Prioritizing Stakeholders, Beneficiaries, and Environmental Attributes: A Tool for Ecosystem-Based Management

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Abstract Successful Ecosystem-Based Management (EBM) approaches have advanced both a socio-ecological approach to systems thinking and the application of principles of structured decision making. This chapter presents a scoping tool designed to help decision makers in the early stages of their efforts by providing a transparent, repeatable, defendable approach for identifying and prioritizing stakeholders, the ways in which they use the environment (their beneficiary roles), and the most relevant environmental attributes for those uses as part of a set of decision criteria within a larger decision context. This scoping tool is a multi-criteria decision analysis approach that uses formalized criteria in stakeholder prioritization, along with the theoretical framework of the Final Ecosystem Goods and Services (FEGS) Classification System, to translate those prioritized stakeholders into the language of ecosystem services. The FEGS Scoping Tool is predicated on the idea that the decisions being made in a community can be complex, and that relevant and meaningful environmental decision criteria, let alone ecosystem services decision criteria, can be hard to identify and incorporate into the decision-making process.

Lessons Learned

• The EBM field lacks a clear pathway to prioritize stakeholders, develop a beneficiary profile, and focus management decisions on the environmental attributes most meaningful to a community.
• Transparent stakeholder prioritization provides clarity over who is included and why, facilitating a decision process that connects more directly to shared values,
uses, and experiences, ultimately leading to increased legitimacy of the final decision.

- Development of a beneficiary profile allows managers to directly connect the ecosystem to the community’s array of benefits, creating a holistic view of people’s interactions to identify commonalities.
- Identification of key environmental attributes on beneficiary uses allows managers to focus their decision objectives on the most relevant metrics when evaluating tradeoffs.
- The FEGS Scoping Tool elucidates which attributes of the environment are highly valued based on the intersecting and overlapping interests of stakeholders and the beneficiaries they represent, which may lead to improved EMB design and buy-in.

**Needs to Advance EBM**

- There is a need to advance EBM practices through a transparent, repeatable, defendable approach for identifying and prioritizing stakeholders, the ways in which they experience the environment, and the most relevant environmental attributes for those uses.
- There is a need to identify how the FST users feel the tool influences their decision-making process and leads to improved EBM.

1 **Introduction**

Structured Decision Making (SDM) is a method of approaching a decision-making process in a formalized way that allows for more transparency and deliberation. Use of SDM is particularly valuable when the decisions being made are difficult ones—touching on a variety of issues, impacting a wide range of stakeholders, surrounded by uncertainty, or involving competing values (Gregory et al. 2012). Particularly difficult decisions are known as “wicked” problems. Some of the characteristics of what makes a problem “wicked” include problems that are essentially unique every time, with no clear stopping rule, with solutions that are neither “right” nor “wrong,” with no clearly defined set of existing solutions, and where every solution is essentially a “one shot operation” (Conklin 2006). Ecosystem-Based management (EBM) decisions, with their need to include social, economic, and political considerations as well as complex ecological issues, are a perfect example of the type of “wicked” problem that could benefit from the use of an SDM approach (Van Bueren et al. 2003).

There are a wide range of SDM approaches (Gregory et al. 2012), but most contain some version of the same generic steps (Fig. 1). These steps are as follows:

1. Clarify the decision context—understand the context for the decision and why you are making it;
2. Define objectives—clearly identify what decision makers or stakeholders value in the context of this decision and metrics for assessing how well alternatives meet those objectives;
3. Develop alternatives—identify possible alternatives for consideration;
4. Estimate consequences—estimate how well each alternative meets the decision objectives;
5. Evaluate trade-offs—examine trade-offs in how well the alternatives meet the decision objectives relative to one another;
6. Select preferred alternative—select an alternative; and
7. Implement, monitor, and review—monitor how well that alternative meets those objectives after implementation and whether any information from its real-world performance could be used to inform future decisions.

Although working through these steps can seem like an increased burden on decision makers, essentially, SDM is a formalization of the steps already being used in an ad hoc or unconscious fashion when making any decision (Gregory et al. 2012). For example, when deciding what to have for breakfast, explicitly clarifying the context, developing performance measures, and carrying out the remaining steps is unnecessarily burdensome. If, however, you were to explain to someone else how you decided upon your breakfast choice, you would see how you rapidly went through each step in the SDM process:

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**Fig 1** The decision steps in a generic structured decision-making process
I wanted to eat breakfast before I left for work (clarifying the context); I wanted something that was quick and filling (defining objectives and metrics); I had cereal and eggs in the kitchen (developing alternatives); I didn’t have time to make eggs and I am trying to eat more fiber (evaluating trade-offs); So, I had cereal (selecting alternatives).

