Appendix C. Pajaro Compass Conservation Theme Aggregate Assessment Methods

Approach

We resampled all data to 90m grids using bilinear interpolation for continuous features and majority area for categorical features. Data layers representing landscape features were then aggregated within the six conservation themes of water resources, biodiversity, agriculture, carbon and soil health[1], recreation, and community, via the following steps:

1. Rescale: We rescaled all data layers to values between 0 and 1, with 0 being no value and 1 being the highest value for that resource.
2. Weight: We assigned weights to each data layer to account for distributional biases, data uncertainty, and the importance of that resource for representing a conservation theme and the conservation vision of the Pajaro Compass participants. We then multiplied the rescaled data layers by the assigned weights.
3. Combine: We combined all the data layers within a conservation theme by summing all of the rescaled, weighted data layers for a given conservation theme.

Data Types

Data layers that represent resources in the Pajaro River watershed consisted of either binary or continuous data. Data layers that displayed the location of a resource were binary and had a value of 1 in regions where the resource

Table C1. Data layers listed by conservation theme and data type.

Conservation Theme	Binary Data	Continuous Data
Water Resources	Floodplain—10 year Floodplain—100 year Perennial Stream Active River Area Ephemeral Stream Active River Area Groundwater Recharge Area Wetlands	Water Quality Index Groundwater Recharge Runoff
Biodiversity	Connectivity Grassland habitat Forest habitat Sycamore alluvial woodland Wetlands, seeps and springs Rare Vegetation Serpentine Soils	Permeability Species Richness Threatened and Endangered Species Aquatic Species Richness Vulnerable Aquatic Species Richness Rare Species Occurrence Density
Agriculture	Farmland Rangeland Previously-farmed land	
Carbon and Soil Health		Aboveground carbon stock Releasable soil carbon stock
Recreation	Public open space Trails	
Community	Farms with on-site markets Historic trails and sites Cultural resources	

[1] Although the identified conservation goals determined by the stakeholders included a goal around carbon and soil health, the spatial analysis only addresses carbon stock. Because carbon stock provides a direct link to Climate Change and Carbon Stock—a primary focus identified in the Pajaro Compass Network survey—it was the sole focus of this theme in the maps and tools. The spatial analysis does not include data or metrics related to soil health. The carbon and soil health theme section discusses both.

was present, and had a value of 0 where the resource was absent. Data layers that varied across the watershed in their contribution to a resource or in their condition of that resource, were represented with continuous data that ranged from 0 to 1 with some distribution of intermediate values. Table C1 displays data layers that together represent each conservation theme listed by binary or continuous data types.

Rescaling Data

Continuous data were rescaled so that the minimum values were 0 and the maximum values were 1. Rescaling the data to a common scale with common units allowed for eventual combination across the data layers, without overemphasizing data measured on a scale with a higher maximum value due simply to its unit of measurement. For example, the rare species occurrence density maximum was 7,642 weighted observations per square kilometer, and the threatened and endangered species habitat-suitability weighted richness index maximum was 8. Combining these layers without conversion to common units would have resulted in a nominal contribution from the threatened and endangered species richness to the aggregate conservation value.

However, the rescaling process still gave unintentional relative weights to the data layers. For example, the maximum aquatic species richness value was 137, rescaled to 1, and the maximum vulnerable aquatic species richness value was 36, rescaled to 1. These data layers were originally on the same scale (i.e. # of species) and a single unit (i.e. a species) had the same value regardless of the source data or vulnerability of that species. However, rescaling the data resulted in a single, vulnerable aquatic species having nearly four times the value of a common aquatic species. In general, after rescaling the data, data layers with larger data ranges resulted in lower per unit values, and data with smaller data ranges resulted in higher per unit values. Table C2 shows the maximum and minimum values of the raw continuous data for biodiversity resources. Often these unintentional weight implications from rescaling were justified in that features that were rarer received higher per unit weights, and therefore had a larger per unit influence on an aggregate theme, and ultimately where conservation action might be directed or development might be avoided. We evaluated the impact of these unintentional relative weights and applied intentional weights where necessary to adjust the relative influence that a data layer contributed within an aggregate conservation theme (see Weights section below).

