CONTEXTUALIZING DATA WITH LANDSCAPE REPRESENTATION TOOLS: ADDING MEANING FOR PUBLIC EVALUATION

SCHRAMM, SARAH
LSU Coastal Sustainability Studio, Louisiana State University, Baton Rouge, LA
sarah.e.schramm@gmail.com

CARNEY, JEFFREY
LSU Coastal Sustainability Studio, Louisiana State University, Baton Rouge, LA
jcarney@lsu.edu

MITCHELL, JACOB
LSU Coastal Sustainability Studio, Louisiana State University, Baton Rouge, LA
mitchell@lsu.edu

1 ABSTRACT

In educating the public, different disciplines rely on different tools for visual communication. At the transdisciplinary Louisiana State University Coastal Sustainability Studio (CSS), we find that data-rich graphs and charts used by scientists and engineers often fall short of communicating the significance of a relationship or process to the public. Visually communicating this meaning is an interpretive step that is necessary for meaningful public engagement. In Louisiana, the coastal land loss crisis impacts communities, industry, and ecological systems at a massive scale and rapid rate. Responding to this crisis requires broad public support and funding. To achieve this, organizations must find a way to present complex concepts to the public in a way that is meaningful, convincing, and moving, in order to inspire the will to act among the public and political leaders.

Drawing inspiration from writings on climate change and the work of landscape designers, the CSS has developed a visualization approach that builds on the framework of ecological understanding developed in Hill et al. (2002). Using three examples, this paper shows how to relate coastal data to human perspectives by contextualizing the data in a scene using three visualization strategies: visual cues for multiple senses, visual cues for process, and narrative. Testing the efficacy of the graphics produced through this method through focus groups would be a valuable next step.

1.1 Keywords

Visual communication, ecological understanding, public

2 INTRODUCTION

In working across disciplines with the shared goal of educating the public, it becomes evident that different disciplines rely on different tools for visual communication. At the trans-disciplinary Louisiana State University Coastal Sustainability Studio (CSS), we work with scientists, engineers, and designers to envision, design, and communicate sustainable communities, environments, and coupled systems on Louisiana's coast. In our visual communications work, we find that our scientist colleagues, trained in abstract thinking and familiar with the mechanisms of a particular process, often use graphs and charts to convey meaning. When communicating with the general public, however, we believe these communication tools often fall short, at most communicating that something happens, without explaining how and why it happens, nor its broader significance. If the goal is to meaningfully engage the public in civic discourse and participation, then we propose for visualizations to go beyond traditional science communication techniques to generate a greater sense of what the data mean for different user groups.

In Louisiana, informed engagement in civic discourse regarding coastal land loss is critical and urgent. Since 1932, coastal Louisiana has lost 1,883 square miles, one quarter of the 1932 land area (Couvillon et.al., 2011). This is approximately 300 more square miles than the entire state of Rhode Island. For the past 30 years the rate of land loss has averaged just over 16 square miles per year, which, if distributed evenly, would be equivalent to the area of a football field of coastal land lost every hour. This land loss has impacts that range from local to global, effecting communities, habitats, fisheries, oil and gas, shipping, and carbon sequestration.

In order to address this rapid and far-reaching problem, the citizens of Louisiana and the larger United States need to be informed and understand the urgency of the situation in order to take action in a timely manner. Several organizations have been and continue producing material to educate the public, including non-profit and governmental organizations; however, misinformation, counter-narratives, and conflicting interests hinder consensus-building at the scale needed for large-scale action.

One organization, the State of Louisiana's Coastal Protection and Restoration Authority (CPRA), a group that integrates the expertise and resources of the Department of Natural Resources, the Department of Transportation and Development, and other state agencies, is charged with developing a Master Plan for Louisiana's coast. This Master Plan, which is revised every five years, proposes a range of projects to restore large-scale systems across the coast (Coastal Protection & Restoration Authority, 2012). The investment and coordination needed to accomplish the goals of the Master Plan require broad public support and funding. To achieve this, CPRA must find a way to present complex concepts to the public in a way that is meaningful, convincing, and moving, in order to inspire the will to act among the public and political leaders.

The CSS has been commissioned by the CPRA as well as by local and national NGO's including the National Wildlife Federation (NWF) and the Coalition to Restore Coastal Louisiana (CRCL) to develop visual material to convey the complex processes and relationships underpinning the need for coastal protection and restoration and the specific projects being proposed. We have observed that there are many graphs, charts, and infographics that display data about coastal land loss, but there is a link that seems to be missing that would help the average person understand the significance of the data, and how the information relates to their lived experience. Our goal at the CSS is to inform and engage the public, preparing them to make informed decisions and bolster political will to take collective action regarding coastal land building strategies. We want people to understand how the data impact them and the systems they depend upon. Developing this understanding is important, not only for our context in coastal Louisiana, but also for those working on communicating other environmental trends, such as the impacts of climate change or the overharvesting of resources.