For more complex decisions, such as in EBM, explicitly working through the steps of a decision-analysis process has many benefits, but these steps will be worked through even without a formal process. The benefits of a formal process include improved guidance for information gathering activities, improved communication with stakeholders, increased opportunities for stakeholder engagement and involvement, improved documentation with a clear and transparent record of what happened during a decision process, and increased creativity in alternative development (Yee et al. 2017).

Decision Support Tools (DSTs) are tools that support decision-making processes. They can be powerfully effective methods for incorporating an SDM approach and increasing the transparency and repeatability of the decision-making process. The concept of decision support systems was developed in the 1970s and came out of the fields of organizational decision making and interactive computing systems (Keen and Morton 1978). By providing a mechanism for conducting one or more of the SDM steps and guiding the user through them, DSTs can facilitate incorporation of SDM thinking into a decision-making process. The tools themselves also provide users with clear and impactful ways to communicate with stakeholders (Fedra 1995).

Both the SDM approach and the use of DSTs support increased engagement with stakeholders and help decision makers identify multiple points in the decision-making process where stakeholder involvement could take place. Stakeholder involvement in making these difficult decisions is important for a number of reasons. Not only do they have the right to participate in making the decisions that impact their lives, stakeholders can also contribute valuable local knowledge that may otherwise be overlooked, and their involvement can lead to a better informed, and ideally, more legitimate (i.e., a “fair”) decision process that considers representative perspectives (Cash et al. 2003; Fiorino 1990; NRC 1996). Despite its benefits, stakeholder engagement can be challenging. The process can be time consuming and expensive; it can be difficult to identify the complete set of stakeholders, and even if all stakeholders can be identified, it may not be feasible to include all of them in the decision-making process (Reed et al. 2009; Luyet et al. 2012), for one of a number of potential reasons (e.g., regulatory constraints, temporal constraints, or willingness or ability to engage). An example from this volume where not all stakeholders were fully engaged in an EBM effort is presented in O’Higgins et al. (2020).

These challenges are heightened in the complex context of EBM decisions. The effects of different management decisions on the environment can be highly uncertain and the ways in which stakeholders benefit from the environment can be easy to
overlook. The concept of ecosystem services was developed to better quantify those benefits (MEA 2005). This concept was further refined as Final Ecosystem Goods and Services (FEGS), the “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd and Banzhaf 2007). Although the language of FEGS provides stakeholders with a way of identifying and articulating the benefits they receive and value, the concepts are ones that require introduction and education (DeWitt et al. 2020).

The concept of ecosystem services is one that can be viewed as having a “supply” side—the goods and services the ecosystem is capable of producing—and a “demand” side—the goods and services that humans are interested in enjoying, consuming, or using (Culhane et al. 2020). Many approaches to ecosystem services focus on the question of supply (e.g., from an ecological standpoint, how large a fish population can be sustained). These questions rely on answers from the biological and ecological realms. In order to incorporate FEGS into decision making as effectively as possible, however, it is valuable to have a clear understanding of the “demand” side of that equation. This includes a clear understanding of who is benefiting from the ecosystem services (Culhane et al. 2020) as well as the specific aspects of the environment necessary to realize those benefits (DeWitt et al. 2020). These questions require answers from society and require engagement with stakeholder groups and community decision makers.

2 Stakeholders as Beneficiaries

The suite of FEGS are the attributes of the environment from which humans directly benefit, such as fish for food, property protection (i.e., protection from storm surge or wave action) provided by coastal habitats, or drinking water from a stream. The concept of FEGS is useful for decision making because it serves as a foundation for defining, classifying, and measuring ecosystem services (Landers and Nahlik 2013). The FEGS concept helps avoid ambiguity, minimizes double counting of a good or service (from a valuation perspective), bridges natural and social sciences to facilitate communication and collaboration, and is beneficiary-specific so it is directly connected to what people value (Landers and Nahlik 2013; Russell et al. 2020). Beneficiary roles are the ways in which an individual or group enjoys, uses, consumes, or interacts with some aspect of the environment. Beneficiaries are those who directly benefit from a FEGS (e.g., people who eat the fish, who own property that is protected by coastal habitats, or who drink the water from the stream) (Landers and Nahlik 2013). Defining a beneficiary helps identify the specific FEGS and connects them to human well-being (Landers and Nahlik 2013; DeWitt et al. 2020). This helps decision makers involved in EBM projects make decisions based on what matters, is directly valued, and directly benefits community members, ultimately improving human health and well-being.

