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**Discussion: Spatial Bias**

1. **How did Metcalfe et. Al. measure sampling bias?**

Statistically significant spatial biases in field sampling were identified and citations across the Arctic region were studied using a comprehensive geo-referenced database of primary field measurements in 1,840 published studies across the Arctic. The database was compiled of all primary field studies in the terrestrial Arctic from an initial list of 4017 scientific arties. Geographic coordinates of field sampling sites and citation data was extracted from each article and then characterized. Using the database, the pan-Arctic distribution of field research was mapped in different environmental science disciplines and the frequency of sampling and citation across gradients was compared in multiple bioclimatic variables: mean annual temperature(from 1960-1990), predicted mean change in mean annual temperature from recent conditions, the mean fraction of absorbed photosynthetically active radiation (from 2007-2011), and the observed change in the fraction of absorbed photosynthetically active radiation (from 1981-2011) from the third-generation Global Inventory Modeling and Mapping Studies data-set. The number of citations was also quantified to identify conditions that are relatively under-cited in the Arctic. Last, the geographic extent of the conditions for all research was mapped for each individual environmental science discipline and then a geo-statistical analysis was used to highlight priority regions for future research.

1. **What are the ways sampling bias in the Arctic can undermine predictions for climate change?**

Sampling bias in the Arctic can undermine predictions for climate change because certain sites and areas are under-represented. The article states that relatively colder and more rapidly warming and sparsely vegetated sites are under-sampled and under-recognized in terms of citations (particularly among micro-biology related studies). These under-sampled areas represent a large fraction of the Arctic ice-free land area, thus possibly biasing the scientific consensuses that attempt to accurately predict and effectively mitigate climate change in the region. Additionally, the current pattern of sampling locations captures mean Arctic conditions reasonably well, but does not capture more extreme conditions.

1. **What is the concept of undone science described by the article written by Nancy Averett?**

The article defines undone science (or “the sociology of ignorance” or “the systematic nonproduction of knowledge”) as a catch-all term used to identify unfunded, incomplete, or generally ignored scientific questions that community groups and other on-the-ground stakeholder consider to be in woeful need of investigation and provides an example of this following the story of Debbie Blackburn. Debbie lived near a coke-manufacturing plant, and the air pollution ultimately altered the lives of her, her family, and other citizens who lived around it due to the negative health effects via the air pollution. Nobody knew how unhealthy the plant was to the citizens around it and nobody planned to even look into it; a prime example of undone science. In a small town such as Avalon, Pennsylvania (location of the plant), nobody initially recognized the importance and danger of the air pollution, thus science was “undone”. However, the plant played such a major role in the lives of the citizens, that the scientific breakthroughs in Avalon play a major role in the scientific community, and should have been recognized sooner. The concept in the article is that there is so much science out there and even in a small town, nothing should go unrecognized; we should always be pursuing the production of knowledge.