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Identifying shared priorities for a bioregional approach to restoration in the Northern Gulf of Mexico

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Natural resource management is often challenged with a mismatch between the scale of decision-making and the scale of the biological, ecological, and physical processes that control a system. Bioregional approaches to adaptive management have emerged as an approach to inform natural resource management at ecologically relevant scales and across multi-level governance structures. The implementation of adaptive management requires the determination of ecological and social priorities that can inform a desired system state across multiple governing bodies. We use the Northern Gulf of Mexico, United States, as a case study for a bioregional approach to adaptive management and illustrate a method for developing objectives and management priorities across programs and jurisdictions. Through this synthesis, using qualitative coding methods to develop a shared vocabulary across the diverse dataset, we identified commonalities and differences in ecological and human community priorities across the five states which line the Northern Gulf of Mexico. Using these shared priorities, we conceptualize a network of priority-focused objectives as a starting point for further stakeholder engagement and effectively monitoring and evaluating progress across boundaries. This approach serves as a framework for cross-program adaptive management by illustrating a desired system state that reflects the shared priorities among decision-making authorities in this region and offering individual programs or projects a method to articulate their contributions to the broader set of shared priorities Gulf-wide. This method can be used by restoration managers in any region of the world to align project objectives within cross-jurisdictional boundaries and illustrate the value of a bioregional approach to restoration.

KEYWORDS

adaptive governance, adaptive management, decision analysis, ecosystem restoration, stakeholder engagement, social-ecological priorities, value-focused framework

Introduction

Natural resources decision-making can be a challenging process, hindered by uncertainty about how an ecosystem might respond to management actions. These decisions can be further complicated when multiple, competing objectives among stakeholders are present and social-ecological interactions are occurring beyond the jurisdictional bounds of the decision-making authority. Adaptive management provides a process to integrate multi-stakeholder objectives and reduce critical uncertainties over time as outcomes become better understood through monitoring and explicit learning (Williams et al., 2009). Foundational to the adaptive management process is the establishment of "fundamental" and "means" objectives. Fundamental objectives are the foundational and aspirational values, referred to in this paper as priorities, that the decision maker and stakeholders aim to achieve, while means objectives serve as the mechanism to achieve the fundamental objectives (Keeney, 1992). Eliciting these priorities can be a starting point for establishing fundamental objectives to determine what stakeholders hope to achieve (Keeney, 1992; McDaniels, 2000). As alternative approaches are devised to determine which are best suited for achieving the collective suite of objectives, tradeoffs may emerge among competing objectives. Adaptive management lends itself to explicitly exploring these competing objectives and the tradeoffs that result, in a transparent way (Williams et al., 2009).

Although adaptive management is an approach for complex decisions, challenges exist in applying adaptive management to ecosystem-scale problems. Biological, ecological, and physical processes influencing or influenced by management decisions are often operating on scales that cross political, jurisdictional, social, and decision-making boundaries. Further, management entities and programs often do not have the resources or authority to holistically address the management, conservation, and restoration decision-making needs of an ecosystem. Decisions being made across jurisdictional boundaries seldom connect in a way needed for broad-scale ecological management (Cumming et al., 2006). The mismatch between the scale of decision-making and the scale of the biological, ecological, and physical processes that control a system can lead to mismanagement of systems and inadequate monitoring frameworks (Cash and Moser, 2000; Cumming et al., 2006; Beever et al., 2019; National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). Furthermore, implementing and monitoring restoration at only site- or project-levels fails to understand cumulative impacts across a landscape, such as improvements to ecosystem services or function (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). For example, local landowners can play a part in keeping their segment of a watershed ecologically healthy, but to achieve a well-functioning ecosystem, solutions may need to be coordinated on a regional scale (Cumming et al., 2006). Failure to address this mismatch can lead to unintended negative consequences such as disruption of ecosystem function. Adaptive management is an example of a flexible framework where priorities (i.e., objectives) and possible solutions (i.e., alternatives) can be updated with new information (Cash and Moser, 2000).

To address this challenge, new approaches to adaptive management have emerged, including collaborative adaptive management, adaptive governance, and adaptive co-management (Folke et al., 2005; Susskind et al., 2012; Beratan, 2014). These approaches have been proposed as frameworks in which collaborative networks (e.g., agencies, stakeholders) can provide new information for resource management across a multi-level governance structure at a bioregional scale (Chaffin et al., 2014 and references therein). Some of the outstanding questions related to implementation of bioregional approaches include how to determine a suite of ecological and social priorities for informing the desired state and how to facilitate collaboration in settings with multiple governing bodies (Huitema et al., 2009; Chaffin et al., 2014). Understanding the underlying priorities of stakeholders and decision makers across management entities and scales can inform dialogue about the development of cross-jurisdictional fundamental objectives and in doing so, illustrate how management efforts at local scales fit into a bioregional framework. This shift to coordinated restoration also provides opportunities to address increasingly complex social-ecological system dynamics, resulting in better informed decisions (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022).