Stakeholders are interested and affected parties. Stakeholder groups result from the roles the individuals within them play in society and the community. For
example, a sporting club representing recreational anglers and boaters could be considered a stakeholder group. There is a lack of data on how people use the environment, and the ways in which individuals use a particular part of the environment is highly variable (e.g., one individual might choose a particular fishing spot because they went with their family as a child, while another individual might choose the same fishing spot because it is close to a car park). By identifying the beneficiary groups within stakeholder groups, decision makers are better able to identify and articulate the ways in which those in the community benefit from the environment. The individual members of the sporting club act as representatives of the club, but the members of the sporting club may benefit from the environment in many different ways and therefore would be composed of several beneficiary groups covering the different aspects of their interaction with the environment (i.e., fishing, boating, swimming, appreciation of views, etc.).

Both stakeholder and beneficiary concepts are valuable for community-level decision making and EBM applications because stakeholder groups make up the groups that should be consulted in the decision-making process and may include those most affected by the decision action. They are also the groups that community decision makers are used to thinking of and considering when making management decisions. Their roles as stakeholders, however, do not necessarily explicitly connect to how they are engaging with and benefiting from the environment. Beneficiary categories, on the other hand, are not necessarily a useful place to start when engaging in community consultation activities as groups and individuals are not used to thinking of themselves in these roles. By using both concepts, decision makers can connect how community members identify themselves within the community to how they benefit from the environment.

3 FEGS Scoping Tool

3.1 Identifying and Prioritizing Attributes Relevant to Stakeholders

Although there are repeated calls for inclusion of ecosystem services in environmental decision making (NRC 2005; Ruckelshaus et al. 2015), they are often less influential in the decision-making process than other social or economic considerations (MEA 2005; NRC 2005; Ruckelshaus et al. 2015; Yee et al. 2017). Often-times this is because the ecosystem services metrics that are used in decision making are ones that are easy to measure or commonly thought of (Yee et al. 2017) but may not be relevant or meaningful to decision makers or the communities they serve (Wasson et al. 2015; Yee et al. 2017). DeWitt et al. (2020) presents an argument on how the FEGS approach allows a decision maker to focus in on those ecosystem services most relevant to stakeholders and Nahlik et al. (2012) states that FEGS are more easily understood by the general public because the FEGS are determined by
beneficiaries. By identifying more relevant ecosystem services, the services can be more influential in the decision-making process. Ecosystem services thinking, however, may not be intuitive for many decision makers, and long lists of potential ecosystem services (e.g., MEA 2005; Haines-Young and Potschin 2012) alone may provide insufficient guidance. Leaving ecosystem services out of the discussion entirely or selecting less relevant services can lead to decisions that omit commonly shared benefits (i.e., derived from recreational, cultural, and existence values), disconnect from what matters to people, and undermine biodiversity, human well-being, and social goals (Chan et al. 2012). For example, conservation and economic development programs in Papua New Guinea that neglected to incorporate culturally-based ecosystem services in restoration design undermined triple bottom line goals, leading to undesirable changes to impacted communities and the cultural values attached to the forest (Chan et al. 2012).

The FEGS Scoping Tool (FST) was designed to help decision makers identify and prioritize stakeholders, beneficiaries, and environmental attributes in a structured, transparent, repeatable process. The relevant and meaningful attributes can then be used to evaluate decision alternatives. The FST uses an SDM approach and the FEGS framework to identify the environmental attributes most relevant to the decision and valued by stakeholders in a transparent and structured fashion. The goal of the tool is to identify the most relevant environmental attributes for inclusion in the larger decision process so that valued FEGS are represented alongside other decision criteria. The level of stakeholder involvement in this or any other part of the decision-making process is entirely in the decision makers’ hands and beyond the scope of this tool.

The FST uses a specific type of SDM, known as Multi-Criteria Decision Analysis (MCDA), with steps that mirror the generic steps of SDM. A MCDA is a formal decision-making framework that aims to represent decision goals in terms of explicitly evaluated criteria (Stewart 1992). This framework informs decision making in a transparent fashion by formalizing key criteria, explicitly stating priorities, and supporting easy replication and justification of results.

There are a range of MCDA approaches. The FST uses the method of ranking the alternatives on the sum of weighted criteria, which has been used in a variety of participatory environmental decision-making contexts (Ralls and Starfield 1995; OST n.d.). There are two main elements of an MCDA: (i) the decision alternatives that decision makers are considering, and (ii) the decision criteria used to prioritize those alternatives. In the FST, the decision criteria are a set of stakeholder prioritization criteria that were developed from the literature across a range of fields (Sharpe et al. under review) and the decision alternatives come from decision maker inputs and the National Ecosystem Services Classification System Plus (NESCS Plus) (DeWitt et al. 2020).