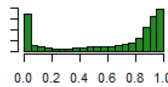
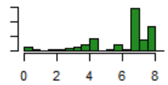
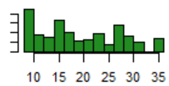
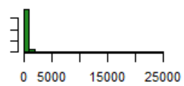
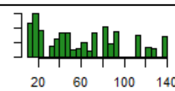
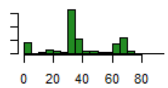
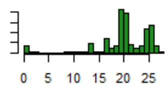
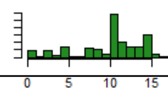
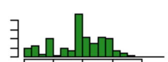
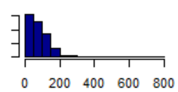
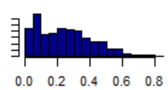
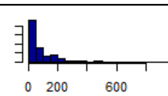
Table C2. The maximum and minimum values of continuous data layers for the biodiversity conservation theme.

Layer	Minimum Value	Maximum Value	Units
Permeability	0.0003	1	Proportion of 3km radius moving window accessible for general species movement
Threatened and Endangered Species	0	8	# of species discounted by habitat suitability
Vulnerable Aquatic Diversity	8	36	# of species
Rare Species Occurrences	0	24,009	weighted # of observations within a 1km radius moving window
Aquatic Biodiversity	13	137	# of species
Bird Richness	0	93	# of species discounted by habitat suitability
Mammal Richness	0	27	# of species discounted by habitat suitability
Reptile Richness	0	16	# of species discounted by habitat suitability
Amphibian Richness	0	9.5	# of species discounted by habitat suitability

Continuous data layers varied in the distributions of their data. Data layers had somewhat uniform distributions (e.g. permeability), negatively skewed distributions (e.g. threatened and endangered species habitat-suitability weighted richness), positively skewed distributions (e.g. vulnerable aquatic species richness), and bimodal distributions (e.g. bird habitat-suitability weighted richness). For most data layers, we rescaled the data so that the native distribution was maintained, but for a few data layers we modified the distribution during rescaling. We maintained the distribution when the relative difference between intermediate values corresponded with a real difference in the value of that resource. For example, 800mm/yr of groundwater recharge is four times as much recharge as 200mm/yr. Alternatively, a watershed with a water quality index of 0.8, normalized to the state, is not necessarily of four times better quality than a watershed with a water quality index of 0.2. For data layers in which differences between values were real, we maintained the native distribution and the relative differences between the values by normalizing the data using equation C1.

Equation C1. $$\frac{x-\min(x)}{\max(x)-\min(x)}$$

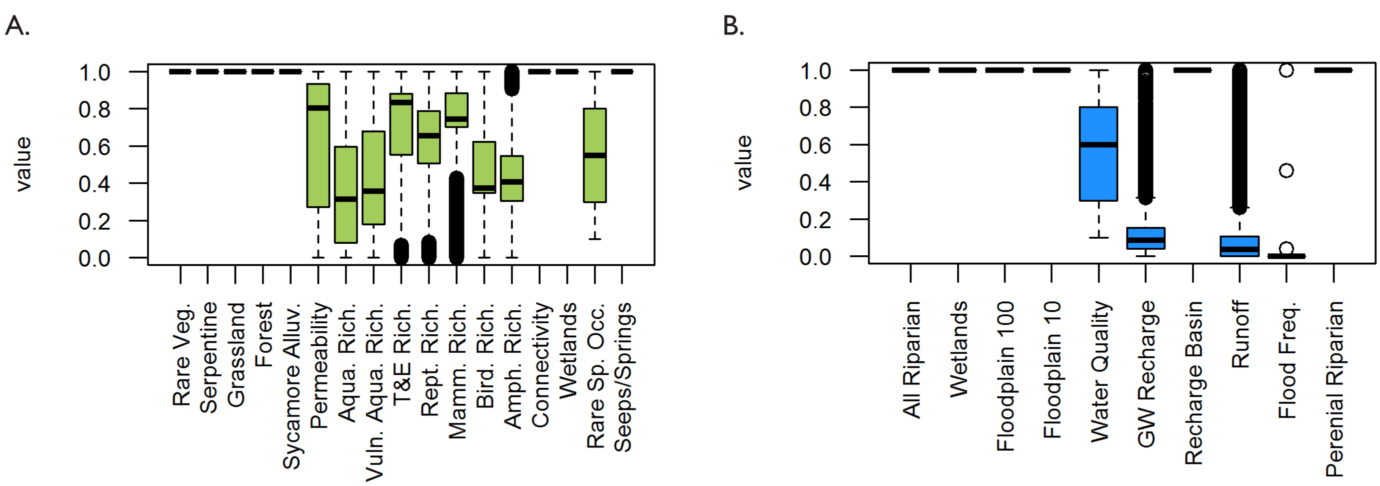
Table C3. Continuous data distributions and the method of rescaling applied.

