Using Spatial Analysis in the Study of Mississippi and Alabama Fisheries

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The profession of urban planning would not be possible without spatial analysis and comprehensive mapping. Maps allow planners to recognize statistically important patterns and relationships that occur within a city. Individuals who compile information from the content of a map by either finding patterns, assessing trends, or making decisions are engaged in the process of spatial analysis.[1] Spatial analysis can be used to determine the redevelopment potential of a land parcel or to determine the size of a watershed.

Coastal communities that engage in spatial analysis can ascertain sites that have close proximity to an abundant array of marine life. They can also utilize numerous decision support tools that can enhance a city's spatial analysis capabilities and improve coastal policymaking with respect to fisheries. By utilizing the full capabilities of GIS software, coupled with decision support tools from governmental partners and NGOs, coastal communities can attain a better understanding of their local fisheries.

An Examination of the GIS Mapping Approach

The evolution from simple navigation charts to the full digital displays made by Geographic Information System (GIS) software is a fascinating history. One innovation that is key to the development of modern GIS is the use of overlays. The practice of creating map overlays gained increasing acceptance in the early and mid-20th century. For example, Sanborn Fire Insurance Maps would create paste-on correction slips.[2] When significant change occurred within a city, such as a new building, a correction slip would be layered onto an existing map and then annotated in a correction record. These slips would effectively keep the map's coverage current. Such a development also signified a move away from perceiving a map as a single, static document towards an interactive tool for documenting change within a complex system like a city.

By the 1950's the concept of map overlays was further expanded with the adoption of transparent map overlays. In the 1967 book *Design with Nature*, Landscape Architect Ian McHarg described how transparent map overlays could be a critical tool for urban and environmental planning. The idea was that different transparent plastic sheets, each containing a unique layer of map information for the same geographic area, could be layered on top of each other to allow cartographers to view several unique maps at the same time.

With the advent of computers, transparent plastic sheets soon gave way to distinct digital layers, which represented individual map themes.[3] By using digital layers, many aspects of the mapmaking process could be easily automated. For example, the Coastal Alabama Restoration Tool collates several different layers of habitat and water quality data into one single online portal.[4] The layers can be viewed online without the need for GIS software, and many of the layers include information on water quality and land coverage. Website users can use the tool to compare past locations of oyster reefs with more modern data on oyster reef distribution. An understanding of GIS map layers, coupled with knowledge on marine ecosystems, can greatly enhance knowledge of local fisheries.

Developing a Suitability Analysis for Coastal Applications

Though land suitability studies have gained increasing acceptance in local planning departments with the rise of GIS, land suitability analysis has been an important component of the planning practice since it was first popularized by Mr. McHarg in the 1960's.[5] A suitability analysis is an approach commonly used by planners, real estate officials, and other land development professionals to determine the ability of a piece of land to support a specific type of land use.[6] There are multiple approaches

one can take to developing a suitability analysis, but one approach that is prized for its flexibility and mathematical simplicity is the rules of combination approach.

The rules of combination approach is a model that most closely emulates the land suitability methods used by Mr. McHarg. In this approach a planner assigns each factor high, moderate, and low suitability ratings. Rather than adding the rankings together, under the rules of combination approach, "the planner decides to establish rules for combining different rankings for each factor to determine level of land use suitability".[7] Consider, for example, a community that needs to analyze the suitability of land to support a new manufacturing operation. A piece of land that has high proximity both to highway and to water/sewer lines could be assigned a high suitability rating. A moderate suitability rating could be assigned to land that has high proximity either to highway or to water/sewer lines. Finally, a low suitability rating could be assigned to a piece of land that does not have high proximity to highways or to water/sewer lines. This method gives communities the option to weigh the importance of specific suitability factors. It also avoids the political pitfalls of more mathematically complex suitability models because it openly acknowledges that the suitability factors are a value judgment made by planners.

In Ohio's Lake Erie region, a comprehensive suitability analysis was used to guide watershed planning efforts. Confronted with water pollution problems coming from non-point sources, the Ohio Lake Erie Commission produced Watershed Balanced Growth Plans. These advisory plans identified priority development areas and priority conservation areas within the Lake Erie region. One watershed in particular, Chippewa Creek, worked with the Commission to develop a methodological framework for implementing balanced growth plans. The framework chosen was a land suitability analysis that employed the rule of combination approach. In total, three separate suitability analyses were devised for the watershed region for: development, conservation, and agriculture. Different suitability factors were utilized for each analysis. For example, the conservation suitability analysis looked at wetlands, FEMA floodplain data, riparian corridors and infiltrative capacity of land. After all these factors were aggregated, a GIS map was produced showing five different land suitability rankings, ranging from very low to very high. Coupled together with the two other land suitability studies, communities in the watershed can use the suitability analyses to guide zoning and land development.

