

Linking supply and demand of ecosystem services to human well-being: addressing the "endpoint problem" in sagebrush rangelands of the Great Basin



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Background

The benefits that humans obtain from ecosystems support their survival and well-being. Informing of ecosystems' capacity to supply ecosystem services (ES) represents a major challenge because of the inability of researchers to communicate the implications of environmental change in a way that is understood by a broad cross-section of society (i.e., the endpoint problem). We propose a conversion factor to express ES supply in terms of population units, which facilitates the understanding of whether or not people's needs are met.

Data sets

- **NLCD: USGS National Land Cover Database.** A 30-m Landsat-based land cover database spanning 8 epochs (1992, 2001, 2004, 2006, 2008, 2011, 2013 and 2016).
- **Rangeland Analysis Platform.** Annual vegetation percent cover estimates of: annual and perennial forbs and grasses, and shrubs.
- **US Census Bureau data.** County Intercensal Tables for population growth.

Mapping

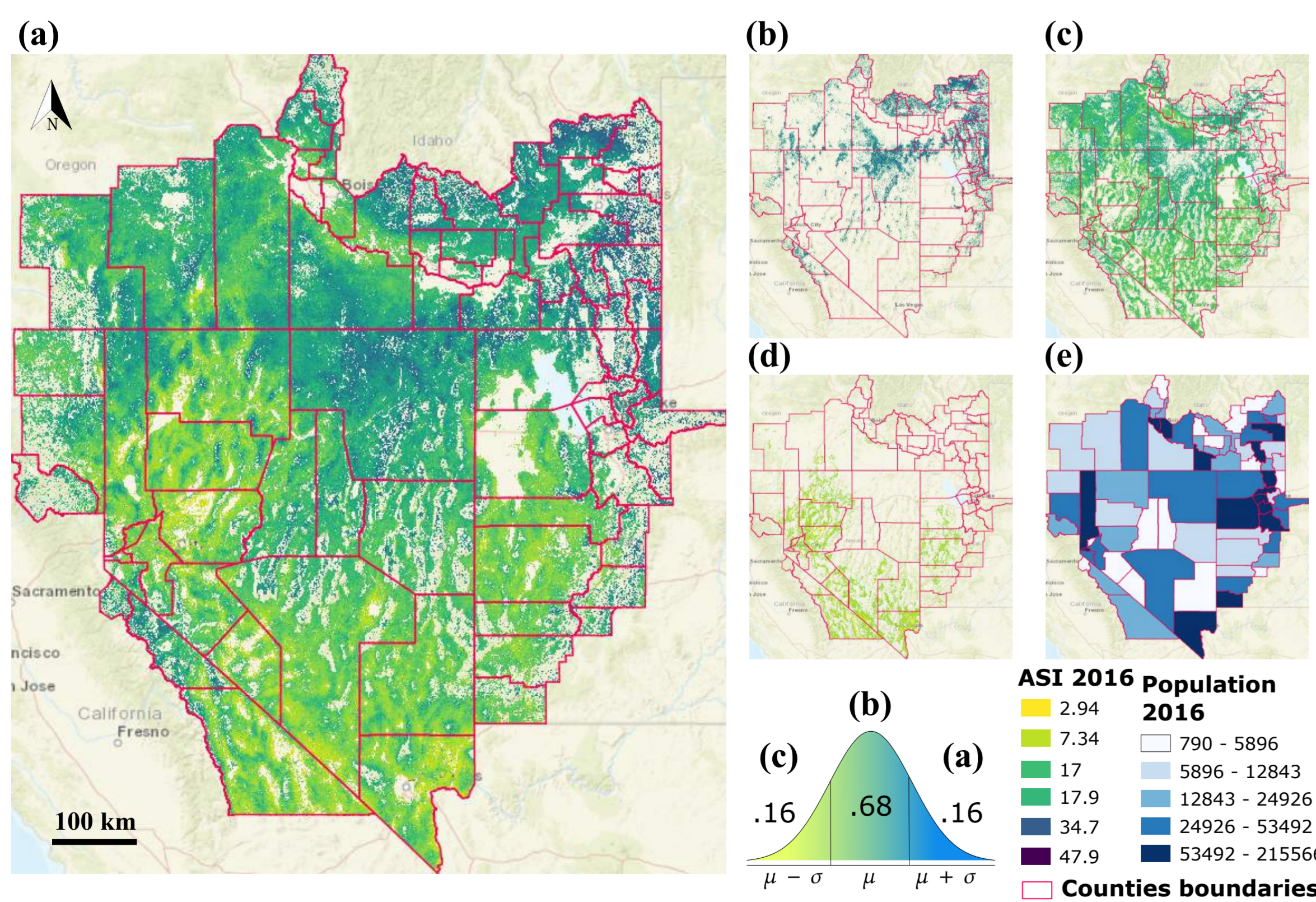
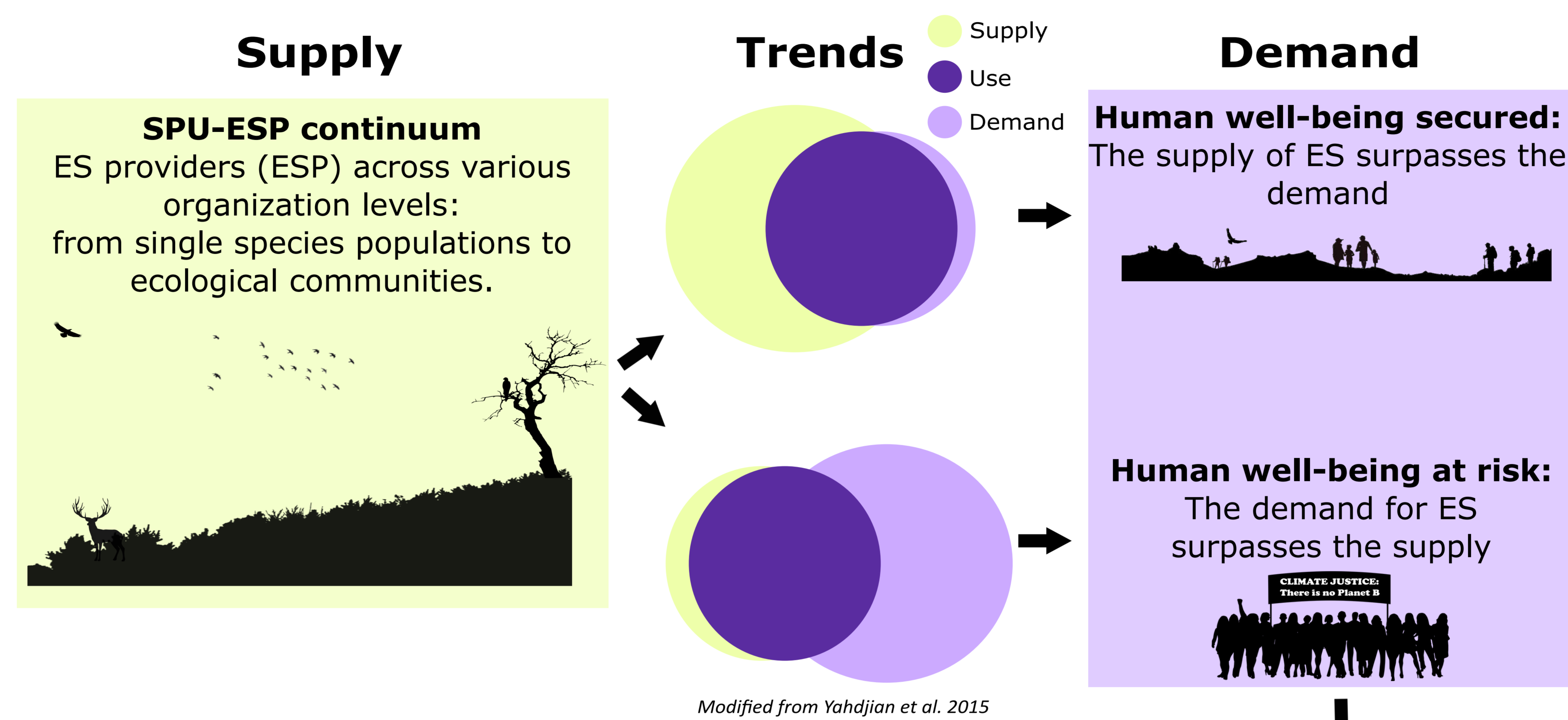


FIGURE 1. The Actual Score Index (ASI) reflects community composition/structure based on fractional cover component maps. (a) The ASI estimated for the rangelands of the Great Basin in 2016. (b) High quality rangeland. (c) Medium quality rangeland. (d) Low quality rangeland. (e) Population in 2016 per county.

