

Research, part of a Special Feature on [Managing local and global fisheries in the Anthropocene](#)

Local knowledge and democracy in fisheries management: a case study of adaptation to the Anthropocene in southeast Louisiana

Jacob E. Lipsman¹

ABSTRACT. The onset of the Anthropocene necessitates new forms of environmental planning and management as communities adapt to new ecological realities. Despite the global reach of the Anthropocene, localized adaptation strategies are critical for a successful transition into this new epoch. Within local contexts, inclusive, democratic political processes facilitate complex and effective ecological solutions to social problems resulting from environmental change. Genuine incorporation of local knowledge into the decision-making process is critical to fostering this ecological democracy and building effective adaptation strategies. Coastal systems are important nexus points to investigate the relationship between environmental problems and social processes. Fisheries are a critical piece of coastal systems that sustain local communities and the larger economy. I provide a case study of local adaptation to ecological changes as the State of Louisiana attempts to protect vulnerable communities, infrastructure, and fisheries through coastal planning and management. Louisiana's fisheries are a critical asset that stand to be significantly impacted by continuing coastal erosion. Like the Anthropocene itself, Louisiana's coastal erosion crisis is largely the result of human intervention in the biosphere for social and economic purposes. The state's adaptive response is an ambitious master plan that seeks to rebuild the coast and protect its communities and economic interests. Although the plan is ambitious and generally lauded, I argue that the top-down approach the State of Louisiana uses in setting coastal priorities undercuts the plan's efficacy by struggling to incorporate local knowledge and establish a trusting relationship with coastal stakeholders. Without a genuinely deliberative process that bridges across scales and knowledge systems, the state will ultimately struggle to draw in local knowledge, inhibiting comanagement of local fisheries and potentially undermining the ecological solutions it aims to achieve.

Key Words: *adaptation; Anthropocene; coastal restoration; comanagement; expertise; local knowledge; Louisiana; risk; trust*

INTRODUCTION

The biophysical changes to the Earth system in the Anthropocene necessitate new forms of environmental governance and natural resource management. Fisheries management represents a critical component of healthy and sustainable food production amid a growing population and a potentially unstable climate in a new geological epoch. Fisheries in southeast Louisiana are among the most productive in the United States and the world (NOAA 2017). The seafood industry is a critical component of the local economy, historically sustaining communities locally while distributing its product nationwide.

The reality of southeast Louisiana is that a land loss crisis is threatening the future of an estuary system that has sustained a significant portion of the state's population for generations. As of 2016, the state has lost roughly 4833 square kilometers of land since the 1930s, a pattern that is projected to continue without intervention (Couvillion et al. 2017). A major cause of this land loss is river levees, constructed in the 1930s and designed to protect coastal communities from flooding. The crisis has been exacerbated by channelization of wetlands for oil and gas activity and maritime shipping and navigation (Khalil et al. 2018).

Just as the Anthropocene has been brought about by human efforts to bend the biosphere to society's will, the land loss crisis in Louisiana has emerged from social engineering and a human exemptionalist approach to natural resource management. Southeast Louisiana's estuary represents a microcosm of the Anthropocene itself: a critical ecosystem, altered through social engineering, which faces the prospect of unpredictable changes and consequences.

This study examines Louisiana's approach to managing this estuary in the context of the social risk experienced by local communities that depend upon it. This study understands the situation in southeast Louisiana, much like the Anthropocene itself, is a result of an industrial modernity that produces risk and erodes public trust in social institutions. Democratic planning and management at the local level is critical to adaptation and to the development of a "democratic Anthropocene" (Purdy 2015). Understanding the importance of effective, localized responses to environmental change in this new epoch, this study interrogates the formulation of Louisiana's *Comprehensive Master Plan for a Sustainable Coast*, developed by the Coastal Protection and Restoration Authority (CPRA 2017).

Literature on local environmental management stresses the need to engage stakeholders at the local level to promote ecological democracy and positive environmental outcomes (Corburn 2003, Brosius 2006, Cash et al. 2006, Miller and Erickson 2006, Trimble and Berkes 2013, Linke and Bruckmeier 2015). Failure to legitimately incorporate local stakeholders into environmental decision making leads to lack of trust in social institutions, breakdowns in communication, and ultimately technocratic environmental management. Louisiana's insufficient engagement with coastal stakeholders in the coastal planning and management process is inhibiting the development of comanagement processes and generating a potentially maladaptive response to Louisiana's environmental future.

Most commentary on the Anthropocene focuses on the global and leans toward top-down, technocratic solutions (Bennett et al. 2016). This case study expands upon a growing literature that

¹University of Kansas

argues for examining responses to the Anthropocene at the local level. This study uses interview data to highlight a lack of public trust in social institutions and argues that this lack of trust will ultimately inhibit ecological democracy and disrupt adaptive responses to the Anthropocene.

Controversy over coastal restoration priorities

This study focuses specifically on the development and implementation of Louisiana's *Comprehensive Master Plan for a Sustainable Coast*, a fifty-year suite of projects with an estimated cost of at least US\$50 billion (Schleifstein 2017). The plan is ambitious, with different project types including structural protections such as river levees and sediment diversions, infrastructure projects, and nonstructural initiatives aimed at improving residents' awareness of coastal risk and how to protect homes and businesses from storm surge events (CPRA 2017). The plan seeks to protect local communities while maintaining the resources, including local fisheries, that make the coast an economic engine of the state.

