Gila National Forest Public Planning Meetings: Results of the Ecosystem Services Station

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Executive Summary

During the week of June 12th, 2017, the Forest Planning team on the Gila National Forest conducted meetings to engage the public in the process of revising and updating the Forest Plan from 1986. This report provides a detailed description of the public input gathered from the 'ecosystem services station', which focused on the perceptions of meeting attendees with regard to the importance of benefits (e.g., livestock grazing, air quality, flood and erosion control, non-motorized recreation) derived from the Gila National Forest, as well as the factors or influences (e.g., invasive species, conditions of roads and trails, land use restrictions) most relevant to the provision of such benefits. As a game-like participatory activity, the ecosystem services station engaged members of the public with the benefits that the Gila National Forest provides them.

Using statistical analysis of two separate activities (i.e., prioritization of ecosystem services and selection of influential factors) completed by 122 members of the public, four typified relationships (archetypes) emerged regarding the importance of ecosystem services and the factors influential to their continued provision. This report details these four typified relationships, dubbed the 'environmental archetype', 'utilitarian archetype', 'water archetype', and 'motorized archetype'. Each archetype highlights a different relationship with the Gila National Forest, as represented by the importance of benefits provided by the Forest. For instance, the environmental archetype tends to assign high importance to benefits that support a healthy ecosystem (e.g., biodiversity and abundance of plants and animals, wildlife habitat and connectivity), while the utilitarian archetype considers material benefits (e.g., timber production, forest materials for personal use) as most important. In addition to a detailed description of each archetype, this report details the factors or influences that were found to be associated with each typified relationship. For example, the water archetype considered unmanaged grazing and extended drought to be particularly concerning, while the motorized archetype was concerned with the amount, conditions, and access to roads and trails on the Gila National Forest.

After presentation of the results of the public input gathered with the ecosystem services station, we highlight potential benefits for the purposes of forest planning on the Gila National Forest. Among the potential benefits of this information is the ability for the Forest Planning team to communicate with the general public about the rationale for decisions made, as well as the different types of people that the Gila National Forest supports. Furthermore, the information

contained in this report may help the Forest Planning team understand how decisions will affect a broad range of people who derive benefits from the Gila National Forest.

Acknowledgments

We acknowledge support for the ecosystem services station from the University of Montana, Aldo Leopold Wilderness Research Institute, and the Gila National Forest Planning Team. We thank all for their support, and we particularly would like to acknowledge the gracious acceptance of us ‘outsiders’ into the public meeting circuit in June 2017 by the Forest Planning team.

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1. Introduction

During the week of June 12th, 2017, the Forest Planning team on the Gila National Forest conducted meetings to engage the public in the process of revising and updating the Forest Plan from 1986. In order to ensure that input from the public could be integrated into the forest revision in a meaningful way, the Planning Team, with support from professional facilitators and collaborators from the University of Montana, used a 'world café' meeting format whereby meeting attendees engaged in three different participatory activities. The three "stations" gathered public input on perceptions of desired conditions (i.e. "desired conditions station"), the noticeability of installations within wilderness areas (i.e. "wilderness station"), and the importance of a broad range of ecosystem services as well as the drivers of change potentially influencing such ecosystem services (i.e. "ecosystem services station").

This summary report provides a description of the protocol for the ecosystem services station, a brief discussion of the methods applied for analysis of the public input, and a detailed analysis of the public input obtained. The station was designed and implemented by collaborators from the University of Montana (UM) and the Rocky Mountain Research Station's Aldo Leopold Wilderness Research Institute (ALWRI), in support of the Gila National Forest Planning team. As National Forests revise outdated forest plans, there is a need to better understand the relationship the public has with the Forest, described as the benefits that the public derives from forests as well as the drivers of change that put those benefits at risk. The ecosystem services station aimed to provide such understanding. The station developed by UM and ALWRI collaborators forms the basis for a protocol for an integrated social-ecological vulnerability assessment in support of National Forest planning and management. Broadly, the protocol is both based on rigorous science and practical for implementation by National Forest planners and managers. The work has been well received by the scientific community, as reflected in recent publications in *Sustainability Science* (i.e., Armatas *et al.*, 2017) and *Ecological Economics* (i.e., Armatas *et al.*, 2014).

As a game-like participatory activity, the ecosystem services station engaged members of the public with the benefits that the Gila National Forest provides them. A primary outcome was to analytically assess the relationship each person has with the National Forest in a meaningful, less polarized and controversial fashion. As participants considered each ecosystem service that

may be more or less important to them, they thought through all the roles and benefits that the National Forest provides. Their prioritization of those ecosystem services, while constructed in a public setting, requires no justification nor verbal defense. Instead, each participant is given an equal opportunity to express what is important to their own relationship with the Forest. This game-like activity is an easily understood and tangible means of engaging the public.

This report will proceed first with an explanation and details of the process used for the ecosystem services station. Following this discussion is a brief overview of the analytic methods applied to the public input obtained. A detailed analysis of the public response is then presented, which is followed by potential implications of such information for decision-making and the ongoing planning process. The overall aim of this exercise was to identify prototypic views held by the public as to the important ecosystem benefits received from the Gila NF.

2. What did the Public do? A Protocol for the Ecosystem Services Station

This section describes the 30-minute exercise, including the station setting, introduction to the individual station groups, and interactive ranking exercise.

Upon arrival at the ecosystem services station, participants in the public meetings were greeted by collaborators from the University of Montana, who asked them to take a seat at tables that were set with the required materials for the prioritization exercise. Typically, three people occupied an eight foot table. Each participant had a poster board with a structure to guide ecosystem service prioritization, a deck of cards with ecosystem services on white thick card-stock, a deck of cards with drivers of change on yellow thick card-stock, a yellow piece of standard paper displaying the drivers of change question, and a demographic form on standard paper.

The participants were asked to first focus on the poster board and the white deck of cards, as these materials were used for the initial task of prioritizing ecosystem services based on the importance of each to their relationship with the National Forest. The participants were instructed to indicate how important each ecosystem service listed in Table 1 is to their relationship with the Forest. The collaborators from UM and ALWRI worked with the Forest Planning team to develop a list of ecosystem services that represented the broad range of benefits

provided by the Gila NF, and the 30 ecosystem services shown in Table 1 comprise the final list that was trimmed down from an initial list of around 150 ecosystem services (the initial list is not provided in this document). The ecosystem services in Table 1, as well as the initial list of 150, were identified as relevant to the Gila NF through analysis of previous public meetings and input summarized by the Forest Planning Team. That input was thoroughly documented in the *Final Assessment Report of Ecological/Social/Economic Sustainability Conditions and Trends: Gila National Forest, New Mexico* (USDA Forest Service, 2017).

In order to illustrate the diverse nature of the list of ecosystem services in Table 1, the benefits have been categorized into provisioning, cultural, and regulating services, which is a common typology developed by Hein et al. (2006). Provisioning services are those that directly support people through the extraction of physical natural resources, such as timber and forage for livestock. Cultural ecosystem services represent a broad category of benefits encompassing recreation, cultural and spiritual use, and the scientific value of natural resources. Due to the broad nature of the cultural ecosystem category and to facilitate communication of the diverse range of relationships that people have with the Gila NF, we have further distinguished between ecosystem services that are perhaps commonly thought of in terms of recreation and leisure benefits. The final category of regulating services refers to those benefits that support human health and well-being through the maintenance of ecosystem functions. These benefits may be thought of in terms of regulating environmental benefits, such as biological diversity, air quality, and wildlife habitat.

For the ecosystem services prioritization exercise, each of the ecosystem services in Table 1 was listed on a separate white card, and participants were asked to indicate the importance of each ecosystem service from “more important” to “less important”. It was stressed that this ranking was an individual exercise with no right or wrong answers. The collaborators suggested a tactic of first sorting the ecosystem services into three piles: a definitely important pile, a definitely unimportant pile, and a pile of those benefits that evoke a more neutral feeling.

Table 1. List of ecosystem services (provided on separate white cards) that participants placed into position on the poster board

Provisioning services (extractive resources and uses)

1. Forest materials for personal use (for example – firewood, Christmas trees, gems, food, traditional and medicinal plants)
2. Timber production
3. Oil and natural gas and minerals (for example – gold, copper, gravel)
4. Woody biomass for energy (for example - wood pellets, chip production)
5. Livestock grazing
6. Water for household and municipal use
7. Irrigation for agriculture

Cultural Services (recreation, historical, scientific, community and cultural, and personal-enrichment benefits)

Recreation and leisure related cultural benefits

8. Outfitting and guiding (for example – hunting and fishing)
9. Hunting and fishing (non-outfitted)
10. Non-motorized recreation (for example - hiking, biking, horses, floating, bird watching)
11. Motorized recreation (for example – Off-highway vehicles (OHVs), dirt bikes)
12. Driving for pleasure
13. Developed camping (areas with toilets, tent sites, and water)
14. Dispersed camping (areas without any services)

Other cultural benefits

15. Solitude, quiet, and a clear night sky
16. Native American cultural benefits (for example – ceremonial sites and materials)
17. Traditional agricultural lifestyle (for example – connection to ranching, and use of irrigation ditches (Acequias))
18. Education and interpretation of the area and ecosystems.
19. Research and science (for example - ecology, forestry, and archeology)
20. Places where human influence is substantially unnoticeable.
21. Cultural and archeological sites
22. Public ownership and access to public land
23. Scenic beauty, aesthetics, and inspiration