The benefit of using an MCDA approach for prioritizing amongst decision alternatives is that it focuses the discussion on the importance of stakeholder values rather than just the components of individual options. It does this by beginning the conversation with what decision makers are trying to achieve in meeting their goals (i.e., identifying the objective (MCDA Step 1 in Table 1)) and then identify what
criteria are necessary for meeting them (Step 2). It then uses metrics (Step 3) to determine as objectively as possible how well each decision alternative (Step 4) meets those objectives (Step 6). This is separate from the question of the relative importance of those criteria (Step 5) to the decision makers. When choosing a car, for example, two people may disagree on whether storage capacity is more or less important than fuel efficiency, but they can easily agree on how each of those options score on those criteria. Together, how well each alternative scores on the criteria and the relative importance of each criterion to the decision makers are used to determine the MCDA value of each alternative and their overall prioritization (Step 7).

### 3.2 Tiers of the FEGS Scoping Tool

The FST has three tiers: (1) a stakeholder prioritization; (2) development of a beneficiary profile; and (3) identification of key environmental attributes, with each tier feeding into the next (Fig. 2a). Because the FST has three objectives—prioritizing the stakeholders, the beneficiaries, and the key attributes—each of the MCDA steps is run through three times in succession in a tiered MCDA approach,
with the output from Tier 1 feeding into Tier 2 and the output from Tier 2 feeding into Tier 3 (Fig. 2b and Table 1). Specifically, the output from the stakeholder prioritization (Tier 1, Step 7) is used to weight the influence of those stakeholder groups in the development of the beneficiary profile (Tier 2, Step 5). Continuing that approach, the output from the beneficiary profile (Tier 2, Step 7) is used to weight the influence of those beneficiary groups in the identification of key environmental attributes (Tier 3, Step 5).

The FST was designed to be relatively simple for decision makers to incorporate in their existing decision-making processes. It does not require decision makers to
collect specific data about the stakeholder groups beyond knowledge of the community and familiarity with the stakeholder groups. The more iterative and participatory a process is structured, the more likely the process will lead to results that are defensible and well-founded. The intent of the tool is to provide a simple, transparent process for prioritizing stakeholder groups and letting that inform a prioritization of the benefits they receive from the environment and the elements of the environment necessary for receiving those benefits. It is anticipated that tool users will often be the decision makers, but this is not necessarily the case. Non-decision makers, such as those interested in evaluating or analyzing a decision made by others, might find the FST valuable as well.

### 3.2.1 Stakeholder Prioritization

During the stakeholder prioritization, decision makers are asked to review and weight the stakeholder prioritization criteria found in Table 2. This is a question of values. In this step, decision makers must ask themselves which of these decision criteria are most meaningful to them when looking at the stakeholder groups they are prioritizing. Criteria weighting is a key element of MCDA and the FST. Priorities

| Stakeholder prioritization criteria | Definition |
|-------------------------------------|------------|
| Level of interest                   | The amount of interest a stakeholder group has in the decision-making process or the decision outcome |
| Level of influence                  | The amount of influence a stakeholder group has over the decision-making process |
| Magnitude of impact                 | The degree of potential impact to the stakeholder group as a result of the decision |
| Probability of impact               | The likelihood of potential impact to the stakeholder group as a result of the decision |
| Urgency/temporal immediacy          | The degree to which a stakeholder group would like to see a decision made or an action taken |
| Proximity                           | How frequently a stakeholder group comes into contact with the environment for which a decision is being made |
| Economic interest                   | Whether a stakeholder group’s livelihoods or assets could be impacted by the decision outcome |
| Rights                              | Whether a stakeholder group has legal, property, consumer, or user rights associated with the decision-making process, the decision outcome, or the environment for which the decision is being made |
| Fairness                            | Whether the exclusion of a stakeholder group from the decision-making process would lead to the process being viewed as unfair by the community |
| Underrepresented/underserved populations | Whether a stakeholder group includes any underrepresented or underserved populations |
will differ from community to community as well as among groups within a community. For example, if a business development group is using this tool to incorporate FEGS into their decision making, they are likely to weigh the criterion of economic interest substantially higher than a non-profit group focused on social justice. In this step, decision makers are asked to identify the criterion most important to them and give that criterion a weight of 100. After that most valued criterion has been identified, all other criteria are weighted relative to that criterion on a 0–100 scale. Those criteria that are not considered by decision makers should be given a weight of 0. The FST provides a visual aid to allow decision makers to see the relative impact each criterion will have on the prioritization process.

