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RETHINKING WATER, PLACE & COMMUNITY

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FEATURE (PEER REVIEW)

SOCIO-ECOLOGICAL SYSTEM OF FLOODING IN BUCKSPORT, SOUTH CAROLINA

By Geoffrey Habron and John Roper

Editor's note: This feature article has been peer reviewed.

Introduction

There is growing awareness that climate change has the potential to deepen inequalities, especially regarding the threat of riverine flooding. For example, the United States published its Fifth National Climate Assessment in 2023 and for the first time dedicated an entire chapter to Social Systems and Justice (Marino et al. 2023). But just as importantly, how we decide to respond to climate change also runs the risk of having disproportionate and differentiated impacts (Petersen & Ducros 2022). We must ask

ourselves: Resilience and adaptation for whom? How will we ensure that our communities are not broken apart by our pursuit of adapting to climate change? It is important, therefore, to understand the intersecting socio-environmental dynamics at play across various scales of time and place that affect past, current, and future conditions in vulnerable communities such as the African American community of Bucksport, South Carolina.



Historical Grace Chapel Church at the intersection of Big Bull Landing Road and Bucksport Road, entering Bucksport community. Image courtesy of Geoffrey Habron.

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Located in the floodplain between the Pee Dee and Waccamaw rivers, the Bucksport community has experienced a sudden onset of catastrophic flooding events since 2015 that exceeded the previous flood frequency record which has led to property damage and loss of population. Due to historical ramifications, many residents lack current legal property deeds and so are unable to receive previous disaster funding from the Federal Emergency Management Agency (FEMA). Community members feel a sense of loss and powerlessness with respect to the larger governance structures across county, state, and federal scales. These conditions represent an example of interacting socio-ecological forces across nested scales that have both led to the

flooding, but also that explain the disparate responses to flooding that affect the resilience and vulnerability of the system. Socially, Bucksport's racial and ethnic history represents slow changing cultural variables that intersect with fast moving variables of larger population growth and economic development driven by tourism in the surrounding county and coast. Changes in the hydrological system occur at a much larger scale, both in terms of direct precipitation patterns on Bucksport as well as precipitation and increased development upstream. Those ecological patterns can be driven by much larger processes such as climate change that have regional, national and global dimensions.



Bucksport landing for Waccamaw River. Image courtesy of Geoffrey Habron.

Background and Context

Bucksport, South Carolina is an unincorporated community in Horry County in the northeast part of South Carolina, 28 miles west of Myrtle Beach and 14 miles south of the county seat of Conway (Figure 1). It comprises a population of 745 people, 89 percent African American, with a median income of \$47,695 and 82 percent home ownership; 81 percent of homes are valued at less than \$100,000 with 25 percent valued less than \$50,000 including 50 percent living in mobile or pre-manufactured homes (U.S. Census 2020). Residents hold a strong Gullah Geechee cultural heritage. Bucksport was initially a sawmill community that transitioned to a farming community after the sawmill industry died (Carson & Owens 2012). Henry Buck established the first sawmill in the Bucksport area and acquired 300 slaves before the Civil War (Carson & Owens 2012). He established Bucksville as well as Bucksport (Carson & Owens 2012). After the Civil War, Henry Buck gave his former slaves land so that they could build their homes, and many black families grew up in this area known as Bucksport

(Carson & Owens 2012). Many of the residents still live on the farmland that their ancestors lived on since the 1700s (Carson & Owens 2012). Therefore, the current residents emanate from the rich history of Bucksport as a sawmill, shipping, and shipbuilding town where agriculture took place by many emancipated slaves after the Civil War. This has resulted in a rich Gullah-Geechee heritage that has drawn the attention of the Gullah Geechee Chamber of Commerce as well as Coastal Carolina University Joyner Institute for Gullah and African Diaspora Studies.

Bucksport is located within the floodplains between the Pee Dee River to the west and Waccamaw River to the east and is situated just north of the Atlantic Ocean and the intracoastal waterway (Figure 1). Bucksport is also subject to tidal influence. The Pee Dee River is the culmination of the 7,200 square mile Yadkin-Pee Dee River basin with headwaters in Blowing Rock, North Carolina in the Blue Ridge Mountains to the northwest and entering the Atlantic Ocean



Figure 1. Location of Bucksport, South Carolina. Pee Dee River is located west of Bucksport. Waccamaw River is located east of Bucksport. Image via ESRI ARCGIS.