Although the master plan is a formidable and ambitious effort to protect vulnerable communities, infrastructure, and fisheries, residents of coastal parishes in the southeast coastal zone (some of Louisiana's most economically and physically vulnerable citizens) are at odds over the state's approach to determining the plan's priorities. Although there is no dispute over the importance of coastal restoration, many in the coastal zone argue that the state's top-down approach to coastal planning excludes local knowledge and jeopardizes the fisheries that sustain the local economy.

The controversy is centered around sediment diversions, one of the eight project types in the master plan. Sediment diversions aim to rebuild land organically by channeling sediment from the Mississippi River into surrounding marsh through strategically located outfall canals. The mainstream science and policy communities argue that this is the most efficient way to build land whereas coastal residents, most significantly the commercial fishing industry, frequently argue that the introduction of freshwater from the Mississippi River into surrounding marsh will alter the salinity of the water and cripple shrimp, oyster, and fish harvests for an industry that is already struggling with increased fuel prices and imported seafood. The Mid-Barataria Sediment Diversion (MBSD), the first of 7 planned diversions in the southeast coastal zone during the 10 years following the 2017 iteration of the plan, will cost nearly US\$1 billion and is unlikely to begin construction before 2020 (CPRA 2017, Schleifstein 2018). Coastal residents argue that money could be used more efficiently, without harming fisheries, by building land immediately using dredged material.

The coastal master plan, most recently renewed in 2017, is an opportunity for the State of Louisiana to take a leadership role in coastal management and provide a framework for other regions facing similar risks in the Anthropocene. This study examines local stakeholders' perceived role in the process of building and implementing the plan and analyzes the potential impact on local prospects for effective comanagement of the coastal ecosystem.

REVIEW OF LITERATURE

The Anthropocene is characterized by climate instability brought about by human intervention in the biosphere. The Anthropocene

is likely to produce unpredictable state shifts in the biosphere that could threaten the viability of complex human civilization (Steffen et al. 2011). Given the unpredictable nature of these biophysical changes, environmental risk exposure across the globe will ultimately grow with the onset of the Anthropocene. The continued use of technology to adapt to risk rather than to mitigate it leads to a society defined by risk and a reliance on risk management rather than risk prevention (Beck 1996, Zinn 2016). Risk society and the Anthropocene are linked by their roots in technological development and technocratic management.

The risks associated with the Anthropocene are global in scope but have the greatest near-term impact at the local level. Although most academic commentary on the Anthropocene has focused on the global, Bennett et al. (2016) argued that research on the Anthropocene should focus on local-scale risk analysis and adaptation planning. Social sciences and natural sciences should work together to lay out pathways toward desirable futures within the Anthropocene (Bai et al. 2016).

Coastal systems represent the most direct environmental connection between humanity and nature (Wright et al. 2018). As such, no system is more imperiled by the onset of the Anthropocene. Human activities including oil and gas production, agriculture, and nutrient runoff can threaten fisheries and ecosystem services including erosion and flood control (Wright et al. 2018). Consequently, the socioeconomic viability of coastal communities is inextricably linked to the health of coastal ecosystems (Wright 2018).

Louisiana accounts for the highest commercial fish landings in the U.S. and 37% of national oyster production (Wright and D'Elia 2018). Eroding wetlands, caused by human processes unique to the Anthropocene, are likely to severely impair the productivity of these fisheries. Louisiana's coastal master plan specifically highlights fisheries as a critical asset of coastal Louisiana as well as a main beneficiary of the master plan's restoration projects (CPRA 2017). Southeast Louisiana therefore represents a unique opportunity to investigate community-level adaptation to fisheries management in the Anthropocene.

Planning a democratic Anthropocene is critical for humanity's ability to adapt to this new era of risk (Purdy 2015). Even within the global context of the Anthropocene, democratic arrangements at the local level are essential for localized environmental management. Ecological democracy at the local level is a critical component of positive ecological outcomes at this scale. Ecological democracy depends upon a comanagement approach to ecological problems that emphasizes participation among local stakeholders (Brosius 2006). Adaptive comanagement is a project rooted in joint knowledge production; bridging between scales and epistemic backgrounds are crucial processes that facilitate democratic approaches to complex ecological problems (Cash et al. 2006, Berkes 2009).

Role of local knowledge in ecological management

In a modernity defined by complexity and social fracture, risk interpretations should be viewed through a subjective, culturally specific lens (Wynne 1996). Knowledge gaps in mainstream science expose local-scale publics to potentially catastrophic environmental risk (Freudenburg 1992). If ecological democracy is the key to adaptation in the Anthropocene, incorporating local

knowledge into local political processes is the key to engendering that democracy.

Local knowledge contributes to democratic formations in part by expanding the range of information and perspectives available to decision makers (Corburn 2003). Local knowledge functions by filling context-specific gaps in mainstream knowledge (Thornton and Scheer 2012). The dialogue between mainstream science and local stakeholders generates interactional expertise; by shifting the focus from objective knowledge to different forms of expertise, the political process becomes more inclusive of varying epistemic perspectives (Carolan 2006).