Current methods of stakeholder analysis in environment decision making focus on stakeholder identification (who is/should be considered a stakeholder), categorization (often focused on distinguishing groups based on level of engagement), and relationship analysis (using tools like social network analysis to understand how the different groups relate to and influence one another). Stakeholder prioritization is discussed in the fields of business, management, and public relations, but the concerns of researchers in those fields are imperfectly analogous to environmental decision making. Therefore, a proposed set of ten stakeholder prioritization criteria was developed specifically for the field of environmental decision making and this tool (Table 2) (Sharpe et al. under review).

These criteria are not entirely independent from one another; however, each captures some element that has been found to be useful or important in stakeholder analyses and it is critical to include all criteria that could be relevant for decision makers (Sharpe et al. under review).

Once the criteria have been weighted, the decision makers are asked to identify all stakeholder groups relevant to the decision context. There is no step or process embedded within the tool itself that ensures that all possible stakeholder groups are being included in the decision process. That is, this tool, just like any stakeholder engagement effort, relies upon the good faith efforts of decision makers to cast a wide net when it comes to stakeholder identification and inclusion. However, by having a record of which stakeholder groups were considered and by using the FST in a transparent and iterative fashion, there will be opportunities for decision makers and their constituents to identify missing stakeholder groups and include them in the process. After the stakeholder groups have been identified, users will then score them on each of the decision criteria. The tool itself lays out specific scoring metrics for each criterion with the goal of making the scoring as objective as possible. Although different decision makers could disagree on how important economic interest is in making a stakeholder group a priority, it should be clear whether (or not) a given group has an economic interest in the decision.

Once the decision criteria have been weighted and the decision alternatives (e.g., the stakeholder groups) have been scored on those criteria, the FST calculates a value for each alternative by summing the weighted scores for each alternative. The value, \( y(i) \), of an alternative, \( i \), is calculated as:
\[ y(i) = \sum_{m=1}^{M} w_m z_i \]

where \( M \) is the number of possible metrics for which \( i \) can be scored, \( w_m \) is the weight given to each criterion, and \( z_i \) is the score of alternative \( i \) on metric \( m \). The value, \( y(i) \), is then normalized, \( n(i) \), to a 0—100 scale by dividing \( y(i) \) by the sum of all weights:

\[ n(i) = \frac{y(i)}{\sum_{m=1}^{M} w_m} \]

This results in an output of a prioritized list of stakeholders with each group given a “value.” This value is only meaningful in describing the relative differences in priority for a collection of stakeholders that have been evaluated in a single exercise. It provides comparative information about the relative priority of different groups but has no meaning beyond that.

### 3.2.2 Beneficiary Profile

In the second part of the tool, users develop a beneficiary profile of the decision context to better understand the ways in which the community benefits from the ecosystem under consideration. It helps decision makers take a more holistic view of various groups’ interactions with the environment and identify commonalities among them. In this step, users are asked to segment each stakeholder group into its component beneficiary groups by percentage, for a total of 100%. Once this has been completed, the FST will once again calculate a “value” for each beneficiary group using the same calculations as in the stakeholder prioritization. In this calculation, however, the output values, \( n(i) \), from the stakeholder prioritization are used as the weights, \( w_m \), for the beneficiary profile.

The beneficiary categories in this step come directly from the Final Ecosystem Goods and Services Classification System (Landers and Nahlik 2013) and the National Ecosystem Services Classification System Plus (NESCS Plus) (DeWitt et al. 2020). At this step, tool users should ask themselves how each stakeholder group benefits from, uses, or values the ecosystem under consideration. For example, a stakeholder group consisting of a fishing club could benefit from the ecosystem through a waterbody that can be navigated by their fishing boats (the “Boaters” beneficiary), fish that can be caught (the “Anglers” beneficiary), and a pleasing view when traveling to and from the fishing site (the “Experiencers/Viewers” beneficiary).

### 3.2.3 Key Attribute Identification

In the final portion of the FST, users build upon the previous steps to identify the key environmental attributes of the decision context. These key environmental attributes
are those attributes that are necessary for the stakeholders to receive the benefits that they value. In this step, users are asked to identify, by percentage, the environmental attributes that are necessary for each beneficiary group to succeed in using and benefiting from the environment. After the environmental attributes of concern have been identified for each beneficiary group, the FST will calculate a “value” for each attribute using the same calculations as in the stakeholder prioritization and beneficiary profile. In this calculation, however, the output values, \( n(i) \), from the beneficiary profile are used as the weights, \( w_m \), for key attribute identification. This step allows the user to see what environmental attributes are relevant for evaluation of decision alternatives and provides a clear explanation of why those attributes are relevant.