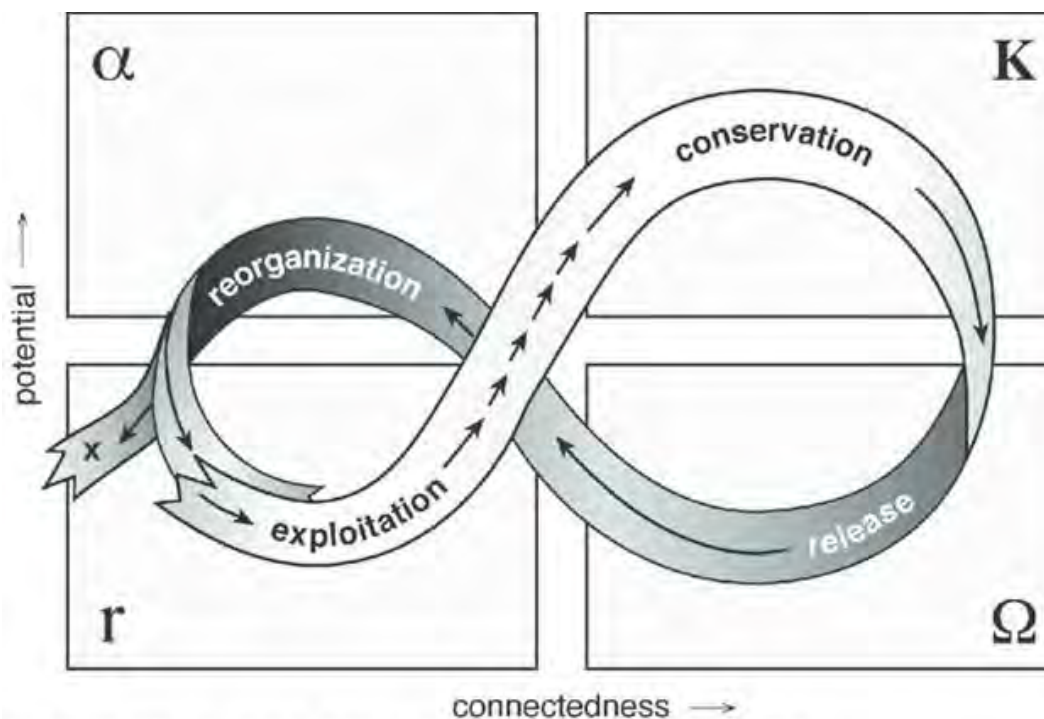
at Winyah Bay (American Rivers 2024). Its 230 miles in North Carolina includes several reservoirs and hydroelectric dams while the 230 miles in South Carolina are free flowing. While the 140 mile long Waccamaw River also originates in North Carolina and empties into Winyah Bay, it is much smaller, encompassing 1,640 square miles along the coastal plain (Winyah Rivers Alliance

2024). The 29,000-acre Waccamaw National Wildlife Refuge formed in 1997 includes both rivers, envelopes Bucksport to the west, south, and northeast, and shares a history of former rice plantations (South Carolina Department of Natural Resources 2020; United States Fish & Wildlife Service n.d.).

Socio-Ecological Systems and Resilience

Based on its location and physical geography, Bucksport is part of a complex socio-ecological system. Recognizing this allows us to engage with the unique interplay among the ecological subsystem of the river, floodplains, and land cover with the social subsystem of the residents, economy, and governance structures and processes (Resilience Alliance 2010). Some key features

to properly understand the interplay among the systems include the role of a range of slow-moving and fast-moving variables that respond within the system at different rates across spatial and temporal scales (Resilience Alliance 2010). Slow-changing ecological variables include soils and landforms such as floodplains, while slow-moving social variables include culture and governance



The adaptive cycle (from Panarchy, edited by Lance H. Gunderson and C.S. Holling: Figure 2-1 (page 34). Copyright © 2002 Island Press.

Figure 2. Illustration of adaptive cycles that indicates the dynamic rise and fall of socio-ecological systems in term of responses to disturbances or disruptions that lead to release and reorganization of a system after a period of buildup and then stagnation/stability. Adapted from Panarchy by Lance Gunderson and C.S. Holling. Copyright © 2002 Island Press. Reproduced by permission of Island Press, Washington, D.C.

and institutional structures such as land rights and jurisdictional boundaries. Fast-moving ecological variables would include stream flows, nutrient cycling, and photosynthesis, while fast-moving social variables include commuting patterns, health responses, and income change. Some of these change at small spatial scales such as the cell, the individual or the family, while others change at larger spatial scales such as whole river basins or the globe (e.g., greenhouse gas loading). The difference in the speed of change among variables across scales is important to recognize when we examine the feedback and effects of a range of disturbances such as floods, wildfire, or hurricanes. Some disturbances

are predictable, such as the daily tide rise and fall. Some are uncertain but fall into regular probabilities such as hurricane seasons. Some arrive suddenly and leave rather quickly in pulses (e.g., hurricanes), while others arise gradually and consistently as press events (e.g., sea-level rise, global temperatures).

Lastly, these socio-ecological systems can engage and respond to feedback and conditions through an adaptive cycle (Gunderson et al. 1995; Gunderson et al. 2022; Resilience Alliance 2010; Figure 2). An adaptive cycle is when a long-established system has built up a consistent and long-lasting set of resources or patterns such as