A major hurdle with watershed planning is that watersheds often span multiple jurisdictions. This means that land use decision-making is often split between multiple cities with different zoning rules and regulations. By pursuing a suitability analysis for a major watershed, communities can consult a common tool for guiding zoning maps and districts. Also, because the suitability analysis allows for the inclusion of multiple suitability factors, coastal communities can choose to include factors that are unique to coastal regions. For example, a coastal suitability study might designate proximity to marinas as a high suitability factor in determining where urban development is prioritized.

A suitability analysis can also be used to inform shoreline restoration practices within a coastal region. In North Carolina, a suitability analysis was conducted in the New River Estuary to ascertain which stretches of shoreline would be conducive to the installation of living shorelines.[8] For this study, a shoreline shape file was converted to points 50 meters apart. Each point was evaluated according to its wave energy input from wind waves and boat wakes, along with its distance to the nearest natural shoreline, assigning wave energy scores of 0, 5, or 10. Each point on the shoreline was assigned either a score of 0 or 10 for proximity to natural marsh shoreline. After scores for each attribute were collected, cumulative scores were tallied for each point. Shoreline points with a score of 0-5 were not recommended for living shorelines, while sites that scored 10, 15, or 20 were considered suitable for hybrid living shorelines, and scores of 25 or 30 indicated points where marsh vegetation alone or marsh with oyster was recommended.

In Louisiana, suitability analysis has even been used in evaluating existing and future habitat conditions of key marine species in coastal Louisiana. As part of Louisiana's Comprehensive Ecosystem Restoration Plan, 12 habitat suitability studies were developed for critical marine species such as brown shrimp, American oyster, and Gulf menhaden.[9] These studies provide insight into how comprehensive restoration decisions undertaken by the state of Louisiana may affect commercially important marine species going into the future.

Decision Support Tools for Local Fisheries

Over the years, there have been numerous decision support tools and applications developed by coastal scientists, planning bodies and NGOs that can take a lot of guesswork out of mapping marine assets and coastal attributes. One application that is of considerable value for Alabama and Mississippi coastal communities is Gulf TREE, because it provides a summary snapshot of the different digital support tools that exist for coastal resilience.[10] The application was developed through a collaborative partnership between the Northern Gulf of Mexico Sentinel Site Cooperative and the Gulf of Mexico Alliance in order to assist local stakeholders in finding climate support tools. A quick, filtered search in Gulf TREE of Mississippi and Alabama for free decision support tools yields 65 results and is indicative of the wide range of technical support and assistance that exists for coastal jurisdictions.

One tool that can be applied to an in-depth analysis of seafood harvesting is the collection of community snapshots compiled by NOAA Fisheries.[11] This digital tool catalogs the qualities and characteristics of major fisheries from across the nation. For example, a summary snapshot of Bayou La Batre, Alabama indicates the general size of commercial boats within the fishery and lists the top species landed by commercial fishermen. The snapshot tool can also provide insight into the how a local fishery compares to other nearby fishery communities. Such information would serve as a good foundation for any comprehensive mapping exercises a city undertakes to understand its local seafood economy.

Spatial analysis of local fisheries should consider the vulnerability of infrastructure. Fortunately there are support tools that can assist coastal communities in assessing infrastructure vulnerability. One of these tools is the Flood Vulnerability Assessment Map developed by the U.S. Energy Information Administration. By utilizing the flood vulnerability assessment map, coastal communities can determine what properties are within a FEMA designated flood zone.[12] The flood vulnerability map also notes the location of offshore oil platforms, which are areas of critical concern for fisheries in the northern Gulf of Mexico.

Another vulnerability factor coastal communities must contend with is sea level rise and one tool that can aid spatial analysis in this area of concern is NOAA's sea level rise viewer. By accessing the sea level rise viewer, coastal communities can analyze various sea level rise scenarios and how they may affect critical infrastructure going into the future.[13] Visitors to the sea level rise viewer are given the option of viewing sea level rise impacts under different scenarios ranging from as low as one foot to as high as 10 feet of sea level rise. Although the viewer is not accurate enough at the parcel level to inform planning regulations and zoning, its ease of use and different ranges for sea level rise make it an effective public outreach tool for getting a handle on coastal vulnerability.

Conclusion

Valuable data on the size of commercial fishing craft and the vulnerability of local infrastructure to coastal hazards can serve as a good starting point for a comprehensive planning report on local fisheries. By deploying decision support tools in the spatial analysis process for local fisheries, coastal communities can improve their knowledge and understanding of the marine ecosystem and apply policy solutions that are appropriate to the needs of local fishers.

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Endnotes

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