The list of attributes used in the FST was developed for NESCS Plus (DeWitt et al. 2020). To continue the earlier example, the “Anglers” beneficiary would likely care a great deal about “Charismatic fauna” (i.e., fish that are of interest to anglers) and “Edible fauna” (i.e., fish that are safe to eat). Attributes related to the fuel, fiber materials, or fungal communities, for example, would likely not have any impact on their ability to realize this benefit.

The prioritized set of environmental attributes are the set that should be considered when evaluating different management options. The combination of prioritized beneficiaries and attributes provides the decision makers with guidance on the appropriate metrics to use when evaluating those options. The metric(s) used to assess the management options should be ones relevant to the beneficiaries that care about that attribute. The NESCS Plus has released a report on the development of national metrics and indicators for a number of ecosystem/beneficiary/attribute combinations and would provide useful guidance for developing sets of metrics for local-scale decisions (DeWitt et al. 2020; US EPA under review).

### 3.3 Using the FEGS Scoping Tool

The FST was designed to be used at an early stage of decision making, when decision makers are aware a decision needs to be made, but before any actions are taken (e.g., step 1 of the SDM process—clarify the decision context). Once those key environmental attributes have been identified, they can be included as objectives for the decision under discussion (e.g., step 2 of the SDM process—define objectives). These FEGS-related objectives can be used later in the decision-making process alongside other, non-environmental attributes, such as cost of the alternatives or job creation associated with each alternative, to estimate the overall consequences for each alternative (e.g., step 4 of the SDM process—estimate consequences). The FST itself is not designed to work through the entire SDM process for a given management decision. Rather, it is designed for use in step 1 and for its outputs to be applied in subsequent steps. Beyond this, the FST provides no additional guidance in conducting those steps, or in making a final decision.
The FST was designed to be used during the scoping phase for any decision with an environmental context by community-level decision makers who are involved in articulating the overall decision objectives and choosing amongst various decision options. Ideally, the FST is used in a participatory, iterative fashion with input from stakeholders, but can be applied in a variety of ways depending on the community’s existing decision-making processes and requires no technical expertise or data collection beyond familiarity with the community and its stakeholder groups.

Decision makers prioritize stakeholders, either consciously or subconsciously. This tool formalizes and records the stakeholder prioritization process and makes those priorities transparent. The stakeholder prioritization results are then used to systematically identify environmental attributes most relevant to the prioritized stakeholders. The FST is predicated on the idea that the decisions being made in these communities are complex and that relevant and meaningful environmental decision criteria, let alone ecosystem services decision criteria, can be hard to identify. Thus, the use of a structured stakeholder prioritization approach results in the ability to provide a transparent, repeatable, and defendable approach for selecting the more relevant environmental attributes for use as decision criteria in that larger decision.

4 FEGS Scoping Tool Applications for Ecosystem-Based Management

Along the coast of Oregon (Fig. 3), communities are inextricably interconnected with estuarine wetland ecosystems and upland watersheds. The region provides highly viable industries (e.g., dairy, agriculture, timber, and fishing) and recreation centered around natural resources, and communities affect ecosystem functions through recreation, resource use, urban development, and dredging for shipping and port access. Many small communities along the Oregon coast have experienced an increase in retirement age migration and are seeing the tourist service industry, residential and resort developments, charter fishing, and whale watching increase in importance to the local economy while extractive industries in timber and fishing have declined (Radtke and Davis 1994; Ackerman et al. 2016). Additionally, historic natural disasters and climate change are straining the ability for communities to solely depend on these resources and seek support in mitigating adverse impacts and restoring ecological functions.

Because the health of Oregon’s coastal habitats is vital to the safety and well-being of its human and wildlife communities, federal, state, non-governmental organizations, academic, and private institutions in Oregon have invested heavily to research and restore impacted ecosystems. We are going to walk through a hypothetical example of using the FST at the beginning of a wetland restoration project to more clearly illustrate the FST process. This example is a simplified version of the prioritization that might happen at a site that is being restored back
to a wetland, and does not include all likely stakeholders, beneficiaries, or attributes that would be included in a real ongoing project.