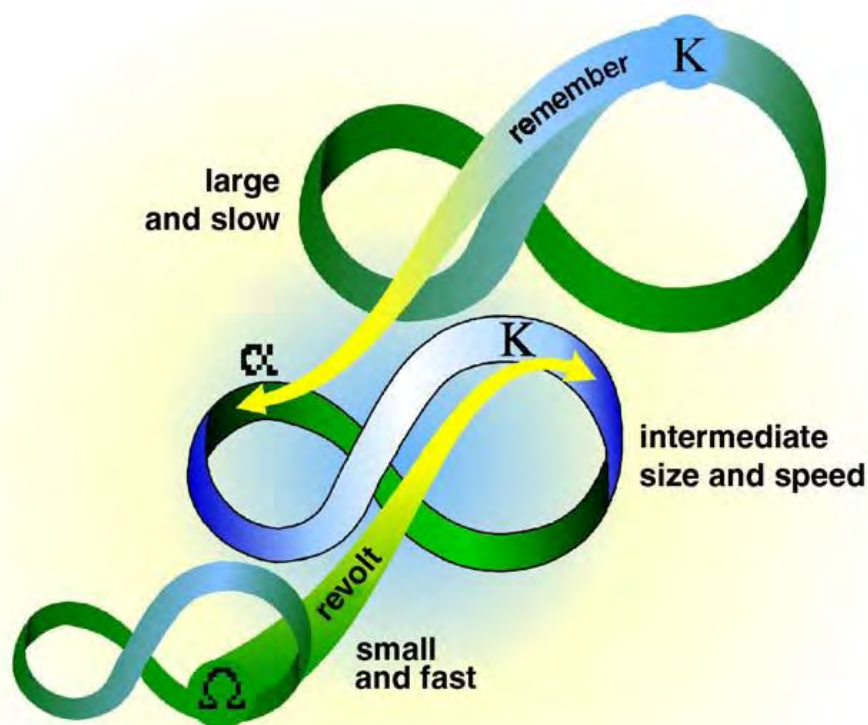


Figure 3. Graphical representation of nested adaptive cycles that reflect fast and slow process at small scales that can affect larger scales and larger scales that can affect smaller scales. Adapted from *Panarchy* by Lance Gunderson and C.S. Holling. Copyright © 2002 Island Press. Reproduced by permission of Island Press, Washington, D.C.

an old growth forest or an established company that reaches a kind of carrying capacity that represents conservation (K phase). The old growth forest or company can then experience a large disturbance such as a hurricane, forest fire, global pandemic, or economic recession that causes a collapse and release of resources (omega phase). For a forest, this release of resources could mean seeds that are released through pinecones. For a company, the release of resources could comprise insurance payments or new investors. This then requires the system to start over by accessing new resources (r phase) and reorganizing (alpha phase). For a forest, reorganization could include germination of new plants or different species that were hindered by the shade of the previous trees that blocked sunlight, water, and other resources. In the company setting, that might

include new equipment or a new governing board or product lines. Once reorganized, the system can stabilize and begin to head toward the conservation phase over a longer time period. A key piece of complexity is recognizing that these adaptive cycles can exist within subsystems and interact across scales (Figure 3), such as the regular patterns with an animal or plant body in terms of fast variables on a daily basis combined with slow variables and changes such as weather patterns, seasons, generations, or evolution (Gunderson et al. 1995; Gunderson et al. 2022; Resilience Alliance 2010). A key problem arises when management solutions are proposed that don't recognize such dynamism by addressing solutions at inappropriate spatial or temporal scales within or across socio-ecological systems (Cumming et al. 2006).

Application: Bucksport as a Socio-Ecological System and Adaptive Cycles

The current situation in Bucksport illustrates the intersecting socio-environmental dynamics at play across various scales of time and place that affect past, current, and future conditions in vulnerable communities. Given the long history of Bucksport (time scale), residents have only recently experienced catastrophic flooding which illustrates the K phase of an adaptive cycle (Figure 2). Prior to 2015, neither the Pee Dee nor the Waccamaw rivers exhibited extreme flooding (Figure 4 and Figure 5). However, between 2015 and 2021 nine flooding events occurred leading to stream heights greater than 20 feet, while none existed from 2008–2014. This series of floods indicates a rapid series of nested cycles (Figure 3). Two of those resulted from Hurricanes Matthew in 2016 and Florence in 2018. The sudden increased frequency represents disturbance events that lead to the release phase in the adaptive

cycle (Figure 2). While both of these occurred during a typical hurricane season, it is unusual to have two large hurricanes hit an area in three years. This enables less time for the system to recover in terms of reorganization (Figure 2) both socially and ecologically which diminishes system resilience (Resilience Alliance 2010). Further, while one storm mainly caused localized flooding, the other storm resulted mainly from precipitation that occurred from inland areas and farther upstream in North Carolina which reflects cross-border effects indicative of river systems. A third major flood event occurred in February 2021 not associated with a tropical event and outside of the normal bounds of the summer season which affects resilience in terms of lack of preparedness. In fact, of the nine events, only five occurred during the typical hurricane season.



Figure 4. Hydrograph of stream gage height of Waccamaw River at Bucksport, South Carolina October 2007–January 2023. U.S. Geological Survey station 02110802. The red line indicates the operational limit of the monitoring station. (https://waterdata.usgs.gov/nwis/inventory/?site_no=02110802).



Figure 5. Hydrograph of stream gage height of Pee Dee River at Highway 701 Bucksport, South Carolina October 2007–January 2023. U.S. Geological Survey station 02135200. The red line indicates the operational limit of the monitoring station. (<https://waterdata.usgs.gov/monitoring-location/02135200>).

Hydrological Impacts on Social Systems

The series of floods has negatively impacted Bucksport residents in a number of ways. The major flooding both damaged homes and trapped residents either in their homes or prevented them from accessing their homes from hours to days (Naik 2018; Watson 2021; Williams 2021). While the community of Bucksport always resided between the two rivers and even utilized the hydrological cycle for rice production (Carson and Owens 2012), the current residents had not experienced this kind of flooding in their own lifetimes. Lifelong resident Jennifer Hunt stated, “We’re encountering flood, after flood, after flood. We never had this when I was growing up!” (Williams, 2021). Another resident, Gary Gause, observed that “I was born here in 1959 and up until about eight years ago, it never flooded. Something is taking effect” (Williams 2021). Further, each subsequent storm caused greater and different damage and alternated between the two rivers as sources of major flooding (Naik 2018). As indicated by one resident, “Bucksport

is on a continuous cycle of flooding unlike we’ve ever seen before” (Watson 2021). While some residents were able to move back into their homes within days, others took years, and some were never able to return to their homes due to the damage. While the home damage was relatively immediate, the response and recovery took months to years and was complicated by other external and institutional factors.

