, cultural or economic aspects of an environmental topic are also considered
General criteria in journalism	
J1	Choice of theme The theme is topical or the piece picks up on a theme that is relevant or original irrespective of how topical it is.
J2	Presentation Elucidating complex environmental relationships.
J3	Factual accuracy The report presents the essential data and facts correctly.

See Appendix II for a more detailed description.

E. Summary

Storytelling is and always has been an effective tool to convey important information in a way that stays with the audience after experiencing it. It is how society advanced throughout history.

Journalism is storytelling with a formula. Journalists should always strive to be accurate, truthful and enlightening when reporting on issues. The reason that is so important is because journalists have a social responsibility to their readers and communities. Stories, especially narrative-centric stories, have real power to spark change in the world.

This is made possible because most people operate in the narrative mode, meaning they understand the world by observing and learning from the experiences of others rather than analyzing it scientifically. When the audience is presented with information in the narrative form and backed up with proof, they are more likely to pay attention and empathize with it. It is also important to frame environmental stories in a way that does not make them “other.” By incorporating elements such as economic effects, changes in food production, or even possible solutions to the issue, journalists can make climate change stories more relatable to their audiences. Making a story relatable and credible makes it more interesting to people, and that is why reporting complex scientific topics like climate change is more effective in the narrative form.

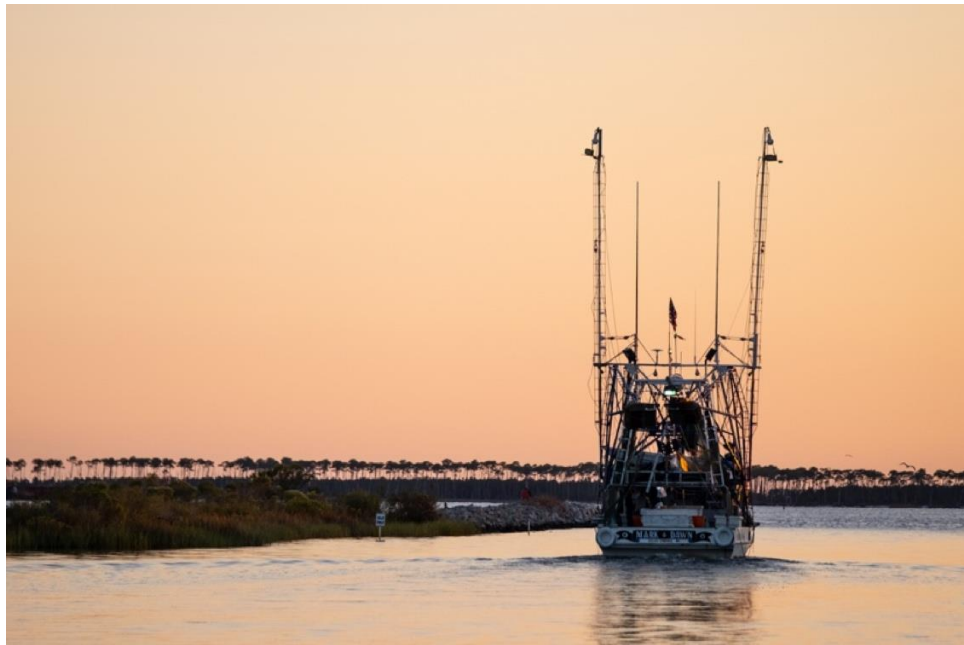
Giving the audience context to ground them in a story while also explaining the seriousness of the issues helps with overall comprehension and increases the chance of motivating people to action, which is a principle that has always been at the heart of journalism.

II. ARTICLES

Here, I present the articles I wrote during my time in the practicum course. All of the photos were taken by a fellow student, Billy Schuerman, during our school-funded and socially-distant trip to the Mississippi Gulf Coast in October 2020. I hope that communities in and around Mississippi begin to understand the serious implications of climate change in our state through interacting with these stories and other contributed stories by my classmates. Change for the better cannot happen until people are properly informed.