In the Northern Gulf of Mexico, restoration programs resulting from the 2010 Deepwater Horizon (DWH) oil spill are implementing restoration activities within the same geographic space and within overlapping time frames, yet through independent decision-making processes. The magnitude of funding, number of decision-making entities, diversity of stakeholders, and complexity of injuries to the ecosystem could benefit from a formal decision process that utilizes best-available science to achieve the holistic ecosystem restoration called for by the restoration programs. Without establishing concerted efforts – and clear authority – to coordinate restoration across programs, synthesizing progress across the region will remain elusive (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). In addition to the DWH restoration programs formed after the oil spill, agencies and other entities have long been conducting restoration in the region in response to ongoing threats to the region's extensive ecological services (e.g., productive fisheries and aquaculture, energy industry infrastructure, nature-based recreation and tourism), such as increasing frequency and intensity of storms, sea-level rise, coastal erosion, and coastal wetland loss. These entities often have existing management plans, guided by their local stakeholders and governing leaders, that articulate their jurisdictional priorities. Although these restoration programs

do not have the authority to transcend decision-making across jurisdictional boundaries, we suggest that programs can use these articulated objectives to inform dialogue with regional partners and stakeholders to collaboratively identify shared restoration goals that are more closely aligned with biogeophysical scales within which they are operating.

Creation of a bioregional approach to restoration in the Northern Gulf of Mexico begins with the development of an explicit understanding of objectives and management priorities across programs and jurisdictions and identify common metrics to measure progress and communicate accomplishments. Several methods are being employed in this area, such as developing targets for programmatic objectives, tracking and communicating progress toward those targets in programmatic reports, or developing a report card to showcase progress in an accessible format (Deepwater Horizon Natural Resource Damage Assessment Trustees [DWH NRDA], 2021). The goal of this process will encourage the identification of commonalities and differences in objectives and management priorities and allow for the co-creation of a network of restoration objectives to set a framework for cross-program adaptive management. Each program or project can then more fully understand their individual contributions to the broader set of shared priorities Gulf-wide.

In this study, we aim to establish a method for identifying objectives that are included in multiple governance structures. The goals of this article are to: (1) demonstrate a method for identifying shared objectives across adaptive management programs and political jurisdictions; (2) identify common priorities across decision-making authorities and scales; (3) examine how funded restoration projects contribute to common priorities, and (4) illustrate how the identified priorities can be used alongside further dialogue and stakeholder engagement to generate a shared, objective-hierarchy network that can guide the implementation of a bioregional approach to adaptive management.

Materials and methods

Our study area is the five states that border the Gulf of Mexico in the United States: Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 1**). This area of the United States was impacted by the 2010 Deepwater Horizon oil spill, is receiving billions of dollars for restoration (Deepwater Horizon Natural Resource Damage Assessment Trustees [DWH NRDA], 2016; Gulf Coast Ecosystem Restoration Council, 2016), and thus serves as an excellent test case for exploring a bioregional approach to adaptive management. We used state-based management plans as our source for identifying existing objectives and priorities across the Northern Gulf of Mexico states and compared shared priorities to those in restoration projects funded in the Gulf Coast Ecosystem Restoration Council's initial funded priorities list (Gulf Coast Ecosystem Restoration Council, 2015). This approach of using guidance documents, approved by senior decision makers, has previously been referred to as the "gold standard value model" (Parnell et al., 2013) and has been used in similar efforts to identify objectives and priorities (McDaniels et al., 2006; Carriger et al., 2015; Samiappan et al., 2019). Management plans often employ stakeholder participation to arrive at goals and objectives, actions, and desired outcomes, and would, therefore, be likely to represent shared priorities across the diverse geography of the Northern Gulf of Mexico region.

Hundreds of plans from communities and agencies have been developed over the last several decades in the Northern Gulf of Mexico region (Samiappan et al., 2019). Referencing the Strategic Conservation Assessment's Conservation Planning Inventory Tool,[1] we identified management plans that met our criteria for inclusion:

- Plans written after the Deepwater Horizon oil spill in 2010 because they would be more likely to represent the current needs of the ecosystem and present-day decision-making authorities than those developed before the oil spill.
- Plans written by an agency or entity that has authority to conduct, direct, or guide restoration in the region or plans signed by the governor as indication of broader political support.
- Plans representative of broad, spatial scales, such as coastal zones or the entire state, because they would be more likely to contain objectives that reflect input from a larger array of stakeholders, than plans developed at a county-level or local community scale.

The resulting 29 management plans represented the following plan types:

- State wildlife action plans: Address the strategies to conserve species of greatest concern in the habitats found within an entire state.
- State outdoor recreation plans: Address the nature-based recreational needs of a state.
- Sea Grant strategic plans: Address the goals of the state's Sea Grant entity toward ocean and coastal health.
- Coastal and Estuarine Land Conservation program plans: Address the use of funds to purchase threatened coastal and estuarine lands or obtain conservation easements.
- Coastal Area Management program plans: Address strategies to balance competing land and water issues.
- Comprehensive plans: Address issues relevant to the entire state and commissioned by a governor (such a plan was located for all states except Florida).