Bucksport residents’ lack of experience and threat recognition is explained by floodplain maps that indicated many residents did not reside in the 100-year or 1 percent annual chance of flooding areas as designated by FEMA (Figure 6). For example, a week after Hurricane Matthew passed through the area in 2016, residents expressed surprise and disbelief that the area could flood, especially because North Carolina and areas to the north experienced the bulk of the storm. When asked to evacuate one resident stated, “They’re telling us to get out so we’ll go ahead and get out. I was kinda surprised about it because

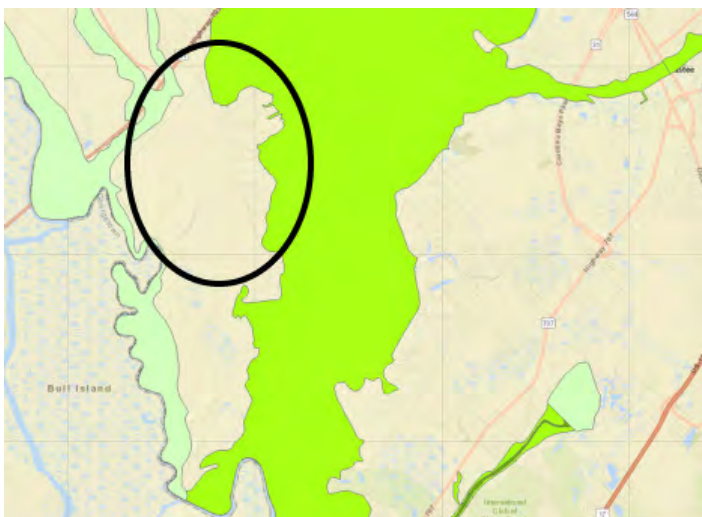


Figure 6. FEMA one percent flood hazard designations in Bucksport as delineated in 1999. Note that the majority of Bucksport is outside the flood hazard area.
Horry County GIS.

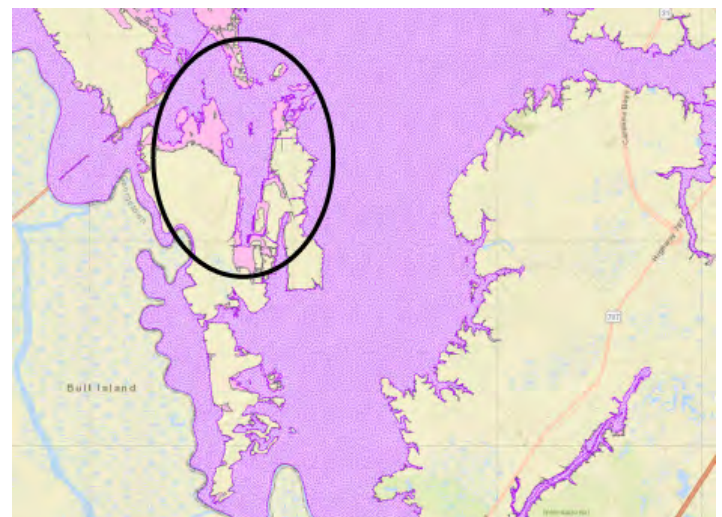


Figure 7. FEMA one percent flood hazard designations in Bucksport as delineated in 2022. Note that the majority of Bucksport is inside the flood hazard area.
Horry County GIS.

you know usually this area doesn't flood. If they'd have given me the option to stay, I'd have stayed. I know some people might say that's crazy, but I would have stayed. I don't think it's gonna be that bad" (Parris 2016). Five years later, residents understand. These flood maps are updated infrequently and did not align with rapid change in flood frequency and risk that emerged since 2015. FEMA began the process of revising the flood maps in 2016, but encountered resistance from a range of entities including residents who contested the changes (Roberson 2016; James 2021). However, when the maps were finally updated in 2021 (Figure 7–8), the updates led to residents needing flood insurance for the first time or being required to pay higher insurance rates (James 2021).

While the flooding caused damages to homes and mental health, further damage was caused when

the federal response system did not align with the community structures and norms. Due to its long history of occupation and roots in slavery and disenfranchisement, many residents simply passed down their property to each generation without having a proper legal deed for the property (known as heirs' property). As long as someone paid taxes to the county and state they could continue to occupy the property (Roberts 2021). However, the Federal Emergency Management Agency requires evidence of ownership by residents before they can receive financial and other compensation for storm damage. Having a clearly designated deed with current residents' names is crucial for aid acquisition. Therefore, many residents were unable to properly recover financially as one Bucksport resident regretted about their siblings' outcomes: "They been having so much problems, it's unbelievable. Because when the water comes, they have to get out of