Brosius (2006) argued that local knowledge represents more than static ecological knowledge; it encompasses the political knowledge and agency of specific local publics. To incorporate local knowledge means not only to include new information but to expand the range of voices and perspectives. Miller and Erickson (2006) argued that bridging across scales and epistemic orientations are necessary steps to creating effective solutions to complex environmental problems. The authors specifically focus on expanding dialogue across epistemic boundaries and delegating political authority across scales as mechanisms for encouraging democratic outcomes. Cash et al. (2006) encouraged cross-scale interplay between social institutions to facilitate comanagement on complex ecological issues.

Mobilizing local knowledge

Literature on environmental outcomes emphasizes the importance of local knowledge in generating positive environmental outcomes at the local scale. The process of harnessing and mobilizing this knowledge, however, cannot be taken for granted. Drawing local stakeholders into the institutional worlds of science and policy is a unique challenge that requires specific effort. Existing power relations create privileged forms of knowledge and constrain local knowledge systems (Andrews et al. 2018). Substantial front-end work must address power imbalances and create a genuinely inclusive space for knowledge codevelopment (Wiber et al. 2009).

Trust is a major component in the relationship between the institutional and local knowledge communities. Trust has been shown to be critical for fostering collaborative approaches to natural resource management (Hamm 2017, Coleman and Stern 2018). Conversely, myriad issues including institutional responses to risk and perceived exclusion from the scientific process sow distrust in mainstream science in the lay community (Michael 1992, Beck 1996).

Establishing trust is a critical step toward drawing local knowledge holders into the scientific process (Usher 2000). Carolan (2006) argued that interactional expertise garnered through engagement with local knowledge generates trust, facilitating collaboration and democracy. Trust building and community engagement foster a culturally sensitive scientific process that prioritizes subjective risk interpretations and seeks to understand the unique risk perceptions of local publics (Wynne 1996). Trust must be fostered through the incorporation of local stakeholders into the political process (Thornton and Scheer 2012). The most effective way to encourage local participation is to provide genuine pathways to process control and decision

stakes (Lauer et al. 2017). Local stakeholders should be treated not simply as knowledge repositories, but as agents who have the ability to contribute politically to positive ecological solutions.

Local knowledge and fisheries comanagement

Natural resource management is a distinct opportunity to generate ecological democracy and positive ecological outcomes in communities experiencing environmental risk. This case study specifically focuses on the incorporation of local knowledge into fisheries management in southeast Louisiana to examine how communities can move democratically into the Anthropocene. Fisheries management is a wicked problem because natural, social, and environmental priorities frequently contradict one another (Jentoft and Chuenpagdee 2009). Without a feasible technical solution, successful fisheries management is subject to the interpretations of stakeholders impacted by policy decisions. Fisheries therefore provide fertile ground for exploring the mechanisms and viability of ecological democracy at the local scale.

Literature on successful fisheries management echoes theoretical contributions on the importance of pathways to participation. Adaptive comanagement depends upon knowledge coproduction among mainstream and lay communities (Berkes 2009). Participatory research facilitates democratic outcomes on several dimensions including shared decision-making power, trust between stakeholder groups, and increased capacity of social institutions (Trimble and Berkes 2013). Trimble and Berkes (2013) found that participatory research and social learning processes could facilitate comanagement in a case study of fisheries management. Linke and Bruckmeier (2015) argued for a multipronged strategy that includes reflexivity, knowledge integration, process management, and collective learning as key elements of successful comanagement.

METHODS

The literature is clear that trust in social institutions and pathways to participation in the political process are key to engendering ecological democracy at the local level (Lauer et al. 2017). Given the difficulty of engaging local stakeholders and the importance of trust in this process, the perception among those stakeholders of the extent to which they are being included is uniquely important. Failure to establish trust among vulnerable populations will ultimately inhibit the development of a comanagement process around ecological policy.

The data come from 30 semistructured interviews of residents in Louisiana's southeast coastal zone, identified through snowball sampling. Interview subjects were residents of St. Bernard, Plaquemines, Jefferson, or Orleans parishes. Subjects were commercial or recreational fishermen, charter boat captains, coastal scientists, or concerned citizens of other occupations (e.g., innkeeper, veterinarian, attorney). This sample was selected because of its geographical proximity to, and economic investment in, coastal marsh potentially impacted by coastal restoration strategies and sediment diversions in particular. Although fishermen and fishing guides are the most directly affected by the changing marsh, coastal residents in general stand to be impacted by economic changes in the southeast coastal zone stemming from changes to local fisheries.

The coastal master plan is therefore a sensitive political issue for this population.

Interviews lasted on average one hour, covering topics including fisheries and the local economy, general environmental attitudes, and specific discussion of coastal restoration and the coastal master plan. The interview guide was designed to interrogate coastal residents' perceptions of the role of local knowledge in coastal planning and the level of inclusiveness in the political process around coastal restoration.

The interviews probed numerous topics related to local knowledge, coastal planning, and management of the estuary. Subjects were asked about their attitudes toward the plan, specifically about sediment diversions, and the bases for these attitudes. Subjects were given the opportunity to discuss the project types that they would prioritize if given the opportunity. Subjects were asked whether locals had been included in the process of setting priorities within the master plan and what value local knowledge had provided or could provide to this process. The interviews probed the ways in which coastal erosion impacted subjects, and how subjects interacted with the major economic and political players in their communities (most frequently the state and the fishing industry), and about the quality of the trust relationships between all of these actors.