Layer	Distribution	Rescaling	Reason
Permeability		None	Raw data varies between 0 and 1; values are proportion of neighborhood accessible to focal cell and relative differences between values are real
Threatened and Endangered Species		Normalize	Differences between values are real
Vulnerable Aquatic Species Richness		Normalize	Differences between values are real
Rare Species Occurrences		Binned to deciles	Data has extreme observational bias; data includes subjective weights for rarity and discounts for spatial uncertainty; data is extremely negatively skewed
Aquatic Species Richness		Normalize	Differences between values are real
Bird Richness		Normalize	Differences between values are real
Mammal Richness		Normalize	Differences between values are real
Reptile Richness		Normalize	Differences between values are real
Amphibian Richness		Normalize	Differences between values are real
Groundwater recharge		Normalize	Differences between values are real
Water Quality Index		Binned to deciles	Statewide rescaled index combined from several factors; differences between values are relative to the rest of the state
Runoff		Normalize	Differences between values are real

For skewed distributions where the relative differences between values were the result of created indices (e.g. Water Quality Index) or biases in data collection (e.g. Rare Species Occurrences), we rescaled the data by binning the data into deciles. Table C3 displays the raw distribution of the data, the type of rescaling applied for continuous data layers, and our reasoning for the application of that rescaling method. The carbon theme only consisted of carbon stock aboveground and belowground, which can be measured in equivalent terms. Therefore, we did not rescale these layers before weight application and combination.

The distribution of the data also had an effect on the relative value that a data layer contributed to the aggregate conservation theme. Distributions with a skewed right tail had less influence on the aggregate theme than data with a skewed left tail, and both had less of an influence on the aggregate theme than binary data layers in which all resources had a value of 1. For example, 75 percent of the watershed had rescaled groundwater recharge values less than 0.15 due to the strong right skew in the data, but 100 percent of the floodplains had a value of 1 because the data was binary. Therefore, in the base data (before weighting), floodplains unintentionally had a higher weight than groundwater recharge. Figure C1 displays the unintentional weights and relative influence of each data layer within a conservation theme for both biodiversity and water resources. A horizontal scan across these figures quickly highlights the differential influences of the data layers to the aggregate theme. Data layers where all or most of the data layers are closer to 1 have a greater influence on the aggregate conservation theme. We evaluated the impact of these unintentional weights and applied intentional weights where necessary to adjust the relative influence that a data layer had within an aggregate conservation theme (see Weights section below).

Figure C1. Boxes show the values of all data in each data layer illustrating the unintentional weights and differential influences of the data layers to the aggregate theme due to distributional differences within the biodiversity theme (A) and the water resources theme (B). Boxes represent the interquartile range, solid lines indicate medians, and dashed whiskers extend to the lowest and highest values within 1.5 times the interquartile range beyond the 25th and 75th percentiles. Circles indicate values that are more extreme than the dashed whiskers.



Weights

Distribution Weights

Rescaled data was multiplied by intentional weights to modify each data layer's relative influence in the aggregate conservation theme. The first type of weight that we applied was a distribution weight. This weight adjusted for the unintentional discounted value of data with right skewed distributions. We calculated adjustment factors for all data layers with rescaled median values that were less than 0.5, as the weight that could be multiplied by the median to increase the median value to 0.5. This adjustment factor was then applied as a weight to all values in the data layer. Table C4 shows the rescaled distribution, the quartiles, the adjustment factor, and the adjusted quartiles of data with applied distribution weights.

