A literature review composite: selecting an ecosystem indicator for investigation.

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Abstract

Ecosystem Services are the benefits people receive from the natural working environment. The evaluation of these services using selected indicators, specific to the state of Kansas, can inform us of the status of our natural systems. The objective of our research, then, is to select the ecosystem service indicators that will best represent the health of the local region and the services of its people. With members of our research group from various backgrounds and disciplines, the research project benefitted from multiple perspectives. After performing a literature review of previous works focused on ecosystem service indicators, we selected dryland corn yield and the standard precipitation index as possible indicators of drought severity in the state of Kansas.

Introduction

The ecosystem performs services, which humans benefit from, at no measurable monetary cost. These services are called ecosystem services, like biodiversity, air quality, nutrient cycling, and climate regulation. Ecosystem services are classified into four categories: Provisioning (supply of food, water, energy), Cultural (aesthetic, religious significance, or non-monetary values), Regulating (climate, disease spread, flooding), and Supporting (soil formation, or long term services) (Millennium Ecosystem Assessment, 2005). One prominent feature of ecosystem services is that they cannot be replaced by technology. Since there is no ideal way to completely replace them, it is vitally important that we maintain them (Caela et. al., 2005).

The health of these services requires constant evaluation. Monitoring the environment for changes in the ecosystem can be challenging without deciding what is to be measured. Some studies have been done reviewing hundreds of indicators to better understand how the ecosystem works for us. “In order to synthesise the different indicator approaches and to detect gaps in the development of common indicator systems, we examined 531 indicators that have been reported in 617 peer-reviewed journal articles between 1997 and 2007. Special emphasis was placed on comparing indicators of biodiversity and ecosystem services across ecosystems…” (Link et. al., 2005).

To make measuring ecosystem services more manageable, the service is often measured as an indicator. Indicators use something measurable as a proxy for the service. Some examples of indicators are crop yield, temperature, species count, and organism population. Indicators make research possible, but they need to be carefully selected for accuracy. In addition to being accurate indicators need to be feasible. Time and budget constraints mean that indicator selection is often made based on already available data (Beier et. al., 2008).

There are many possible indicators. Some studies, such as Hancock et. al. (2013) had over 50 indicators. However due to time constraints we will be more limited. It was apparent that we were in need of an efficient way to focus in on an ecosystem service and the appropriate indicators for our group to study. Therefore, our objective was to select the ecosystem service indicators that best represent the health of the local region and the services of its people. This paper diagrams our methods for conducting an extensive review of literature and selecting a topic, or ecosystem service and indicators.

Our group of student researchers is unique in that we are all studying in different disciplines. These range from Geology and Park Management and Conservation to Agronomy and Social Sciences. This characteristic makes it particularly difficult to select an ecosystem service to investigate that is pertinent to everyone’s interests. Furthermore, we are given a single semester to complete this project. This limits our time as well as our available resources, equipment, and locations that we are able to utilize.

Materials and Methods

The literature review began with each team member reading and noting key features of fifty articles pertaining to ecosystem services, which were found using peer-reviewed journal article databases (figure 1). As a team, with each member reviewing fifty, around 300 articles were documented and the sources and details of each article's topic were included in a table. We employed a number of online databases to complete this literature review. Databases used were: ProQuest, Web of Science, Agricola, and Google Scholar. We then used Microsoft Excel and Google Documents to summarize and share selected articles amongst the whole team.

Following the initial search for previous works, each team member narrowed down their article selection to 10 articles. A more thorough examination of each of these articles was completed and homogenized into a chart format in Microsoft Excel (figure 1). The recorded information includes: ecosystem service, indicator, calculation, inputs, region, time, and reference. Using this chart, each team member wrote a summary of their preferred articles. The summary aimed to compare indicators, determine the relative ease of calculating these indicators, realize the data required, and select which indicators were feasible for our group to study. Google Documents was used throughout this process as a medium for sharing articles, charts, and summaries amongst the group members. Each progressing step narrowed our list of indicators until at last we agreed on indicators for research. In discussing and comparing all of our summaries, final ecosystem indicators, suitable to our group members and our project limitations, were selected (figure 1).

The literature review process for determining the appropriate ecosystem service indicators for investigation was completed through several steps. Our research team, made of undergraduate students, collaborated when it was required and did much research individually. Each step was a milestone in the process, but between these steps collaboration and discussion refined the direction of our research.