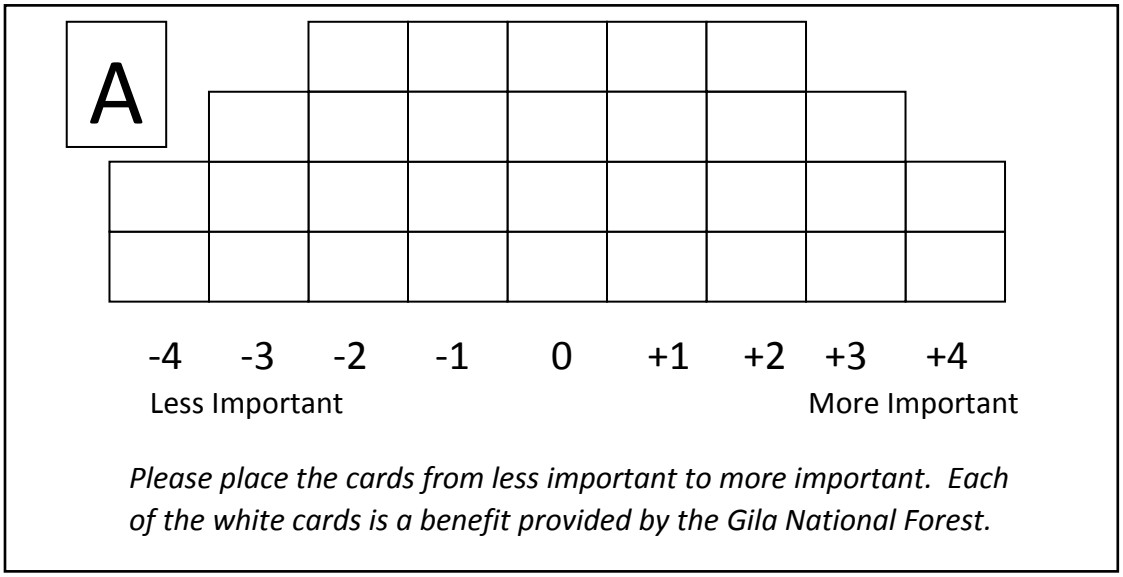
Regulating Services (environmental benefits)

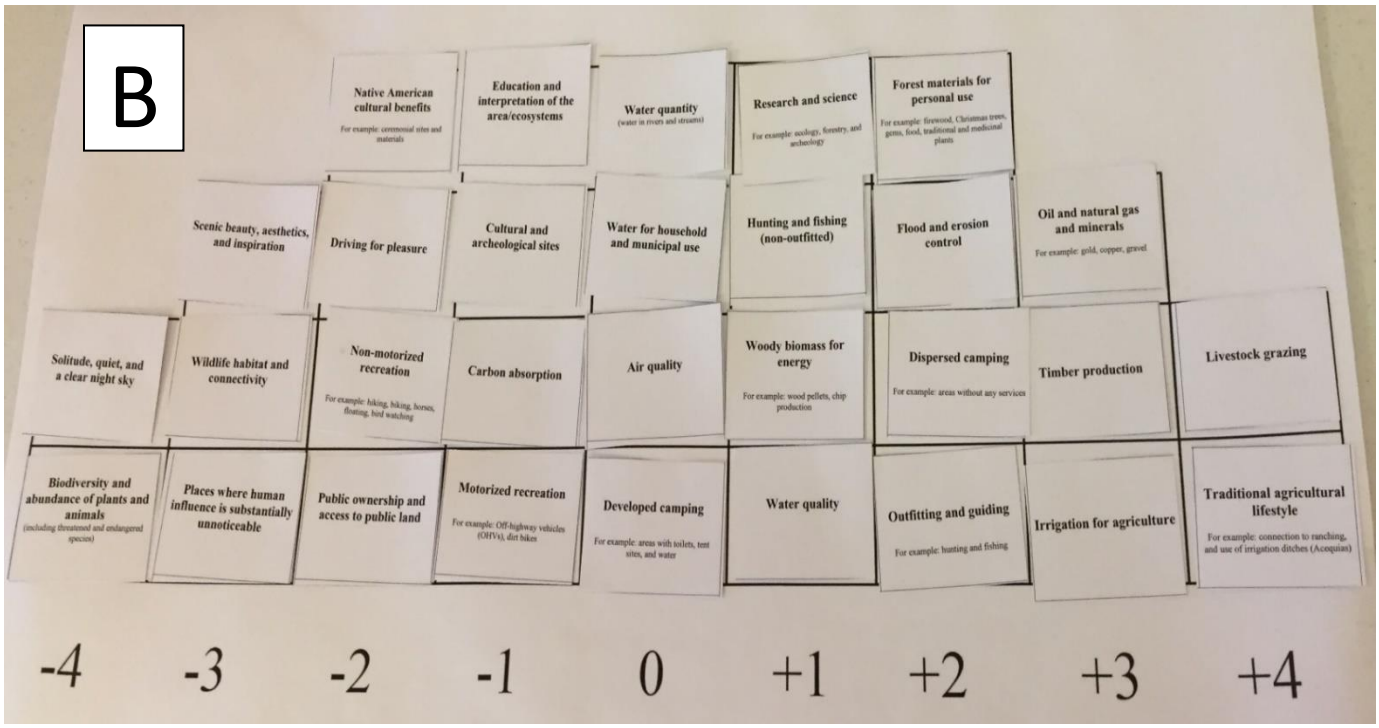
24. Flood and erosion control
25. Carbon absorption
26. Biodiversity and abundance of plants and animals (including threatened and endangered species)
27. Wildlife habitat and connectivity
28. Water quality
29. Air quality
30. Water quantity (water in rivers and streams)

*Note: Italicized categories of ecosystem services, and numbers associated with ecosystem services were not given to participants. In other words, each card had an ecosystem service only (e.g. “Livestock grazing”, “Outfitting and guiding (for example – hunting and fishing)”)

The participants were then instructed to use the ranking board (Figure 1A) as a guide to further sort the ecosystem services from "more important" to "less important". The participants were asked to place each of the thirty ecosystem services onto the thirty ranking-board squares. Figure 1B illustrates a completed ranking exercise done. Regarding the ranking board, it was stressed that that the rows are not different from one another, only the columns. So, each participant was required to choose their two 'more important' benefits, then their next three 'more important' benefits, and so on all that way until the two "less important" benefits were filled in.

Figure 1. (A) Board that participants used to prioritize thirty ecosystem services; (B) Example of completed rank ordering exercise





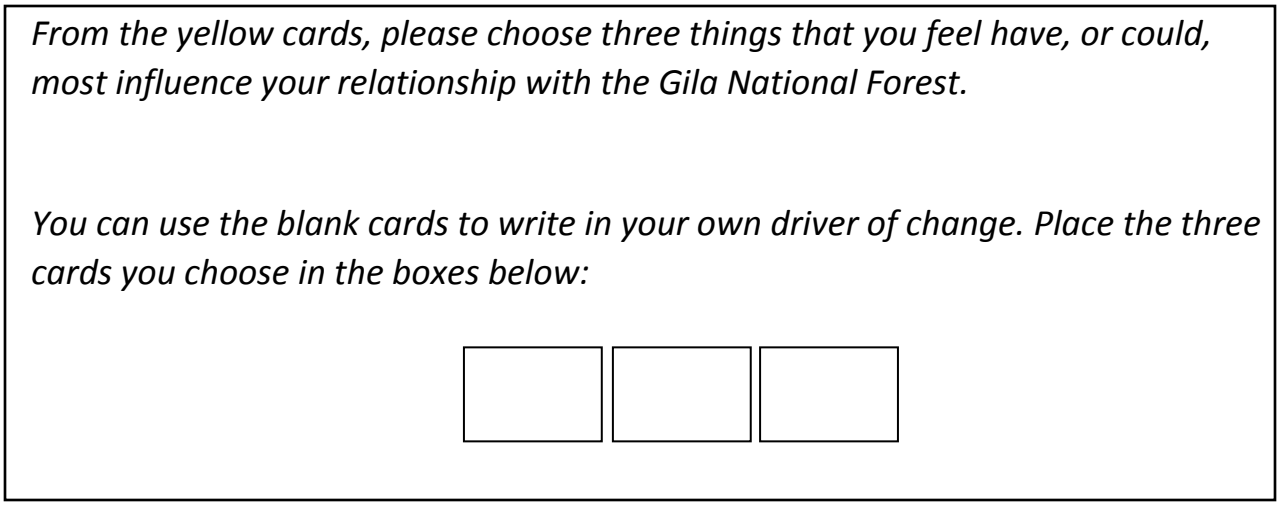
Once the prioritization of ecosystem services was complete (a task that typically took 15-20 minutes), the participants were instructed to focus on the yellow deck of cards and the yellow piece of paper. At this stage, the participants reviewed the list of drivers of change shown in Table 2. The list of drivers of change, like the list of ecosystem services, were developed from review of previously summarized public input (i.e., USDA Forest Service, 2017), as well as from additional input from the Planning Team. Regarding the drivers of change listed in Table 2, participants were asked to decide which three were most influential to their relationship with the Gila National Forest. In other words, which three drivers of change were most influential to their ability to receive the ecosystem services that they ranked in the previous task? The participants were also given blank cards so they could write in relevant drivers of change that were not included in the short list shown in Table 2, if they desired. Figure 2 illustrates the directions presented on the yellow sheet of paper, which guided the participant for the task related to drivers of change.

Table 2. List of drivers of change (provided on separate cards) that participants considered following prioritization of ecosystem services

1. Invasive species
2. Uncharacteristic fire
3. Woody encroachment of grasslands
4. Declining Forest Service budgets
5. Extended drought
6. Extreme weather
7. Streamflow alterations
8. Roads and trails (conditions, access, amount)
9. Land use restrictions
10. Lack of land use restrictions
11. Predators, including wolves
12. Unmanaged grazing (wildlife or livestock)

*Note: Numbers associated with drivers of change were not provided to participants. In other words, each card had a driver of change only (e.g. “extended drought).

Figure 2. The visual guide for the drivers of change task



Upon completion of the drivers of change task, the participants were instructed to provide the planning team with a brief summary of demographic information to allow understanding of who attended and participated in all three exercises during that public meeting. The questions included in this demographic description were ones most critical to understanding representation of results, and were as follows:

1. What is your age?
2. In which county do you reside?
   (If you live in this area seasonally, list the local county)
3. How would you describe yourself (ethnicity, race)?
4. For how many years has the Gila National Forest been important to you (for any reason)?

It was made clear that these questions were only to be used to understand the range of people who completed the task, and not as a means to connect the participant to their answers nor to categorize their responses by age, ethnicity/race, or residence. It was made clear on multiple occasions that the tasks were anonymous, and that no attempt would be made to connect an individual to their answers.