Table C4. The rescaled distributions, quartiles, adjustment factors, and adjusted quartiles of data with applied distribution weights

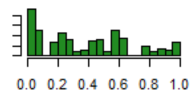
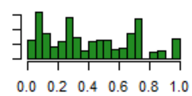
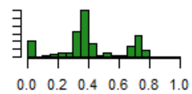
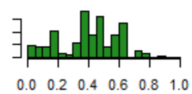
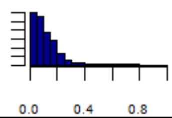
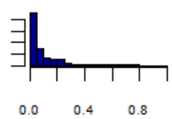
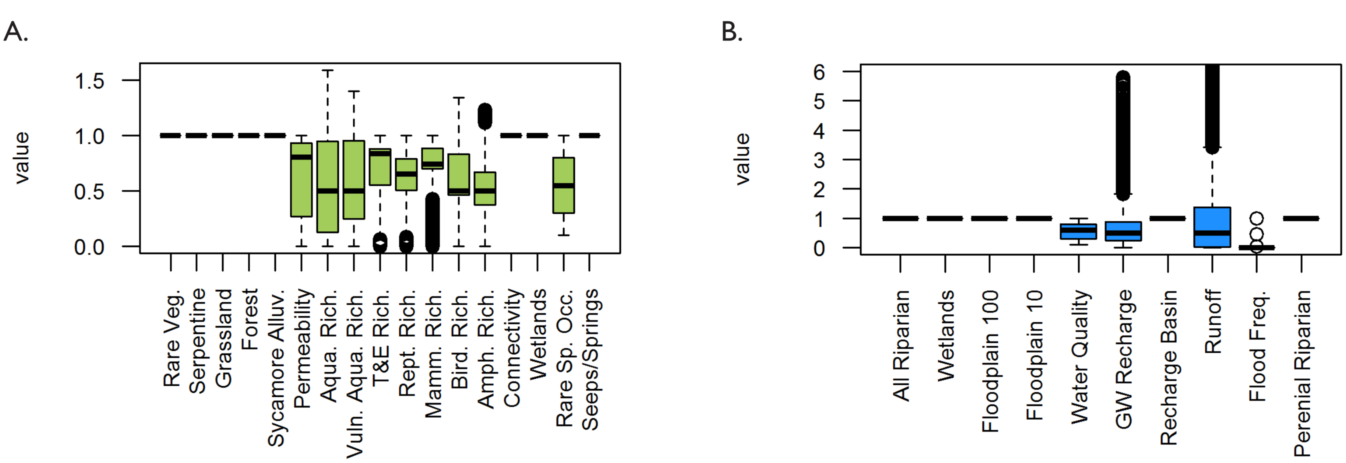
Layer	Rescaled Distribution	Rescale 25%	Rescale Median	Rescale 75%	Adjustment factor	Weight 25%	Weight Median	Weight 75%
Vulnerable Aquatic Species Richness		0.18	0.36	0.68	1.4	0.25	0.5	0.95
Aquatic Species Richness		0.08	0.32	0.60	1.59	0.13	0.5	0.95
Bird Richness		0.34	0.36	0.66	1.4	0.48	0.5	0.92
Amphibian Richness		0.31	0.41	0.56	1.23	0.38	0.5	0.7
Recharge		0.042	0.086	0.15	5.798	0.24	0.5	0.88
Runoff		0.003	0.039	0.11	12.95	0.03	0.5	1.38

Figure C2. Boxes show the values of all data in each data layer illustrating the differential influences of the data layers to the aggregate theme with weights applied to right skewed data layers in the biodiversity theme (A) and the water resources theme (B). Boxes represent the interquartile range, solid lines indicate medians, and dashed whiskers extend to the lowest and highest values within 1.5 times the interquartile range beyond the 25th and 75th percentiles. Circles indicate values that are more extreme than the dashed whiskers



The agriculture, recreation, and community themes consisted only of binary data. Therefore, none of the data layers from these themes received distribution adjustment weights. Although aboveground and belowground carbon stock varied in their distributions, these layers could be directly combined without rescaling due to their like units and so no distribution weighting was necessary.