Framework



e.g.: **Carbon sequestration**

$$\frac{\text{kg C}}{\text{people}} = \frac{\text{ha of rangeland}}{\text{people}} * \frac{\text{kg C}}{\text{ha of rangeland}}$$

When people's need is known, then the supply in unit of population directly informs if the demand is met or not.

Supply in unit of population Conversion Factor for unit of population Supply in unit of area

How to inform if People's need is met by the supply

Endpoint problem (Kontogianni et al. 2010)

Results

How do service-providing units (SPU) of rangeland change over space and time per county?

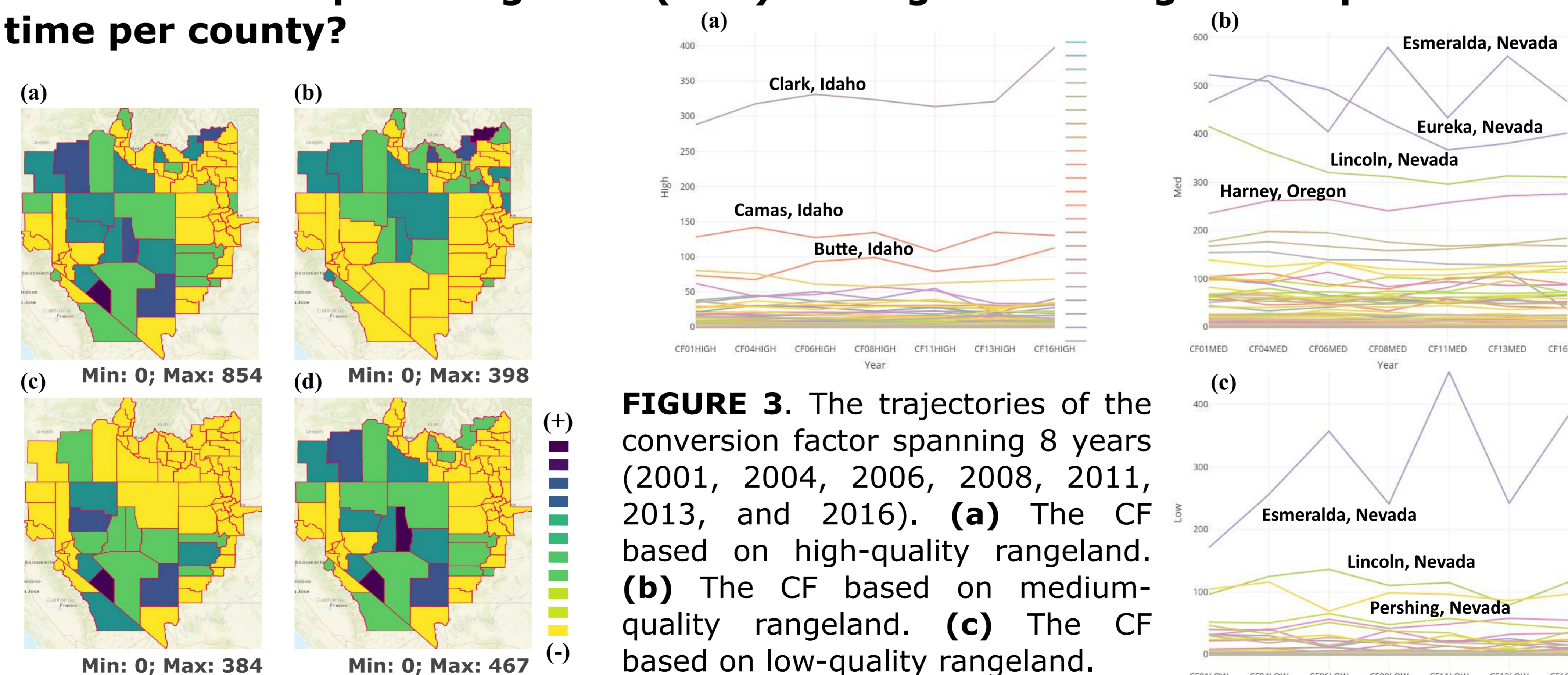
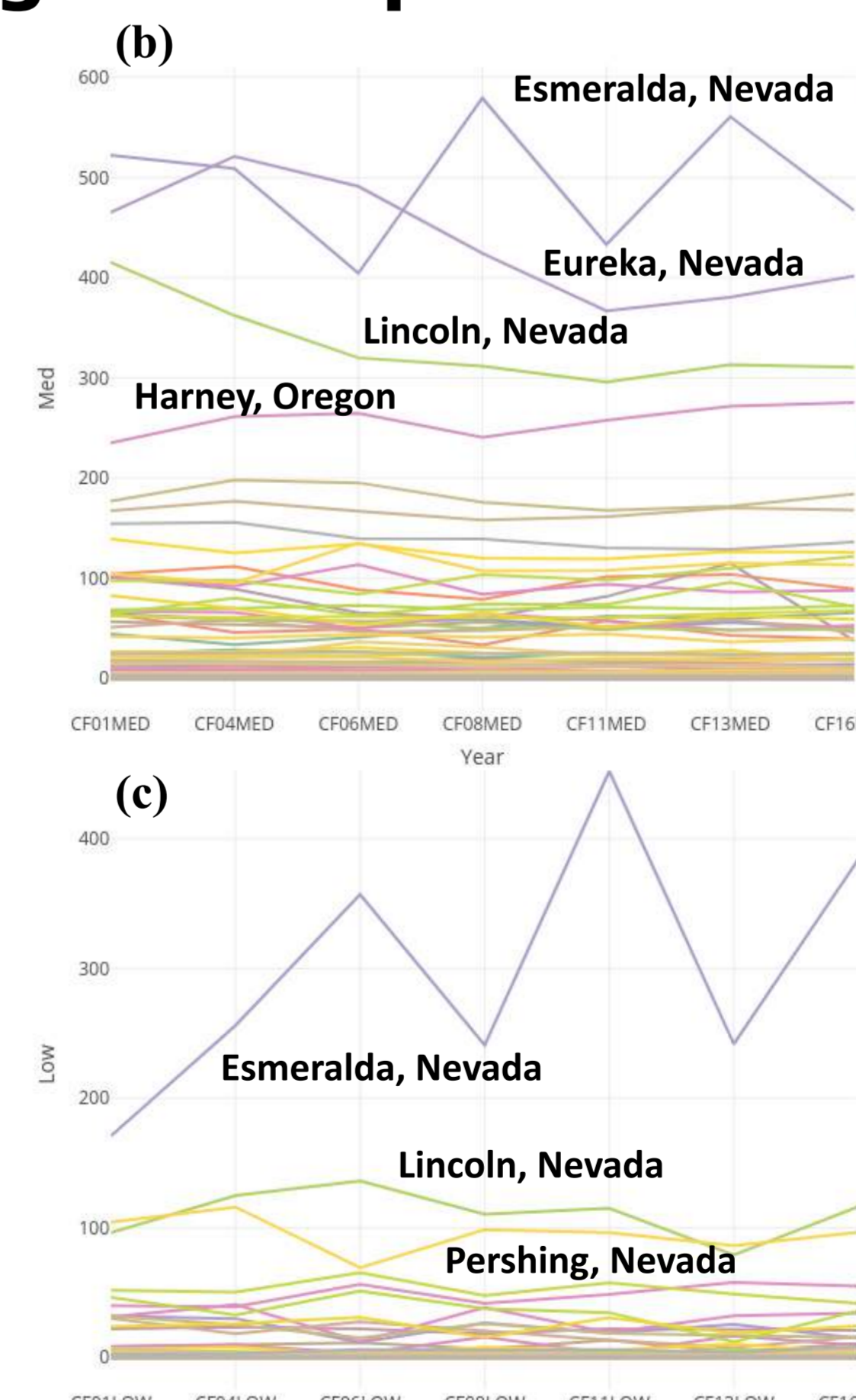


FIGURE 2. The number of Has of rangeland per one people (CF) estimated by county in 2016. (a) The CF based on has of rangeland. (b) The CF based on has of high-quality rangeland. (c) CF based on has of medium-quality rangeland. (d) The CF based on has of low-quality rangeland.

FIGURE 3. The trajectories of the conversion factor spanning 8 years (2001, 2004, 2006, 2008, 2011, 2013, and 2016). (a) The CF based on high-quality rangeland. (b) The CF based on medium-quality rangeland. (c) The CF based on low-quality rangeland.



Take home messages

1. To help society make informed decisions about the appropriate use of natural resources, scientists should inform the ecosystem's capacity to provide ES in such a way that directly links the supply to society's needs.
2. Informing ES supply in population units instead of area units can help society to a better understanding of whether or not human well-being is jeopardized.

Next steps

- To validate the preliminary results using an upcoming release of the vegetation percentage cover maps.
- To characterize the biophysical factors that control the spatio-temporal dynamics of the Has of rangeland available per person in the counties of the Great Basin.
- To map the supply of carbon sequestration in the Great Basin.

Acknowledgments

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