Step 1: Search Journal Article Databases.

For our preliminary research, each member of our group researched possible articles in journal article databases by searching ‘Ecosystem Service Indicators.’ Looking for commonalities among elements in each article such as inputs for calculations, ecosystem services, indicators. If an article would not fit the criteria we set out it would not be selected or reviewed any further; however, for all the articles we could use, we each made a table.

Step 2: Select 50 Articles for Review

The fifty articles that were reviewed by each of us were listed and summarized. This table was the first collection of articles. Many ecosystem services were evaluated in the articles, so the table represents a wide array of indicators and approaches to examining these. Each member of our group searched many of the same databases and keywords so there was without doubt some overlap, but with six members each reviewing fifty articles the scope covered was vast. Collectively we reviewed over 300 articles for ecosystem service indicators.

Step 3: Document Article Elements in Table

The table profiled each article in great detail for further reference among the group. The details highlighted were ecosystem service, indicator, inputs, calculations, landscape type, region, and date. Each having done a separate literature review over fifty vastly different articles introduced the collective group to many interesting areas and approaches to selecting and examining ecosystem service indicators.

Step 4: Narrow/Focus Table to 10 Indicators

After having a large view of ecosystem service indicators, we narrowed the scope. Each member of the group reviewed their literature review tables and selected ten articles that were most relevant, plausible, or interesting individually. The tables were shortened to ten articles but expanded in detailing those articles. As the first literature review table was long, it was a quick overview. The new, focused table was the product of more intensive review of the articles for calculations, equipment, and data needed to assess and ecosystem service indicator and also whether the indicator was relevant for our region. The tables were summarized and reviewed by each member.

Step 5: Select Indicators as a Team

As a team, we came together having reviewed all the tables. We collaborated deciding which indicators were most relevant and plausible for our purposes. Some indicators required data we had no way of obtaining, and equipment and software was mentioned for several data sets that were unavailable. Using the six tables of ten indicators each, we collectively decided on the indicators for our research.

Results and Discussion

As a group, we decided to focus on drought severity and how it affects our crop production in Kansas. The benefits we receive from water cycling include water supply, food production, and soil conservation and health. As a group we decided some indicators that reflect the well being of the these services involve crop yield, PSI, temperature, incidents of rationing water use, burn bans, and soil type. In order to find these specific indicators, we looked at articles that focused on similar indicators from our literature review.

From our literature review charts and the articles we collectively documented, we saw that some of the published articles have the data available to use and already interpreted, or used similar data to calculate other indicators. Others are collections of datasets and use a simple ratio to summarize and interpret the raw data (table 1). From this literature review chart, we were able to find the indicators to focus on and the best way to calculate them. We feel that water cycling, specifically drought severity, is a significant ecosystem service because of the impact it has on the economy, culture, and natural environment. It is important to recognize how ecosystem services operate and are sustained. Today it is easy to let the economic factors take priorities, but conserving ecosystem services is economical.

After narrowing down the list of indicators, some of the indicators still had inputs that were unavailable because the necessary data was not complete. Other indicators had a time factor in which some of the data required several years to obtain. Our project is subjected to a single semester term (about five months), and obtaining similar information would not be possible in our limited time span. Location of information also played a role on why some of the indicators were not chosen. Several of the studies were varied from a regional area to a global study. While studying these areas, the authors have a lot of resources at their disposal and more funding. We have very little resources to conduct our study, so we are focusing our project within the state of Kansas. The information we collected are open to the public. This allowed us to pick the Standard Precipitation Index (SPI) and non-irrigated corn yield data for Kansas' nine districts as our indicators.

The process of narrowing down over 300 articles to selecting just two indicators came down to our group needs. All the constraints and characteristics of information and team members guided us through the process. Each limitation narrowed our focus until region, data and equipment available, time, and personal interest were the barriers of our scope. SPI as an indicator of drought shows the average precipitation in Kansas over many years. The precipitation is beneficial to all living things in the ecosystem and a species we rely on greatly here in Kansas is corn. Corn is a crop that is highly susceptible to drought situations. When comparing the corn yield over many years with the SPI indicator, the two indicators should paint a picture of the status of our ecosystem services in Kansas.