Drawing inspiration from writings on climate change and the work of landscape designers, the CSS has developed a visualization approach that bridges the specificity of data analytics and science communication with an aesthetic tradition germane to landscape architecture.

One source of inspiration has been Kristina Hill's work discussing what landscape architects can do to engage themselves and the larger public in responding to climate change. Her work has helped us clarify our strategy of using aesthetics to enhance ecological understanding. In her lecture at Coastal Sustainability Studio, Hill discussed the role of aesthetic performance to inspire in the public the courage to invest, a sense of shared resourcefulness, and the expansion of public compassion (2013). She gave examples of public infrastructure projects that engaged with aesthetic performance as an additional layer to an engineering solution in order to achieve these goals.

From Hill, the CSS has incorporated the value of engaging an observer's imagination by designing with beauty and narrative in our communication and education graphics. We do this by showing more than the basics of a flow diagram—we engage with beauty, narrative, and perspectives to engage the imagination of the viewer. In this way, we intend for our work to promote the public's existing ecological understanding of Louisiana's coastal crisis—helping them understand the web of interrelated relationships that tie changes in ecological and geological processes to impacts in human communities, economies, and ways of life (Hill et. al., 2002). By empathizing with the human in the landscape in these images, we engage the viewer's imagination foster an understanding for the need for state led restoration that leads to project support and informed decision making.

A second source of inspiration has been the work of other designers communicating landscape narratives through two-dimensional graphics. Previous examples by designers integrating data with the experience of a place include Corner's Taking Measure Across the American Landscape (1996), Mathur and de Cunha's Mississippi Floods (2001), Misrach and Orff's Petrochemical America (2014), and Seibert's Dredge Research Collaborative work with the CSS (Milligan, 2015). These precedents tested methods of layering data and collaging human experience. These resources contain beautiful, data rich images that are best studied in large print or book form. In contrast, the work presented in this paper is primarily intended to be delivered in a presentation, on a screen, or in a mass-produced hand out. The images must work quickly in this forum to communicate broadly about not only the need for restoration but the stake that most Louisiana citizens have in it.

3 METHODS

In our images we try to show how coastal data relate to human perspectives and use of the landscape by contextualizing the data in a place or scene. To contextualize the data in a scene, we use three visualization strategies: *visual cues for multiple senses, visual cues for process*, and *narrative.*

The use of visual cues for multiple senses means that in our two-dimensional imagery we use visual cues to convey triggers of multisensory perception. This visualization strategy relates to visualization techniques developed in landscape architecture: representations of ephemerality and ambience. Empherality is an experience of space that is important to represent because a landscape architect will have considered how a place changes through the seasons, through the years, and through the various perspectives of a person moving through the space. These considerations of change over time are often represented with semi-transparent elements. Trees, for example, are often shown as semi-transparent because they are only temporary visual barriers, both temporally (through the seasons and years as they change shape) and spatially (along the course of a person's path). Seeing trees represented semi-transparently in a static image relates to a person's experience of change and movement through a landscape.

Representations of ambience are yet another technique used by landscape architects. Ambience can be represented in many ways to convey many qualities about a space. Wind can be shown with white caps or blowing hair; muggy air can be shown with haze and the quality of light. Details such as these can trigger a sense of what the air of a place might feel or even smell like. Cues that trigger multisensory perception can help the viewer's imagination enter the scene and increase interest in the embedded information.

The second strategy, use of *visual cues for process* means that we incorporate the principles underlying and guiding the work of landscape processes. We refer to the principles underlying and guiding landscape processes as a "landscape aesthetic," building on an existing definition of *aesthetic*, "a set of principles underlying the work of a particular artist or artistic movement" (Oxford University Press, 2016). An example of showing visual cues for process (landscape aesthetic) would be drawing a sediment plume at the mouth of a river to indicate that the river is carrying sediment out into a larger body of water. In this case, the landscape process would be sediment deposition and the principles underlying it would be that the river carries it to an open body of water. While the river could be accurately drawn without the sediment plume, the plume's addition conveys a landscape aesthetic, or underlying process.