1 https://www.quest.fwrc.msstate.edu/sca-project.php

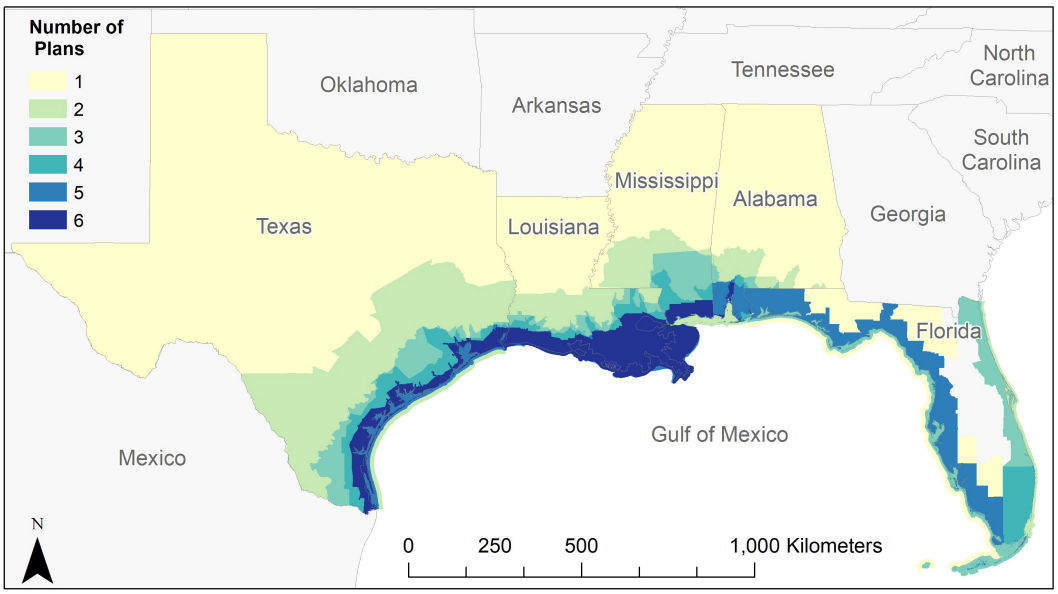

FIGURE 1
Management plans often overlap in geographic scope, presenting managers with the challenge of considering multiple priorities in decision-making. Because restoration projects funded by the RESTORE Council focus primarily on coastal and offshore areas of the Gulf of Mexico region, management plan content considered for this project was narrowed in geographic scope to the coastal areas shown on the map. The darker blue areas on the map indicate locations within our study area which all selected management plans address.

Table 1 shows management plans from five Gulf States selected for this study.

The resulting management plans serve as a representative sample of existing objectives and priorities but are not intended to represent a comprehensive inventory of all objectives and priorities in every state. We analyzed the content of the plans in MaxQDA (VERBI Software, 2019) using the qualitative method, coding. Coding has wide applicability to research involving thematic synthesis of qualitative data, often from stakeholder interviews, literature content, or other non-numerical data sources (Braun and Clarke, 2006; Atkins et al., 2008; Barnett-Page and Thomas, 2009; DeCuir-Gunby et al., 2011). The coding method involves assigning descriptive terms, called codes, to phrases, sentences, or paragraphs within a body of text. Codes can be deductively or inductively identified, meaning they are either pre-determined or are identified during the coding process, respectively, and it is common to utilize both frames in a single study (Aronson, 1995; Hsieh and Shannon, 2005; Whittemore et al., 2014). The codes serve as a standardized vocabulary and when applied across diverse content, allow an end-user to identify common themes as well as nuances within complex information, despite the wide range of writing styles and terminology in the content.

To identify themes in our selected management plans, we first identified sentences in each document that contained terms such as "goal," "purpose," "objective," or other similar terms that allude to the fundamental objectives of the plan. These statements were assigned the code "Fundamental Objective," along with additional descriptive codes that best reflected the priority being communicated in the sentence. For example, in the sentence, "It is the goal of this Resiliency Plan to promote a strong economy and healthy environment for all who live, work, play or otherwise benefit from the natural resources and infrastructure along the Texas coast." The codes "Economy," and "Ecosystem Health" were applied alongside "Fundamental Objective." We then expanded the analysis and investigated the remaining text for statements that alluded to priorities of a plan not already captured in the "Fundamental Objectives." The coding terminology evolved as content was reviewed to ensure the final coding terminology accurately reflected the broad application in which codes were applied. The resulting coding terminology and process was then applied to all 49 projects from the RESTORE Council's Funded Priorities List 1 (FPL1) to assess how funded restoration projects align with shared priorities. For each project, we identified reoccurring concepts in the project descriptions, goals, and objectives provided by the project implementer (e.g., principal investigator) for project proposals and data management plans, available online and shared with our research team by RESTORE Council staff, respectively (Gulf Coast Ecosystem Restoration Council, 2015). To address inter-rater reliability and minimize bias during the coding process, two researchers independently coded a portion of the dataset, discussed differences in coding, then proceeded with the agreed upon application of the code tree. Data can be found in Guilbeau et al. (2021).

TABLE 1 List of management plans (n = 29) from five Northern Gulf of Mexico states that were reviewed for this qualitative analysis.