Conclusion

It will be interesting to see what the ecosystem services and indicators this group has selected can tell us about the region of Kansas. It is important to comprehend the ways the ecosystem naturally works for us here in the Midwest. Our future plan is to complete the drought indicator analysis. Completing this analysis will give a better visual of how climate regulating services affect dryland corn yields in Kansas. Kansas's economy is largely driven by agriculture and thus climate regulation is an important ecosystem service for the well being of Kansas.

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List of Tables and Figures

Ecosystem service	**Indicator**	**Calculated**	**Input**	**Country/region**	**Time/period**	**Reference**	**Reviewer**
Aquatic Ecosystem Change	Low level nutrient cycling, shifting, phytoplankton, eutrophication	HPLC^PDAS/ChemTax, nitrate concentrations	Natural perturbations, including droughts, storms, and floods, cyanobacteria, blooms	Various European Countries	Aug. 2003	Paerl, 2003	Ryanne Rahjes
Small-bodied Freshwater fish	Changes in water quality, and habitat availability, condition and connectivity	Drought conditions, over-abstraction	Fish assemblages	South East Australia	7/1/2012	Wedderbern et. al., 2012	
Salinity on dry wetlands	Propagule bank-the resting stages of aquatic animals and plants persisting in dry wetland sediments	Salinity here is indicated by electrical conductivity at 25°C	Salinity (g L^{-1}) Moisture content (w:w) Compaction (g m^{-3}) Organic content (%), electrical conductivity	Murray–Darling Basin, Australia	2001	Skinner et. al., 2001	
Arid zones - birds	Bird residency and nomadism	EMGs	Breeding records per month/average, 1-9 reference qualification system	Southern Africa	Sept/Oct 2013	Dean et. al., 2012	
Zooplankton in highly regulated Rivers	Zooplankton habitat, lifestyle, etc., quantity, biomass, pollution	Shannon-Weiner Biodiversity Index	Biodiversity, species, type, distribution, peak value, niche, ratio, resources,BOD5, CODCr, NH3-N	Huai River Basin, China	9/1/2013	Zhao, 2010	
Arctic ground squirrels related to climate change	Population Monitoring of ground squirrels, slow, cold, growth rates	Distribution, physiological and ecological interactions, ecosystem processes	New predators, competitors, diseases and parasites, global warming	North Pole; Arctic Climate area	2012	Wheeler et. al., 2013	
Butterfly assemblages in coffee-banana farms	Habitats, migration patterns, butterfly density, vegetation	Shannon-Weiner Biodiversity Index	Species constancy, pollination, spatial variation	Uganda	2011	Munyuli, 2012	
Ecosystem service losses in toxicity	Estuarine sediments contaminated with polycyclic aromatic hydrocarbons; also measured by loss of these and other indicators; amounts of toxins, reproduction, food web disruptions, contaminate realtionships	Habitat equivalency analysis (HEA); type, severity, degree, extent, organizational level	Lost services, replacement services, when loss began, replacements are provided, present time of damage claims, periodic discount rate	n/a	2005	Cacela et. al., 2005	

Soil tilth and fertility	Microbial populations (aerobic, pseudo-nomad, nitrifying), microbial biomass N, substrate-induced respiration rate	CFU’s per gram of dry weight soil (no equation)	Plate counts	Grant Co., WA in shrub-steppe	March 2003-04	Cochran et. al., 2012	Michelle Busch
Biodiversity	Earthworms, spiders, bees	Farm model, abundance and species richness curve	Habitat factor, # habitat types per farm, total area of the farm, arable area, grassland area, # arable fields, # grassland fields	Central Hungary	2010	Kovacs-Hostyanszki et. al., 2013	
Surrounding plant richness (& feedback dynamics among plant species)	Streptomyces populations	Streptomyces antagonistic potential	Enumeration (plate counts) and radius of inhibition zone	Cedar Creek Ecosystem Science Reserve, MN	7/9/2013	Bakker et. al., 2013	
Soil physical quality	Penetration resistance, bulk density, water stable aggregates, infiltration rate, water holding capacity	Bulk density = mass of dry soil/volume of soil, etc.	Dry soil weight and sampling depths, mass of sand free aggregates, etc.	Southern Cape REgion, Africa	10/11/2013	Swanepoel et. al., 2013	
Structural and biological soil health	SOC, water stable aggregates, enzyme activity	SOC, water stable aggregates, enzyme activity	Bulk density, total carbon, mass of sand free aggregates, etc.	NW Missouri	June-July, 2003-2008	Kremer and Hazel, 2012	
Soil fauna	Earthworm, mite, springtail, and nematode populations	Population counts	25*25*25 cm3 volume of soil	Sanandaj, Iran	2008-2009	Moradi et. al., 2012	
Oil gas and fields	Activity, distribution, and abundance of methane-oxidizing bacteria	T-RFLP profiles (rel. abundance)- NO EQUATION GIVEN	T-RF, cloning, and sequencing data	Shandong, China	6/11/2013	Xu et. al., 2012	
Ecosystem degradation in dry land	Above-ground net primary production (ANPP), and rain use efficiency (RUE)	ANPP and RUE plotted against annual precip., etc.	Annual precipitation and land use intensity	Arid and semi-arid environments	923 yrs.	Ruppert et. al., 2012	
Land use change	Biochemical/microbial indicators	SOC microbial biomass, soil respiration, and metabolic quotient	CO2 production and fumigation-extraction	South Andaman Islands, India	unknown	Dinesh and Ghoshal-Chandhuri, 2013	
Diversity in agricultural landscapes	Patch number density, richness, shannon heterogeneity, and connectance	GIS geoprocessing, V-late extension for ArcGIS, and Fragstats (spatial approach)	Land use classes and indicator data put into categories	Provence of Enna in Sicily, Italy	1999 and 2010	La Rosa et. al., 2012	