The third strategy, use of *narrative*, means that in our graphics we incorporate elements that suggest a story, characters, or action. Narrative can be deployed both in sequence images and in stand-alone images. In sequence images, progress through time and/or space can tell a narrative story of relationships, history, and experience. In a stand-alone image, narrative can be incorporated into a scene by showing characters in action or by showing a path that crosses through varying environmental conditions.

By using the representation strategies of visual cues for multiple senses, visual cues for process, and narrative to augment data, we at the CSS have created visuals that try to communicate processes, an experience of place, and relationships in data that will make the information about coastal land loss meaningful to the public.

4 EXAMPLES

4.1 The Growth of Louisiana's Delta

Our first instructive example that integrates data and human perspectives is a series called *The Growth of Louisiana's Delta* (Figures 1a-1c). In these images we show current geological theory of where the Mississippi River deposited sediment over 6500 years. The intention is to highlight the relationship between the river changing course and land building along the new route, and land eroding along the old route no longer supported by river inputs. This message highlights the dynamic and impermanent nature of deltaic land, which is an important foundation for understanding why Louisiana is experiencing a land-loss crisis today.

The data conveyed in *The Growth of Louisiana's Delta* are the river courses and lobe names, extents, time frames, and area built. The information about river courses was simplified from a 1944 geological investigation of the Mississippi River stream courses (Office of the President, 1944). This information accompanied a 170-page document that has formed the foundation of how geologists understand the age and development of the delta through a sequence of lobes (Fisk, 1944). Subsequent work simplified the lobe sequence into between 5-7 major divisions (Frazier, 1967, Morgan, 1977). Land area was based on McLindon's presentation of Frazier's work (McLindon, 2015). In our drawing, we simplified the graph and removed numbers on the y-axis to focus the viewer's attention on trends and relationships.

Using these resources, we made the information more meaningful to viewers by introducing visual cues for multiple senses, visual cues for process, and narrative. To do this, we added details that suggest materials, processes, and time that help reinforce the underlying coastal principles at work. Visual cues for multiple senses include colors and patterns that suggest material quality of land, water, and sediment. These are simple additions to a geology drawing that helps reclaim the specificity of the subject. The viewer can see the materials that are moving over time rather than abstract lines. Visual cues for process include textures for sediment and decay. We used sediment plumes to show an active river depositing sediment and showed lobes in decay with a tattered look to the land. These details help give the drawing signs of life and change, reinforcing the message objective of a dynamic coast. Narrative is incorporated into this series by showing how the coast changes, allowing the viewer to see the consistent relationship between river path, sediment deposition, and land erosion as the image changes. (Figure 1a-c.)

By integrating data into a scene using the three visualization strategies in The Growth of Louisiana's Delta, we strive to reconnect the experience of a landscape—the tactile materials and flows—with the abstract representations of the geologic history of the site. This strategy engages both the logics of scientific knowledge and the logics of perception. In doing so, the explanation of how the landscape evolved over time carries a more nuanced message than the geology drawings while simultaneously being more readily understood by viewers. By understanding the history and processes that led to the development of Louisiana's delta, the public will be better equipped to build on that knowledge to understand how river management practices have affected the land building and land decay processes inherent to the system.

