

STUDYING CLIMATE IN TWENTY-FIRST CENTURY
OREGON: An Analysis of Sources for the Third Oregon Climate
Assessment Report

by

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A THESIS

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Analysis of Sources for the Third Oregon Climate Assessment Report

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This thesis examines the sources utilized by researchers at the Oregon Climate Change Research Institution in the Third Oregon Climate Assessment Report, published in 2017. The report follows Oregon legislation from 2007, creating the Institute and requiring reporting biannually on the state of Oregon’s changing climate. The legislation’s intention is to be better informed when making environmental decisions impacting its residents. But how thorough is the research behind the report, and does it really represent findings from study sites across the state? This study takes a random sampling of 100 of the source articles from the Third Oregon Climate Assessment Report and analyzes their study locations, the variables investigated, and the frequency with which those sources have been utilized by other papers. The goal of this investigation is to determine whether Oregon’s 2007 legislation and the research it prompted really are enough to prepare for a the healthy future of Oregon’s climate, residents, and wildlife.

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Introduction: Climate Change

“Climate change” and “global warming” are two phrases heard repeatedly in today’s political speeches in addition to many private conversations. These environmental phenomena are highly controversial, polarized politically, and denied by many. Why have these issues become so contested? What do scientists really mean when they mention human-induced climate change? And lastly, why should governments and the public be concerned about these issues?

The word “climate” refers to the weather conditions of a place or region as they occur over spans of many years. The same patterns are observed annually. These could be warm, dry summers that become cold, wet winters in one region, or cold weather that brings heavy snow throughout fall, winter, and spring in another. Climate has been important to sedentary civilizations throughout human history, as they have relied on expected conditions to know when to plant and harvest their crops. Humans have long known how to dress to survive regions with regular harsh conditions, such as the frozen tundra in North America or the great Sahara Desert in Africa.

Climate change occurs when any long-term change to these expected patterns is observed. This can happen for myriad reasons. Evidence in the fossil record and in the scarred landscape of Earth’s continents indicates multiple ice ages during which glaciation dominated the continents. During these ice ages, climate around the globe was much colder on average, and many of the forests, plains and even mountains we know and enjoy today did not exist in the same way as they now do, as they were covered in ice. This is to say climate conditions and subsequent weather events can dramatically change the landscape.

Today, an additional factor accelerates the global changes in climate that naturally occur and threatens the wellbeing of billions of people around the globe. Human industry has released potent chemical pollutants into groundwater and soil, vast quantities of carbon dioxide gas into the atmosphere released from factories and millions of combustion engines worldwide. CO₂ and other gases, including methane, contribute to a “greenhouse effect” which allows solar heat to penetrate the atmosphere and traps it inside. The heavy impact of our species on the planet is indisputable, though many politicians and people choose to be skeptical due to political or personal beliefs.

Very recently, a report on global climate by the IPCC made sensational headlines. The Intergovernmental Panel on Climate Change was formed in 1988 by the United Nations Environment Programme and World Meteorological Association to focus on scientific knowledge of climate change and predict potential impacts, according to their website. The panel is comprised of thousands of scientists who contribute their work for free. There are procedures that govern the work of this group (IPCC 2018, a). The report published was reported on by CNN, Forbes, TIME, and the Washington Post, among many other major news outlets. News headlines latched onto one benchmark of climate danger set in 2030. The IPCC report states that warming beyond 1.5°C would be catastrophic to human populations globally. If current greenhouse gas emissions remain constant or increase by 2030, even greatly increased mitigation or reduction methods would be too late to prevent warming beyond 1.5°C (IPCC 2018, b). While news media tends to oversimplify or sensationalize scientific studies such as this one, the real data does indeed confirm the claims that great actions to reduce greenhouse gas emissions must be taken by world governments before 2030.

Background

Oregon

This research solely analyzes Oregon's climate. While governments and cultures operate within man-made, often arbitrary sociopolitical lines, climate is not confined within these political regions, nor does weather behave differently across the border of two nations. Why, then, complete research focused on just one state? The simplest answer is because national and state governments operate along these lines, and are responsible for any climate science, research, or mitigation that occurs within them. Organizations like the IPCC exist to foster cooperation among nations, as global mitigation is appropriate for a global-scale problem. Though it may work with neighbors Washington, California, or Idaho, Oregon by and large is responsible for its own climate regulations and mitigations.