A. CHANGE REFLECTED IN JOBS AND DOLLARS ALONG GULF COAST

Inland regions might not notice it, but the Mississippi Gulf Coast is a major contributor to the state's economy. From oysters, to shrimp, to fish and more, Mississippi's aquaculture and commercial fishing industries are vital. In the wake of contributing factors — both manmade and naturally occurring — the Mississippi coast joins the longer Gulf of Mexico coasts of Texas, Louisiana, Alabama and Florida in facing environmental, and subsequently economic, peril.



Billy Schuerman

Work to keep the lower Mississippi River deep and useful for commerce – and in its banks – during much of the last century meant diverting the flow of silt and nutrients away from thousands of square miles of marshland. The result has been vast coastal erosion, with Louisiana losing about a football-field-sized chunk of wetlands every 90 minutes. Hurricanes have also been occurring at higher rates and intensities since the

1980s due to an array of possible factors, one being the rise in the surface temperature of water.

To reverse wetlands loss in Louisiana and avoid more flooding due to hurricanes, a Coastal Master Plan was adopted in 2005 and placed under the management of the Louisiana Coastal Master Plan. One of the plan's components has been more freshwater diversion, releasing freshwater from the Mississippi River immediately into coastal areas and eventually into the Gulf of Mexico. In several recent years, freshwater has been too plentiful due to record snow and rain upstream, forcing the rare opening of emergency spillways, including Bonnet Carré. The most infamous of openings so far was in Spring .2019 when freshwater flowed into the Mississippi Gulf Coast for an accumulated 118 days.

The result was the loss of oysters, shrimp and other sea creatures in the Mississippi Gulf Coast that cannot just swim away. They simply can't live without the salt and minerals found in seawater but absent in freshwater. While the opening of the spillway is crucial to one environment and the people around it, it is detrimental to the neighboring environment and its people.

Brown shrimp reside in estuarine areas in the Mississippi sound during their infancy. The adults spawn offshore in gulf waters, and then the larvae are hatched in the marsh areas to grow. Once they get bigger and mature, they move offshore to start the cycle over again. When the spillway opened, brown shrimp were forced out of their normal waters to a less ideal habitat where they faced reduced growth and higher mortality.



Billy Schuerman

By law, shrimp are counted at an average of 68 shrimp per pound in the commercial fishing industry. In 2019, shrimpers were actually bringing in around 90 shrimp per pound. The commercial fishing industry opened early that year so that fishermen could catch the smaller shrimp before they died off.

Read Hendon is the associate director for the University of Southern Mississippi Gulf Coast Research Laboratory in Ocean Springs. The laboratory conducts research programs in marine aquaculture, biodiversity, ecology, and other related areas.

Reducing flood damage, maintaining navigation and coastal restoration elsewhere has benefits for jobs and the economy, but there's a down side, too. "Particularly here," Hendon said. "It's kind of a double-edged sword because when we have spillway openings, we can have too much freshwater that leads to increased mortality in oysters and issues with essentially anything that lives in that estuarine environment. When we get

into summer, fall, and spring when we don't tend to have as much rainfall, then we see too much saltwater in the estuarine system and that's a result of hurricane damage and wetlands loss in the coastal areas which allows gulf water to come more easily into the Mississippi Sound."

Oysters need both freshwater and saltwater during their life cycle, and they cannot survive with just one or the other. With the influx of freshwater, the oysters were, of course, stuck. They lack the ability to move to avoid predation or environmental changes.

Rayne Palmer is coordinator for the Mississippi Oyster Gardening Program. She knows a lot about the topic. The program is an ongoing project that focuses on developing oyster gardens for restoration and enhancement efforts.

Some saltwater organisms, she said, were able to move toward the Gulf of Mexico and escape the vast inflow of freshwater into the vast Mississippi Sound and smaller areas. "Obviously, oysters can't move," she said. "and 95 percent of those oysters were wiped out by the freshwater. Our shellfish industry in Mississippi was pretty much nonexistent in 2019."

In 2004, the state allowed 500,000 sacks of oysters to be harvested. One sack is roughly equivalent to 300 oysters. In 2017, the state only allowed 10,000 sacks to be produced.