Plan category	Texas	Louisiana	Mississippi	Alabama	Florida
Comprehensive plan	(Texas General Land Office [GLO], 2019)	(Louisiana Coastal Protection and Restoration Authority [CPRA], 2017)	(Mississippi Department of Environmental Quality [DEQ], 2013)	(Coastal Recovery Commission of Alabama, 2010)	N/A
Wildlife action plan	(Texas Parks and Wildlife Department [TPWD], 2012)	(Holcomb et al., 2015)	(Mississippi Department of Wildlife Fisheries and Parks [WFP], 2016)	(Alabama Department of Conservation and Natural Resources, and Division of Wildlife and Freshwater Fisheries [DCNR], 2015)	(Florida Fish and Wildlife Conservation Commission [FWC], 2019)
Outdoor recreation plan	(Texas Parks and Wildlife Department [TPWD], 2017)	(Louisiana Department of Culture, Recreation, and Tourism [CRT], 2014)	(Mississippi Department of Wildlife Fisheries and Parks [WFP], 2015)	(Alabama Department of Economic and Community Affairs [DECA], 2013)	(Florida Department of Environmental Protection [DEP], 2019)
Sea grant strategic plan	(Texas Sea Grant, 2018)	(Sea Grant Louisiana, 2014)	(Sea Grant Mississippi-Alabama, 2012)	(Sea Grant Mississippi-Alabama, 2012)	(Florida Sea Grant College Program, 2018)
Coastal and Estuarine Land conservation plan	(Texas General Land Office [GLO], 2010)	(Louisiana Department of Natural Resources [DNR], 2011)	(Mississippi Department of Marine Resources [DMR], 2015)	(Alabama Department of Conservation and Natural Resources, and State Lands Division [DCNR], 2006)	(Florida Coastal Management Program [CMP], 2013)
Coastal area management plan	(Texas General Land Office [GLO], 2015)	(Louisiana Department of Natural Resources, Office of Coastal Management [DNR-OCM], 2016)	(Mississippi Department of Marine Resources [DMR], 2015)	(Alabama Department of Conservation and Natural Resources, and State Lands Division, Coastal Section [DCNR], 2017)	(Florida Coastal Management Program [CMP], 2015)

Results

Within the state management plans we reviewed, we identified 157 instances of "Fundamental Objectives" (TX = 33, LA = 44, MS = 31, AL = 25, and FL = 24), or explicitly stated priorities. Additionally, we identified 9,379 references to implicitly stated priorities found elsewhere in the plans (TX = 1520, LA = 2717, MS = 2095, AL = 1936, and FL = 1111). In the 49 projects from the RESTORE Council's Funded Priorities List 1 (FPL1), at least 1 fundamental objective was identified for each project, and an additional 440 priorities were found within the remaining project descriptions.

In addition to identifying priorities within selected management plans, we identified 123 metrics within 12 of the 29 plans. The number of metrics found within a single plan ranged from one to 29, with 17 of the plans having no identified metrics. Most of these metrics were found within Sea Grant plans from all five states (N = 70, 57%). The remaining metrics were identified in 4 of the remaining 5 plan types (Coastal Management plans = 6 in 2 states; Comprehensive plans = 8 in 1 state; Outdoor recreation plans = 10 in 2 states; Wildlife action plans = 29 in 1 state). No metrics were identified in any of the Coastal and Estuarine Land Conservation program plans.

Below we explore both the shared and competing priority themes found within and across these state management plans and restoration projects.

Shared priorities

The coding process resulted in four overarching themes: "Ecological Priorities," "Human Community Priorities," "Stressors," and "Strategies." Priorities related to natural resources or processes were assigned to "Ecological Priorities," while those related to social-economic concepts fell under "Human Community Priorities." Although the initial effort focused on identifying shared priorities, numerous stressors emerged in the content analysis that alluded to degradation of natural resources or other inhibitors to restoration and management progress; the "Stressors" overarching theme was created to capture and analyze that content. Finally, management actions and approaches to restoration were assigned to "Strategies."

Ecological priorities

When analyzing the fundamental objectives of selected management plans for themes, we determined all the Gulf States share ecological priorities regarding "Ecosystem Health," "Ecosystem Service," "Habitat," and "Water" (**Table 2**). This finding indicates, not surprisingly, an interest across the geography in the overall function and benefit of a healthy ecosystem. Perhaps because fundamental objectives often represent the high-level intention of a management plan, we did not identify any shared priorities at a more granular specificity. When analyzing priorities outside of fundamental objectives, we found "Wildlife" to be an additional ecological priority. In fact, when considering management plan content outside of the fundamental objectives, "Wildlife" and "Habitat" represented the most frequently observed themes by far. There is not, however, a shared wildlife priority (e.g., amphibians, birds) or habitat priority (e.g., wetlands, forest), perhaps because of the vast diversity of ecosystems and taxa across the region. In other words, specific wildlife and habitat priorities appeared in management plans across all five states, but in varying frequencies and not consistently within all plan types. For example, upland or bottomland forest habitats were prioritized

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TABLE 2 Shaded cells represent themes present in at least one segment coded as "Fundamental Objectives" across each of the Gulf States.