Once the participants finished all three short tasks (i.e. prioritization of ecosystem services, selection of three relevant drivers of change, and the demographic description), their

answers were recorded by collecting the demographic sheets and taking a photo of the remaining information. Participants then moved to another station.

3. How was the Public Input Analyzed? An overview of analytic methods for understanding the diverse opinions gathered

In total, 122 attendees of the public meetings completed the tasks described above during the week of June 12th, 2017. Each of the 122 participants completed their ranking of ecosystem services and selection of corresponding drivers of change in a unique way (no two ranking exercises and selection of corresponding drivers were exactly the same). However, inspection and discussion of each unique relationship, though interesting, is not practical for the purposes of forest planning. Decision-makers in most contexts would have difficulty incorporating 122 unique opinions on the topic of interest, and in the context of forest planning, where tradeoffs among forest benefits are inherent in the decision-making process, it is perhaps impossible. Therefore, it is necessary to provide decision-makers with an understanding of the diverse and typical range of relationships that people have with the Gila NF in a way that is conducive to integration into the forest planning process.

To provide a tractable number of relationships for integration into forest planning, the 122 individual viewpoints of participants are distilled into a limited number of viewpoints that captures, to the greatest extent practicable, the diversity of opinion about the importance of Gila NF ecosystem services as well as the drivers of change most influential to their continued provision. The process of distilling 122 unique relationships into a manageable number is completed in two steps: (1) factor analysis of the 122 ranking exercises and; (2) regression analysis of the selected drivers of change to understand if there is a relationship between opinions about the importance of ecosystem services and the drivers of change considered to be most relevant. This section *briefly* discusses the analytic methods applied to complete these two steps.

3.1. Factor analysis: distilling the ecosystem services ranking exercises

Factor analysis is a statistical approach designed (in this instance) to find similar patterns of response among people who completed the ranking exercise. In other words commonly used in statistics, factor analysis is a method of simplifying a complex set of data, whereby a group of

observed variables (122 participant sorts in this case) are represented by a much smaller number of unobserved dimensions (i.e. factors) which account for the correlations, or similarity, between the observed variables (Kline, 1994). By applying factor analysis to the 122 ecosystem prioritizations, it is possible to find a limited number of typified relationships (archetypes) that generally represents how different people feel about the importance of ecosystem services derived from the Gila NF.

We only provide a very basic discussion of this application of factor analysis due to the desire to only present information most relevant to the decision-making process. For the reader more interested in the statistical method applied in this systematic approach to understanding peoples' opinions, we recommend the following: (1) for further general information about the method and associated statistical analysis used herein, consider Stephenson (1954), Brown (1980), Watts and Stenner (2012), McKeown and Thomas (2013) and; (2) for information about the method and associated statistical analysis that is specific to Federal land management and planning, consider Steelman and Maguire (1999), Armatas (2013), Armatas *et al.* (2014), and Armatas *et al.* (2016). These references will provide further detail, understanding and credence to the analytic decisions made.

Factor analysis of the ecosystem services ranking exercises was completed using the free software program *PQMethod* (Schmolck, 2014), which is designed to analyze information collected using the method implemented for the ecosystem services station. The user-friendly program provides an interface for the entire analytic process, from data entry to the export of results. Data entry is facilitated by safeguards against data-entry errors and, upon its completion, the analyst is primarily concerned with deciding on the number of factors to extract and rotate. This process requires the analyst to decide on the most appropriate factor solution, which is facilitated by a variety of statistical considerations common to factor analysis. For the 122 participants being analyzed herein, a four-factor solution was chosen based upon statistical criteria, including consideration of factor loadings and the Scree test of eigenvalues. The four factors were rotated using varimax rotation, which is the most common, and statistically rigorous, method of rotation applied to these types of ranking exercises.

3.2. Linear regression analysis: testing the relationship between ecosystem services and drivers of change

It may be helpful for forest planners to understand not only what ecosystem services are important to a broad range of people, but also to understand if there are particular factors (i.e. drivers of change) that the public consider as influential to the continued provision of their important ecosystem services. To understand this within the context of the ecosystem services station, linear regression analysis was performed to highlight associations between the archetypes discovered with factor analysis and the drivers of change selected as most relevant.

Linear regression analysis is a commonly used statistical technique that aims to model the relationship between a dependent variable (in this case, the archetype about the importance of ecosystem services) and one or more explanatory variables (in this case, the drivers of change listed in Table 2). Although relatively straightforward in a statistical sense, an in-depth discussion of regression analysis is beyond the scope of this report. Such discussions are widely available, and DeVeaux *et al.* (2012) present one which is accessible to readers who may not be familiar with the approach.

Instead of discussing the mechanics of the approach, a brief discussion of the purpose of regression analysis, and the possible conclusions that can be drawn from it, are provided. Regression analysis is often used for the purposes of prediction and/or explanation. For example, one could use regression analysis to predict whether it will rain on a given day based upon information such as temperature, humidity, season, and any other explanatory variable found to be relevant (e.g., altitude, proximity to a mountain). For the purposes of explanation, regression analysis could be used to understand the influential factors that lead someone to graduate from college. For example, are gender, household income, race, and state residence associated with the probability that someone graduates from college? In order to answer these questions, whether for prediction or explanation, one needs information related to both the dependent and explanatory variables.

In the case of the ecosystem services station, there is interest in understanding if the selection of particular drivers of change can explain what archetype one may align with. Therefore, four separate regression analyses were completed. The dependent variables in the regression analyses are the ‘scores’ that each person (122 people total) had with relation to the four archetypes presented below, and the explanatory variables are the 12 drivers of change

listed in Table 2 (using a value of '1' if that driver was selected as one of three most influential, otherwise a value of '0').

4. What did the Public say? Results from the Ecosystem Services Station

This section of results first presents a basic overview of the range of participants and the location of the public meetings. A statistical analysis of the ecosystem services prioritization exercises and interpretation of the resulting archetypes is presented. This analysis includes both individual discussion of each archetype, as well as comparison between the different archetypes. Finally, an analysis of the drivers of change that participants selected as being most relevant to maintaining their relationship with the Gila NF is provided.

4.1. Meeting locations, numbers of participants, and characteristics of participants

Members of the public completed the ecosystem services station at five public meetings and one 'technical meeting' during the week of June 12th, 2017. The public meetings were 2.5 hour meetings that took place in locations throughout New Mexico in close proximity to the Gila National Forest (Quemado, Reserve, Silver City, Truth or Consequences, and Las Cruces). The technical meeting took place in Silver City and, although it covered much of the same material as the public meetings, it spanned 6 hours, which allowed participants with more technical knowledge about Forest programs to delve into greater detail on particular topics. The ecosystem services station was the same in both the public meetings and the technical meeting.

There were eight participants in Quemado, 11 in Reserve, 25 at the technical meeting in Silver City, 30 at the public meeting in Silver City, 15 in Truth or Consequences, and 33 in Las Cruces. Demographic information was collected to understand the range of people who completed the ecosystem services station, which is important to ensuring that a diverse range of perspectives regarding the importance of ecosystem services. The non-random sampling approach prevents any assertions about the distribution of perspectives across the population. In other words, this sample is not representative of the greater population. However, the 122 participants were relatively diverse in their age, county of residence, race/ethnicity, and years of connection to the Gila National Forest, which suggests that a broad range of perspectives was collected.

The ages of participants ranged from 22 to 89 years old, with an average age of 58 and a median age of 61. The majority of participants resided in the counties where the meetings took place (i.e. Grant, Catron, Doña Ana, and Sierra), but some participants hailed from the following counties: Bernalillo, Cibola, Otero, Sandavol, Socorro, Santa Fe, El Paso (CO), Jefferson (CO), Pima (AZ), and Yavapai (AZ). Participants described themselves in a variety of ways, including white/Caucasian (73%), Hispanic (5%), Native American/white (3%), mixed race (4%), and other (15%). "Other" includes those who were less specific (e.g. "American", "human"), and several responses made by only one person each (e.g., "Mexican American", "Taoist", "Swiss", "Native American"). Lastly, the length of time that participants felt a connection to the Gila National Forest ranged from six months to 80 years. The average number of years that participants felt connected to the Gila National Forest is 30 years, and the median years is 28.

As an activity for engaging the public in National Forest Plan revisions, the ecosystem services activity was described as fun, real, worthwhile, and challenging. Participants were genuinely interested in the activity and welcomed the opportunity for their relationship to the National Forest to be documented and considered. Participants took the activity seriously and many expressed their distinct desire for accuracy and precision in recording their perspectives. While the activity was anonymous and individually recorded, several participants discussed the activity with friends and neighbors. These conversations sometimes continued as they left the station and a good number took their own photographs to document their thoughts and continue consideration at a later date. In sum, we found this activity to be a valid and reliable description of how the public describes their relationship with the Gila National Forest.

4.2. Four typified relationships with the Gila National Forest

Through the application of factor analysis, four typified relationships representing the diverse range of opinions regarding the importance of ecosystem services derived from the Gila National Forest were found. Prior to a detailed discussion of each relationship, it is worthwhile to briefly discuss what the relationships represent, both individually and in aggregate.

Individually, the four archetypes presented below represent four different typified relationships with the Gila NF. The interchangeable terms 'archetype' and 'typified relationship' are used to stress the point that each perspective represents, *in general*, how

different participants feel about the importance of ecosystem services. In other words, none of the four perspectives presented below are exactly how any of the 122 participants feel; however, we would expect that if all of the 122 participants assessed the four relationships below, many would reply that one or more of the relationships is *close* to their sentiments.

In aggregate, the four typified relationships represent the different shared perspectives held by the general public that attended the public meetings. Given the analysis applied to the 122 ranking exercises, there is confidence that all four archetypes do indeed exist among the population of people interested in management and planning of the Gila NF. They are not just averages of the participants, but differentiated viewpoints observed. However, it is not possible to assign a magnitude to any of the typified relationships. It is not possible to assert, for example, that the 'environmental' relationship is held by 25 percent of the population, or that the 'water' relationship is held by 50 percent of the population. In order to draw such conclusions, there is a need for a random sample of the population of a particular size, which would provide what is commonly referred to as a 'representative' sample. In this case, the sample of participants who provided their opinions about the importance of ecosystem services derived from the Gila NF is not representative of the population at large. Because we observed that people with a diverse range of opinions attended the public meetings, it is appropriate to conclude that the four relationships presented below represent the general perspectives existing in the population of people interested in the Gila NF.