The National Oceanic and Atmospheric Administration (NOAA) made estimates on Mississippi's coastal economic impacts. In 2009, the Mississippi seafood industry generated total economic impacts of \$275.59 million.

Of this total economic impact, the commercial shrimp industry generated \$141.77 million. Updated statistics of the shrimp industry from 2011 show that the sales contributions were \$132 million, and it is still trending downward.



Billy Schuerman

Dawn Ross is the assistant to the director of Mississippi Commercial Fisheries United in Long Beach. Mississippi Commercial Fisheries United assists in many service projects related to the commercial fishing industry. Ross said that the price of shrimp per pound in 2015 was \$6. With much of the price pressure also coming from imports, today the same shrimp brings \$3 per pound.

“Unfortunately for us,” Ross said. “The work doesn’t go down, the gas and fuel prices don’t go down, but shrimp prices are steadily decreasing and fleet is dwindling.”

The seafood industry in Mississippi generates a variety of jobs such as harvesting, processing, wholesaling, fish markets, restaurants and more. Of these, the oyster industry contributed roughly 562 jobs. In a 2011 estimate, this number was reduced to 354 jobs.

Negative trends in marine life on the coast led to a significant loss in commercial fishery jobs. For example, Crystal Seas Oysters, run by the Jenkins family, is the last oyster shucking house in Mississippi. Everywhere else closed down over the years or got wiped away by Hurricane Katrina and replaced by casinos.

“It’s just sad,” Ross said. “All of my family has always been commercial fishermen, shrimpers mostly... Around Christmas, we would have our family bring home a big sack of oysters. To me, that’s history, but it’s also memories. It’s hard to see the devastation that is caused. It’s hard to see people without a job. You used to see boats left and right everyday selling their oysters, and now, unless you have the money to be able to go out and grow them, they just aren’t.”

Clifford Lancon is a seafood restaurant owner and oyster farmer on the Mississippi coast. He said that he had to make changes to his menu due to the fluctuations in seafood availability. “To give you an idea,” Lancon said. “In 2012, I was selling oysters for \$5 a dozen on the half shell. Now we have to get \$18 to \$20 a dozen because they’ve gone up so much in price and availability.”

Clifford and his son, Jason, are learning how to cultivate their own oysters, raise them on their farm and sell them to other restaurants and oyster farmers.

The Lancons manage only one of many oyster farms that are cultivated off of Deer Island and in other places around the coast.



Billy Schuerman

Clifford Lancon (left) and his son Jason Lancon (right) stand in their restaurant, CJ's local Cuisine. The Lancons were the first to begin oyster farming in Mississippi. Because of climate change disrupting the ocean conditions, their oyster farm has struggled to keep up with the demand for oysters.

There are several conservation, restoration and culture efforts currently under way on the coast. The Gulf Coast Research Laboratory handles a variety of aquaculture projects, one of which is cultivating oysters. Angelos Apeitos is a fish hatchery expert at GCRL. He manages many projects, including oyster cultivation.

“It’s exhausting,” Apeitos said. “It’s awesome... If you have work to do, this is where you’re going to be; this is what you signed up for. Otherwise, sign up to work for an industry that allows you to have every weekend off. This is not this industry.”

There are hopes across the board for a balance to the coastal marine environment soon. People’s livelihoods are at stake. Whether the term “climate change” is applied or not, aquaculture on the coast is changing, and life outside of the water is changing with it.

<http://msclimatereport.com/2020/12/04/change-reflected-in-jobs-and-dollars-along-gulf-coast/>

B. LAB-SPAWNED OYSTERS IS A KEY SOLUTION

Farming the Gulf of Mexico is the answer to a lot of economic and environmental questions.

“Well, (as to the matter of) oyster abundance, the answer to that issue is aquaculture,” said Angelos Apeitos of the Gulf Coast Research Laboratory. “The answer to, say, how many fish are available, or maybe shifting the market to putting more fish that are cultured as opposed to being removed from the wild resources, again, our answer is culture, you know, aquaculture.”