Overarching theme	Specific theme	Texas	Louisiana	Mississippi	Alabama	Florida
Ecological priorities	Ecosystem health	■	■	■	■	■
	Ecosystem service	■	■	■	■	■
	Habitat	■	■	■	■	■
	Natural processes	■	■	■	■	
	Water	■	■	■	■	■
	Wildlife	■	■		■	■
Human community priorities	Connection with nature	■	■	■	■	■
	Economy	■	■	■	■	■
	Human communities	■	■	■	■	■
	Infrastructure	■	■	■	■	■
	Management values	■	■	■	■	■
Stressors	Habitat degradation					■
	Harmful natural processes		■			■
	Human vulnerability		■			
Strategies	Enhance economic resiliency			■		
	Enhance hazard mitigation and response		■	■	■	■
	Enhance public engagement	■	■	■	■	■
	Improve planning and assessment		■	■		■
	Protect and conserve habitat				■	

throughout the region, but more so in Mississippi and Alabama (42.1 and 28.3% of all "Forest" segments, respectively) than in Texas, where we only see 5.5% of "Forest" segments.

Human community priorities

Within priorities related to human communities, we found "Management," or segments generally referring to factors that are important to successful implementation of an effort, used by decision-makers or those in power, to be the most frequently occurring theme (Table 2). Analyzing more specific themes here, we found shared priorities within fundamental objectives to include "Stakeholder Engagement," "Coordination and Collaboration," and "Adaptive Management," for example, although at varying frequencies across management plans. The issue of varying degrees of frequency occurred in other themes, such as with "Connection with Nature." This theme was found across all five states, but when analyzed for more specificity, shows "Recreation," for example, appeared in all five state's Outdoor Recreation Plans, although not consistently in the other state management plans. "Economy" was a shared priority within fundamental objectives, as well. "Seafood Industry," "Workforce Development," and "Tourism" all appeared as shared economic priorities across the region, although in varying degrees across plan type. Interestingly, we saw similar patterns when we expand our analysis to all plan content. Additional shared priorities which surfaced included "Comprehensiveness," or references to multi-level, interdisciplinary, or holistic planning, restoration, or other implementation of other efforts and "Accessibility" or references to the degree to which an individual can reach or use a natural area; this theme was often used in reference to increasing accessibility to a park or coastal area for recreational purposes. Again, although these themes did occur within all states across the region, they are not necessarily in every plan type within each state.

Stressors

Because fundamental objectives within management plans are often focused on priorities within the scope of the plan, we did not find any shared stressors in our analysis of fundamental objectives. Only two plans from Louisiana and Florida mentioned the stressor of "Hurricanes or Storms" in an objective statement, but this was not shared by all plans in the states or throughout the region. However, when we expanded our analysis to the priority stressors emphasized throughout the rest of the plan content, we saw a different story. Four stressor themes are found across the region, including "Habitat Degradation," followed by "Water Degradation," "Human Vulnerability," and "Harmful Natural Processes." Several more specific themes appear when we analyze "Habitat Degradation" including, "Invasive Species," "Development," Habitat Loss," and "Disturbance," among others which appear with less frequency. "Non-Point-Source Pollution" presents as a shared stressor within "Water Degradation," while "Lack of Data or Information" and "Lack of Funding or Resources" appear as shared stressors within the "Human Vulnerability" theme. Finally, within the theme of "Harmful Natural Resources," "Sea Level Rise" and "Climate Change" were named across all states, although at varying degrees within plan type. This level of specificity reveals the reality that both ecological and

human community factors present stress on the health of an ecosystem.

Strategies

Similarly, strategies to ecosystem restoration or management are not often included in fundamental objectives, since these are used to respond to the question of "why?" whereas strategies might reveal "how" an objective will be accomplished. It is not surprising, then, that only one strategy theme, "Enhance Public Engagement," and more specifically, "Promote Stewardship and Environmental Education" was shared by fundamental objectives of all the states, but not all plan types within the states. When we considered the remaining plan content outside of the fundamental objectives, we found priority themes across eight distinct concepts. These shared strategy themes included "Improve Planning and Assessment," "Enhance Public Engagement," and "Protect and Conserve Habitat." More specifically, we saw a shared desire to "Conduct Research and Improve Data," which aligns with the shared "Lack of Data or Information" stressor mentioned previously, as well as "Habitat Management and Stewardship," although this strategy varies across plan types. Of note, the only strategy theme identified but not shared by all states was "Restore Oyster Habitat." This theme was not present in Florida and was the least frequently observed strategy in Alabama, Louisiana, and Mississippi.

Competing priorities and tradeoff examples

Within any given state, we found multiple priority themes and stressors. When we considered the priorities within Alabama management plans, for example, we saw ecological themes related to "Birds" and "Terrestrial Mammals," referring specifically to shorebirds and the endangered Alabama Beach Mouse found within the coastal geography of our study scope. We also found the commonality in the human community theme "Tourism," which contributes a significant portion to the state's operating budget. A nuanced look at stressor intersections showed common "Habitat Degradation" themes of "Development," "Disturbance," and "Fragmentation."