In the first tier of the tool, Stakeholder Prioritization, decision makers must assign weights to each criterion and then score the stakeholder group for those weights. When assigning weights, the decision makers might highly weight criteria such as Level of Influence and Level of Interest, if they are interested in making sure that influential and interested groups were prioritized and they might highly weight Underrepresented and Underserved Representation if they are interested in environmental justice concerns. Decision makers might also give Proximity moderate weight if they are interested in prioritizing those groups most likely to come into contact with the area and give Economic Interest moderate weight if they are interested in prioritizing those who may see an economic impact, either positive or negative, as a result of the project. For the purposes of this example, all other criteria are being considered unimportant to the decision makers and given a weight of zero. Figure 4 shows the user input form for the weights as well as the visual representation of the weights relative to one another.

After the weights are input into the tool, users identify the relevant stakeholder groups and score them, using provided metrics, on those criteria. In this case, some of the stakeholders sitting at the decision-making table might include Funding
Organizations, an NGO Conservation Trust, County Government Agencies, and Neighbors & Landowners. The metrics vary from criterion to criterion. In the case of Underrepresented and Underserved Representation, users are asked a yes or no question as to whether the stakeholder group contains any underrepresented or underserved groups. In this hypothetical example, only the Neighbors & Landowners group does. For the criterion of Proximity, however, users select from a range of scores based on how frequently the stakeholder group is in contact with the area in question or adjacent spaces. Once users have input the weights and the scores, they are combined to produce the stakeholder prioritization (Fig. 5). In this example, the Neighbors & Landowners are likely to include underrepresented or underserved groups and therefore have a higher prioritization given that this criterion was weighted higher than Economic Interest, which the other three stakeholders have. The County Government is prioritized the lowest because this stakeholder has less of an influence over the decisions being made than the other three stakeholders. This

| Color | Criterion                                      | Weight |
|-------|-----------------------------------------------|--------|
|       | Magnitude & Probability of Impact             | 0      |
|       | Level of Influence                             | 100    |
|       | Level of Interest                              | 100    |
|       | Urgency & Temporal Immediacy                   | 0      |
|       | Proximity                                     | 50     |
|       | Economic Interest                              | 50     |
|       | Rights                                        | 0      |
|       | Fairness                                      | 0      |
|       | Underrepresented & Underserved Representation  | 100    |

Fig. 4 The FST user input form for the weights (left) and the visual representation of the weights relative to one another (right)
would be a good time to communicate with the stakeholders and ensure that a key stakeholder group was not left out in the process.

In the second tier of the tool, Beneficiary Profile, users are asked to identify the ways in which each stakeholder group is benefiting from the area. In this example, decision makers might find that the Neighbors & Landowners group, while principally benefiting through owning the area or land adjacent to it, also benefit through recreational opportunities such as fishing (angler beneficiary category) and hiking (experiencer/viewer beneficiary category). These beneficiary scores are then combined with weights arising from the stakeholder prioritization to lead to a beneficiary profile (Fig. 6). The beneficiary profile allows decision makers to identify commonalities among stakeholder groups. In this case, we can see that all four stakeholder groups have common ground in that they all care about the continued existence of a healthy wetland ecosystem.

In the third tier of the tool, Key Attribute Identification, users are asked to identify the ecosystem attributes necessary for each beneficiary group to receive their benefit. In this case, a recreational angler beneficiary would likely care about water quality, water quantity, flora community, fauna community, edible fauna, viewscapes, and the ecological condition of the site. These attribute scores are then combined with weights arising from the beneficiary profile to lead to identification of key environmental attributes (Fig. 7). This final output allows decision makers to identify the key environmental attributes that should be considered and measured when contemplating restoration options for the site. It is unlikely that the entire suite of attributes can be considered, but if the user focuses on the attributes related most directly to sustaining the availability of the FEGS that anglers care about, it is more likely...
that the ultimate decision will include ecosystem service metrics relevant to the stakeholders and the ways in which they benefit from the site.

While this example is hypothetical, there are numerous restoration efforts that have taken place in estuarine systems along Oregon’s Northern Coast, such as the Southern Flow Corridor (SFC) project and the Beaver Creek watershed restoration project (Fig. 3). The SFC project was implemented by the Tillamook Estuary Partnership (TEP), one of EPA’s 28 National Estuaries Programs that was established to conserve and restore estuaries and watersheds in Tillamook County (TEP2019). The Tillamook Estuary Partnership first implemented a Comprehensive Conservation and Management Plan in 1999, and work was done to encourage broader community and stakeholder participation to identify values relevant to the estuary, prioritize conservation goals, and specify resource management actions (Gregory and Wellman 2001). The focus of the SFC project was restoring tidal wetland habitats and ecological function at the deltas of the Wilson, Trask, and Tillamook rivers (SFC2019). The SFC produced a Project Effectiveness Monitoring Plan in which stakeholders and decision makers outlined four flood mitigation and restoration goals and expected ecological and economic benefits (Brophy and van de Wetering 2014). Interventions included a conditions assessment and various infrastructure changes to ditches, levees, dikes, floodgates, and buildings (Brophy and van de Wetering 2014). The project is currently in the monitoring phase to determine if the flood attenuation and ecological function goals were met (Brown et al. 2016;
SFC 2019). The conservation and restoration being done in the Beaver Creek watershed addresses critical watershed restoration issues (The Wetlands Conservancy 2018) and aims to simplify instream habitat, move roads that are too close to the stream, and increase the number of riparian trees and shrubs (TEP 2019).