In 2007, the Oregon State Legislature passed House Bill 3543 which established the Oregon Climate Change Research Institute (Oregon Climate Change Research Institute 2018). To reside in Oregon's public university system, OCCRI would be responsible for providing a report to the public and legislature biannually concerning the state of Oregon's changing climate. This research project is an in-depth analysis of the Third Oregon Climate Assessment Report from 2017, which will be discussed in the next section (this publication will be referred to as OCAR 3 throughout this thesis paper for brevity).

Oregon is unique for its assortment of varied biomes all existing within the same state boundaries. The journal article, "Wet, Dry, Hot, and Cold" by George R. Miller

and H. Michael Mogil was published September 30 of 2011. Even just the title itself reminds the reader of the diversity of climate experienced by Oregon residents. The article claims that Oregon's mid-northern latitude, proximity to the Pacific Ocean, and wide range of topographical elevation contribute to its varied climate (Miller and Mogil 2011). To follow is an exploration of the main regions as outlined by Miler and Mogil.

West of the Cascade Range, the coastal region of the state experiences wet fall, winter, and spring seasons as westerly ocean winds bring storms of precipitation from over the ocean. In the summertime, these winds shift and warm, dry east winds from over the land flow out across the Pacific, and a dry period is experienced for several months (Miller and Mogil 2011). This wet/dry pattern is accompanied by small changes in average temperature seasonally and characterizes the area west of the coast range year after year.

The river valleys west of the cascades, most notably the Willamette, still receive this coastal precipitation. Just like the coast, it is heaviest in the winter months, but will drop to less than five inches in the summertime. The densely populated Portland metropolitan area receives a heavy 50 inches of rain annually (Miller and Mogil 2011). The state experiences snow when cold air fronts move down from Canada and the northern inland United States. Normally, the Rocky Mountains protect the state from any such influx of cold air, so snowfall on the floor of the western valleys does not occur annually (Miller and Mogil 2011).

The Columbia River Gorge in the north of the state acts as a channel for air currents as it passes through the Cascade Mountain Range. This can accelerate air in either direction depending on pressure systems and season. Winds in the gorge can

reach 100 mph. The gorge itself stretches from near the Portland area to the eastern part of the state, affecting weather conditions in both places (Miller and Mogil 2011).

Speaking of which, Eastern Oregon is different from all the regions previously discussed. Rain shadow by the Cascade Range prevents the wet systems from the Pacific Ocean from reaching this region, so it is significantly drier than the western portion of the state.

Meta-analysis

Meta-analysis is an important tool that can be used to compare data sets coming from different sources. The Third Oregon Climate Assessment Report uses meta-analysis to synthesize many published results to formulate an overall picture of climate as precisely as possible.

True meta-analysis is the practice of combining data from multiple sources and comparing it statistically to draw new findings not possibly made from each study individually. Its applicability in the field of ecology and evolution is outlined in the book, *Handbook of Meta-analysis in Ecology and Evolution* edited by Julia Koricheva, Jessica Gurevitch, and Kerrie Mengersen. Multiple authors make thoroughly researched contributions to each chapter, and most chapters include an appendix in which statistical calculations and methods are stated and explained. This book focuses heavily on the use of statistical analysis to draw meta-analytical findings. Chapter contributors explore topics such as data gathering, combining observational and quantitative data from different studies, and troubleshooting the array of statistical problems that can come from the practice, such as publication biases, sampling errors, and more (Koricheva et al.). Most of the book's contributors also recommend using meta-analysis to compare

the original scope and impact of multiple studies being compared, to help contextualize the combination of two previously unrelated publications.

Editor Jessica Gurevitch makes an important contribution in chapter 19, discussing “Meta-analysis of results from Multisite Studies” (Gurevitch 2013). She makes a statement about the application of meta-analysis that relates directly to the Third Oregon Climate Assessment Report and to this thesis paper as well. Gurevitch writes, “while the primary goal of the meta-analysis might be to determine the current state of knowledge about the particular experiments in this group, data synthesis may become curious about placing their results in a wider context. Should new sites and experiments be included?” (Gurevitch 2013). The primary goal of my project is to answer this question regarding OCAR 3. Does it include enough study sites from across the state, or does it exemplify significant location bias? Are its practices of literature review and synthesis enough, or should researchers at OCCRI seek to implement methods of meta-analysis in their next publication?