The "Energy Industry" theme applied to segments referring to a mixture of industries involved in the production and sale of energy, including fuel extraction, manufacturing, refining, and distribution. While represented primarily by the oil and gas industry, it only appeared in two fundamental objectives within management plans; although it is the third most common theme when we consider all economy-related management plan content. There is a predictable variation in theme representation across the Gulf states, with the "Energy Industry" representing nearly half (49.7%) of all Texas management plans "Economy" theme segments, compared to only 1.2% of Economy theme segments relating to the energy industry in Florida. Still, this theme plays a significant role in Human Community Priorities when all plan types are considered. We see an almost identical geographic pattern across the management plans when considering the "Oil Spills" theme, where it appears as the sixth most common theme among twelve "Water Degradation" themes.

Funding shared priorities

Our analysis of themes present within funded restoration projects is essential to understanding whether priorities articulated within state management plans align with the projects funded by large-scale multi-million-dollar funding sources such as the RESTORE Council's funded priority list 1 (FPL1). Considering the priority themes outlined so far in the results section, we can clearly determine where priorities lie for this major funding source, as well as where future opportunities for priority alignment might occur. In the fundamental objectives of the FPL1 funded projects, "Habitat" and "Water" were the most commonly occurring "Ecological Priority" theme, which aligns with the overarching ecological priorities found within management plans. "Human Community Priorities" also were in alignment, with "Management" commonly found among both management plan and restoration project data. "Comprehensiveness" was the most heavily represented "Management Value" across all fundamental objective data, showing a mutual desire between management plan authors and restoration project funders to consider a holistic view of regional priorities.

When considering whether "Strategies" used in the funded restoration projects aligned with those recommended in management plans, we see a slightly different focus in priorities, mainly because the RESTORE Council plays a specific role in a larger restoration community. Common themes within restoration project objectives included "Improve Planning and Assessment," "Restore Hydrology and Natural Processes," and "Protect and Conserve Habitat." These priorities reflect the stated goals of the FPL1 scope. Future funding opportunities may consider other shared priorities across the region, such as "Enhance Public Engagement," a priority seen across all plan types throughout the region.

Objectives hierarchy

Several themes emerged from this synthesis which can be translated into a model objective hierarchy (**Figure 2**). Although not surprising, we found that all Gulf States prioritize healthy and high-quality habitats, water, species, and the ecosystem services they provide and FPL1 funded projects reflect these priorities. The segments within management

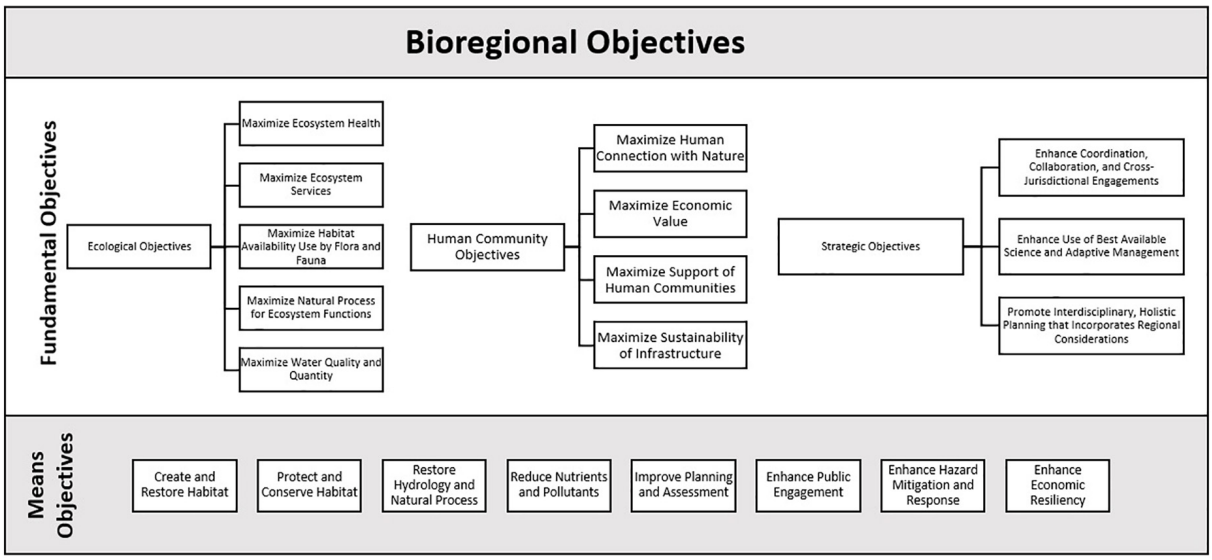

FIGURE 2
Shared priority themes can inform an objective hierarchy, as shown, including both fundamental and means objectives to be considered in bioregional planning.

plans coded as "Fundamental Objectives" often spoke to these concepts in broad, general terms, such as "Build regional capacity for long-term resilience" (Coastal Recovery Commission of Alabama, 2010). These broad objectives serve as an indication of the top, or "fundamental," level of a hierarchy, with more specific objectives elicited from our analysis providing the supporting, or "means," levels. The means objectives shown in **Figure 2** can act as a starting point for determining strategies to realize fundamental objectives across the region.