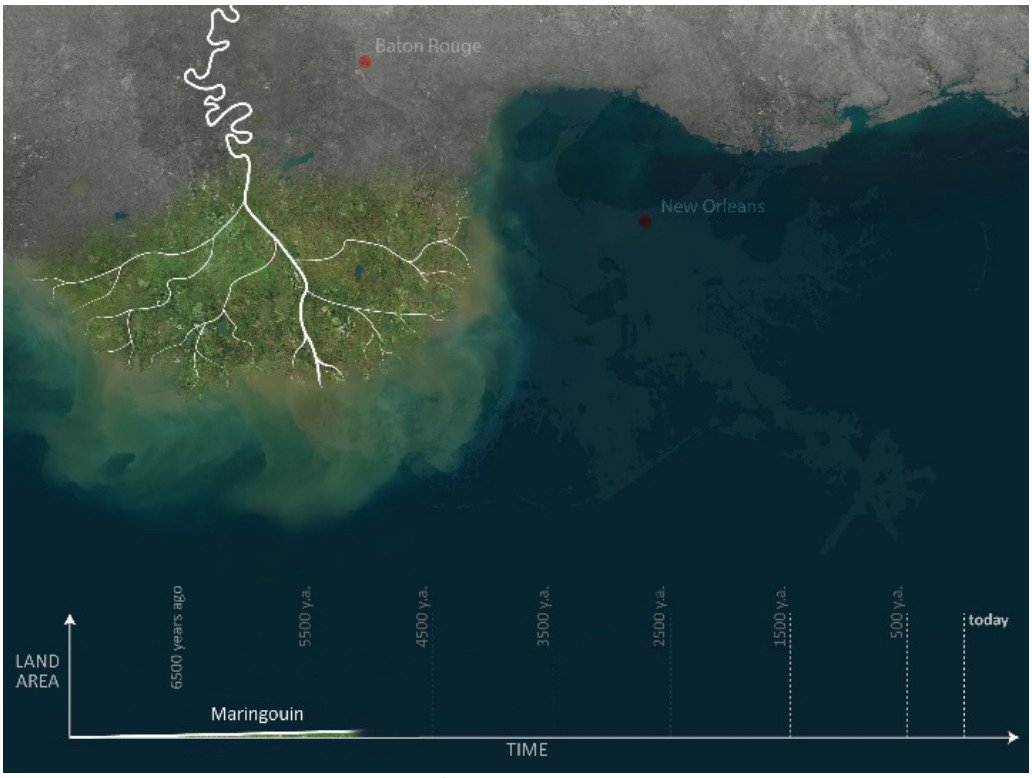

Figure 1a.

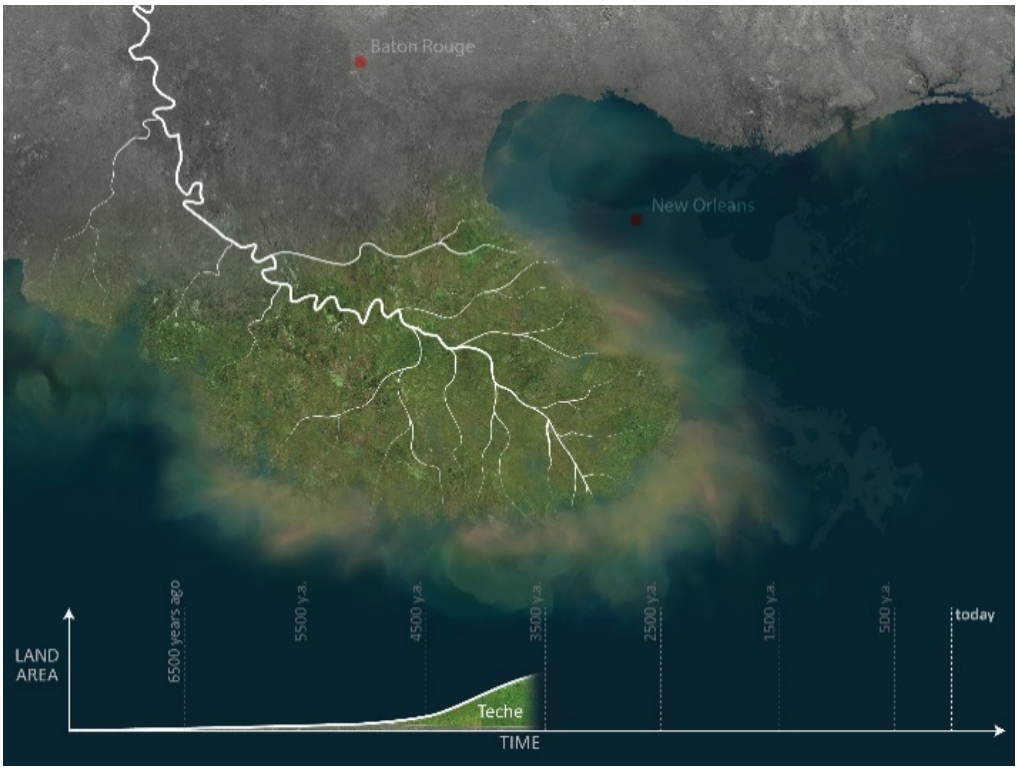

Figure 1b.