Given that restoration is so important to the state of Oregon, it is important to assess the effectiveness of restoration relative to the achievement of a project’s restoration goals that are meaningful to adjacent communities. By using locally-relevant ecosystem metrics and indicators derived from stakeholder and beneficiary goals, the local ecology, and the NESCOs Plus, restoration effectiveness can be evaluated by assessing a restoration site based on its capacity to produce and deliver priority nature-derived benefits (i.e., FEGS). The set of FEGS will vary with, and be dependent on, community values and priorities. The FST is important to this process because it can be used in the initial stages of the restoration to identify priority FEGS, beneficiaries, and benefits for a particular restoration site. For example, the FST could be a useful approach to use at a nascent project site along the Tillamook River where a parcel of land that is currently farmland has been acquired and designated for restoration and enhancement. Dairy farms, forest, and rural homes surround the site, along with a road that often floods from the river. The driving interests of

![Fig. 7 Tier 3 output of the FST: Environmental Attribute Prioritization](image-url)
stakeholders at the site include the construction of flood mitigation structures, habitat restoration to support salmonid growth, waterfowl hunting, and a designated shooting range, while aligning with the county’s policy of no-net farmland loss.

Prioritizing stakeholders in restoration projects such as this is necessary because of potential conflicting stakeholder interests. Although there is no mechanism in the FST to ensure that all stakeholder groups are considered and represented, the SDM approach it builds on supports the inclusion of as wide a range of stakeholder groups and interests as possible. All engagement efforts rely on the good faith of the decision makers. This tool is one way for them to be transparent about who is considered, who is most relevant to the decision and the community impacted by it, and why ultimately not everyone’s interests may be feasibly incorporated into decisions and goals. Additionally, an iterative and participatory approach can be taken in the stakeholder characterization step to allow for additional stakeholders to be identified and incorporated into the process. Using the FST to identify a broad range of potential stakeholders functions as a documented structure to prioritize stakeholders, beneficiaries, and ecological attributes and can help site planners decide on which type of site to target, on which FEGS to focus, and evaluate available options towards achieving restoration goals—whether that be salmon for fishing, waterfowl for hunting, or habitat for flood protection. From there, it can be determined how local FEGS metrics and indicators may be used to assess progress towards achieving those desired benefits.

5 Conclusion

Ecosystem-based management is a field requiring complex tradeoffs for its decision makers. In addition to the difficulty and uncertainty surrounding ecosystem forecasting, weighing socioeconomic concerns against environmental ones can be challenging. The concept of FEGS helps provide managers with language that more directly connects environmental concerns to the community’s values. Using an SDM approach like the FST provides a clear pathway to prioritize stakeholders, develop a beneficiary profile, and focus management decisions on the environmental attributes most meaningful to the community, all of which help facilitate effective communication of the value of proposed work. It is rarely feasible to include all possible stakeholders in a decision-making process. Stakeholder prioritization provides clarity over who is included and why, enabling managers to be transparent about the perspectives being given weight in the decision process and, ultimately, leading to increased legitimacy (as defined as a “fair” decision process that considers representative perspectives; Cash et al. 2003) of the final decision. Development of a beneficiary profile allows managers to directly connect their community to the array of uses it has for the area under discussion. This allows managers to find common goals across beneficiary groups as well as potential points of contention. The holistic view of these uses also lowers the chance that valued uses are overlooked and then impacted by the decision. Identification of key environmental attributes of concern
based on these uses then allows managers to focus their decision objectives on the most relevant metrics when evaluating tradeoffs. Ultimately, inclusion of the FST in an EBM process could lead to identification and consideration of more relevant ecosystem service metrics as a result of a more deliberate approach to stakeholder engagement and an improved understanding of community priorities.

Disclaimer This chapter has been subjected to Agency review and has been approved for publication. The views expressed in this paper are those of the author(s) and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.

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