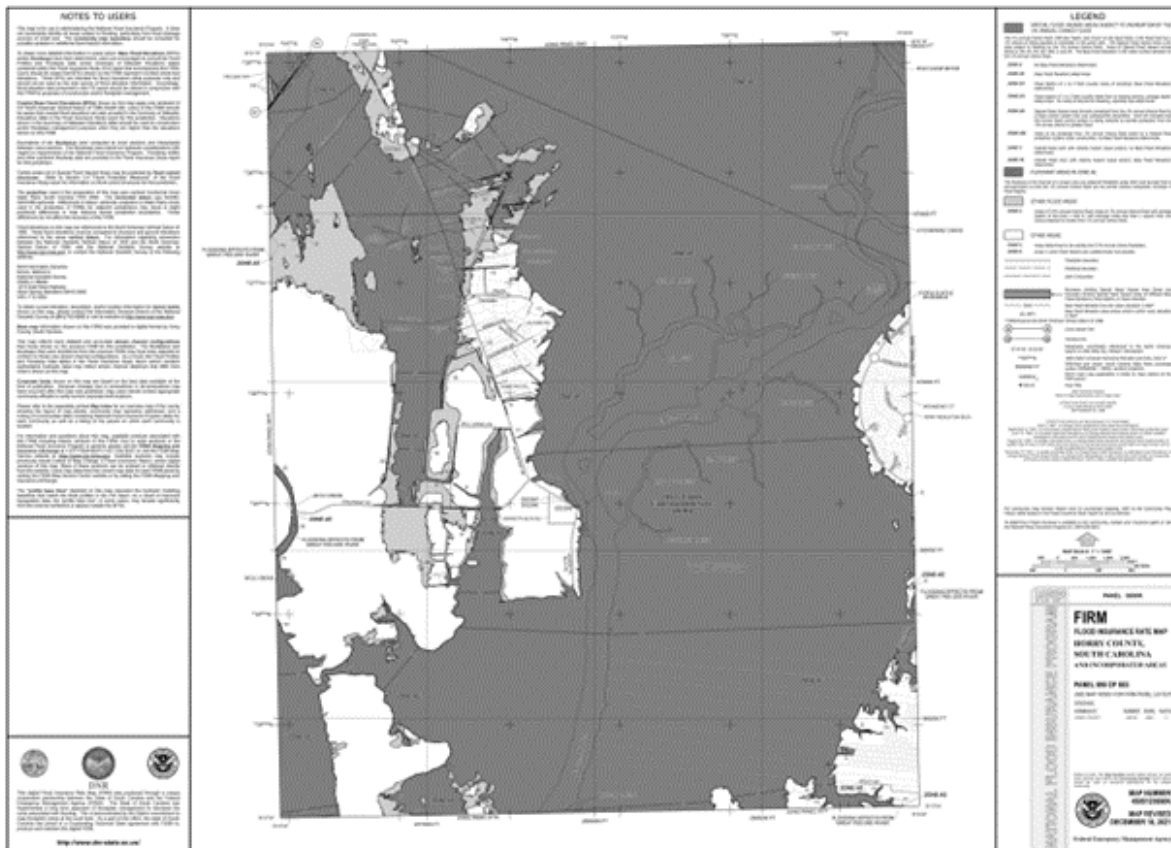


Figure 8. This Flood Insurance Rate Map for Bucksport, revised December 16, 2021 (FEMA National Flood Hazard Layer), indicates the extent of area within one percent annual flood probability (Zone AE). Bucksport Road runs north to south.

Social System Response

The rise in flooding elicited two major intersecting responses from those involved at different scales: Horry County and the Bucksport community. In February 2020, the chair of Horry County Council tasked its Infrastructure and Regulation Committee to launch a subcommittee solely focused on Flooding (Montgomery 2020). The chair selected the members to represent a range of elected officials (city, county, and state) and residents representing builders, roads, and activists. The subcommittee convened meetings, commissioned studies, and received briefings

from county staff as they solicited state and federal funding. They summarized the planned projects in October 2022, including a plan to mitigate flooding in Bucksport through a two-pronged project to elevate a major road in the community called Big Bull Landing Road (Figure 7), as well as develop a flood bypass channel for the Cowford Swamp (MyHorryNews 2020; Horry County 2022b, 2022c) that flows into Bucksport under Big Bull Landing Road and into the Waccamaw River. The county responded to the revised FEMA flood maps by communicating to residents about



*Cowford Swamp on Highway 701, just upstream of Bucksport community.
Image courtesy of Geoffrey Habron.*

new insurance requirements. David Gilreath, the county's assistant administrator over infrastructure and regulation, explained the importance of residents applying for insurance prior to the acceptance of the flood maps on December 16, 2021:

We're doing everything we can to make sure that the people that are going into the flood zone have every opportunity to purchase flood insurance before that date. Because if they get it before the date, it's cheaper. If they maintain flood insurance after that date, it will rise...Within a few years, they're going to be at the normal rate. But if they get it before Dec. 16, they can get a discount for a number of years before they get to that maximum. (Perry 2021)

For the longer-term approach to reducing flood vulnerability, the county approved its Flood Resilience Master Plan in September 2022 funded by the FEMA Hazard Mitigation Plan Grant

Program which highlighted the vulnerability of Bucksport among three communities of most concern (Horry County 2022a).