Interviews were transcribed verbatim. All coding was completed heuristically by the author using NVivo qualitative software. Subjects' discussion of issues broadly related to local knowledge, epistemology, and the relationship between knowledge and political involvement were coded "Local Knowledge." These data were then inductively coded according to emergent patterns that included "Trust," "Expertise," and "Inclusion." See Appendix 1 for a complete description of the coding scheme with operational definitions and sample quotations.

This in-depth analysis focused on themes and patterns that elucidate the otherwise opaque political process around coastal restoration in southeast Louisiana. By understanding coastal residents' perceptions of the relationship between institutional actors and local stakeholders, it is possible to analyze engagement with local knowledge and therefore the extent of democratic management of the coastal system. Given the inextricable relationship between coastal management and sustainable fisheries, analysis of stakeholders' perceptions directly interrogates the prospects for positive outcomes for local fisheries.

The tendency to view environmental expertise exclusively within the realm of natural science inhibits our ability to generate effective solutions to complex ecological problems (Sörlin 2013). The present study promotes a research agenda that expands upon social-ecological literature on localized adaptation to the Anthropocene. Southeast Louisiana represents a case study of the ways in which a vulnerable community on the front lines of environmental change grapples with risk and economic instability. The interview design, sample, and coding scheme for this study were selected to gain the analytical depth appropriate for a qualitative case study.

RESULTS

The literature is clear that democratic decision making facilitates complex solutions to challenging environmental problems and

that mobilizing local knowledge benefits this process. The literature is also clear that pathways to participation and trust in social institutions among local stakeholders are key to mobilizing local actors.

My focus was on two key findings related to these ideas. The first is that many coastal residents feel excluded from the decision-making process around the coastal master plan, specifically on the sediment diversion issue, and argue that this exclusion occurs on the grounds that their experiential knowledge lacks legitimacy when compared to the institutional knowledge of mainstream scientists. The second finding is that major trust issues exist between coastal residents and mainstream social institutions. Perceived exclusion and trust issues hinder local participation, potentially reducing the efficacy of restoration strategies and positive impacts on local fisheries.

Inductive coding and interpretation of the interview data yielded clear patterns of discourse that support the results discussed in the following two sections. This methodology is uniquely suited to elucidate these patterns and contextualize them within the social-ecological literature on local knowledge and comanagement. The evidence presented in the following two sections represents dominant patterns of discourse within this case study.

Exclusion from political process

The overwhelming response from coastal parish residents was frustration at what they perceived to be a lack of inclusion in the decision-making process. Gerald, a charter captain and activist in St. Bernard parish, argued that the state "doesn't take advantage of local people," in its coastal planning process and that the state "goes through the motions" when it comes to public outreach. The "motions" that Gerald references are scoping meetings, held in Plaquemines and Jefferson parish, that are required of the state as part of the National Environmental Policy Act (NEPA) permitting process. The meetings provided an opportunity to hear from the CPRA and the U.S. Army Corps of Engineers (USACE) and to make comments on the public record about sediment diversions.

Outreach efforts like the scoping meetings were perceived by locals as the bare minimum required for acquiring a permit for sediment diversions, and a strong belief existed that public comments were not being considered. Residents generally argued that the process was disingenuous at best. Miles, a commercial fisherman in St. Bernard parish, described the experience of making a comment at a public meeting:

It's not even being considered. That's the sad part of the whole thing. You go to the meeting, you speak, and that person over there is texting somebody. They aren't even listening to you because they've got their mind made up already.

Epistemic differences played a significant role in the perceived exclusion from the political process. Coastal residents felt that their input was being excluded, at least in part, because of their lack of formal education. These residents exuded pride in their experiential, localized knowledge. Cal, a commercial fisherman in St. Bernard parish, argued:

You said education. I've got seven generations... in the fishing business. I've got a lifetime degree in the fishing business that you can't learn in a college.

Miles felt he was being treated like a “dumb fisherman” and that he was being ignored because he does not hold a master’s or a doctorate degree. Said Miles:

I may not be educated, but I have knowledge.

Coastal residents were aware of the role they could play in the coastal restoration process. Multiple land-building alternatives, focused on preserving the marsh and protecting fisheries, were raised in interviews, most commonly dredging sediment (dredging projects do appear in the master plan, in combination with diversions). But even in a general sense, locals argued for the value of their knowledge. Bradley, an oysterman in Plaquemines parish and member of the Louisiana Oyster Task Force, argued that:

scientists (and) academia miss a great opportunity to see the perspective of those who have actually witnessed the coast... and how it’s changed.

Alice, a retired Plaquemines parish employee and fourth-generation resident, understood the value of locals as political agents:

Locals know better than anybody. You’ve got to get them to the table... it can’t just be about you.

Trust in social institutions

Trust issues between coastal stakeholders and social institutions have hindered the political process around coastal planning and management, potentially disrupting positive outcomes for local fisheries. These trust issues flow in both directions and are rooted at least in part in epistemic differences. Coastal residents argued that their experiential knowledge uniquely positions them as experts on coastal management.

David, a seafood distributor in Jefferson parish, questioned why he should trust scientists:

Is it because he’s got a Ph.D.? Where did he get it from? Show me anybody that ever fixed the coast... How did they become an expert if they never fixed (anything)?

Gerald argued that:

it doesn’t take a Ph.D. to see what’s going on.

Ferris, a commercial fisherman and former St. Bernard parish elected official, put it bluntly:

No, we don’t trust them. Those guys ain’t from down here... (They’re) from the middle of the country, where they ain’t got to worry about coastal erosion.