Discussion

Our study describes an approach for summarizing priorities across governing authorities, scales, and stakeholders to further synergistic opportunities for restoration and achievement of shared goals across the landscape. Bioregional approaches to adaptive management can be more effective when they begin with an assessment of the underlying priorities of stakeholders and decision makers. Failure to reach consensus on shared priorities may inhibit a region's ability to track progress at larger-than-project scales, resulting in difficulty in designing holistic monitoring programs and communicating cumulative impacts across jurisdictional boundaries (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). To address this challenge, the methods we present here serve as a starting point for a Gulf-wide framework of shared objectives. There are existing organizations that facilitate adaptive co-governance and management at broader spatial scales such as the Migratory Bird Joint Ventures which operate within the former Landscape Conservation Cooperatives (LCC; Jacobson and Robertson, 2012). Through the development of shared goals and objectives, the LCC concept created a framework for landscape conservation involving multiple jurisdictions (Jacobson and Haubold, 2014). Our work builds upon related efforts in the Northern Gulf of Mexico region, a complex web of governing bodies, laws, and regulations (Jordan and Benson, 2013). This complex structure is an underlying challenge in implementing adaptive governance and other bioregional approaches (Chaffin et al., 2014). Previous efforts aimed to develop indicators and monitoring frameworks to evaluate restoration progress associated with several DWH oil spill settlements (National Academies of Sciences, Engineering, and Medicine [NASEM], 2017; Baldera et al., 2018). Likewise, Carriger et al. (2015) sought to develop fundamental objectives associated with the DWH oil spill settlements, while Samiappan et al. (2019) focused primarily on objectives and priorities associated specifically with land-conservation (e.g., land acquisition, easements). This project elicits shared priorities from a broad range of management plans, which allows for consideration of objectives not previously integrated in bioregional approaches to restoration. Utilizing qualitative coding methods allows for an in-depth analysis of content that goes beyond a plan's stated objective, an important methodological expansion toward a more representative set of priorities.

Clearly articulating objectives so that they are unambiguous helps provide guidance through the decision process (Keeney, 1992). By understanding the priorities that span multiple

management entities, we can inform the development of cross-jurisdictional fundamental objectives and in doing so, illustrate how management efforts at local scales fit into the broader landscape mosaic. For example, we see that selected restoration projects and management plans broadly reflect the "Habitat" and "Management" priorities within the identified themes, indicating an alignment of project- and program- level decision-making. However, we also see areas which differ, such as the relatively high number of "Water"-related priorities within selected restoration projects compared to selected management plans (Table 3). This may reflect a disconnect between priorities identified in broader management plans with allocated funding for restoration projects, but it also speaks to the presence of multiple restoration programs across the region, each playing a specific role in the broader goals.

Just as an ecological system is made of intersecting, interdependent elements, our approach allowed us to examine intersections of the themes we identified throughout the analyzed management plan and restoration project data. Many segments alluded to multiple priority themes or alluded to a priority theme and its stressors. The ecological priorities, human community priorities, stressors, and strategies do not occur in silos and all are considerations within the holistic context of the entire Northern Gulf of Mexico region. When considering the intersections of these themes even within one state, a manager may find themself having to carefully consider tradeoffs and competing ecological and human community priorities.

TABLE 3 Number of RESTORE FPL1 projects that contain theme in project objective.

Overarching theme	Specific theme	Number of RESTORE council FPL 1 projects
Ecological priorities	Ecosystem health	17
	Ecosystem service	11
	Habitat	37
	Natural processes	11
	Water	32
	Wildlife	13
Human community priorities	Connection with nature	7
	Economy	8
	Human communities	5
	Infrastructure	6
	Management values	17
Stressors	Water degradation	14
	Harmful natural processes	8
	Human vulnerability	1
Strategies	Create and restore habitat	8
	Enhance economic resiliency	2
	Enhance public engagement	3
	Improve planning and assessment	17
	Protect and conserve habitat	12
	Reduce nutrients and pollutants	9
	Restore hydrology and natural processes	12
	Restore oyster habitat	1

It is important to point specifically to a nuance mentioned throughout our results, which is while there may be shared priorities within one or more plan types across all five states of the region, it is common to find differences across plan types. This points to the fact that decision makers connected to a certain ecological or human community scope, such as the coastal restoration community or tourist recreation industry, might find their priorities heavily represented within some plan types, but not at all in others. The six plan types reviewed in this study represented a diversity of perspectives and priorities, and our results show that this may inhibit a truly shared priority across all states and plan types. We see, for example, state wildlife action plans encourage limited human access to protected areas because of, for example, the risk of disturbance or the unintentional introduction of invasive species, compared to Sea Grant plans, which aim to enhance community access and stewardship of natural resources. This recognizes the importance of collaboration across sectors and priorities, since these are not mutually exclusive priorities but rather, an opportunity to reduce stressors, achieve objectives, share limited funding resources, and enhance partnerships for continued conservation success. Methods to move this collaboration forward can include gathering key stakeholders together for a facilitated workshop to refine the objective hierarchy by prioritizing objectives, understand distinctions and trade-offs across boundaries, identify measurable parameters, or conduct rapid elicitation to connect priorities, stressors, and strategies across the region. This facilitated process, which often occurs at smaller scales, can help to establish a bioregional approach to restoration.