The residents of Bucksport responded to the increased flooding by mobilizing at two levels. First, they formed a resident organization, The Association for the Betterment of Bucksport. The organization mobilized residents and spoke out to the media and to Horry County Council about their needs and the lack of voice in the flood response (Roberts 2021b) as well as concerns with the designated mitigation approaches in terms of elevating Big Bull Landing Road (Klein 2022). The Association also organized community education efforts such as heirs' property workshops led by the Center for Heirs Property Preservation. The second approach involved catalyzing a collaborative of local and regional nongovernmental organizations and academic institutions called the Bucksport Community Partnership; it is led by American Rivers to support the Bucksport community through advocacy, capacity building,



*Big Bull Landing Road west of the main Bucksport Road and residential community.
Image courtesy of Geoffrey Habron.*

and technical assistance (Cail & Davis 2022). The collaboration assisted the Association for the Betterment of Bucksport in acquiring grants through the federal American Rescue Plan Act in 2022 (Benson 2022); a pilot sustainable development assessment through Coastal Carolina University in 2021 (Laguerre 2021); rain gardens through American Rivers, Clemson University Extension, Coastal Conservation League, Furman University, and Carolina Wetlands Association in 2022 (Laguerre 2022); and cultural heritage conservation through Coastal Carolina University in 2022 (South Carolina Humanities n.d.). While the county worked to address large scale issues and apply for funding from federal and state programs, residents in Bucksport wanted smaller scale approaches, such as cleaning and maintaining the local ditches in the community (Roberts 2021b). However, that encountered difficulty as well both due to heirs' property issues and lack of trust when landowner permission was required to transect private property to access the ditches that crossed property boundaries.

The abrupt rise in flooding of the Pee Dee (Figure 5) and Waccamaw (Figure 4) rivers in Bucksport

represents a dynamic socio-ecological system (Resilience Alliance 2010) reflective of a series of adaptive cycles (Figure 3) across nested scales (Gunderson et al. 1995; Gunderson et al. 2022; Figure 4). This dynamic reveals a lack of fit and scale mismatch between and among the social and ecological components (Cumming et al. 2006). This mismatch illustrates how entanglements of rivers and borders shape our relationships with water. Bucksport's main socio-ecological features are the land, the rivers, and the human residents at one geographic scale that have changed their interactions over a range of time scales and therefore have generated a unique cultural identity and sense of place, particularly important for threatened African American communities in the U.S. South (Schumann et al. 2022). While built on historic interactions (Carson and Owens 2012), due to climate change, precipitation and flooding patterns have changed faster than the infrastructure, culture, and governing institutions can respond.

The governing institutions also reflect varying scales and borders with an emphasis on the structures, processes, and responses of Horry



Looking southwest down Big Bull Landing Road at the intersection of Bucksport Road entering Bucksport community. Image courtesy of Geoffrey Habron.

County and the federal government in the form of FEMA. As stated by the National Climate Assessment, “conditions that create the disaster impacts described above occur over decades or centuries, while governance responses to these impacts are asked to be created in far less time in order to be effective” (Marino et al. 2023).

Adding to the complexity lies the larger demographic and economic forces occurring in Horry County with rapid development and population change challenging county governance and structures in terms of infrastructure and development codes and standards. This confluence affects individual resident’s ability to prepare, respond, and recover from flooding (individual adaptive cycle, see Figure 2), which also affects and is affected by the Bucksport community scale ability to prepare, respond, and recover (community adaptive cycle). Both individuals and community dynamics are then affected by the larger Horry County governance and institutions adaptive cycle and timing (local governance adaptive cycle) that is also affected by FEMA’s adaptive cycle in terms of resources and policies (federal governance adaptive cycle). Of course, all of this is brought about by the change in river and flooding behavior (river adaptive cycle) elicited by climate change that alters the frequency, duration, and timing of large precipitation events both locally, but also upstream in North Carolina.

The river, land, and people interact through flooding impacts and responses. There are policy level implications of flooding as well, such as FEMA designation of flood zones and how that has changed over time and whether people fall into the flood zones and the ramification of that designation. The time span of the social system changes regarding FEMA flood zones from 2016 to approval in 2021 failed to align with the sudden frequency of flooding in the natural system that would have better protected and compensated Bucksport residents. The policy also then affects whether people can get insurance, how much it costs, as well as similar

questions related to flood damage compensation. This arrangement then interacts with the lack of property deeds and affects eligibility for FEMA compensation. One can also see this pattern in national processes and outputs such as the National Risk Index (Department of Homeland Security). The National Risk Index compiles data on a location’s risk to hurricanes, flooding, wildfire, and earthquakes and compares that to social vulnerability, such as the income level and education of the residents. This index is used frequently as an indicator of eligibility or priority for receiving federal funds. The risk index score is determined by collecting data within U.S. Census tracts. While other data collected at the scale of Bucksport indicate social vulnerability, Bucksport exists within a larger census tract with more wealthy residents. Because Bucksport’s borders exist within a larger census tract, this scale of analysis can have negative implications for efforts to secure federal assistance for Bucksport to address the flooding issues, such as through the federal Justice40 initiative launched in 2022 (The White House 2022). The Justice40 initiative seeks to designate 40 percent of federal funds to overburdened and underserved communities. The current draft of the Climate and Economic Justice Screening Tool fails to identify Bucksport as a designated disadvantaged community due to this census tract scale issue (Council on Environmental Quality n.d.). Again, this illustrates the lack of fit between the scale of river flooding, the communities impacted, and the policy tool used to identify risk that would generate resources to aid in recovery and reorganization within an adaptive cycle (Cumming et al. 2006; Figure 3).

This census designated place is then affected by external forces and scales such as the larger context of Horry County. This context has implications for economic and demographic fluxes such as population growth, tourism, need and plans for roads, and rise in housing costs that create pressures on Bucksport itself. Also at play is the timescale of governance, such as

representation on county council. For example, the 2022 elections changed Bucksport's county council representative who also served as chair of the Horry County Flood subcommittee and who advocated on behalf of Bucksport. Bucksport's denotation as a designated place also has implications for categorization of disaster declarations, such as needing to receive disaster designation by county instead of by census designated place and approaches to the federal American Rescue Program Act, Community Development Block Grant, or FEMA funding. The land development across the county can also affect hydrology, flood vulnerability, and impacts due to runoff and impervious surfaces as well as change in tree

cover (Horry County 2022a). Cleaning of ditches also falls into this category in terms of county maintenance and jurisdiction as well as efficacy that exists beyond the borders of Bucksport and the immediate one-percent flood zones of the Pee Dee and Waccamaw rivers.