The Gulf Coast Research Laboratory (GCRL) in Biloxi is a research and education enterprise of the University of Southern Mississippi’s College of Science and Technology. Professors and students there primarily focus on sustainable coastal and marine resources through aquaculture. One project under way is the spawning of oysters.

Apeitos is a fish hatchery manager at GCRL and helps oversee the oyster projects.

Researchers at GCRL begin by bringing in adult oysters either from the field or from other campuses, and putting them in a controlled environment tank. This allows the oysters to purge and cool down so they don’t metabolize as much food. “You’d think we’re trying to kill these oysters, but this is actually part of the process,” Apeitos said.



Billy Schuerman

After the purge, researchers put the oysters on a table that is connected to a water basin with a pump and a heater. Oysters are naturally accustomed to tidal fluctuations, so they can sit in open air for hours if needed. The next step is to turn on the pump and let warm water fill the table. Fertilization happens outside of the oyster. When an oyster feels the rush of warm water, it starts to open up and begin spawning. Males broadcast sperm first, and females will sense the chemical cues from the sperm and start broadcasting eggs.

Once a male starts producing sperm, a lab attendant will separate that male from the rest in an individually marked basin. The same is done with the females. When the lab attendants see that they have enough gametes – “ready” sperm and eggs – they

will remove the oysters and start mixing everything together. There is a delicate balance to maintain. “Oysters are very prone to deformities when you mix too much sperm with the eggs,” Apeitos said. “It’s called polysperm.”

The attendants assess how ready the eggs are and the motility of the sperm, and they mix them at the appropriate proportions to get them to fertilize. Once fertilization occurs, cell division is actually visible. The cell structure moves from a round egg shape to a D-hinge shape in just 48 hours.



Billy Schuerman

Baby Oysters

The fledgling oysters are fed micro algae until they are about 14 to 16 days old, when they start developing a pseudopod – fake foot – to feel the bottom of the substrate.

Once the oysters reach this stage, workers at the GCRL will consolidate them on a wet coffee filter, and they refrigerate the oysters for five to seven days. After this, they set the oysters on any material, or cultch, that is effective. Oyster shell is the optimum cultch material, but limestone can also work. Once an oyster sets on a piece, it doesn't move.

The GCRL cannot produce enough algae to feed oysters beyond a certain stage in a controlled environment. They feed constantly. Therefore, they work closely with other researchers and oyster farmers.

“They filter an unbelievable amount of water,” Apeitos said. “It’s like us eating every so many seconds. They don’t move, and they grow very, very quickly.”

The GCRL conducts a wide array of other research, including water quality and the effects of toxins, monitoring sport fishing and reef restoration.

<http://msclimatereport.com/2020/12/04/lab-spawned-oysters-is-a-key-solution/>

C. FAMILY KNOWS FUTURE OF OYSTERS IS IN FARMING

They are an oyster family. The grandfather of Biloxi native and seafood restaurant owner Clifford Lancon opened a first raw and steamed oyster processing plant in 1919. Clifford said he learned everything about growing and harvesting oysters from him. Clifford's son, Jason, said he has fond childhood memories of sliding down the mountainous piles of dried-out oyster shells at various shucking houses. Today, only one oyster shucking house remains in Mississippi, and the pile of shells is a fraction of the size it used to be.



Billy Schuerman

Jason Lancon secures oyster traps that had come loose during Hurricane Delta in 2020.

The Lancons faced weeks of repair of damage done to their farm during the record hurricane season

“This generation, the aquaculture side of the industry, will never be what it was before, back from dad’s generation,” Jason said.

These days father and son operate a two-acre oyster farm near Deer Island off Biloxi in waters leased to them by the Mississippi Department of Marine Resources. Oysters are among sea animals that cannot survive without saltwater. When the Bonnet Carré spillway was opened in 2019 to divert flooding from the Mississippi River, freshwater flowing into the Mississippi Sound killed 100 percent of the oysters the Lancons farmed. (see related story, <https://msclimatereport.com/2020/11/17/more-river-flooding-means-less-gulf-of-mexico-seafood/>) Not only did they have to start over from scratch, they intend to remain in and promote growth of the oyster farming industry. Their first fully-grown harvest came at the end of 2020.