The four typified relationships discovered through the analysis of all 122 participants, for ease of communication, have been dubbed the "environmental archetype", "utilitarian archetype", "water archetype", and "motorized archetype". These names, which overly simplify the relationships observed but are perhaps better than generic descriptors (e.g., archetype 1), are based upon the ecosystem services that were prioritized as most important within each perspective.

Of the 122 participants that completed the ranking exercise, only six participants did not identify with one of the four archetypes. In other words, only six participants completed their ranking exercise in a way that is not generally represented by the archetypes presented below. These six people could be considered to have idiosyncratic (highly unique) viewpoints, which were not shared by others at the public meetings.

The four archetypes are illustrated with 'factor arrays', which represent the relationships through a typified ranking exercise, as illustrated in Figures 3-6. In addition, Tables 3-6 facilitate interpretation of the archetypes by highlighting the differences between the archetypes in a consistent way by, for example, listing those ecosystem services ranked higher by one archetype than all others. Although it is important to consider each archetype holistically by considering all 30 ecosystem services, it can be helpful to pay special attention to those ecosystem services that are 'statistically distinguishable', or those that are assigned a level of importance that is notably different among the four archetypes. In other words, if a statement for a particular archetype is statistically distinguishable, it means that it was ranked differently enough[1] by that archetype than by all others to warrant special attention. The statistically distinguishable statements for each archetype are those highlighted in bolded black within each factor array (see Figures 3-6).

The four archetypes are illustrated with specific ecosystem services appearing in italics, and the corresponding ranking value in brackets. For example, the 'environmental archetype' (illustrated in Figure 3) is referred to as such partially because the highest level of importance was given to *biodiversity and abundance of plants and animals (including threatened and endangered species)* [+4] and *wildlife habitat and connectivity* [+4]. In order to support both the discussion of each archetype and the comparison of the archetypes, the ecosystem services are categorized in the same way that Table 1 is categorized. That is, the archetypes in Figures 3-6 are color coded; the provisioning services with orange, the cultural services in two shades of green (dark green for recreation and leisure related services and light green for other cultural services), and the regulating services with blue.

4.2.1. The Environmental archetype

Those who identify with this archetype are, in general, more interested in the provision of regulating services and cultural services that are not related to recreation and leisure. In addition, Figure 3 is mostly devoid of provisioning and recreation cultural services (orange and

[1] Statistically distinguishable statements are calculated using measures of standard error related to factor scores. The statistical program, *PQMethod*, automatically computes the statistically distinguishable statements for each relationship; however, the interested reader can see Armatas (2013:379-381) for exact computational details.

dark green) in the positive half of the factor array with only two ecosystem services that are NOT related to environmental regulation and other cultural benefits.

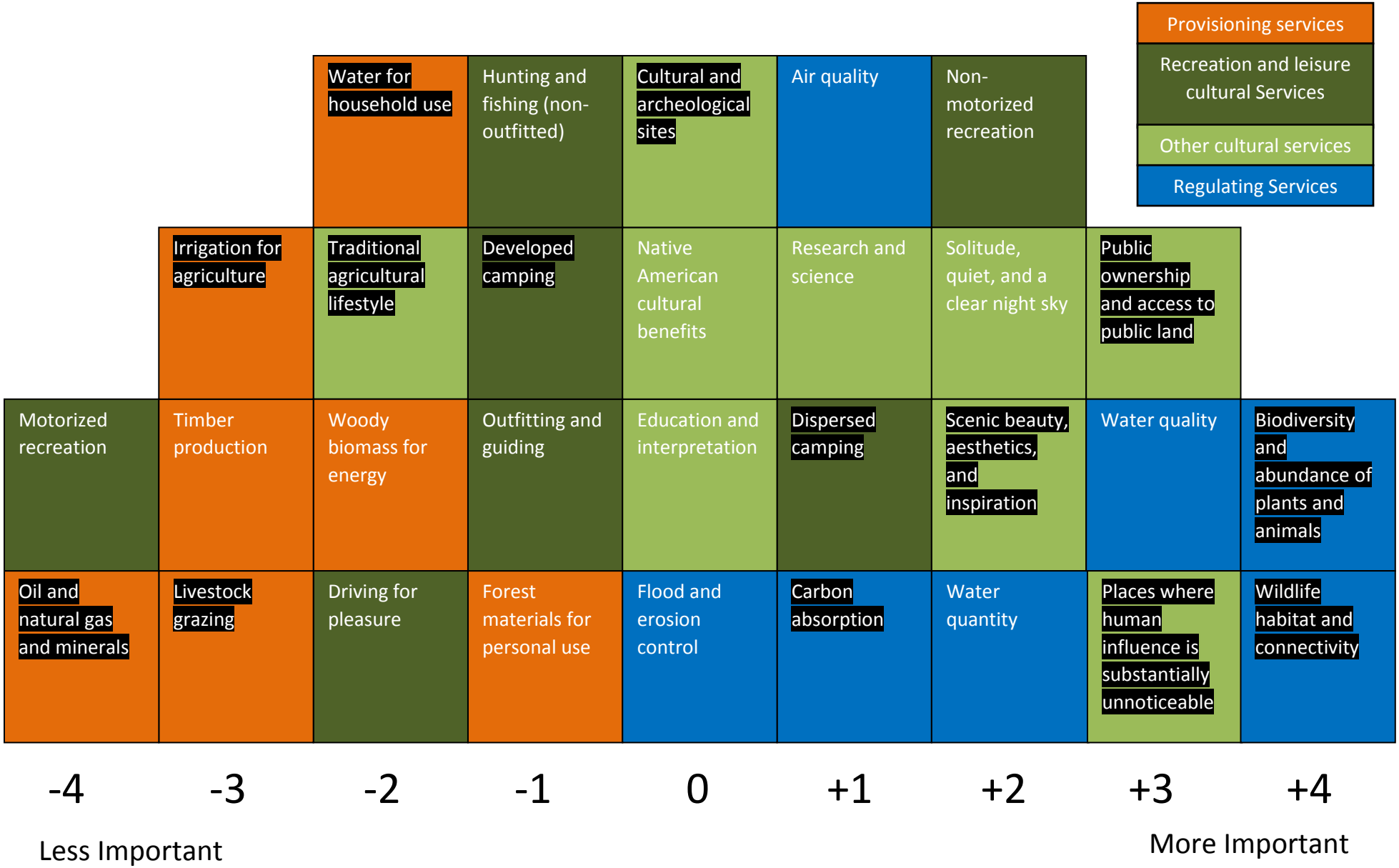
Another way to think about the environmental archetype is the low priority assigned to utilitarian benefits provided by the Gila NF. As reflected in Table 3, those who adopt this archetype assign the lowest level of importance, relative to the other archetypes, to ecosystem services that rely on consumption of natural resources (e.g., *livestock grazing* (-3), *non-outfitted hunting and fishing* (-1)).

Those who align with the environmental relationship appear to perceive tradeoffs between environmental and non-recreation related cultural benefits and utilitarian benefits. By paying attention to the statistically distinguishable statements highlighted in black, it appears that there is a perception that those ecosystem services that represent a landscape unmodified by human activities (i.e., *biodiversity and abundance of plants and animals (including threatened and endangered species* [+4], *wildlife habitat and connectivity* [+4], *places where human influence is substantially unnoticeable* [+3]) are subject to tradeoffs with agricultural-based benefits (i.e., *livestock grazing* [-3], *traditional agricultural lifestyle* [-2], *irrigation for agriculture* [-2]) and extraction of *oil and natural gas and minerals* [-4].

Table 3. Environmental Archetype

Ecosystem services ranked +4
Biodiversity and abundance of plants and animals (including threatened and endangered species)
Wildlife habitat and connectivity
Ecosystem services ranked higher by the Environmental archetype than all others (ranking)
Places where human influence is substantially unnoticeable (+3)
Cultural and archeological sites (0)
Carbon absorption (+1)
Wildlife habitat and connectivity (+4)
Biodiversity and abundance of plants and animals (including threatened and endangered species) (+4)
Ecosystem services ranked lower by the Environmental archetype than all others (ranking)
Oil and natural gas and minerals (for example – gold, copper, gravel) (-4)
Livestock grazing (-3)
Hunting and fishing (non-outfitted) (-1)
Traditional agricultural lifestyle (for example – connection to ranching, and use of irrigation ditches (Acequias)) (-2)
River-based fishing (-1)
Ecosystem services ranked -4
Oil and natural gas and minerals (for example – gold, copper, gravel)
Motorized recreation (for example – Off-highway vehicles (OHVs), dirt bikes)

Figure 3. The Environmental Factor Array



4.2.2. The Utilitarian Archetype

The Utilitarian archetype is named as such for the high level of importance assigned to ecosystem services that support the economy (i.e., *livestock grazing* [+4], *timber production* [+2], *outfitting and guiding* [+2]), as well as those ecosystem services that support subsistence needs and the culture of resource use (i.e., *hunting and fishing* [+3], *traditional agricultural lifestyle* [+3], *forest materials for personal use* [+3]). Although the Utilitarian archetype does not assign a high level of positive importance to woody biomass for energy (another practical use of the forest), this particular ecosystem service is ranked higher by the Utilitarian archetype than all others (as shown in Table 4).

Another noteworthy aspect of the Utilitarian archetype is the statistically significant ecosystem services in the negative half of the factor array. The low level of importance assigned to *places where human influence is substantially unnoticeable* [-2] and *biodiversity and abundance of plants and animals* [-4] supports the utilitarian name assigned to this archetype; however, one might wonder why the utilitarian archetype ranked *water for household and municipal use* [-3] so lowly. One potential explanation is that those who align with this archetype do not consider the Gila NF to be significantly influential to the overall provision of water, much of which is sourced off the forest. Close examination of this archetype may raise a question about why the Utilitarian archetype is partly named for its high level of importance given to *traditional agricultural lifestyle* [+3], while a low level of importance was assigned to other cultural benefits related to specific ways of life (i.e., *cultural and archeological sites* [-2], *Native American cultural benefits* [-2]). Although these other cultural ecosystem services may be considered utilitarian in that they directly support current and past cultural aspects of life, such as Native American cultural and spiritual uses of the Gila NF, there seems to be a nuanced distinction among those who adopt the Utilitarian archetype between cultural ecosystem services specifically related to economic opportunities and subsistence (i.e., *traditional agricultural lifestyle* [+3]).