For each of these dimensions there are processes and patterns that vary in scale that can have implications from the bottom up, as well as top down in terms of mismatch in the scale of ecological processes and the corresponding institutions and processes responsible for managing or responding to such ecological processes (Cumming et al. 2006). These processes intersect in ways



*Grand Strand Water and Sewer gated access to the Eddy Lake Cemetery site.
Image courtesy of Geoffrey Habron.*

such that even the same amount of precipitation over time can cause more flooding due to changes in land use. Changes in land use and development patterns could also cause more economic damage due to increases in homes, increases in homes in flood zones, or increases in the value of homes that puts pressure on Bucksport residents and the community. Other factors, such as crime (Harris 2021) in Bucksport, could add cumulative effects that would cause the same level of flooding to lead to more displacement as it adds a critical tipping point for certain individuals that leads them to leave. As with flooding, this also implicates change over the time dimension, this time from a social system dimension as demonstrated in the words of a long time Bucksport resident: “The

community is not the same anymore. Something has got to be done. I’ve never seen it like this. I wish my neighborhood could go back to how it was in the ’60s. There was better communication, people loved each other, and nobody hurt each other” (Harris 2021). Alternatively, the increase in the precipitation-flooding dynamic can create more change, even when holding all other parameters the same. There are also scenarios where a confluence of events can lead to a potential regime shift whereby Bucksport will not look like it has, leading to changes in demographics in terms of number, race, ethnicity, and value of homes that mirrors larger concerns in other communities that result from “a confluence of heightened hazards exposure, rising land values,



*Historical cemetery behind fence with view of cement blocks used as grave markers.
Image courtesy of Geoffrey Habron.*

unaffordable flood insurance premiums, and crumbling neighborhood infrastructure induced by historic public disinvestment” (Schumann et al. 2022, 316).

These conditions and strains point to the critical importance of understanding the dynamics and impacts of this socio-ecological river system and the cross-scale interactions across borders with implications for resilient remembering that represents how African American communities can “create and maintain heritage sites over the long term specifically to remember narratives of past resilience or repurpose sites to pursue power and liberation (i.e., resistance) in the present” (Schumann et al. 2022, 306). Resilient remembering describes how,

amid ongoing adversity, Southern BIPOC [Black, Indigenous, People of Color] communities have consistently adapted and survived by transforming their social vulnerabilities into ‘inherent resilience’ by linking collective efficacy, creativity, and community action with a

Conclusion

A key to applying an equitable approach to improving a community’s entanglements with rivers (resilience and adaptation for whom?) then becomes understanding these socio-ecological dynamics. Understanding how the various scales and dimensions interact can encourage opportunities to foster adaptive capacity and resilience as illustrated by efforts by the Association for the Betterment of Bucksport and the Bucksport Community Partnership collaboration. Any proposed approach to improve community resilience with rivers can then be run through this socio-economic adaptive cycle lens to assess its efficacy. For example, we can use this lens to assess the equitable community impacts of flood adaptation strategies like elevating Big Bull Landing Road; installing rain gardens;

sense of community, place, and narrative. (Schumann et al. 2022, 306)

For example, the community identified a historic African American cemetery that had been hidden and forgotten due to overgrowth of vegetation; it is located on private property owned by the Grand Strand Water and Sewer Authority, which is the largest landowner in the community (Bell 2020, Klein 2020). The community engaged in its own research and garnered the cooperation of the landowner and local government to fence in the area and erect a sign. The project emerged in response to plans to expand and upgrade roads in the community which threatened the existence of, and access to, the cemetery. The previous loss and recent recovery of the cemetery exemplifies the multiple changes in the community that threaten erasure of community history by those in more powerful positions. The dynamics in Bucksport illustrate the compounding destabilizing forces around climate disruptions that can threaten African American communities through social disruption and loss, conditions and experiences that will remake places and people (Schumann et al. 2022).

supporting the Association for the Betterment of Bucksport; increasing jobs, education, or entrepreneurship in the community; changing FEMA flood designation; enacting the Horry County Flood Resilience Plan; or changing development codes. From a cross-scale perspective, the sudden appearance of multiple disturbances in a short time frame (local scale, short time period) produced by climate change (global scale, longer time period) since 2016 can have stronger effects on Bucksport (small scale) than Horry County (medium scale) as a whole. Adaptive cycles can operate on different trajectories, such as the role of re-setting and/or renewal phases (reorganization, exploitation, conservation, release). While river flooding and floodplain wetland ecosystems in general represent well-studied processes of

conservation, reorganization, and renewal from an ecological perspective, they have different effects on the social system, especially when not part of the longer-term history.