Regulating (Soil Quality - Erosion Prevention)	Land Suitability Class	LSC is determined by multiple criteria before and after SWC measures are implemented. Criteria:Soil (texture, pH, SOC, drainage), climate, land use (agriculture, pasture, native), topography, geology	Soil Sampling equipment, DEM/Topography Maps, Geologic information, land use data	Ethiopia - Highlands / Montane ecosystem	1984-2010	Alemu et. al., 2013	Dorothy Menefee
Provisioning (Fish and WIldlife production)	Deer harvest, fish Harvest, logging intensity, forest condition	Data was added to GIS which was used to interpolate data over the selected watershed. Layers were added to rank areas on overall ecosystem quality.	Software, datasets, watershed extension data, fish and deer catch reports	Southern Alaska / Maritime Temperate Rainforest	2007	Beier et. at., 2008	
Regulating (Water Quality - Wetlands)	Cropland cover, pasture cover, distance to CAFO, impervious cover, well locations, wetland cover	Data was mapped with GIS and layers were combined to give land units scores based on weights of layered maps	Maps, GIS software	Florida	2002	Boyd et. al., 2002	
Regulating, Provisioning, and Cultural (Erosion Prevention, Food Productions, Water Quality, Aesthetics)	Pine nut harvest, tree cover, tourism, rodent disease spread, erosion levels	Data from remote sensing and datasets were added to GIS. Layering and interpolation was used to determine how well the area was suited for the criteria of the Millennium Ecosystem Assessment	Datasets, Remote Sensing equipment, computer software	SW USA	2011	Breshears et. al., 2011	
Supporting (Crop Pollination)	Amount of rangeland / habitat for pollinators, crop yields	Land use data (rangeland compared to other uses), Yield data (watermelon); entered into LANDFIRE software. Equations on page 36	Datasets (yields and land cover), computer software	California	2011	Chaplin-Kramer et. al., 2011	

Provisioning (Wood Production)	Tree density, tree growth rates, carbon storage, forest area	Modeling of Climate Change Scenarios (IPCC A1F1, A2, B1, and B2), IPCC Models with HADCM3 software determine land cover which is plugged into equations on page 17 and 18.	Datasets; FAOSAT, IPCC CLimate data, land use maps, and Modeling Software	Italy	2008	Ding et. al., 2010	
Supporting (Habitat and Water Quality)	Survey of income and practices, water quality data	Compile water erositivity (amount, speed, sediment load) with survey data to see of the Gain for Green program is effective. Equations on page 491.	Survey, datasets, computers	USA/China	2008	Gauvin et. al., 2010	
Regulating (Carbon Sequestration)	Vegetation Carbon	Land use maps (dominant vegetation, wild or agriculture), carbon content of plants. Uses Bayseian Belief Network, GIS, and InVEST models.	Mapping and software, tissue analysis	United Kingdom	2011	Haines-Young, 2011	
Provisioning (Forestry Products)	Toxin levels, disease levels, invasive species presence, plant productivity, (defined exactly on page 473)	Making measurements by sampling. Data estimate were made by using GIS and layer calculation functions. Data was calculated using Data Envelopment Analysis (DEA) which scores areas on suitability.	Toxicology test equipment, searching for invasive species and diseased plants, estimate of PP	USA	2004	Hof et. al., 2004	
Regulating (Waste Recycling)	Greenhouse Gas Emissions, water contamination	Measured via sampling and calculated with the mass-balance method as described by Bengimer and Cruz and displayed in table 1.	Sampling and measurement equipment	Finland	2003	Korhonen et. al., 2004	
Regulate	Decline soil fertility, decline avail., forest fire risk	Temp., CO2, precip., population	GCMs	Med. & mount	10/1/2005	Schroter, 2005	Brady Salvatorelli
Cultural, provision, support	Crop production, biodiversity, water quality, landscape	Provision, cultural, regulating	Flower diagrams	Quebec, Canada	2/1/2010	Raudsepp-Heame et. al., 2010	