To get started, the Lancons received their young oysters from other states or from schools such as the University of Southern Mississippi and Auburn University. They grow them in cages immersed into Gulf of Mexico water. “Helping” oysters by providing habitat is not new to them. Clifford’s grandfather also helped build a manmade oyster reef off Pass Christian.

It takes anywhere from 10 months to a year to fully grow an oyster in the Gulf of Mexico due to its warm waters. In a way, this is a bonus because in other areas such as the waters off the Northeast and Northwest coastlines, it can take up to two years.

As with many land crops, the oysters are pre-sold. The Lancons take orders ahead of time because they have to grade and clean the oysters. The oysters then are put into sacks and refrigerated within a few minutes. If the oysters aren’t the right

temperature, Department of Marine Resources inspectors tell the Lancons to take the oysters back or confiscates them.



Billy Schuerman

Clifford went through a class at Auburn University to be certified to start his farm. He hopes to teach more people how to farm and garden oysters so they can the industry in Mississippi can grow.

The father-son duo also plans cultivating their own oysters. They purchased larvae from Auburn, and they began cultivating them in an up-weller in the Biloxi Small Craft Harbor. An up-weller is an apparatus that houses baby oysters and feeds them algae from the water until they are big enough to latch onto cultch, a mass of material that

serves as an oyster bed. Jason also visited the Gulf Coast Research Laboratory (GCRL) to learn more about their cultivation process.



Billy Schuerman

Jason Lancon (center) learns about different methods of encouraging oysters to reproduce in hopes of carrying some practices back to his family oyster farm.

“We set our own oysters this year,” Clifford said, “And so we were glad that we did it. We learned a lot, and we’re ready to move forward.”

They plan on being 100 percent autonomous by spring. They set sights on hopefully creating an independent oyster industry in Mississippi. As of right now, that is their only concern.

“[The Department of Marine Resources] gave each student 10,000 oysters,” Clifford said. “And they actually purchased oysters from a hatchery in Alabama to give to their students, which was I mean, that’s fine, you know, but we would love to have seen it come from Mississippi. So that’s what we’re trying to do. We’re trying to supply our farmers first and foremost, with oysters. That’s our goal.”

The oyster farming industry is something to watch. With the loss of almost all of the wild oysters in Mississippi coastal waters, this is one of the biggest solutions.

The market awaits. “Right now, there is not enough supply to meet the demand,” said Angelos Apeitos of the GCRL. “And, you know, based on the current information, we don’t think that any single state or nationally, anywhere can even get close to meeting that demand.”

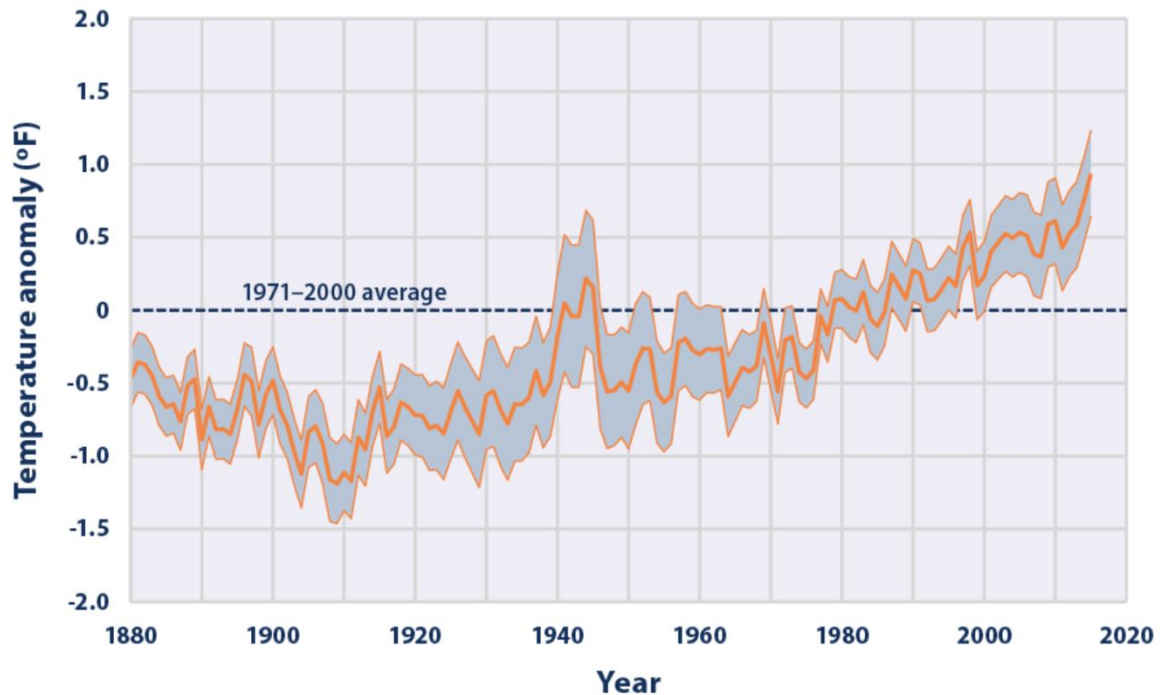
<http://msclimatereport.com/2020/12/04/family-knows-future-of-oysters-is-in-farming/>