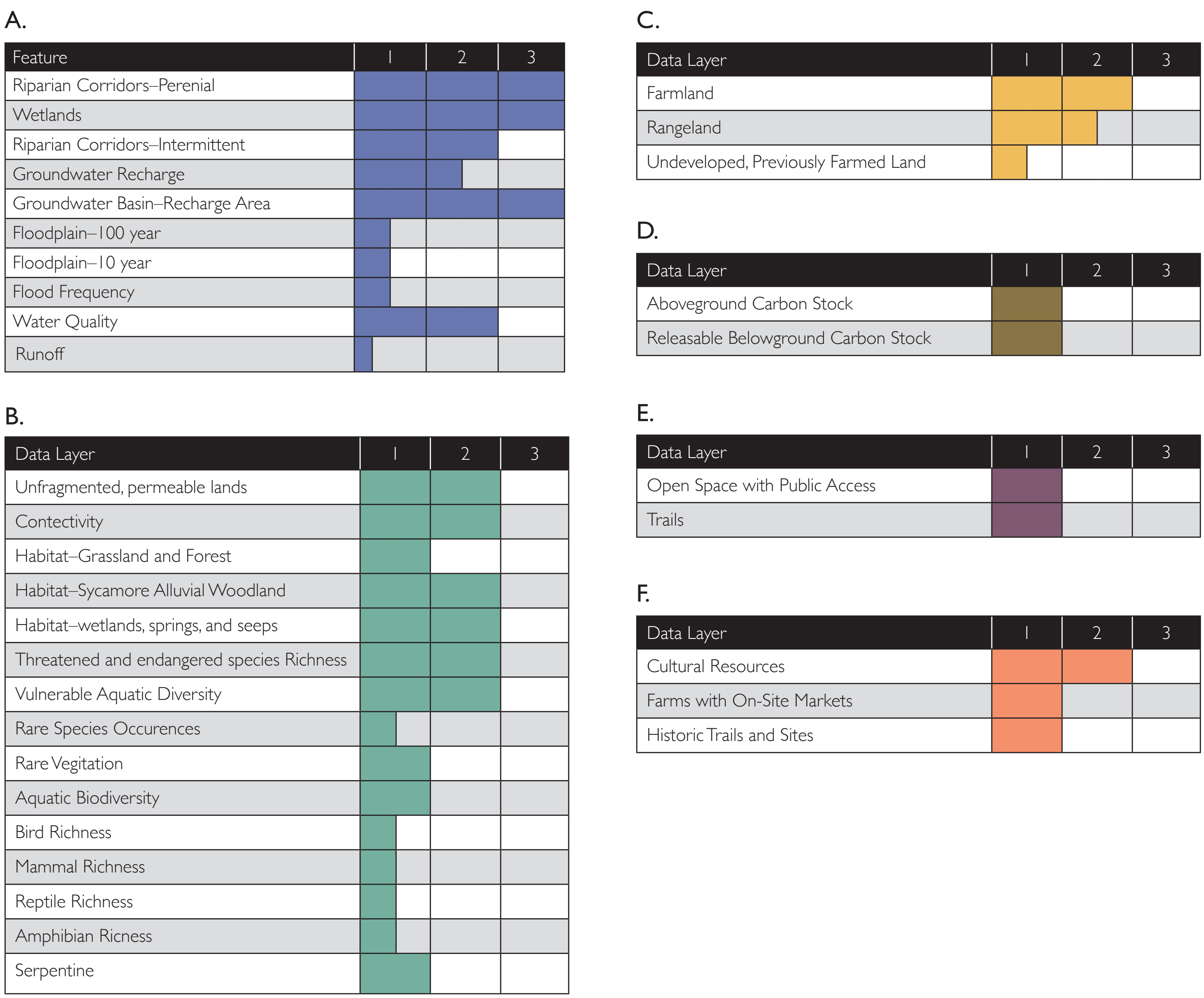
Importance Weights

The second type of intentional weight that we applied was an importance weight. The importance weight reflects the participants' perceptions of the importance of the resource in representing conservation theme, the rarity or conservation significance of the resources, and also the quality of data and its ability to represent the resource it intends to represent.