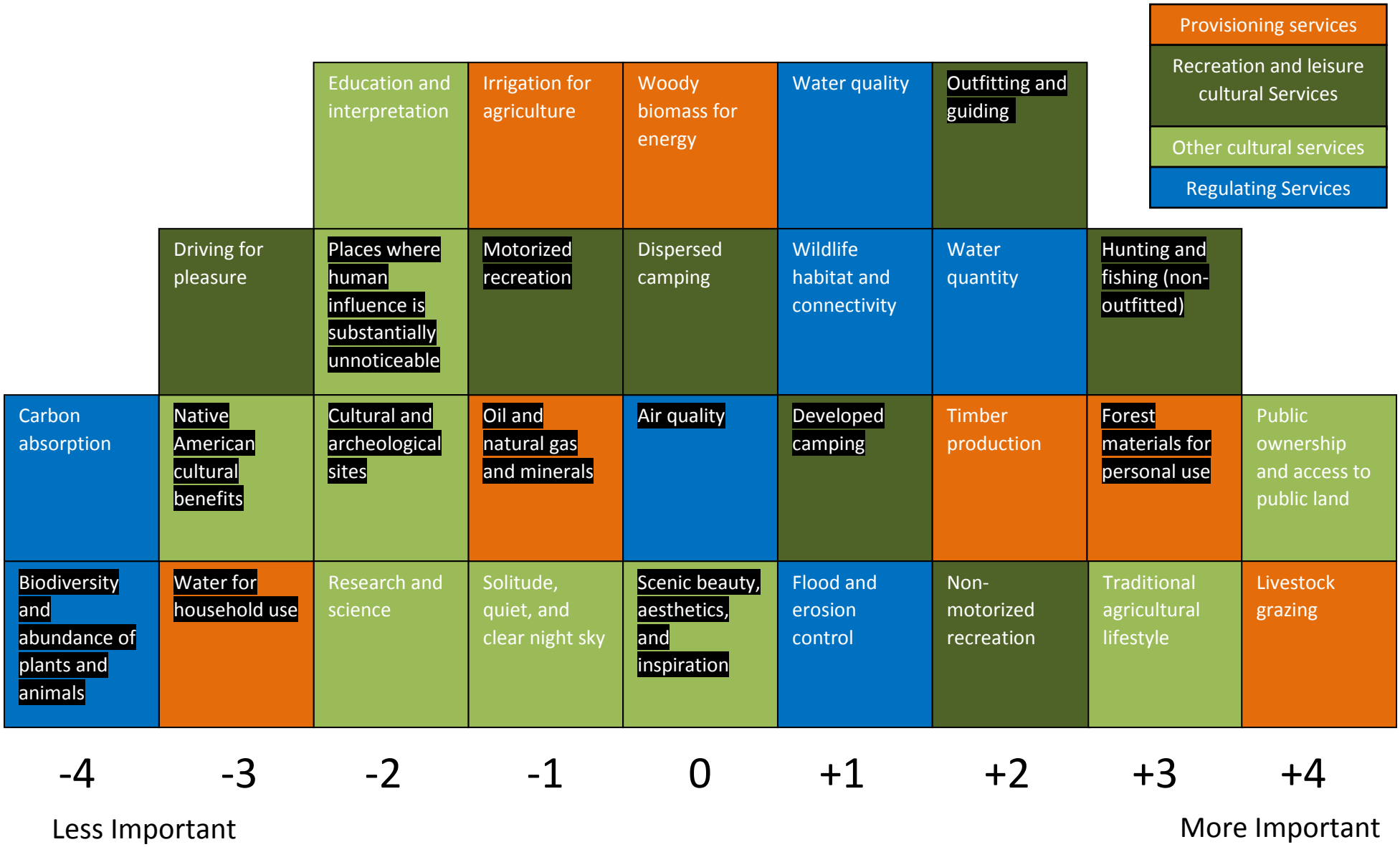
Interestingly, this typified relationship assigns the lowest level of importance to *carbon absorption* [-4], which one could argue provides the most tangible benefit of all regulating services through the reduction of carbon in the atmosphere. This low level of importance is potentially the result of carbon absorption being an ecosystem service that is implicitly tied to climate change. Due to the political nature of climate change, it is possible that a low level of

importance was assigned to carbon absorption by those identifying with this archetype because it was a way to state one's skepticism or lack of belief in the common narrative surrounding climate change as an issue that needs to be addressed. Another potential reason for the low importance to this particular ecosystem service is that locals do not benefit from carbon capture any more than nonlocals.

Table 4. Utilitarian Archetype

Ecosystem services ranked +4
Public ownership and access to public land
Livestock grazing
Ecosystem services ranked higher by the Utilitarian archetype than all others (ranking)
Forest materials for personal use (for example – firewood, Christmas trees, gems, food, traditional and medicinal plants) (+3)
Woody biomass for energy (for example - wood pellets, chip production) (0)
Outfitting and guiding (for example – hunting and fishing) (+2)
Hunting and fishing (non-outfitted) (+3)
Developed camping (areas with toilets, tent sites, and water) (+1)
Ecosystem services ranked lower by the Utilitarian archetype than all others (ranking)
Water for household and municipal use (-3)
Native American cultural benefits (for example – ceremonial sites and materials) (-3)
Research and science (for example - ecology, forestry, and archeology) (-2)
Cultural and archeological sites (-2)
Carbon absorption (-4)
Biodiversity and abundance of plants and animals (including threatened and endangered species) (-4)
Water quality (+1)
Air quality (0)
Ecosystem services ranked -4
Carbon absorption
Biodiversity and abundance of plants and animals (including threatened and endangered species)

Figure 4. The Utilitarian Factor Array



4.2.3. The Water Archetype

People who identify with the water archetype assign a high level of importance to those ecosystem services related to water. This connection to water is reflected both through the high importance of ecosystem services that are clearly water related (i.e. *water quantity* [+4], *Flood and erosion control* [+3], *water quality* [+3], *irrigation for agriculture* [+2], *water for household and municipal use* [+2]) and those where the connection is perhaps a little less clear (i.e., *livestock grazing* [+4], *traditional agricultural lifestyle* [+3]). As shown in Table 5, several of these water benefits, including the statistically distinguishable regulating service of *flood and erosion control* [+3], are ranked higher by this archetype than all others.

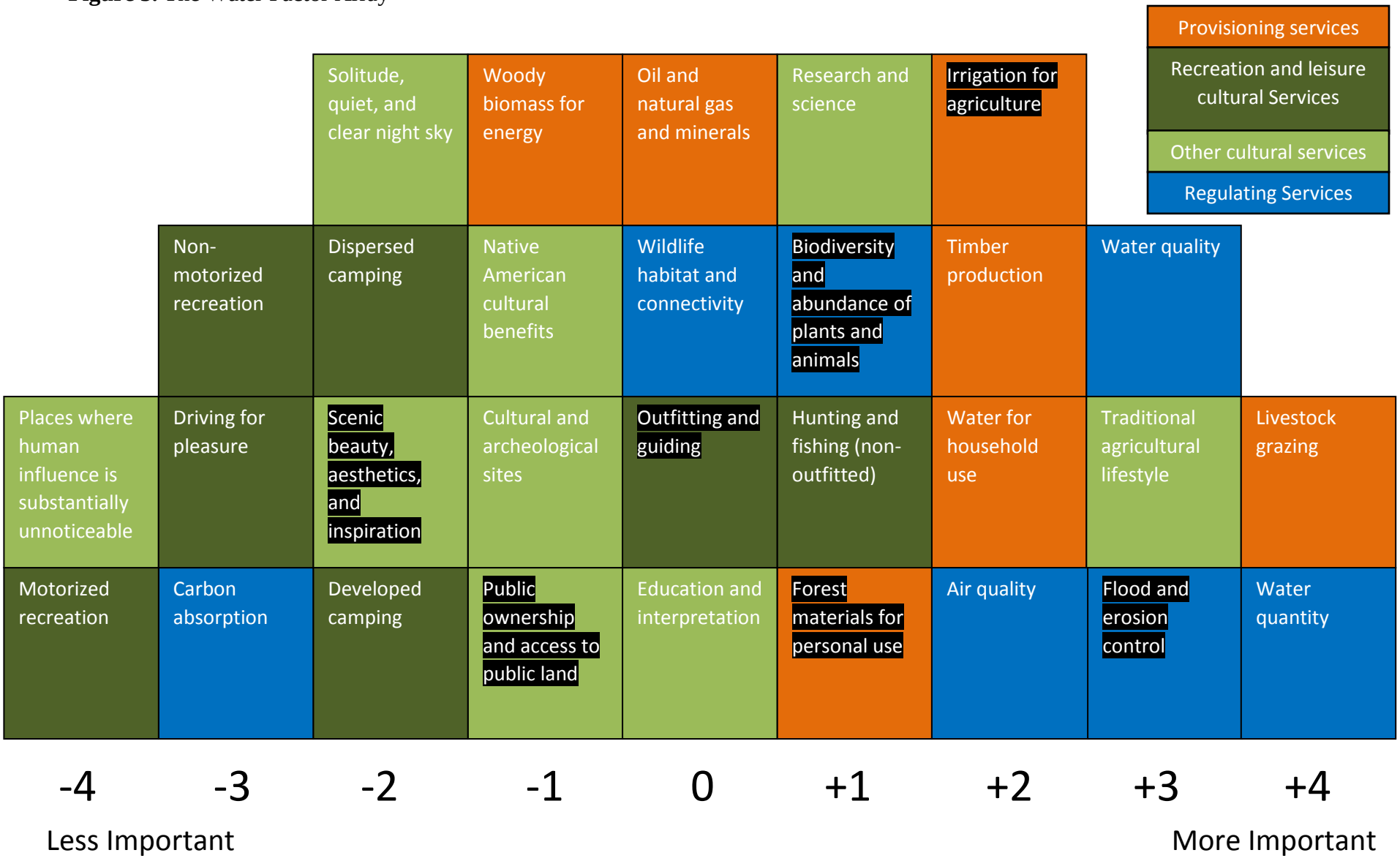
The water archetype could have been named the 'non-recreation' archetype, as all recreation related ecosystem services other than *hunting and fishing (non-outfitted)* [+1] are relatively less important at a level equal to or less than zero. One potential explanation for this archetype is that the regulating services in the positive half of the factor array are considered to be integral to the provision of highly important cultural and provision services; whereas, recreation ecosystem services are generally seen as those that may force unwanted tradeoffs. That is, provision of recreation services could be perceived as a tradeoff for other water-related benefits.