Regulate, support	Landscape, metric, organisms-soil microorganisms, macro invertebrates, terrestrial and stream ecosystems, nitrogen and phosporus	Analyses : spatial scales of metrics	Agricultural services	United States	12/1/2007	Dale and Polasky, 2007	
Provision	Soil microbial biomass, fungal: bacterial biomass ratios, nitrogen levels	Soil pH, bulk density, nitrogen levels	Computer: ADAS Botanical Monitoring scheme	Northern England	5/1/1998	Bardgett and McAlister, 1999	
Regulate , Provision	Tree cover, soil, pH, soil organic matter, infiltration, temperature	Tree cover, coil pH and comp., organic matter content, etc.	UFORE model	Florida	3/1/2011	Dobbs et. al., 2011	
Cultural, Regulate	Non market value - peer review journal articles used	Travel cost method; Vij = f(Cij, Qj, Mi)	Data was obtained from previous studies	United States	1999	Wilson and Carpenter, 1999	
Provision, Regulate	Water Quality, wildlife, fish population, naturalness	Survey and funding	Computer	Little Tennessee River	5/1/2001	Holmes et. al., 2001	
Provision, Regulate	Ecology, economic, soil science	Ecosystem service framework	Data was obtained from previous studies	New Zealand	7/1/2010	Dominati et. al., 2010	
Provisioning, regulating, cultural	Soil formation, nutrient cycling, oxygen production, primary production, provision of habitat	Taxonomic coverage	Global Assessments	Global	3/1/2006	Pereira and David-Cooper, 2006	

Soil Conservation, Forest Production, Water Supply	Soil conservation, reduction of abandoned land, reduction of sediment deposition, reduction of soil nutrient loss, fruit, timber, water supply	Soil bulk density and ratio of soil deposition compare, figure from comparison of data, based on nutrient type in soil, compare to healthy levels, Beijing Forestry Survey, ratio f runoff to rainfall, ratio of rainfall interception by canopy and soil porosity	Sixth Forest Inventory of Beijing data: bulk density and depth, method price for forest land, replacement price method sediment removal, replacement price method of fertilizer, market comparison, how many nutrients to balance, annual production, market price method of fruit, annual increase ratio of timber market price method of timber, replace cost of water supply, cost of reservoir engineering	Beijing	-	Larondelle and Hasse, 2013	Brian Muselmann
(CSOP) Carbon sequestration + oxygen production, soil conservation/health	Photosynthesis, soil erositivity	Ratio of photosynthesis and organic matter, RUSLE, empirical model, A=RxKxLxSxCxP	NPP dad collected via ariel photo and GIS, A is estimated avg. soil loss, R is rainfall erositivity factor, K is the soil erodibility factor, L is the slope length factor, S is the slope steepness factor, C is the vegetation management factor, P is the conservation practice factor	Yhane Watershed, China	-	Su et. al., 2012	
Recreation Mental and Physical Health, Climate/Air Quality Regulation	Rec Area Per Capita, accessibility of rec areas, tree-cooling potential	Recreation area (ha)/population (n), distance from homes to recreation areas, standardized empirical equation	Census data, spacial data, GIS, empirical data, tree shadow data	United Kingdom	-	Larondelle and Hasse, 2012	