Although some themes were not shared by all states, this does not suggest that these are not important priorities or are not relevant to restoration in these states. Additional themes were often found elsewhere in the management plans, reflecting that the objective statements as written may not necessarily reflect all priorities in a region. Furthermore, we also recognize the management plans selected may not capture all priorities, stressors, and strategies within a region, nor reflect all stakeholders within a region. However, they serve as a starting point for additional refinement and expansion through engagement with stakeholders across the region. Multiple data collecting strategies to engage stakeholders are often needed to obtain a comprehensive understanding of priorities (Parnell et al., 2013; Jacobs et al., 2018). The identified concepts will also need to translate into shared metrics that can be quantified in order to monitor progress over time. The selection of valuation

methods to quantify these metrics should aim to represent diverse stakeholders and reflect the distinct priorities people have for the social-ecological system (Jacobs et al., 2018).

One of the goals of adaptive management is to learn from outcomes of actions taken, therefore it is important to have a means to measure progress toward restoration objectives. In our analysis, few management plans provided programmatic metrics to quantify objectives and assess progress over time. Fewer than half of the selected plans identified metrics (41%) and the metrics that were identified varied in number per plan, scope, and specificity. This observation could be explained by the fact that metrics are often not included in higher level, aspirational management plans or they are too vague (Dale and Beyeler, 2001) and are sometimes later developed by project implementers. The metrics then become defined by these implementers and so reflect their priorities, not necessarily broader programmatic goals (Schiller et al., 2001). An apparent exception to this norm appears in the consistent metrics found in the state Sea Grant plans reviewed in this study. National or regional programs such as Sea Grant may be more likely to encourage or require inclusion of metrics, especially if they provide resources to aggregate state outcomes to a national level. This model of coordination to align objectives and metrics, as well as aggregate monitoring data, is constrained by influences on divergent funding priorities, data collection methods, data availability, and capacity to synthesize at large scales. To maximize the potential for projects to meet broader restoration goals, and to allow for better assessment of cumulative effects of multiple projects across a bioregional scale, funding entities responsible for programmatic success can invest in meaningful and ongoing coordination across multiple restoration projects, including, for example, encouraging one to two common metrics across restoration projects to allow for aggregation across the bioregion (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). These metrics could represent a shared means objective (**Figure 2**), such as using common methods and parameters to monitor the reduction of nutrients and pollutants in water bodies across the region or to collect data on public land visitor use and experience.

We recognize the limitations in our methods to elicit social-economic priorities in particular. Although we attempted to characterize social-economic priorities using simple terms such as "Infrastructure," we may have inadvertently lumped diverse or competing priorities together (Robinson et al., 2019). Future work could benefit from investigating the nuances in social-economic priorities, incorporating stakeholder engagement approaches, and exploring diverse valuation methods. Furthermore, developing metrics of environmental, economic, and social impacts across the bioregional scale could help quantify progress.

A bioregional approach to adaptive management requires consideration of ecological and social priorities that relate to the decision-making contexts of the region (Huitema et al., 2009). These priorities can serve as the basis for an objective hierarchy that articulates "why" something is important (fundamental objective) and "how" to achieve it (means objective). This paper provides an approach for restoration managers to elicit priorities across several decision frameworks (i.e., management plans) over a large geographic scale and in doing so, serves as a starting point for identifying common stakeholder and decision priorities to guide the development of a Gulf-wide objective hierarchy. After utilizing this method, decision-makers can work to connect objectives across plan types for a holistic understanding of priorities across the region. Articulating these bioregional objectives, developing measurable parameters for each, and providing adequate resources to monitoring and evaluate progress can help further understanding of cumulative impacts of restoration over time and across boundaries (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). This approach can inform the development of on-the-ground restoration projects which may be more representative of the priorities of diverse stakeholders across a region, improving support for funding and implementation across jurisdictional boundaries. This approach also provides a solid foundation upon which environmental managers and governing bodies can begin to build a bioregional approach to restoration, allow for monitoring and evaluation of cumulative progress, and provide a means to communicate rationale for project funding across a bioregion.

A bioregional approach to restoration can help to ensure on-the-ground projects align with landscape-scale objectives and depends on several factors, including continued stakeholder engagement and an ability to accurately evaluate impact of restoration across jurisdictions boundaries (DeAngelis et al., 2020). The approach presented here can be used to highlight how funded restoration projects fit into broader goals for restoration, as well as aid in understanding potential areas of alignment for future funding cycles. By utilizing this content analysis method, fundamental and means objectives can be constructed as a starting point to alignment of priorities across a landscape. Stakeholder engagement can be used to refine the objectives and then work toward quantifiable metrics for evaluating restoration at a Gulf-wide scale. Further, the objectives can be revisited in an adaptive management cycle as new information is learned about the system, priorities change, or as the underlying decision context evolves.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://www.sciencebase.gov/catalog/item/6058b4a8d34e1894882f6ffb.

Author contributions

KG: methodology, formal analysis, and writing—original draft. AH: conceptualization, writing—original draft, project administration, and funding acquisition. SR: data curation, writing—original draft, and funding acquisition. GS: writing—review and editing and funding acquisition. All authors contributed to the article and approved the submitted version.

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Conflict of interest

Author KG was employed by Cherokee Nation System Solutions.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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