Some parts of Horry County might (a) build back and (b) build back better due to larger and more powerful political and economic forces of tourism and in-migration; Bucksport might not experience either of these practices in the same way. The call to build back better emphasizes a need to not just address what is lost or damaged with disturbances by returning to pre-disturbance normal, but to improve the situation, such as by addressing root causes, improving equity and

inclusion, reducing risks to future disturbance, and increasing resilience while rebuilding (Hamann 2020). It is important to consider that different visions of “build back better” can exist (Hamann 2020) regarding what and how to rebuild, which may not yield beneficial results for all those involved. An example of the need to implement a “build back better” approach can be viewed in terms of a new Bucksport marina and industrial development supported by the Myrtle Beach Regional Development Corporation and the local water and wastewater utility (Vazquez-Juarbe 2022). Building a commercial marina may generate certain large and new benefits, but what those benefits will be and how they will



*April 2022 Rain Garden Information and Planning Event.
Image courtesy of Geoffrey Habron.*

impact the Bucksport community system remains unclear. The new marina adjusts to the changing river dynamics and rising county population and development better than the slower moving variables of fixed homes and culture of Bucksport. The same might be said for elevating Big Bull Landing Road. If it does reduce flooding, will that benefit Bucksport or lead to its quicker demise and change due to increased property values and gentrification? The Horry County Council might view this as better due to increased tax revenues and reduction in high value flood damage (fiscally and physically better), but residents may not share that assessment (not equitable or inclusively better). Climate change has the potential to

deepen inequalities and so does how we decide to respond to it. We must ask ourselves “resilience and adaptation for whom?” How will we ensure that our communities are not broken apart by our pursuit of adapting to climate change?

Bucksport provides a specific example of larger issues confronting other communities and their entanglements with rivers in terms of encountering the deleterious effects of a rapidly changing climate. Further, it illustrates how entanglements of rivers and borders shape our relationships with water. We must work with communities to ensure that proposed approaches to reduce or adapt to river flooding align with community benefits



Bucksport residents and Bucksport Partnership members after completion of the first pilot rain garden at Frazier Community Center in June 2022. Image courtesy of Geoffrey Habron.

and don't lead to their demise. Resources must be provided, and collaboration must occur to make sure that no one is left behind. As noted in the U.S. National Climate Assessment, we must acknowledge the key governance issues that undergird and affect climate social justice (Marino et al. 2023). Therefore, Horry County needs to improve its community engagement process to acknowledge and incorporate how "people's histories, educations, cultures, and ethics determine how they understand and experience climate change" and explicitly "include community perspectives and multiple forms of knowledge in climate discussions and decision-making" in order to build clear objectives and benchmarks for what it means to build back, and build back better in an equitable and just way (Marino et al. 2023). Including community perspectives and recognizing adaptive cycles could ensure economic, engineering, and environmental approaches account for, and align with, the temporal social processes and conditions of the past, current, and future through resilient remembering (Shumann et al. 2022). The hope is to address the root causes of both environmental and social disparities such as racism, neighborhood disinvestment, political disenfranchisement, and low social capital (Adger 2003; Fang et al. 2022; Yuen et al. 2017). As such, any approaches to addressing the flooding risk of similarly situated communities should engage the multiple dimensions of equity: procedural, distributional, and structural (Yuen et al. 2017). Procedural equity addresses the processes of information sharing and decision making that are transparent and fair with opportunity for everyone to have a voice. Distributional equity addresses the proportional spatial and social impacts of implemented strategies in terms of benefits and risks. Structural equity resolves past and current institutional harms, conditions and processes that oftentimes lead to unintended and uneven consequences.

As identified in the Steps to Resilience toolkit approach established by the U.S. National Oceanic and Atmospheric Administration's

Climate Program Office, an equitable approach incorporates a full continuum of community engagement (Fang et al. 2022; Yuen et al. 2017). This engagement moves beyond just informing community members of proposed approaches (as occurred in Bucksport), and instead moves toward shared leadership and community-driven efforts where community ideas are considered and modeled to assess the impacts of a range of alternatives especially in the face of dynamic river systems with multiple possible effects, scales, and disturbance regimes. Efforts for meaningful community engagement should exist across the timespan of project development, from project initiation through plan development, implementation, monitoring, and evaluation in a way that is fully transparent so community members can see and understand the modeling efforts that are applied.

An equitable approach that recognizes cross-scale adaptive cycles also requires anticipation of unintended consequences and plans for prevention and mitigation to build capacity to withstand and recover from disturbances. For example, implementing green (or other) infrastructure to reduce the kinds of flooding experienced in Bucksport should recognize the potential to elevate property values and taxes that could lead to community displacement and gentrification (Marino et al. 2023). A recommendation would be to develop a plan for tax abatement. A similar approach would also recognize the implications of updated FEMA flood maps and impacts on insurance needs which could involve collective negotiation with individual insurers or a group of insurers. Another recommendation involves incorporating other more timely flood models either derived from onsite hydrological models or use of other options such as the Risk Factor models developed by First Street Foundation that incorporate models of future climate—and not just past flooding—behavior.

From a structural and spatial perspective, an equitable approach recognizes that development

patterns in areas of the county upstream from Bucksport, or other similarly at-risk communities, could have disproportionate cumulative impacts downstream on communities like Bucksport which are least positioned to address those impacts. Therefore, development plans, regulations, and zoning should be adjusted accordingly and not reviewed purely on a site-based or neighborhood-impact dimension. That would involve incorporating data such as the federal Climate and Economic Justice Screening

Tool that addresses co-occurring risks and vulnerabilities (Fang et al. 2022; Yuen et al. 2017) but adapted to the census designated place scale for county decision making and planning. It is even more important to recognize the time delay in implementing such changes adds to the disproportionate impact. In this case, the frameworks and tools exist to address such scale mismatches but require the awareness and commitment from those with decision-making authority to implement the frameworks and tools.

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