We gave each layer an intentional weight based on the following three factors:

1. Participants' identification of a resource as critical or important for representing their conservation vision in the watershed (see Appendix A, Table A1).
2. Rarity or status and conservation importance of the data layer (e.g. threatened and endangered species, wetlands).
3. Confidence that the data and its spatial distribution accurately reflects the value and location of that resource in the watershed.

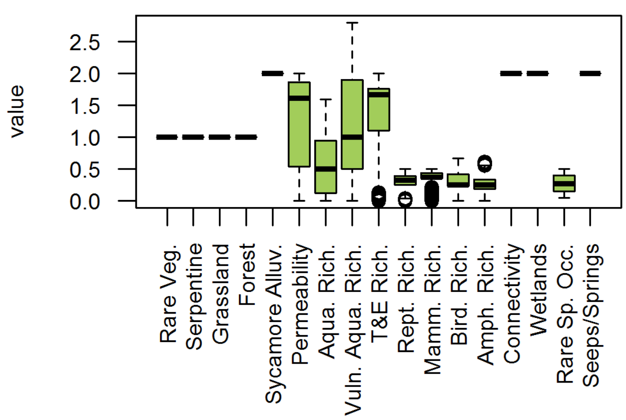
Figure C3. The importance weights that we applied to each of the data layers within a conservation theme for a) water resources, b) biodiversity c) agriculture, d) carbon, e) recreation and f) community.



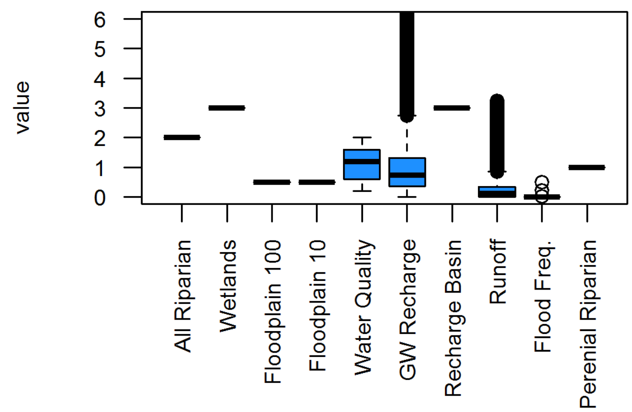
We multiplied importance weights and distribution weights by rescaled data to obtained standardized, weighted data layers within each theme. Figure C4 compares values across data layers that have been rescaled and weighted by distribution weights and/or importance weights, for biodiversity and water resources. A horizontal scan across these figures quickly highlights the differential influences of the data layers to the aggregate theme.

Figure C4. Boxes show the values of rescaled data, weighted by distribution weights and/or importance weights for biodiversity (A) and water resources (B). Boxes represent the interquartile range, solid lines indicate medians, and dashed whiskers extend to the lowest and highest values within 1.5 times the interquartile range beyond the 25th and 75th percentiles. Circles indicate values that are more extreme than the dashed whiskers.

A.