Forest and hunting recreation, freshwater supply, crop and range production	Recreation score, annual groundwater recharge, expected annual crop and forage yield	Recreation usage data, hunting license sales compared to populations, annual field measurements, comparison of crop yields from years past, GIS mapping to identify forage flora on range	Field measurements and census data, ArcGIS	Yahara Watershed, WI	-	Qiu and Turner, 2013	
Forest health	Arthropod structure and diversity	Capture and graph the levels of arthropod populations in a forest habitat (whole and segmented)	Field measurements, traps in 4 areas, graphing soil	Forested area	-	Maleque et. al., 2006	
Human well-being, spiritual, maintenance of air, increase in health, noise reduction	Soil bulk density, ecosystem function, regulation	Population density ration with input data recorder per plot of land	Percent tree and shrub cover, plantable, space, and surface covers. Diameter of breast.	Florida	-	Dobbs et. al., 2011	
Soil quality/health	Earthworms, spiders, bees	Refraction analysis, general linear mixed effects models	18 low input farms, earthworms: soil sample of 3cmX30cmX20cm, bees: sampled 3 times daily, walked a 100, spiders: caught with D-VAC, 3 time in June, May	HomoKatsag, Europe, Sandbased	-	Centeri and Baldi, 2013	
Food production, Arthropod suppression, seed dispersal, pollination	Bats	Comparison of crop yields with bat population	Sampling of bats/arthropods populations	Across United States	-	Kunz et. al., 2011	
Pollination, seed dispersal, decomposition	Invertebrates	Comparison to previous years	sampling of invertebrates	Worldwide	-	Laws et. al., 2009	Ethan Haney
Recreation, cultural	Participants, aesthetic	(n/ha), value determined by comparing housing prices in various areas	Number of people using park space, housing prices, spatial data	Germany	-	Hernandez-Morcillo et. al., 2013	

Fishing/stream health	Size of organism, aggregate biomass, species, trophodynamics	Mean length = all lengths/number of organisms, biomass percentage = 50% flatfish, overfishing. Overall biomass/aggregate, mean number of interaction between species (L/S)	Field study, length of fish, chart measurements, number of individuals, average lb, food web structure	Georges Bank, Gulf of Maine	-	Link, 2005	
Cultural/Heritage, habitat support, water	Sense of place, gene pool protection, water storage capacity	Number/area (n/ha), ratios of species in system (n/ha), intact suitable habitat, (m3/ha) and max sustained water extraction/yr	Number of cultural sites and species, n of people using as cultural importance, natural biodiversity and integrity, total amount of water (in soils)	Netherlands	-	deGroot et. al., 2010	
Ecosystem Health	Mayfly populations	(P/B), population health by length and abundance	(P) production and (B) annual biomass, collecting, sampling, and documenting populations	Ann Arbor MI Great Lakes	-	Edsall, 2001	
Climate/drought	Forecast Precipitation Index (FPI), stream flows, reservoir storage	Normal precip, threshold, normal compared to present	Forecast of precip. with past (norm) precip. levels, norm, healthy stream flow data averages and current field data, average height of storage and current	Southeastern US	-	Steinemann, 2006	
Climate Drought and Cultural Index	Flora, fauna, environment/atmosphere	Snot Apple: too many leaves and fruits, below normal/drought year, Blue Swallow: present, imminent rain, Frost: if it does not appear, drought	Observation	Zimbabwe	-	Chisadza et. al., 2013	
Climate change	Ice over lake, snowmelt stream flow	Annual ice-in and ice-out dates were averaged and compared, normal flow rate from past data sets compared to current stream flow rate (1 cfs=1 cubic foot per second = .0283 m3/s)	Citizen Lake Ice Monitoring Program (CLMP), U.S. Geological Survey (USGS) National Water Information System (NWIS) website	Minnesota	-	Johnson et. al., 2006	

Climate change	Scot's Pine Growth	Compare age and growth patterns from tree-ring samples at peatland site to drier site	Samples, peatland scot's pine trees rings (peatland and dry sites)	Southern Sweden	-	Linderholm et. al., 2002	
Sense of place (cultural)	Small community	Average response score for "small community feeling"	Census: n of producer owners and n of residential land owners, Survey: Scale 1-5 (agree)	California	-	Plieninger et. al., 2012	

Step 1: Search Journal Article Database

Step 2: Select 50 Articles for Review

Step 3: Document Article Elements in Table

Step 4: Narrow/Focus Table to 10 Indicators

Step 5: Select Indicators as a Team