Supplementary - Workshop Methods

S.1. Participatory Mapping Workshops

S.1.1 Study Objectives

Rapid population growth in coastal South Carolina is exerting considerable development pressure on rural areas, including Johns Island. The purpose of this research was to understand the ecosystem services (the services provided by nature that make human life both possible and worth living) found on Johns Island and to incorporate those ecosystem services into land change models. Long-term residents of Johns Island and those that identify as "Johns Islanders" through historic, cultural, and family affinity have valuable knowledge about the cultural, natural, and historic sites and resources (or "ecosystem services") of the island. This knowledge is disappearing as younger generations leave the island for economic opportunities elsewhere.

In the workshops, we asked participants to identify and describe the natural and cultural resources of the island and to locate these places on a map. Examples include fishing and hunting spots, locations where forest products or sweetgrass (used in basket making) are harvested, sites/buildings of historic and/or cultural importance, locations of community events, etc. The input from participants will help the research team to understand what about Johns Island is important to long-term residents and why. In the second phase of research, we will identify potential instruments for conserving the ecosystem services provided by natural ecosystems and working landscapes on Johns Island (e.g., conservation easements). This study will provide spatially explicit (mapped) data about ecosystem services, including cultural services, as well as information about the matching or mismatching patterns between development and protection of services. Mapping of ecosystem services can inform urban and conservation planning and could provide a way to incorporate stakeholder input into decision-making processes. This research will further identify local preferences across different conservation instruments to preserve those ecosystem services.

S.1.2 Workshop Protocol

Through a series of three workshops, study participants were asked to identify and describe the natural and cultural resources of Johns Island and to locate these places on a map. Participants were asked to provide feedback about the acceptability and feasibility of different growth/development scenarios and to evaluate trade-offs between scenarios. Each workshop took 2-3 hours, followed by a provided lunch or dinner, for a total study duration of 6-9 hours. Workshops took place at the community center of Wesley United Methodist Church and the Johns Island Public Library; both spaces are commonly used for public meetings on Johns Island. Each workshop started with the Principal Investigator (PI) describing the project and

asking for verbal consent.

In workshop #1, participants identified and mapped the cultural, natural, and historic resources of Johns Island (i.e., what's important on Johns Island and why?). Paper maps, digital maps, and 3-D renderings of Johns Island were provided to aid in identifying locations. In workshop #2, participants reviewed the cultural and natural resources of Johns Island that they identified in workshop #1 and were asked to rank the importance of these resources, both as individuals and as members of the community. The PI and research assistants introduced the FUTURES land change model (see Section S.2 below) and showed preliminary results of development simulations, highlighting areas likely to be developed in the future and the natural and cultural resources at risk. Participants provided feedback on the development model and were asked for their input in developing new scenarios for the FUTURES model. This ensured that participant values, questions, and concerns were included in the next round of FUTURES simulations (workshop #3). Based on scenario outputs, participants were asked once more in workshop #3 to identify cultural, natural, and historic resources (or ecosystem services) and discuss the state of those resources under different scenarios.

Multiple forums for participation were implemented to ensure that single voices didn't dominate the conversation. Participants mapped locations through a) GIS interfaces (with a facilitator), b) by identifying locations on a 3D surface, and c) by placing stickers on paper maps. Mapping was done both individually and in small groups. Participants also answered open-ended questions (e.g., "What parts of the island are important to preserve for future generations?") individually (recorded on paper), in small groups (recorded on paper), and by "reporting out" to the entire group. Small group reports were followed by whole group discussion.

S.1.3 Workshop Participants

Workshop participants were those who self-identified as "Johns Islanders". These are individuals who have ancestral ties to Johns Island (parents or grandparents lived on Johns Island) and feel a historic, cultural, and/or family affinity for Johns Island. Workshops #1 and #2 had 21 and 26 participants respectively. Of those participants who chose to provide demographic data (62% in workshop #1 and 77% in workshop #2), 91% resided on Johns Island and 90% owned property on the island. Workshop participants were 43% women and 57% men. Participants ranged from 34 to 89 years old, with an average age of 62.

The Lowcountry Land Trust and the Center for Heirs' Property Preservation, two nonprofit partner organizations based in Charleston, SC, identified and invited workshop participants. These nonprofits have longstanding and productive relationships with Johns Island residents. Recently, the Lowcountry Land Trust in cooperation with the Progressive Club (a historic civil-rights organization that is being revitalized as an island cooperative) and other partners came together to protect the Angel Oak, an iconic historic and cultural site, and the surrounding land.

Participants were not offered compensation for participating in the workshops. Participants may consider maps of the natural and cultural resources of the island, as well as maps of different development scenarios, as direct benefits of participation. All project map outputs and aggregate summary data were shared with participants. Indirect benefits will be in the form of increased knowledge about cultural, natural, and historic resources and possible impacts to these resources under different scenarios of growth and development.

S.1.4 Workshop Facilitators

Workshops were facilitated by faculty and graduate students from North Carolina State University (research team) and staff from the Lowcountry Land Trust, a local non-profit organization and community partner. There are no relationships between the research team and participants.

S.2. The FUTURES Model

The FUTure Urban-Regional Environment Simulation model (FUTURES) [1] is an open-source land change model run through several modules in GRASS GIS [2]. Multi-level, spatially-explicit land change processes are simulated through three sub-models: 1) DEMAND, which specifies the amount of per capita land change, 2) POTENTIAL, which estimates locations of change based on site suitability factors, and 3) a Patch Growing Algorithm (PGA), which simulates the spatial pattern of land change through a stochastic algorithm. By representing realistic spatial patterns of land change, FUTURES is designed to help stakeholders evaluate and visualize alternative scenarios of landscape change [3, 4, 5]. Validation of FUTURES shows that simulated patterns of land change better agree with empirical observations compared to other modeling frameworks, based on metrics of quantity, allocation, and landscape configuration [6]. Up-to-date step-by-step instructions for calibrating and running FUTURES through open source GIS may be found at:
https://grass.osgeo.org/grass74/manuals/addons/r.futures.html.

We ran FUTURES under three development scenarios: one scenario continuing the region's business-as-usual policy for development and two alternative scenarios of increased development density (moderate and aggressive). For the business-as-usual scenario, we calibrated the model to reproduce the quantity, allocation, and configuration of land change that occurred since the early 1990s. Our application of the model on Johns Island continued these trends in urban and rural development over a 50-year period (2010 - 2060). Stakeholders used the business-as-usual simulation as the primary reference for comparison to the land change scenarios with increased development density. Following Dorning et al. 2015 [3], we simulated the scenarios of increased development density by raising the patch-growing

algorithm's (PGA) incentive parameter to a power of two for moderate infill of development and a power of three for aggressive infill. All other parameters of the model were held constant.

References

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