Lack of experience among mainstream actors was one cause for distrust; accusations of corruption was another. Randall, a marina owner in St. Bernard parish, argued the reason the state was so focused on diversions was:

to do projects they want to do... for their cronies to make money.

This group accused the state of utilizing “politicized” science to earn support for diversions. Evan, a recreational charter captain, argued that:

the (state) got the science they paid for. I wouldn’t necessarily trust it.

Bradley described why a lack of trust exists:

there (are) trust issues when people that live it have experienced scientists, academia, saying things that are not one hundred percent true or accurate, and they know it.

Trust issues flowed both ways in the conflict over sediment diversions, with supporters of the plan voicing a lack of trust in coastal stakeholders to take the best approach for Louisiana as a whole. These subjects argued that many in the coastal zone are more concerned with short-term economic gain than the long-term health of the estuary. Flynn, a small business owner in Plaquemines parish challenged the idea that local knowledge is beneficial in the coastal restoration process:

(the) locals aren’t as educated about (the) wetlands as they should be.

Flynn described opposition to diversions as uneducated, short-sighted, and self-centered. Ronald, a charter captain in Plaquemines parish, called the antidiversion science “propaganda.” Forrest, a retired state scientist argued that:

science is a dirty word among coastal residents and that if they hear you have a Ph.D., they’re even more skeptical.

These accusations of selfishness and ignorance to the scientific process inhibited trust in local knowledge among those who supported the state’s approach to the diversion issue. These trust issues disincentivize local participation and hinder the state’s ability to maximize the health of the coastal ecosystem and its fisheries.

DISCUSSION

The Anthropocene is a shift in the biosphere that will have global consequences, but southeast Louisiana has the opportunity to demonstrate localized pathways to adaptation that protect coastal systems and fisheries. Coastal erosion is an issue that is currently affecting Louisiana, but one that will become more widespread as ocean acidification and sea-level rise continue their current trajectories (Cooley and Doney 2009). The literature is clear, incorporating local knowledge benefits complex ecological solutions by facilitating cross-scale interaction and comanagement (Corburn 2003, Cash et al. 2006, Miller and Erickson 2006, Berkes 2009). The findings of this study suggest that the state is missing an opportunity to engage local stakeholders and to encourage a democratic process of multiscale decision making.

This study presents two distinct findings. First, many coastal stakeholders, particularly those who oppose the state’s plan to install sediment diversions in the Mississippi River, perceive exclusion from the political process on the grounds that their experiential knowledge is viewed as less legitimate than the institutional scientific knowledge held by “experts.” Second, trust issues inhibit meaningful progress toward effective comanagement of southeast Louisiana fisheries.

The State of Louisiana argues that it utilizes local knowledge, but its process is opaque. The state’s outreach efforts include meetings designed to educate citizens on the plan itself, the key organizations and actors involved (e.g., CPRA and USACE), and the processes in place to protect the fisheries (e.g., NEPA). Although these meetings offer opportunity for public comment,

it is unclear how these comments are used in the planning process. What is clear is that coastal residents frequently feel they are being paid lip service or being ignored altogether.

The perception of exclusion is significant. The challenges of mobilizing local knowledge necessitate buy-in from those who possess that knowledge (Usher 2000). Simply taking comments at public meetings without follow-up or conversational exchange (comments were provided via court reporter at scoping meetings) does nothing to address the inherent power imbalances that shape the political process around coastal planning. The meeting format, i.e., information about coastal projects was presented by CPRA representatives to an audience of coastal stakeholders, does not resemble the colearning or knowledge coproduction processes that are critical to fisheries comanagement (Wiber et al. 2009, Trimble and Berkes 2013).

The state has provided information to coastal residents through meetings as well as information campaigns. The state has also acknowledged the risk to fisheries posed by diversions in particular, even initiating programs to support the oyster industry through a potentially significant transition period (Sneath 2018). In each of these cases, however, the state's process has ultimately been top-down and has not offered the pathways to decision power that are so crucial to mobilizing local knowledge (Lauer et al. 2017).

Developing a participatory approach to coastal restoration

As biophysical risk grows in the Anthropocene, associated ecological problems like climate change and ocean acidification threaten coastal systems and create significant social consequences for communities who depend on those fisheries (Cooley and Doney 2009). As a critical element of coastal systems, fisheries depend upon effective coastal management and are uniquely impacted by coastal erosion (Wright and D'Elia 2018). Participatory research and adaptive comanagement are critical processes that can facilitate democratic planning and positive ecological outcomes for fisheries at the local level as communities struggle to adapt. Local institutions, like those in southeast Louisiana, must take a reflexive approach and evaluate the ways in which their fisheries management strategies facilitate or hinder these democratic processes.

Pathways to participation and decision power are important for overcoming trust issues that plague the deliberative process on coastal planning. Trust is a critical component of effective natural resource management and participatory research has been shown to facilitate trust and effective comanagement (Hamm 2017, Coleman and Stern 2018). The State of Louisiana would benefit from a deliberative decision-making process that engages a wide range of stakeholders; this process would facilitate colearning that maximizes different forms of knowledge. A more transparent process would also help to alleviate commonly held perceptions of a corrupt scientific process. Participatory research facilitates cross-scale institutional networking that would increase the involvement of coastal stakeholders in governance structures and encourage a democratic decision-making apparatus (Trimble and Berkes 2013). The state has recently launched a program that solicits the public for coastal restoration proposals (IDR 2018). This form of engagement, however, does not address power imbalances or create more transparency because the state will ultimately make any final decisions on whether to utilize these proposals.