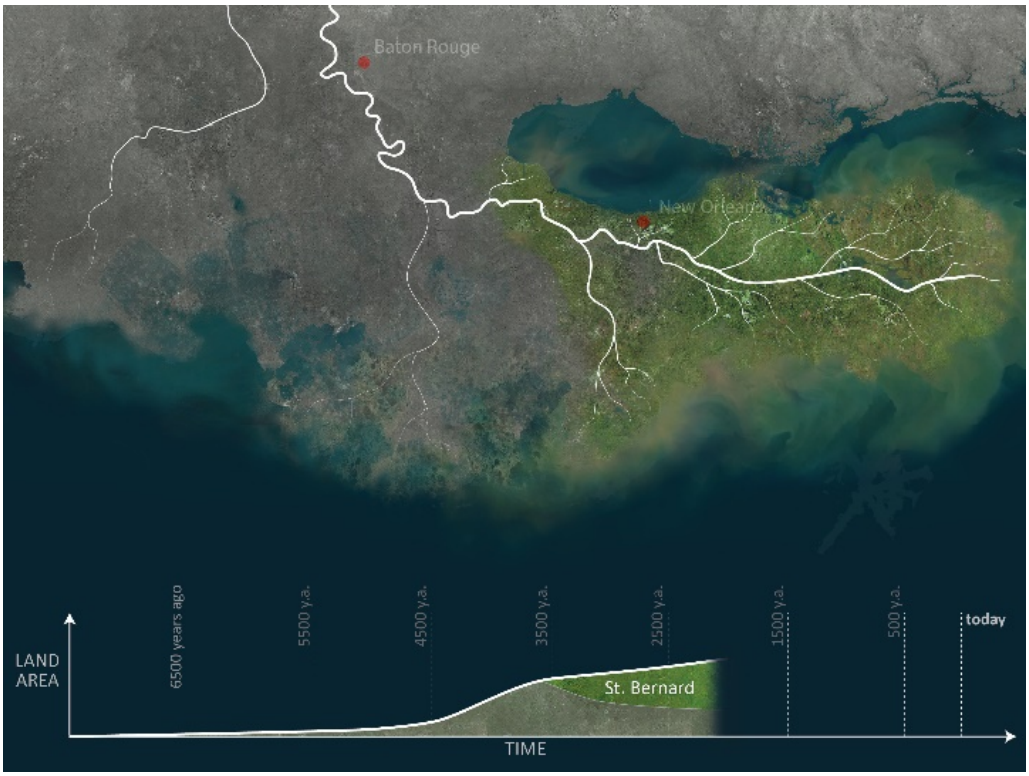

Figure 1c.

Figures 1a-c. *The Building of the Louisiana Delta* sequence showing the use of visual cues for multiple senses, visual cues for process, and narrative. Visualization by LSU Coastal Sustainability Studio.

4.2 The Shrimp Eye View

Our second example, Shrimp Eye View, shows the life cycle of a shrimp from the perspective of a shrimp travelling from a low salinity environment full of food, shelter, and predators as it returns to the gulf to spawn (Figure 2). The intention is to contextualize life cycle information while also relating the ideas of shrimp as an environmental variable with shrimp as a resource. By relating these two ideas, we embed information that shows connection between freshwater marsh habitat and an economic resource while showing the basic elements of the shrimp life cycle. (Figure 2.)