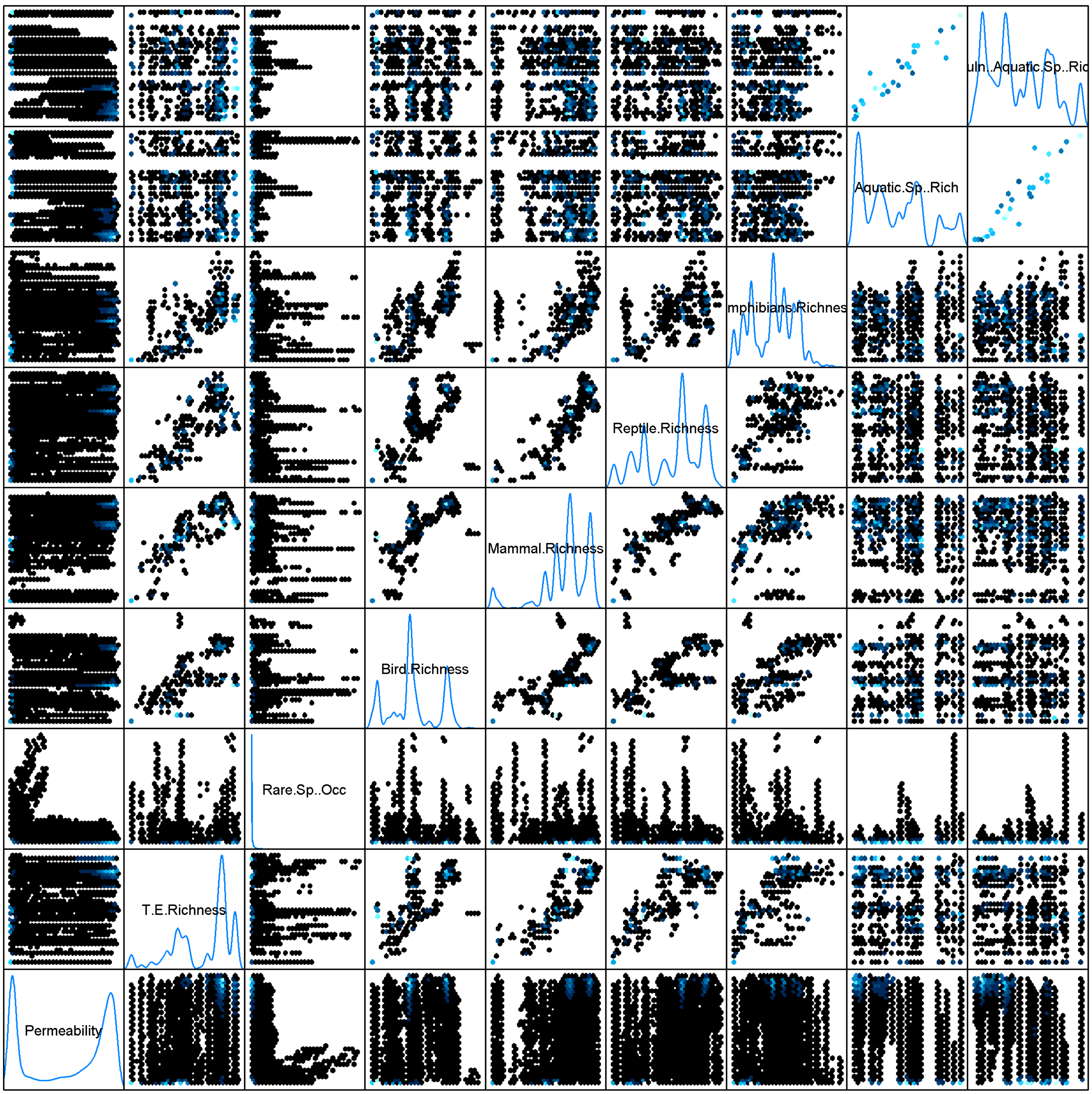
B.



Combination

Combining data layers via an additive benefit function assumes that data are independent. We evaluated the data to test for correlation between layers (Figures C5 and C6).

Figure C5. Scatterplots of data show the pairwise comparisons between data layers for the biodiversity conservation theme.



In general, datasets from independent data sources were not correlated and did not appear to violate the assumption of independence. However, some of the data layers were created by subsetting a single data layer. For example, vulnerable aquatic species richness was a subset of aquatic species richness. Including both of these datasets allows vulnerable species of importance for conservation and/or policy to provide an additional contribution to the aggregate conservation theme. Similarly, bird, mammal, reptile, amphibian and threatened and endangered species habitat-suitability weighted richness, were all derived from the same dataset. We subset this data to allow for equal contribution to the aggregate between classes regardless of quantity of species in a class, and to provide an additional influence of species with policy or conservation implications (i.e. threatened and endangered species) to the aggregate conservation theme.

We summed the rescaled, weighted data within each conservation theme to create aggregated conservation theme layers that show the weighted overlap of landscape features that represent the conservation theme (Figures 3, 4, 5, 7, 8, 9 in the main document).

Figure C6. Scatterplots of data show the pairwise comparisons between data layers for the water resources conservation theme.