Several of the statistically distinguishable ecosystem services for the water archetype (i.e., *biodiversity of plants and animals* [+1], *forest materials for personal use* [+1], *outfitting and guiding* [0], *public ownership and access to public land* [-1]) occupy the middle of the factor array, or those columns denoted value of -1, 0, and +1. This suggests that these particular ecosystem services do not resonate, one way or another, with those aligning with the water archetype, which is a departure from all other archetypes presented. Relative to other archetypes, the water archetype assigns the lowest value to *scenic beauty, aesthetics, and inspiration* [-2] (it is also statistically distinguishable), which suggests that this benefit is viewed as a reason for limiting highly important ecosystem services such as *livestock grazing* [+4].

Table 5. Water Archetype

Ecosystem services ranked +4
Livestock grazing
Water quantity
Ecosystem services ranked higher by the Water archetype than all others (ranking)
Water quantity (+4)
Air quality (+2)
Flood and erosion control (+3)
Irrigation for agriculture (+2)
Ecosystem services ranked lower by the Water archetype than all others (ranking)
Dispersed camping (areas without any services) (-2)
Wildlife habitat and connectivity (0)
Scenic beauty, aesthetics, and inspiration (-2)
Solitude, quiet, and a clear night sky (-2)
Public ownership and access to public land (-1)
Ecosystem services ranked -4
Places where human influence is substantially unnoticeable.
Motorized recreation (for example – Off-highway vehicles (OHVs), dirt bikes)

Figure 5. The Water Factor Array



4.2.4. The Motorized Archetype

The Motorized archetype is named for the high level of importance assigned to *motorized recreation* (+4) and *driving for pleasure* (+3), both of which are ranked higher by this archetype than all others. Generally, those who align with this viewpoint appear to place relative high importance on ecosystem services that contribute to the motorized recreation experience, both through environmental conditions (i.e., *water quality* [+2], *water quantity* [+2], *wildlife habitat and connectivity* [+2]) and experiential conditions (i.e., *scenic beauty, aesthetics, and inspiration* [+3], *solitude, quiet, and a clear night sky* [+3]). An aspect of the experience that is important to the motorized archetype is the freedom to roam, which may be supported by the importance assigned to *public ownership and access to public land* [+4]. The importance of public access is also likely implicit in the importance assigned to *non-outfitted hunting and fishing* [+1].

This archetype arranged several of the utilitarian benefits toward the middle of the factor array, including provisioning services (i.e., *livestock grazing* [+1], *irrigation for agriculture* [0], *oil and natural gas and minerals* [0], *forest materials for personal use* [-1]) and cultural services (i.e., *traditional agricultural lifestyle* [+1], *hunting and fishing (non-outfitted)* [+1]). The relegation of these benefits to the middle of the factor array suggests that such benefits are not perceived to force tradeoffs with the more important ecosystem services located toward the right of Figure 6. Unwanted tradeoffs may be perceived to occur when the provision of lower priority ecosystem services, *such as non-motorized recreation* [-3], *education and interpretation of the area and ecosystems* [-3] and *biodiversity and abundance of plants and animals* [-2], are increased.

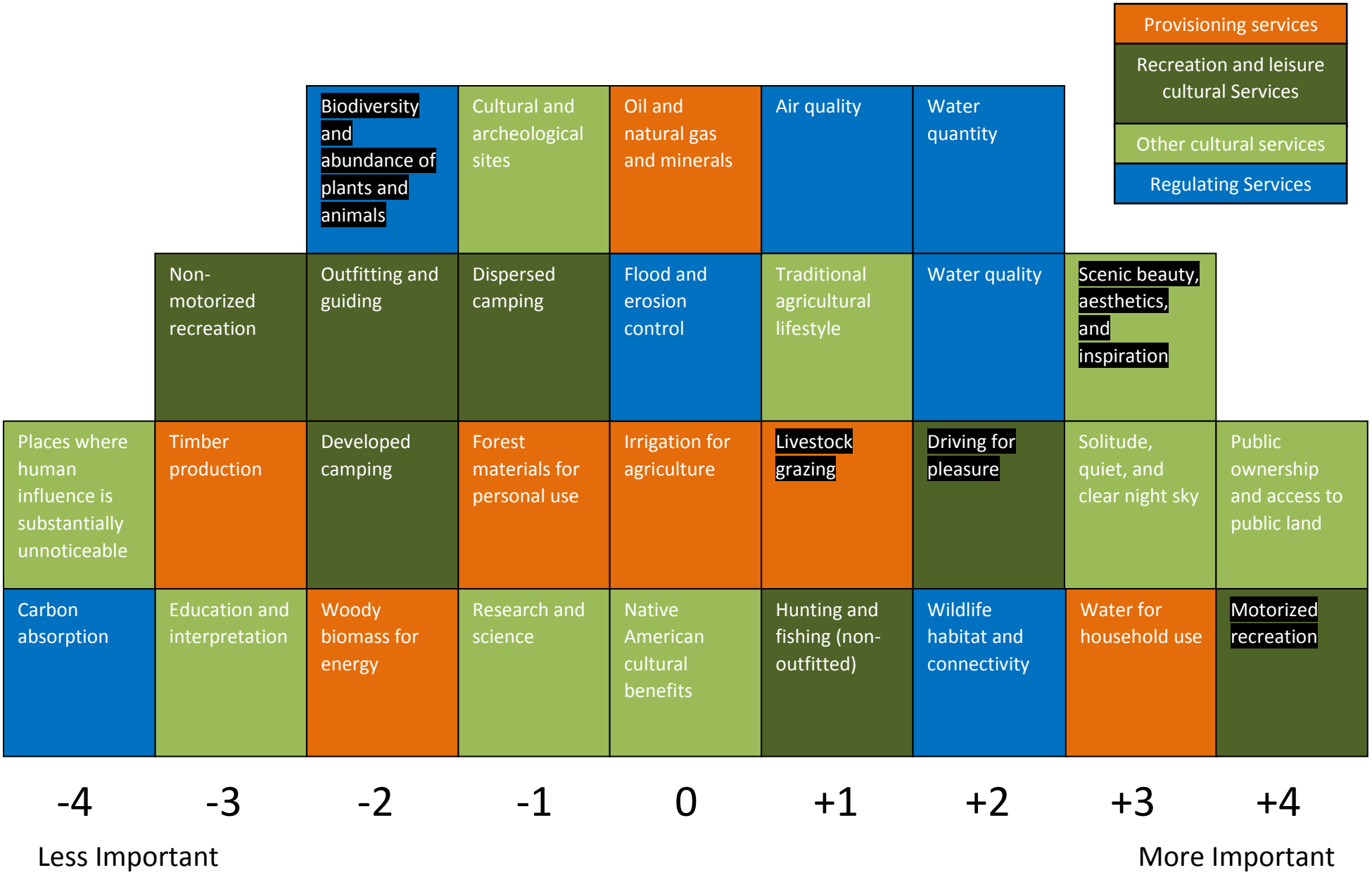
The ranking of *solitude, quiet, and a clear night sky* [+3] is, as shown in Table 6, higher for this archetype than all others. This is not surprising when a literal interpretation of this ecosystem service is applied, as such conditions are likely desired by the majority of visitors spending time on the Gila NF and they may be particularly important for the motorized archetype as it facilitates an experience supported by a freedom to roam through undeveloped landscapes. However, these conditions are often associated with Wilderness land, and the political nature of Wilderness designation and the fact that motorized use is prohibited certainly adds an interesting element to this archetype. On the other hand, *places where human influence is substantially unnoticeable* [-4] is ranked least important, which is perhaps due to a tolerance

or lack of concern about seeing human influence on the landscape and/or an interpretation of this ecosystem service as one associated with Wilderness and the regulation of motorized use. Another potentially political ecosystem services that may be influencing the priorities of this archetype is *carbon absorption* [-4].

Table 6. Motorized Archetype

Ecosystem services ranked +4
Motorized recreation (for example – Off-highway vehicles (OHVs), dirt bikes)
Public ownership and access to public land
Ecosystem services ranked higher by the Motorized archetype than all others (ranking)
Motorized recreation (for example – Off-highway vehicles (OHVs), dirt bikes) (+4)
Scenic beauty, aesthetics, and inspiration (+3)
Driving for pleasure (+2)
Solitude, quiet, and a clear night sky (+3)
Water for household and municipal use (+3)
Ecosystem services ranked lower by the Motorized archetype than all others (ranking)
Education and interpretation of the area and ecosystems (-3)
Outfitting and guiding (for example – hunting and fishing) (-2)
Ecosystem services ranked -4
Carbon absorption
Places where human influence is substantially unnoticeable

Figure 6. The Motorized Factor Array



4.3. Comparison of the four archetypes

Tables 3-6, as well as the accompanying discussions of each archetype above, provide some level of comparison between the four archetypes. In addition, the process of factor analysis is inherently about providing viewpoints that are distinct from one another and, therefore, close examination of Figures 3-6 facilitates an understanding of the differences (and similarities) between the four typified relationships. Despite these built-in comparisons, it is worthwhile to further discuss particular differences and similarities related to the four different archetypes. This section does not summarize each and every similarity and difference, as we believe such an understanding can be obtained in the previous sections. Instead, we make specific comparisons between the archetypes that may be of interest for the purposes of forest planning and communication with the public. As part of the results section, we primarily highlight how the different archetypes view specific ecosystem services, reserving the discussion related to the implications of such an understanding for management and planning for the following section.