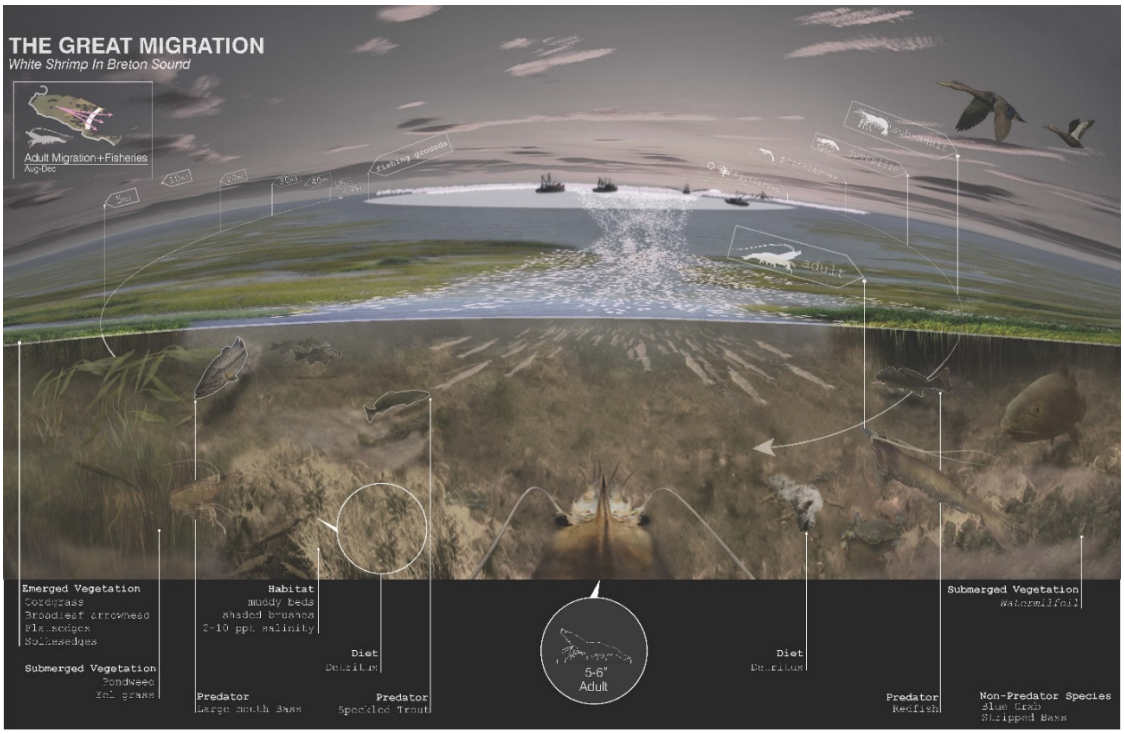

Figure 2. *Shrimp Eye View* showing the use of visual cues for multiple senses and narrative. Visualization by LSU Coastal Sustainability Studio.

In this drawing, the data conveyed are the life cycle of shrimp as they move through waters of different salinities and dangers, and habitat elements like food, predators, and shelter. The information about life cycle and habitat is from Louisiana Sea Grant and U.S. Fish and Wildlife service (Louisiana Sea Grant, n.d., Muncy, 1984). Currently, a common visual guide for showing how shrimp move through an estuary during its life cycle is a Louisiana State University Sea Grant poster, shows images of shrimp life stages superimposed on a simple plan-view map (Louisiana Sea Grant, n.d.).

Taking these resources, we added additional elements that take the abstract information of where shrimp are during different life stages and make it more visceral and meaningful to human systems using the visualization strategies. In *Shrimp Eye View*, visual cues for multiple senses include the realistic colors, textures, and scale of elements in the habitat scene such as the decaying detritus, murky water, and aquatic vegetation bending in the current. These elements help the viewer intuit relationships between elements that are reinforced through annotation.

Narrative is also employed in this image and is facilitated by the section cutaway, the unusual perspective, and the character elements. The section cutaway shows an active habitat scene with predators, shelter, and food, contextualizing the shrimp's environment, imbuing the image with signs of life, ambience, and relationships between elements. The unusual perspective, from that of a shrimp, also supports a narrative by priming the viewer to look for novel relationships in the image and draws the viewer's attention in to the world of the shrimp and its journey to the Gulf of Mexico. The character elements in *Shrimp Eye View* are the protagonist shrimp in the foreground, the cohort of shrimp migrating to the Gulf along a path, and the fishermen in the background (implied by the boats). These character elements, along with the perspective of the image helped us create a narrative of a journey, highlighting the distance and dangers with the foreshadowing of a dramatic scene at the end.

Through both using visual cues for multiple senses and supporting a narrative in the image, this drawing helps the viewer develop an intimate awareness of the needs and challenges of non-human living things in the system. This awareness of other perspectives within the shared system is intended to increase

the ecological understanding of viewers, enhancing their ability to make informed assessments about coastal management practices, which have the potential to cause unintended effects on the system.

By applying aesthetic qualities to ecological information, this visualization explores the intersection of ecological and human systems. It juxtaposes two perspectives of Louisiana shrimp: the ecosystem where white shrimp develop into adulthood and their harvest by fishermen for consumption and sale. This drawing helps to bridge conversations in coastal Louisiana between those advocating for the environment and fishing industry; both have a common interest in the shrimp, but view the species from different perspectives. By seeing the shrimp both as a creature that requires particular habitat conditions to grow and as a resource for human use, we can help expand the conversations of how aquatic resources are managed to better achieve sustainability goals.

4.3 Coastwide Reference Monitoring System Stations in Barataria Basin

The third drawing, *Coastwide Reference Monitoring System Stations in Barataria Basin*, uses a landscape scene to explain how Louisiana's Coastwide Reference Monitoring System Stations are used to collect a wide range of measurements about how the coast is changing. (Figure 3.) This drawing is intended to inform the public about data collection methods used by the CPRA to monitor long-term changes in soil, water, and vegetation across the Louisiana coast. The image provides context for the public to interpret the CPRA's data and also demonstrates the rigor the CPRA employs in monitoring and responding to issues facing the coast.