D. HURRICANES DESTROY HABITAT, BRING CONTAGIONS

Hurricanes as experienced in Mississippi are a natural phenomenon that starts when warm, moist air rises from the surface the Atlantic Ocean and displaces the cooler air higher up which comes down, warms up and rises again. This results in an increasingly intense cycle of violent winds and rain. The storms typically originate near the equator and, thus, are born as tropical storms.

The Geophysical Fluid Dynamics Laboratory (GFDL) is a part of the National Oceanic and Atmospheric Administration (NOAA). Scientists there recently released a report on their findings about global warming and hurricanes. It clearly shows that because of higher sea surface temperatures, hurricanes are occurring at higher frequencies in the Atlantic.

“The global proportion that reach very intense levels will likely increase due to anthropogenic warming over the 21st century,” one GFDL report said. “It is premature to conclude with high confidence that increasing atmospheric greenhouse gas concentrations from human activities have had a detectable impact on Atlantic basin hurricane activity, although increasing greenhouse gases are strongly linked to global warming.”



Source: <https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature>

Hurricanes are scaled numerically from Category 1 with sustained winds between 74 and 95 miles per hour and Category 5 with sustained winds of 157 miles per hour or greater. After forming closer to Africa, the storms track west toward the Caribbean and often into the Gulf of Mexico where landfalls are usually on the Texas, Louisiana, Mississippi, Alabama or Florida coasts.

Most reporting on hurricanes relates to loss of human life, property devastation and costs associated with rebuilding. Katrina, which made landfall in Mississippi on August 29, 2005, was called the worst natural disaster in American history by former Gov. Haley Barbour in his book, “America’s Great Storm.” More than 200 people

perished and all but the northern tier of counties received federal disaster declarations. Damage totals were pegged at \$30 billion.

Less reported is the severe damage inflicted on coastal sea life. The larger waves, faster currents and invading foreign species like bacteria can devastate natural habitats and the animals that live in them. While free-swimming animals such as sharks, whales and dolphins can move away from the tumultuous conditions, slow-moving fish, turtles and shellfish cannot. Oysters have severely suffered, and hurricanes play a major part in that.

“Oysters can survive full-strength seawater,” said Dr. Read Hendon of the Gulf Coast Research Laboratory (GCRL) said. “But it’s the disease and parasites associated with our salinities that then wipe out oyster populations. That’s a double-edged sword. We’ve had hurricanes since the beginning of time, but with increasing temperatures, we have seen, and this is well-documented throughout NOAA and the weather service, we’re seeing more frequent storms.”

Angelos Apeitos, also with GCRL, said that the warm water and invading parasites and bacteria are the most detrimental results of hurricanes in regards to oysters.