In fishing communities in particular, social and economic contexts are absolutely critical to effective policy and management (Wiber et al. 2009). Bethel et al.'s (2011, 2014) Sci-TEK is an empirical example of participatory research that addresses power imbalances by empowering locals to guide field studies and report their own experiential knowledge. Sci-TEK uses GIS technology to translate this local knowledge into useable datasets that can benefit the decision-making process around coastal management. To encourage local participation and democratic outcomes, the State of Louisiana should invest in participatory research like Sci-TEK rather than top-down solicitations that do not acknowledge the state's power over coastal communities and provide no decision power to these stakeholders.

CONCLUSION

Louisiana is missing an opportunity to maximize effective ecological solutions to its coastal erosion problem by attempting to solve the problem without thoroughly engaging power imbalances and the value of local knowledge. The urgency of coastal erosion necessitates instrumental action by the state to protect coastal wetlands and the fisheries that depend on them. Given the outsized impact of Louisiana fisheries on the local economy and national seafood production, effective coastal management in southeast Louisiana is a critical concern as environmental conditions worsen in the Anthropocene.

As the entity holding political power, the state must actively engage local knowledge to maximize the efficacy of its coastal restoration strategies. Whether or not the State of Louisiana proceeds with sediment diversions, providing coastal residents with genuine pathways to participation and decision power is essential for ultimately maximizing ecological outcomes and sustaining local fisheries. By establishing trust and building a democratic apparatus to address complex ecological issues, the state will foster ideal social and economic conditions for local adaptation to the Anthropocene.

This case study provides a paradigm for locales and regions to explore the relationship between institutional and local knowledge within the context of local environmental politics. Future research in coastal Louisiana's restoration planning should investigate the political economics of funding the master plan and the political ecology of risk distribution resulting from the plan's priorities. Nevertheless, until local knowledge is genuinely incorporated into the planning process, these factors will continue to reflect the interests of the state and exclude the localized needs of coastal stakeholders. Southeast Louisiana fisheries continue to be a critically important asset both culturally and economically. Planning the future of this region should reflect each of these priorities, a goal that can only be achieved through egalitarian deliberation across scales, communities, and social institutions.

Given the challenges of creating environmental policy at the national and global scales, regional adaptation to the Anthropocene is critically important to the future of social organization, and sustainably managing local fisheries is a significant piece of effective adaptation. Southeast Louisiana is already facing ecological impacts and therefore has the opportunity to take a leadership role in adaptation strategies at the state and community levels. On its face, Louisiana's coastal master plan is just that, an ambitious plan designed to build a sustainable coast and fisheries that will continue to benefit the

state and region into the future. The State of Louisiana must directly engage local knowledge by addressing power imbalances and fostering trust to avoid undercutting the efficacy of its plan and compromising ecological, social, and economic outcomes.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/11100>

Acknowledgments:

This work was supported by the National Science Foundation under Grant Number 1703120.