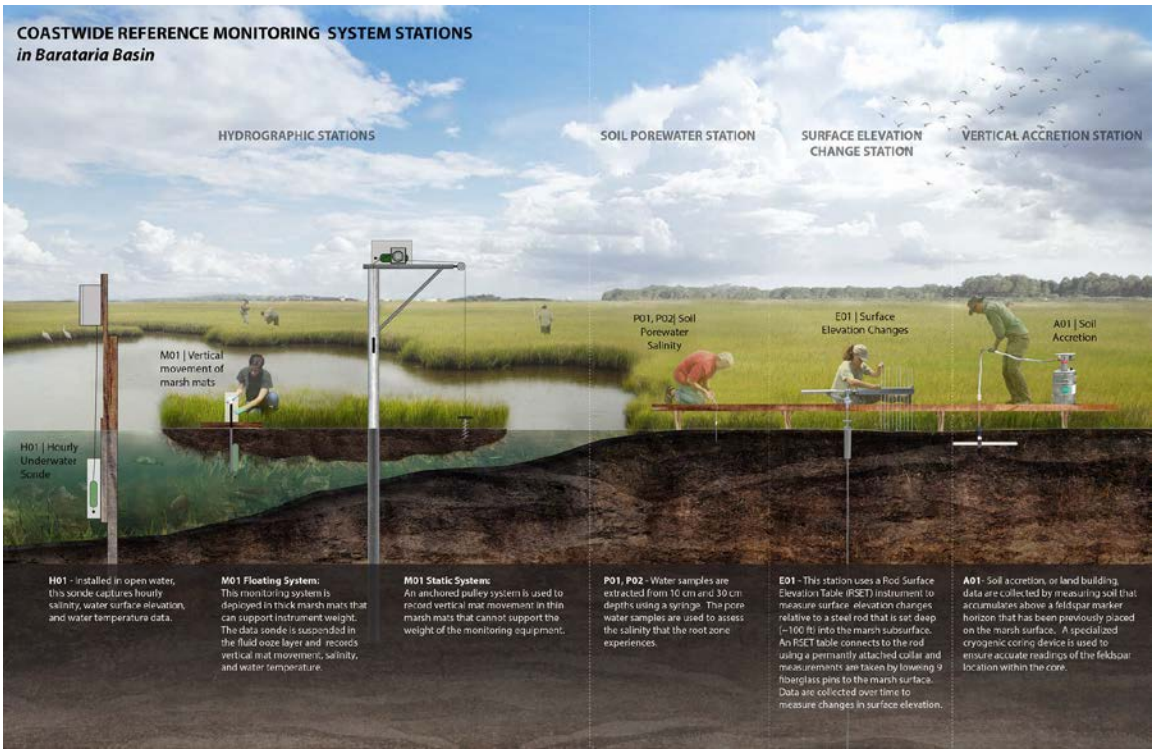

Figure 3. *Coastwide Reference Monitoring System Stations in Barataria Basin* showing the use of visual cues for multiple senses and narrative. Visualization by LSU Coastal Sustainability Studio.

The science conveyed in this drawing are the tools used to assess how the coast is changing, what the tools monitor, which data are collected, and what the data are used for. Existing resources for this information are the CRMS Fact Sheet (Steyer, 2010) and the CRMS website which provides data access (*Coastwide Reference Monitoring System*, n.d.). Visual explanations of how these tools work together to tell the story of coastal changes are limited to photos of individual data collection sites and maps showing how the stations are arranged.

Using these resources, we added aesthetic qualities that give the information meaning by using the visualization strategies of using visual cues for multiple senses and narrative. In *Coastwide*, the visual cues for multiple senses include the light quality, clouds, and still water surface that suggest a warm, still-weather, sunny day. Additionally, the material quality of the section showing sediment textures and underwater life add context for the tools allowing us to show the relationships between each tool and what it monitors in the environment. By showing in section what is otherwise unseen, we are able to improve the viewer's understanding of elements in the environment that are changing and how the CPRA's tools monitor that change. This understanding is intended to add meaning to the data that come from the monitoring tools.

Narrative is the second visualization strategy used in *Coastwide*, and it is integrated into the image both by compressing space and showing people in mid-action. In our drawing we show all of the station elements together in one scene, as if they are side-by-side. In reality, they are hundreds of feet apart. This compression of space allows us to better tell a narrative featuring the elements of coastal monitoring, highlighting the places where monitoring action occurs. We further amplify this narrative quality by showing people using the monitoring tools, giving the drawing signs of life and demonstrating that these tools are valuable to people.

5. CONCLUSION

What we have demonstrated in *The Growth of Louisiana's Delta, Shrimp Eye View,* and *Coastwide Reference Monitoring System Stations in Barataria Basin* are strategies for integrating visualizations of aesthetic experience with ecological and geological data. By incorporating visual cues for multiple senses, visual cues for process, and narrative we can convey relationships and engage the viewer's imagination. In doing this, we believe we can improve the public's ecological understanding of the science, data, and processes related to Louisiana's coastal land loss. Visually communicating this meaning is an interpretive step that we think is necessary for meaningful public engagement.