This paper intends to represent a basic meta-analysis as methodology for evaluating the sources used in OCAR 3. The way to determine whether this publication truly gives a balanced examination of Oregon’s climate is by examining the studies it synthesizes. Though many of the advanced statistical methods utilized in Koricheva, Gurevitch, and Mengersen’s book are beyond my own skills and knowledge and would not be feasibly applied to the large number of samples collected in the data set for my research, this report is in every way meant to represent meta-analysis as a valuable method for analysis in the environmental science fields. Gurevitch concludes her chapter by writing that meta-analysis can change initial findings by expanding the range

of data available for analysis. It also expands research from a practice among a close group of researchers into a broader alliance of scientific individuals working on the same subject. It is in this spirit that my project is completed.

Oregon Climate Assessment Report

In 2007, the Oregon State Legislature passed House Bill 3543, as mentioned previously. This Bill followed similar national and international legislation and created the Oregon Climate Research Institute, which would report on the state of climate change in Oregon and its potential effects on residents, wildlife and natural resources every two years. The OCCRI is housed within Oregon's higher education system and is headquartered at Oregon State University. The OCCRI website states that it is comprised of researchers at all of Oregon's public universities who contribute to its work and biannual reports.

The Third Oregon Climate assessment report is the focus of this research and analysis. It is authored by Meghan M. Dalton, Kathie D. Dello, Linnia Hawkins, Philip W. Mote, and David E. Rupp from the OCCRI at Oregon State University. It is organized into eight chapters, plus a summary for the legislation. Aside from an introduction, the chapter subjects are climate change in Oregon, water resources, coastal issues, forest ecosystems, agriculture, human health, and regional risks. These sections focus heavily on air temperature, changing observed weather patterns, precipitation, streamflow, and forest vegetation. In total, it measures just over 100 pages. There are many visuals used throughout, and all come from the studies cited by the report or from web climate databases, though a few are original by the researchers.

Oregon House Bill 3543 follows suit of other national and international legislation measures previously passed. The IPCC, introduced in the earlier in this paper, was founded in 1988 in order to provide climate reporting to world governments. Like OCCRI and other domestic U.S. reporting groups, IPCC does not conduct its own research but synthesizes as many relevant peer-reviewed scientific publications as it can (IPCC 2018, a). (It should be noted here that most of the OCCRI scientists do frequently publish their own articles, even though the OCAR 3 is not new original research.) Another example, the article *Climate Change in the Northwest* published in 2013 states that it was created as a section of the Third National Climate Assessment, satisfying the Global Change Research Act of 1990. This act requires a report on the state of the nation's climate to the U.S. President and Congress every four years. *Climate Change in the Northwest* serves as one of the eight regional technical reports comprising the whole national report along with sections on energy, agriculture, etc. Interestingly, *Climate Change in the Northwest* also was used to fulfill the legal reporting requirements of the OCCRI under Oregon HB 3543. This will be discussed further in the results of this paper.

Methods

The Third Oregon Climate Assessment Report is the focus of this project. It serves as the base for research and as the source of data collected. The background information for this research comes from the original Oregon Climate Assessment Report and similar articles. Background on the practice of meta-analysis in environmental science come from the Handbook of Meta-Analysis in Ecology and Evolution edited by Koricheva et.al.

Data collection utilized the cited studies from the list of 362 citations within the References section for each chapter of the OCAR. It was not feasible to find and obtain each source and collect data on it, and a random sampling could yield reliable, accurate results. A sample size of 100 articles was chosen for this project. While this sampling leaves a certain margin of error (calculated to be about 8.3% for this project), this sample size should yield results representative of the source articles whole. I numbered each citation in the Third Oregon Climate Assessment Report, then used a random number generator to randomize the numbers 1 to 362. I took the first 100 values from the resulting list as the sample numbers.

Using the University of Oregon Libraries and Web of science databases, I found each sample article and record the name, authors, number of times it has been cited, and date of publication in a Microsoft Excel spreadsheet. After reading OCAR 3, I created a list of subject categories so that the focus of each paper could be record and fit into a limited set of categories for ease of analysis. Finally, each paper was read to discover whether latitude and longitude coordinates were included. These values were recorded when present. When a large geographic region was presented on a map with latitude and longitude in any of the sample studies, the center point was recorded.

This data generation will allow me to create important figures to add to this paper. I will include frequency charts for the number of times the sample studies are cited in other works and the frequency with which certain variables are supported with sources in OCAR 3. I will analyze where the sample studies were conducted; this will be a map with latitude/longitude points and may reveal gaps in climate data source areas when compared to areas studied very heavily.