LITERATURE CITED

- Andrews, E. J., M. G. Reed, T. D. Jardine, and T. A. Steelman. 2018. Daming knowledge flows: POWER as a constraint on knowledge pluralism in river flow decision-making in the Saskatchewan River Delta. *Society and Natural Resources* 31 (8):892-907. <https://doi.org/10.1080/08941920.2018.1451582>
- Bai, X., S. van der Leeuw, K. O'Brien, F. Berkhout, F. Biermann, E. S. Brondizio, C. Cudennec, J. Dearing, A. Duraiappah, M. Glaser, A. Revkin, W. Steffen, and J. Syvitski. 2016. Plausible and desirable futures in the Anthropocene: a new research agenda. *Global Environmental Change* 39:351-362. <https://doi.org/10.1016/j.gloenvcha.2015.09.017>
- Beck, U. 1996. Risk society and the provident state. Pages 27-43 in S. Lash, B. Szerszynski, and B. Wynne, editors. *Risk, environment, and modernity: towards a new ecology*. First edition. Sage, London. <https://doi.org/10.4135/9781446221983.n2>
- Bethel, M. B., L. F. Brien, E. J. Danielson, S. B. Laska, J. P. Troutman, W. M. Boshart, M. J. Giardino, and M. A. Phillips. 2011. Blending geospatial technology and traditional ecological knowledge to enhance restoration decision-support processes in coastal Louisiana. *Journal of Coastal Research* 27(3):555-571. <https://doi.org/10.2112/jcoastres-d-10-00138.1>
- Bethel, M. B., L. F. Brien, M. M. Esposito, C. T. Miller, H. S. Buras, S. B. Laska, R. Philippe, K. J. Peterson, and C. P. Richards. 2014. Sci-TEK: a GIS-based multidisciplinary method for incorporating traditional ecological knowledge into Louisiana's coastal restoration decision-making processes. *Journal of Coastal Research* 30(5):1081-1099. <https://doi.org/10.2112/JCOASTRES-D-13-00214.1>
- Bennett, N. J., J. Blythe, S. Tyler, and N. C. Ban. 2016. Communities and change in the Anthropocene: understanding social-ecological vulnerability and planning adaptations to multiple interacting exposures. *Regional Environmental Change* 16:907-926. <https://doi.org/10.1007/s10113-015-0839-5>
- Berkes, F. 2009. Evolution of co-management: role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management* 90:1692-1702. <https://doi.org/10.1016/j.jenvman.2008.12.001>
- Brosius, J. P. 2006. What counts as local knowledge in global environmental assessments and conventions? Pages 129-144 in W. V. Reid, F. Berkes, T. Wilbanks, and D. Capistrano, editors. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment*. First edition. Island, Washington, D.C., USA. [online] URL: <http://citeseerx.ist.psu.edu/viewdoc/download?jsessionid=14F000C08A7EE76D7CD226FAE4DC584F?doi=10.1.1.189.4228&rep=rep1&type=pdf>
- Carolan, M. S. 2006. Science, expertise, and the democratization of the decision-making process. *Society and Natural Resources* 19:661-668. <https://doi.org/10.1080/08941920600742443>
- Cash, D. W., W. N. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. Young. 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society* 11(2):8. <https://doi.org/10.5751/ES-01759-110208>
- Coastal Protection and Restoration Authority of Louisiana (CPRA). 2017. *Louisiana's comprehensive master plan for a sustainable coast*. Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, Louisiana, USA. [online] URL: <http://coastal.la.gov/wp-content/uploads/2017/01/DRAFT-2017-Coastal-Master-Plan.pdf>
- Coleman, K., and M. J. Stern. 2018. Exploring the functions of different forms of trust in collaborative natural resource management. *Society and Natural Resources* 31(1):21-38. <https://doi.org/10.1080/08941920.2017.1364452>
- Cooley, S. R., and S. C. Doney. 2009. Anticipating ocean acidification's economic consequences for commercial fisheries. *Environmental Research Letters* 4. <https://doi.org/10.1088/1748-9326/4/2/024007>
- Corburn, J. 2003. Bringing local knowledge into environmental decision making. *Journal of Planning Education and Research* 22:420-433. <https://doi.org/10.1177/0739456X03022004008>
- Couvillion, B. R., H. Beck, D. Schoolmaster, and M. Fischer. 2017. *Land area change in coastal Louisiana (1932 to 2016)*: U.S. Geological Survey scientific investigations map 3381. U.S. Department of the Interior, Reston, Virginia, USA. <https://doi.org/10.3133/sim3381>
- Freudenburg, W. R. 1992. Heuristics, biases, and the not-so-general publics: expertise and error in the assessment of risks. Pages 229-250 in S. Krimsky and D. Golding, editors. *Social theories of risk*. First edition. Praeger, Westport, Connecticut, USA.
- Hamm, J. A. 2017. Trust, trustworthiness, and motivation in the natural resource management context. *Society and Natural Resources* 30(8):919-933. <https://doi.org/10.1080/08941920.2016.1273419>
- International Dredging Review (IDR). 2018. Project ideas requested for the Louisiana Comprehensive Master Plan for a Sustainable Coast. *International Dredging Review*, 10 October. [online] URL: <https://www.dredgemag.com/2018/10/10/project-ideas-requested-for-the-louisiana-comprehensive-master-plan-for-a-sustainable-coast/>
- Jentoft, S., and R. Chuenpagdee. 2009. Fisheries and coastal governance as a wicked problem. *Marine Policy* 33:553-560. <https://doi.org/10.1016/j.marpol.2008.12.002>
- Khalil, S. M., A. M. Freeman, and R. C. Raynie. 2018. Sediment management for sustainable ecosystem restoration of coastal Louisiana. *Shore and Beach* 86(1):17-27.