4.3.1. Public ownership and access: an important aspect of public land on the Gila NF?

Large swaths of the United States, particularly in the West, are managed by the Federal government and owned by the American public at large. The benefit of public ownership and access to public land is derived both from the variety of uses that are enjoyed on and off the forest, as well as the symbolic value associated with areas of land being guided by the democratic process.

With regard to the four typified relationships identified on the Gila NF, three of the four archetypes appear to be in consensus that *public ownership and access to public land* (Environmental [+3], Utilitarian [+4], Motorized [+4]) is highly important. The Water archetype placed *public ownership and access to public land* [-1] in a more neutral position. The high level of importance placed on this benefit by the majority of archetypes suggests that this particular benefit resonates with people, even if the benefits derived because of public ownership and access are different across the archetypes. It is difficult to know exactly why the water archetype placed public access in a more neutral position, but one potential explanation is that several of the benefits highly important to the water archetype (i.e., *Flood and erosion control* [+3], *water quantity* [+4], *irrigation for agriculture* [+2], *livestock grazing* [+4],

traditional agricultural lifestyle [+3]) may not be dependent on public ownership and access. One potential thought process is that the provision of particular benefits such as *flood and erosion control* [+3], *irrigation for agriculture* [+2], and *livestock grazing* [+4] may increase under a different land ownership and management arrangement.

4.3.2. Ecosystem services often associated with Wilderness land

Although the ecosystem services presented to participants did not ever mention Wilderness areas, *solitude, quiet, and clear night sky,* and *places where human influence is substantially unnoticable* are often associated with Wilderness. In addition, several provision ecosystem services and motorized recreation are not heavily derived from Wilderness.

Those who identify witht the environmental relationship potentially hold the most positive view towards Wilderness with *solitude, quiet, and clear night sky* [+3], and *places where human influence is substantially unnoticable* [+3] ranked as highly important; whereas, *motorized recreation* [-4] and all provisioning services occupy the left side of the factor array. It is also possible that this archetype considers Wilderness as important for supporting other ecosystem services occupying the right side of the factor array, such as *biodiversity and abundance of plants and animals* [+4], *wildlife habitat and connectivity* [+4], and *water quality* [+3].

The underlying perspective regarding Wilderness for the other three archetypes is more ambiguous. This topic with regard to the Motorized archetype is explored in Section 4.2.4. The Utilitarian and Water archetype both place *solitude, quiet, and clear night sky*, and *places where human influence is substantially unnoticable* in the negative half of the factor array, though, *motorized recreation* is also in the negative half of the factor array for both relationhips.

4.3.3. Disparate rankings of water for household use: making the connection between forest resources and human benefits?

Through inspection of the four typified relationships, one may notice that *water for household and municipal use* is ranked positively by the water archetype [+2] and the motorizd archetype [+3]; while it is ranked negatively for the environmental archetype [-2] and the utilitarian archetype [-3]. A disagreement among the importance of ecosystem services is not

notable on its own, but when it is a universally-relevant benefit such as water for household use, it may be worth considering. Without any supporting rationale from the public meeting attendees it is not immediately possible to draw any definite conclusions, but one possible reason for the disagreement related to *water for household use* is that some participants relate its continued provision to other concerning occurences. For example, the environmental archetype may view *water for household use* as supporting future water development projects. Similarly, the utilitarian archetype supports water for agriculture use, but given limitations in water supply there is a trend across the West of municipalities being able to purchase water rights, which may be perceived as a threat to shared water systems such as acequias.

4.4. Drivers of change considered to be influential to ecosystem service provision

This section presents the results of the drivers of change task. First is a general summary of the drivers of change selected by participants as most influential to maintaining their archetype with the Gila NF. Following the general overview, results from the statistical analysis (breifly explained in Section 3.2) are presented, which provides an understanding as to whether particular archetypes were correlated with particular drivers of change.

4.4.1. A general overview of the drivers of change task

Table 7 provides an initial, basic understanding of what drivers of change were considered relevant. Table 7 lists both the preselected drivers of change (i.e. those from Table 2) and the additional drivers of change that participants "wrote in" with a corresponding frequency representing the number of times that each driver was selected as one of the three most relevant drivers of change. With regard to those drivers of change provided by respondents, we did our best to provide the verbatim responses of participants; however, some drivers of change have been merged in cases where they were deemed similar enough, and in other cases drivers have been shortened to be more concise without losing the meaning.

Table 7. List of drivers of change and corresponding frequency in descending order

Preselected drivers of change provided to respondents	
Roads and trails (conditions, access, amount)	56
Streamflow alterations and diversions	44
Declining Forest Service budgets	40
Land use restrictions	37
Lack of land use restrictions	34
Predators, including wolves	27
Unmanaged grazing (wildlife or livestock)	27
Uncharacteristic fire	25
Woody encroachment of grasslands	14
Extended drought	14
Extreme weather	12
Invasive species	8
Drivers of change "written in" by respondents	
Public land transfer	2
Climate change	2
Inability of local managers to manage local forests and conflicts	2
Fuelwood collection	2
Long-term restoration following wildfire	1
Travel management restrictions	1
Fire management	1
Balancing multiple use and wilderness designation	1
Local timber and livestock production as tools for management	1
2012 Forest Planning Legislation	1
Gila trout protection	1
Loss of natural night sky	1
Restrictions to livestock	1
Lack of trail maintenance, mapping, and development	1
Restricting multiple use instead of using it as a management tool	1
Tree management selective harvest	1
Public relations	1
Managed grazing (livestock)	1
Cuts to ranching allotments	1
Jeeping availability and trails	1
Four-wheel drive access to all lands	1

Note: Climate change was not listed among the pre-determined possible factors of influence; rather some of the potential outcomes of climate change were among those offered to participants. The two that listed climate change as an influential force, therefore, does not provide insight into how climate change might impact relationships with the National Forest. Related to the preselected drivers of change, it is worth highlighting that the climate change related disturbances (e.g. extended drought, uncharacteristic fire, etc.) and ecological conditions were selected less often than the drivers of change related to humans (e.g. declining forest service budgets, and streamflow alterations and diversions). A similar focus on human-related drivers of change is represented by the "written-in" factors provided by respondents.

Considering that 122 people participated in this activity and no driver could be selected twice by an individual, the numbers in Table 7 can be thought of in terms of percentages. For

example, 46% of participants (56/122) considered the driver related to roads and trails as one of the three most influential to their relationship with the Gila National Forest; whereas only 7% (8/122) considered invasive species to be among the most relevant drivers of change to their relationship with the Gila NF. However, it should be noted that the specific strength of wording for any driver (e.g., "extreme weather", "extended drought") may have weakened or strengthened which drivers were perceived as most influential.

4.4.2. Are drivers of change considered influential associated with particular archetypes? Results from a linear regression analysis

Linear regression analysis of the four archetypes in relation to the drivers of change list in Table 2 suggest that there is some relationship between the drivers of change selected as most influential and the archetypes related to the importance of ecosystem services. Table 8 provides the results from the four regression analyses. The dependent variables are the factor scores for each of the four archetypes and they are listed in the columns. The predictive variables are indicator variables for the drivers of change, which populate the rows. Prior to discussing the results in Table 8, it is worth breifly explaining three aspects of the table: (1) the numbers (i.e. coefficients) in each cell; (2) the asterisk denoting statistical significance; and (3) the concept of 'all else constant'. The coefficients in the table cells can be interpreted as the associated change in the factor score for each archetype if a particular driver of change is selected. For example, selecting "streamflow alterations and diversions" is associated with an average *increase* (as indicated by the positive number) in the factor score on the environmental archetype of 0.23, all else constant. This indicates a positive relationship between the driver of change "streamflow alterations and diversions" and the environmental archetype. In other words, if a person selected "streamflow alterations and diversions" as one of their three most influential drivers of change, then we would expect them to be more associated with the environmental archetype than those who did not select this driver of change (holding all other drivers of change constant). Regarding the asterisk, interpreting the numbers in this manner is only appropriate in cases where asterisks accompany the number. In cases where an asterisk is not present, there is not enough evidence to conclude that there is a relationship between the driver of change and the corresponding archetype. More asterisks indicate more confidence for such a relationship. Lastly, the 'all else constant' aspect of interpreting the coefficients stresses that each of the numbers represent a

parital rate of change in the factor scores. That is, each number represents the average change in the factor scores corresponding with selecting a particular driver, *holding all other drivers of change constant.* It is useful to do so as we inspect each individual driver of change.

Being cognizant of these interpretation-related details, Table 8 shows that selecting "streamflow alterations and diversions", "declining forest service budgets", "unmanaged grazing", "extreme weather", and "invasive species" are associated with increases in the average factor score on the environmental archetype. This suggests that the environmental archetype may be most concerned with these particular drivers of change, and it also highlights that this archetype potentially perceives these drivers of change as the most influential to the continued flow of their most important ecosystem services. On the other hand, selection of the "land use restrictions" is associated with a decrease in the factor score on the environmental archetype of 0.31, all else constant. In other words, selecting this particular driver of change means that, on average, one is less associated with the environmental archetype. This result also suggests that the environmental archetype is likely not concerned with land use restrictions for the provision of their important ecosytem services.

Regarding the utilitarian archtype, the drivers of change that appear to be most concerning are "land use restrictions" and "woody encroachment of grasslands". This is not particularly surprising, as land use restrictions are generally considered as an impediment to realizing many of the utilitarian benefits flowing from the Gila NF, and woody encroachment of grasslands may be percieved as more threatening to the agricultural benefits (e.g., livestock grazing and traditional agricultural lifestyle). On the contrary, "streamflow alterations and diversions", "unmanaged grazing", and "extreme weather" are perhaps of less influence to this archetype.

The drivers of change associated with the water archetype are "predators, including wolves", "woody encroachment of grasslands", and "extended drought". Considering this archetype assigns a high level of importance to water related benefits in general, and those related to agriculture specifically, a concern for these three drivers of change is apparent. Lastly, the motorized archetype appears to only have a single driver of change that is particularly relevant, which is "roads and trails (conditions, access, amount)". This association is also understandable, as motorized use of the Gila NF is dependent on the network of roads and trails.