“If you think of the origin of the hurricane,” Apeitos said. “By the time we get it, and it’s migrated through literally hundreds, sometimes thousands, of miles of open water. Think of a parasite that’s not present here that impacts, the well-being; brings it here, puts it here... and then when the water recedes, it takes everything that was on land back into the water.”

The National Climate Assessment also published a statement about the multiple causes that are likely contributors to the rise in sea surface temperature in the Atlantic.

“Numerous factors have been shown to influence these local sea surface temperatures, including natural variability, human-induced emissions of heat-trapping gases, and particulate pollution,” the assessment reported. Too, there are some reports showing no connection between climate change and increasing storms.

<http://msclimatereport.com/2020/12/04/hurricanes-destroy-habitat-bring-contagions/>

III. REASONING

My interest in the Mississippi Gulf Coast and saltwater aquaculture in general began before I enrolled in the climate change practicum course. In January 2020, I travelled to New Orleans, Louisiana for a winter intercession Study USA course, also offered through the School of Journalism and New Media. During this course, we spoke with Dr. Rob Moreau, a biologist and director of Southeastern Louisiana University's Turtle Cove Environmental Research Station in Akers, Louisiana. Moreau explained how opening the Bonnet-Carré Spillway was one of the ways the state of Louisiana protects its wetlands. He mentioned that the opening of the spillway had negative effects on Mississippi's coast, but he quickly moved on to talk about other areas of conservation in Louisiana.

After that day with Dr. Moreau, the conundrum between saving the Louisiana wetlands versus saving the Mississippi Gulf Coast fascinated me. That story was the main subject I wanted to follow after enrolling in the climate change practicum course.

When I first began writing my main story, I reached out to Dr. Moreau again to get follow-up quotes from him. Through our talk, I then gathered the names of other specialists in related fields.

I wanted to try to incorporate solutions to the issue if there were any, as that is one of the unofficial standards of environmental journalism. However, with this story in particular, each solution for each side was detrimental to the other side. I felt it was important to accurately relay the implications for both sides of the issue.

I was then given the opportunity to go on a school-funded trip to the Mississippi Gulf Coast with Professor Michael Fagans and student photographer Billy Schuerman. I

contacted and set up interviews with several important sources over the course of the weekend.

I first reached out to The University of Southern Mississippi's Gulf Coast Research Laboratory (GCRL). They play an integral role in sea life conservation on the coast. I first spoke with Dr. Read Hendon, the Associate Director for GCRL, during a phone interview, and Dr. Hendon pointed me in the direction of other individuals who were very knowledgeable on the subject. Visiting the GCRL and their oyster breeding station was one of the highlights of our trip. Not only did the scientists I interviewed convey the scientific processes in a way that was understandable and not full of jargon, but they also had really nice insights for the situation. They were living in the thick of everything I was reporting about. As I've mentioned before, I wanted to highlight people who were actively trying to alleviate climate change repercussions rather than just reporting on the doom and gloom of the changes happening in Mississippi.

With that in mind, I also set up an interview with Dawn Ross, a representative for Mississippi Commercial Fisheries United. That organization had been doing a lot, not only for the oystermen, but also for other fishermen. She was particularly knowledgeable about the shrimp industry.

I also wanted to get firsthand experience from an oysterman. I found Clifford Lancon, an oysterman and seafood restaurant owner, by searching the web for seafood restaurants on the coast. Clifford and his son, Jason, took us under their wing for most of the trip. They showed us their oyster farm and the place where they cultivated their own oysters. They also took us to the last oyster-shucking house in Mississippi. Their insights were priceless considering they were a multi-generational oysterman family. Clifford told

us that the piles of discarded oyster shells at the shucking houses used to be mountainous compared to the piles that sit there today. This leg of the trip allowed us to see the economic damage that the changes in the water were bringing to our state, thus allowing room for more context in my stories.

I think my most valuable takeaway from that trip was that I was able to actually see and speak with people who were going through these physical changes firsthand. I especially loved that we got to speak in depth with people who had personally watched the changes happening over the course of their lives. It was so powerful to be able to spend time getting to know these real people experiencing real effects of climate change.

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