- Lauer, F. I., A. L. Metcalf, E. C. Metcalf, and J. J. Mohr. 2017. Public engagement in social-ecological systems management: an application of social justice theory. *Society and Natural Resources* 31(1):4-20. <https://doi.org/10.1080/08941920.2017.1364456>
- Linke, S., and K. Bruckmeier. 2015. Co-management in fisheries - experiences and changing approaches in Europe. *Ocean and Coastal Management* 104:170-181. <https://doi.org/10.1016/j.ocecoaman.2014.11.017>
- Michael, M. 1992. Lay discourses of science: science-in-general, science-in-particular, and self. *Science, Technology, and Human Values* 17(3):313-333. <https://doi.org/10.1177/016224399201700303>
- Miller, C., and P. Erickson. 2006. The politics of bridging scales and epistemologies: science and democracy in global environmental governance. Pages 297-314 in W. V. Reid, F. Berkes, T. Wilbanks, and D. Capistrano, editors. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment*. First edition. Island, Washington, D.C., USA.
- National Oceanic and Atmospheric Association (NOAA). 2017. *Fisheries of the United States, 2016: a statistical snapshot of 2016 fish landings*. National Marine Fisheries Service Office of Science and Technology, Silver Spring, Maryland, USA. [online] URL: <https://www.fisheries.noaa.gov/resource/document/fisheries-united-states-2016-report>
- Purdy, J. 2015. *After nature: a politics for the Anthropocene*. Harvard University Press, Cambridge, Massachusetts, USA. <https://doi.org/10.4159/9780674915671>
- Schleifstein, M. 2017. Louisiana's \$50 billion coastal master plan, \$644 million annual plan OK'd by Senate. *Times-Picayune*, 17 May. [online] URL: https://www.nola.com/news/environment/article_ccd26b36-795c-5e5b-9a6a-95ec66ce6a05.html
- Schleifstein, M. 2018. Mississippi River's land building ability is focus of Coastal Connections event. *Times-Picayune*, 22 August. [online] URL: https://www.nola.com/news/environment/article_5e76d985-cfe3-5c92-b3bc-e0c2b957f730.html
- Sörlin, S. 2013. Reconfiguring environmental expertise. *Environmental Science and Policy* 28:14-24. <https://doi.org/10.1016/j.envsci.2012.11.006>
- Sneath, S. 2018. Louisiana hopes new oyster leases will ease pain of coastal restoration efforts. *Times-Picayune*, 19 June. [online] URL: https://www.nola.com/news/environment/article_2ea7b163-16c6-5b0d-bcdb-be6fce23f67b.html
- Steffen, W., Å. Persson, L. Deutsch, J. Zalasiewicz, M. Williams, K. Richardson, C. Crumley, P. Crutzen, C. Folke, L. Gordon, M. Molina, V. Ramanathan, J. Rockström, M. Scheffer, H. J. Schellnhuber, and U. Svedin. 2011. The Anthropocene: from global change to planetary stewardship. *AMBIO* 40(7):739-761. <https://doi.org/10.1007/s13280-011-0185-x>
- Thornton, T. F., and A. M. Scheer. 2012. Collaborative engagement of local and traditional knowledge and science in marine environments: a review. *Ecology and Society* 17(3):8. <https://doi.org/10.5751/ES-04714-170308>
- Trimble, M., and F. Berkes. 2013. Participatory research towards co-management: lessons from artisanal fisheries in coastal Uruguay. *Journal of Environmental Management* 128:768-778. <https://doi.org/10.1016/j.jenvman.2013.06.032>
- Usher, P. J. 2000. Traditional ecological knowledge in environmental assessment and management. *Arctic* 53 (2):183-193. <https://doi.org/10.14430/arctic849>
- Wiber, M., A. Charles, J. Kearney, and F. Berkes. 2009. Enhancing community empowerment through participatory fisheries research. *Marine Policy* 33:172-179. <https://doi.org/10.1016/j.marpol.2008.05.009>
- Wright, L. D. 2018. Future societal vulnerability, risk and adaptability. Pages 293-304 in L. D. Wright and C. R. Nichols, editors. *Tomorrow's coasts: complex and impermanent*. First edition. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-75453-6_18
- Wright, L. D., and C. F. D'Elia. 2018. Coastal Louisiana. Pages 207-220 in L. D. Wright and C. R. Nichols, editors. *Tomorrow's coasts: complex and impermanent*. First edition. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-75453-6_13
- Wright, L. D., J. P. M. Syvitski, and C. R. Nichols. 2018. Coastal systems in the Anthropocene. Pages 85-99 in L. D. Wright and C. R. Nichols, editors. *Tomorrow's coasts: complex and impermanent*. First edition. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-75453-6_6
- Wynne, B. 1996. Misunderstood misunderstandings: social identities and the public uptake of science. Pages 19-46 in A. Irwin and B. Wynne, editors. *Misunderstanding science? The public reconstruction of science and technology*. First edition. Cambridge University Press, Cambridge, UK. <https://doi.org/10.1017/CBO9780511563737.002>
- Zinn, J. O. 2016. Living in the Anthropocene: towards a risk-taking society. *Environmental Sociology* 2(4):385-394. <https://doi.org/10.1080/23251042.2016.1233605>

Appendix 1. Operational child codes within “Local Knowledge” parent code data

Child Code	Operational Definition	Example Quotation(s)
Local value	Value/role of local knowledge/people in coastal restoration; ideas of local people on coastal issues	“We've been begging them for pipeline dredging. Not diversions; pipeline dredging.” “Not everyone has a formal education...but a lot of people have some creative ideas as far as what to do to rebuild the coastline...It may not sound the greatest coming from someone who may not have a formal education...but they experienced it. They kind of know.”
No include	Local knowledge is not effectively incorporated into planning process	“To me it's just like you're talking to that countertop right there, because whatever you say they don't hear because they've got their minds made up what they're going to do.”
Yes include	Local knowledge is effectively incorporated into planning process	“Well, they're trying to, yeah. They're trying to take advantage of locals' knowledge.”
No should	Local knowledge should not be included in planning process; locals should be familiar with mainstream science in order to participate	“If they're knowledgeable they should. If they understand the dynamics of our delta, yes...If you're not educated, I don't care about your opinion because you're ignorant.”
Yes should	Local knowledge and people should be included in planning process	“The most important part is talking to the locals, because locals know better than anybody. You've got to get them to the table.”
Locals wrong	Local knowledge is wrong on coastal issues	(Referring to locals): “A lot of these people, they're subscribing to bad science, I call it.”
Scientists wrong	Mainstream science/policy community is wrong on coastal issues	“What kind of projections they got for actual land being built? Is it backed by their scientists? Because if I had some information I couldn't argue with, I'd be pro-diversions. I've never seen it. Does it exist?”

Expertise	Expert authority; differing forms of expertise	“The expertise is there. It's part of our community. And it comes up in discussions all the time. When the oystermen are talking about coastal issues, they're pretty good experts themselves.”
Trust	Trust issues; why trust/do not trust particular actors or groups	“See it's hard to get oyster fishermen to be honest about this. There's only a few that'll go sit at the table and be honest.” “We don't trust them. Those guys ain't from down here. (They're) from the middle of the country where they ain't got to worry about costal erosion.”