Table 8. Coefficients from linear regression analysis between of drivers of change (independent variables) and archetypes (dependent variables)

	Archetypes (typified relationships)			
Drivers of change	**Environmental**	**Utilitarian**	**Water**	**Motorized**
Roads and trails (conditions, access, amount)	0.02	-0.06	0.07	0.10**
Streamflow alterations and diversions	0.23***	-0.14***	-0.02	-0.04
Declining Forest Service budgets	0.22***	-0.10*	0.07	-0.02
Land use restrictions	-0.31***	0.21***	0.10	-0.01
Lack of land use restrictions	0.08	0.04	-0.04	0.03
Predators, including wolves	-0.16**	0.06	0.15**	0.03
Unmanaged grazing (wildlife or livestock)	0.28***	-0.13**	0.01	-0.03
Uncharacteristic fire	0.06	0.12*	0.06	0.07
Woody encroachment of grasslands	-0.13	0.20***	0.16**	0.03
Extended drought	0.01	-0.10	0.21***	-0.04
Extreme weather	0.24**	-0.23***	0.08	-0.05
Invasive species	0.24*	-0.11	0.04	0.06

Note: Levels of statistical significance denoted as: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. So What? A Discussion of Potential Benefits and Implications of Public Input from the Ecosystem Services Station

Increased knowledge of diverse public opinions regarding important ecosystem services and influential drivers of change is of limited use without an understanding of how such knowledge can support the Forest planning process. A common question during the public meetings was: how will this information be used? This section provides a discussion of how the information gathered at the ecosystem services station, and the results presented within this report, may be beneficial for the decision-making process. In other words, how can the ecosystem services station help the Forest Planning Team?

Prior to a discussion of potential benefits and implications of this report, it is worth noting that the authors of this report are not part of the Gila NF Planning Team nor experts on the planning process. It is with this caveat that we hope to make clear that decision-making by the Planning Team and the responsible official is guided not only by public input, but also by the legal and administrative frameworks that guide Forest management and planning decisions. In short, this report provides an undertanding of the public input gathered at the ecosystems station, as well as potential uses of such information; but it does so with the acknowledgment that the

Planning Team and the responsible official will ultimately make decisions within the planning process based on several information sources and the frameworks established for the process.

The overarching goal of the ecosytem services station was to collect a diversity of perspectives regarding both the important benefits derived from the Gila NF and the factors or influences relevant to continued provision of such benefits. The process for obtaining such an understanding, in addition to the information yielded, may provide several benefits. The potential benefits for the planning process can be thought of in two broad categories, which are related to: (1) improved transparency, communication, and relationship building and; (2) better understanding of how forest planning decision-making may impact the general public.

5.1. Providing support for enhanced transparency, communication, and relationship building

With regard to administration of public land owned by all U.S. citizens, a critical component of successful national forest planning and management is to both clearly communicate with the general public about decisions, and create an atmosphere where there is potential for relationship and trust building. The ecosystem services station may be beneficial within this context in several ways.

First, there are benefits stemming from the systematic and structured process that incorporates a broad range of ecosystem services. As an individual activity, it is difficult for dominant personalities to overtake the process and, consequently, the potential is lowered that members of the public will feel disillusioned with the planning process. In addition, the statistical analysis applied provides a clear process for arriving at the results (i.e., archetypes and corresponding drivers of change), which can assuage concerns about researcher bias. The inclusion of a broad range of ecosystem services not only ensures that each participant thinks carefully about the myriad ways the Gila NF supports society, but it also provides a cognitively manageable way for the Planning team to visualize the role of various ecosystem services. Furthermore, the typified relationships that result provide an inclusive picture of the different types of people interested in the Gila NF without prioritizing the interests of some over the interests of others. In other words, this approach does not, for example, suggest that 50 percent of people belong in the utilitarian archetype, but instead encourages decision-makers to consider all

archetypes equally. Also, the archetypes are perhaps difficult to dismiss in that they are made tangible and serve as constant reminders about the differing perspectives.

Second, there are benefits that result from the broad range of perspectives gathered, which are represented by a limited number of typified relationships in the form of clear and concise 'factor arrays' (i.e., Figures 3-6) and can serve as communication tools to engage both the Planning Team and the general public. The archetypes may facilitate continued learning and discussion about how the Gila NF supports the general public and, consequently, they may help to align the Forest Planning Team perceptions about what ecosystem services are important with those of the public. For the general public, understanding the different archetypes may foster empathy and encourage productive conversation. Improved communication and understanding can happen in two ways: (1) between the Planning Team and the general public and; (2) among different members of the general public. Regarding improved communication between the Forest and the general public, the disparate archetypes presented above illustrate how difficult Forest Planning is, as the inherent goal is to administer the Gila NF in a way that supports a broad range of society. A clear understanding of the disparate perspectives that are meant to be accommodated could encourage both patience during the planning process (often described as a 'marathon'), as well as understanding when decisions regarding the forest plan are finalized (even if such decisions are considered undesirable). These diverse archetypes can potentially give legitimacy to viewpoints that differ from one's own. If one is no longer skeptical about the existence of a different viewpoint, then perhaps acceptance of that different viewpoint and subsequent civil discourse can commence.

Third, the input related to the drivers of change can facilitate better communication and relationship building within the forest planning process by highlighting potential differences in perceived priorities among the Forest Planning team and the general public, as well as highlighting areas where additional information and conversation is likely beneficial. The association between archetypes and the drivers of change selected may be informative. For example, the drivers of change exercise highlighted an association between "land use restrictions" and the utilitarian archetype. This suggests that this archetype typically considers human administration of the forest as an impediment to receiving important ecosystem services (e.g., timber production, livestock grazing). Although land use restrictions on the forest may

influence the provision of such ecosystem services to some extent, there are likely other drivers of change that influence the ability to derive particular benefits from the Gila NF. For instance, timber production on the Gila NF may be partly influenced by broad political and economic forces (e.g., market values and cheap substitutes) that are beyond control of the Forest.

Lastly, the results from the drivers of change analysis (i.e., regression analysis) provides some additional validity to the presented archetypes. For example, an association between the water archetype and the three significant drivers of change in Table 8 (i.e., "predators, including wolves", "woody encroachment of grasslands", and "extended drought") is not surprising; however, this logical association may provide confidence about the validity of the archetype itself. As a result, it is possible that the general public will be more accepting of the final forest plan if there is increased confidence in the compilation of the public input. As the public thinks deeply about the ecosystem benefits and the potential drivers of change, more confidence and understanding of the overall plan is gained.

5.2. Understanding how forest planning decision-making may impact the general public

Up to this point, the potential benefits of the information presented herein have been related to the public-relations aspect of forest planning, without much discussion of how this information may be valuable for informing on the ground decision-making. The reality of forest planning and management is that decisions made (e.g., improved trail maintenance, habitat restoration, approved timber sales) will affect those who derive benefits from the Gila NF. Therefore, the benefits discussed in this section focus on how the information in this report may be beneficial for informing decision-making or, similarly, how it may be beneficial for understanding the implications of decisions.

One potential benefit of the public input gathered is the ability to understand perceived tradeoffs regarding the importance of ecosystem services among the four archetypes. The archetypes presented can highlight when the same tradeoff is being perceived by different archetypes in different ways. For example, it appears that the environmental archetype and the motorized archetype perceive a tradeoff between *biodiversity and abundance of plants and animals* and *motorized recreation*, but the Environmental archetype likely considers motorized recreation as a potential threat to biodiversity while the Motorized archetype likely adopts the

opposite position. A similar scenario is likely taking place between the water archetype and the environmental archetype with regard to *livestock grazing* and *places where human influence is substantially unnoticeable*. An implication of understanding such situations is that planners and managers can better understand perceptions of how increasing the provision of one ecosystem service may influence the provision of another. This can help the Forest Planning Team understand if a planning decision is likely to affect the archetypes in different ways, and if such decisions may create backlash from the public.

Also related to understanding tradeoffs, the archetypes highlight how increasing the provision of particular ecosystem services through a planning related decision may affect archetypes disparately. For instance, an increase in livestock grazing on the Gila NF is likely to be beneficial to the water and utilitarian archetypes, whereas the environmental archetype may be negatively impacted.

By combining knowledge related to both the archetypes and their association with drivers of change, it may be possible for the Forest Planning team to understand how particular archetypes will be influenced by human-caused changes, or how the types of decisions that the archetypes are interested in. For instance, the motorized archetype is clearly concerned with issues of access, as reflected in the high level of importance assigned to the ecosystem service *public ownership and access to public land*. A driver of change that is integral to continued provision of this benefit, in conjunction with other benefits (e.g., *motorized recreation*), is the conditions of roads and trails. Therefore, any decisions related to changes in planning and management related to the system of roads and trails in the Gila NF is likely to be particularly relevant to this archetype.

6. Conclusion

The ecosystem services station provided the opportunity for participants in the public meetings to express their opinions about what ecosystem services were more and less important. The task required that participants not only consider a full range of ecosystem services derived from the Forest, but also make tradeoffs among those benefits. In addition, participants considered the drivers of change that are most relevant to maintaining the flow of their most important ecosystem services. The results of the ecosystem services station illustrate four

typified relationships, each of which highlights different opinions regarding the tradeoffs among ecosystem services. The participants were demographically diverse and, in general, there appears to be a tendency to consider human-caused drivers of change that are not specifically related to climate change as the most relevant to their relationship with the Gila National Forest. The analysis of the drivers of change highlight several associations between the relevant drivers of change and the resulting archetypes.

Being integrated within an ongoing series of public meetings has allowed this activity to gain legitimacy and access to a diverse range of the public. These engaged citizens are vocal and attentive to issues of national forest management and this activity has successfully tapped their expertise and desire to be meaningfully involved. With a data-driven approach and subsequent analytical opportunities, the public recognizes this activity has scientific legitimacy and independence. While building on existing planning documents, the insights and results of this activity are neither obvious nor pre-determined. The ecosystem-services station yields insights and documentation of the relationships the public has with the Gila National Forest not previously available.

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