Testing the efficacy of the graphics produced through this method through focus groups would be a valuable next step. Specifically, input about the legibility, credibility, and impression of the work from people of different backgrounds would be important feedback into the design process as images are developed. Engaging the public in this way would help ensure that the intended message is understood, even if there are differences of agreement about the message. Often materials intended to engage the public are only reviewed by peers of those who produce the work, but the intended audience might not readily understand certain terminology, critical context, or graphic devices used in the presentation materials. A review would help ensure that the material makes sense to the intended audience. Additionally, a review would help designers learn what the viewers take away from the graphics, what issues are important to the viewers but not shown in the images, and what is inadvertently communicated that is off message. This research would help future development of visualization materials not only for coastal land loss in Louisiana, but for other large-scale environmental trends that require personal and political will to affect change.

In *Shifting Sites*, Kristina Hill writes, "sites are where the sciences and humanities meet" (Hill, 2005). This is what we are trying to show—how these systems are intertwined in coastal Louisiana in a way that relates to people's experience and inspires them to act.

6 REFERENCES

1. Coastal Protection & Restoration Authority. (2012). *Louisiana's comprehensive master plan for a sustainable coast*. Baton Rouge, LA: Coastal Protection & Restoration Authority.

2. *Coastwide Reference Monitoring System*. (n.d.). Retrieved from http://lacoast.gov/crms2/home.aspx.

3. Corner, J. (1996). *Taking measures across the American landscape*. Yale University Press.

4. Couvillion, B.R., Barras, J.A., Steyer, G.D., Sleavin, W., Fischer, M., Beck, H., … Heckman, D. (2011) *Land area change in coastal Louisiana from 1932 to 2010: U.S. Geological Survey Scientific Investigations Map 3164*, scale 1:265,000, 12 p. pamphlet.

5. Fisk, H.N. (1944). Geological investigation of the alluvial valley of the lower Mississippi River, Report to the Mississippi River Commission.

6. Frazier, D.E. (1967). Recent deltaic deposits of the Mississippi River: their development and chronology. *Gulf Coast Association of Geological Societies Transactions, 27*, 287-315.

7. Hill, K. 2005. Shifting sites. In C.Burns & A. Khan (Eds.), *Site matters: Design concepts, histories, and strategies* (131-156). New York, London: Routledge.

8. Hill, K. (May 10, 2013). *Shorelines spectacle: Aesthetic experience and infrastructure*. Presented at Louisiana State University, School of Art and Design, Coastal Sustainability Studio. Retrieved from http://coadmediasite.lsu.edu/mediasite/SilverlightPlayer/Default.aspx?peid=1ba7d51c4da64361ba3dee432c10b9ad1d

9. Hill, K., White, D., Maupin, M., Ryder, B., Karr, J. R., Freemark, K.…Schauman, S. (2002). In Expectation of relationships: Centering theories around ecological understanding. In B.R. Johnson & K. Hill (Eds.), *Ecology and Design: Frameworks for Learning* (271-304).Washington, Covelo, London: Island Press.

10. Louisiana State University Sea Grant. (n.d.) *The Life Cycle of a Shrimp*. Retrieved from http://www.lsu.edu/seagrantfish/biological/shrimpniche.htm

11. Mathur, A. & de Cunha, D. (2001). *Mississippi floods*. Yale University Press.

12. McLindon, C. (2015). *Rethinking coastal restoration: The delta cycle and land area change in the Louisiana coastal plain*. Retrieved from http://biotech.law.lsu.edu/climate/docs/The_Delta_Cycle_and_Land_Area_Change_in_Coastal_Louisiana.pptx

13. Milligan, B. (June 2015). Landscape migration. *Places Journal*. Retrieved from https://placesjournal.org/article/landscape-migration/

14. Misrach, R. & Orff, K. (2014). *Petrochemical America*. Aperture.

15. Muncy, R.J. 1984. *Species profiles: life histories and environmental requirements of coastal fisheries and invertebrates (Gulf of Mexico) – white shrimp.* U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers.

16. Oxford Dictionaries. (2016). *Aesthetic*. Retrieved from http://www.oxforddictionaries.com/definition/english/aesthetic.

17. Steyer, G.D. (2010). Coastwide Reference Monitoring System (CRMS): U.S. Geological Survey Fact Sheet 2010-3018, 2 p. (Revised August 2010).