Results

Presentation and Discussion of Tables and Figures

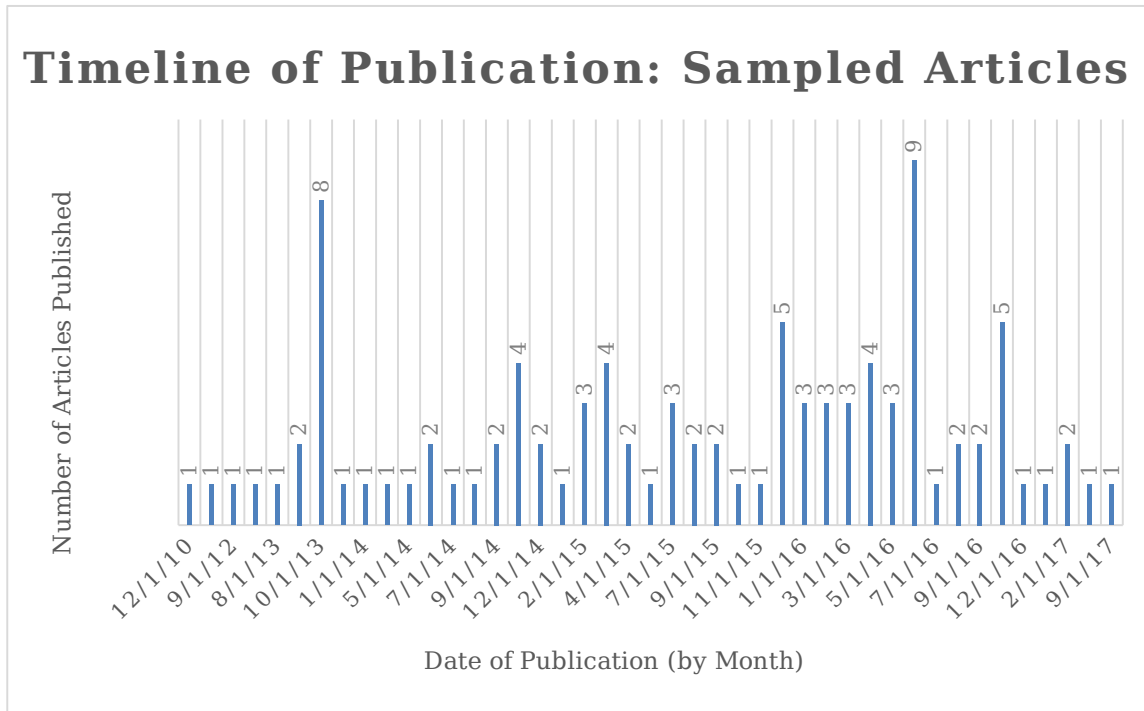


Figure 1. Chart showing timeline of publication of sources in random sample.

In Figure 1, the distribution of publication over time of the articles sampled is visible. The data shows even distribution for the most part, with spikes in October 2013 and mid-2016. Overall, the data shows a large number of publications in 2016. This is a representation of thorough, strong research by the OCCRI as they included a large number of articles from the year before publication in their study. This timeliness ensures that the end report is accurate to the most current climate data available. One consideration is that with such a specific topic, it can be difficult to find sufficient sources published recently enough to be appropriate to use. Only 16 articles cited are from before 2014, and two are simply the previous OCAR publications.

Article Repeated	Author(s)	Variable(s) Examined	Number of Repeat Citations	
Climate Change in the Northwest	Dalton, MM	Impact to Humans-Health, Wave Climate	5	
Changing streamflow on Columbia basin tribal lands- climate change and salmon	Dittmer, K	Fish/Wildlife, Impact to Humans-Health, Hydrology	2	
The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment	Multiple per chapter	Impact to Humans-Health	8	

Table 1. Table showing repeat articles included in the citations sampled.

Some articles are repeatedly cited in the OCAR 3. In all cases, this gives credit and recognition to the authors of the section being examined. But in the case of the health chapter, this redundancy is great and does not make for the most balanced study.

The article, “The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment” Is cited eight times in the Human Health Chapter. On one hand, each chapter was sighted to recognize the authors, as “Human Health in the United States” is another large, edited publication. Giving proper credit is always important, though it would have been nice to see the researchers gather a few more sources for the Human Health chapter. Relying heavily on one source is not the most balanced method of doing research, and the national “Human Health in the United States” article does not match the Oregon-specific focus of OCAR 3.

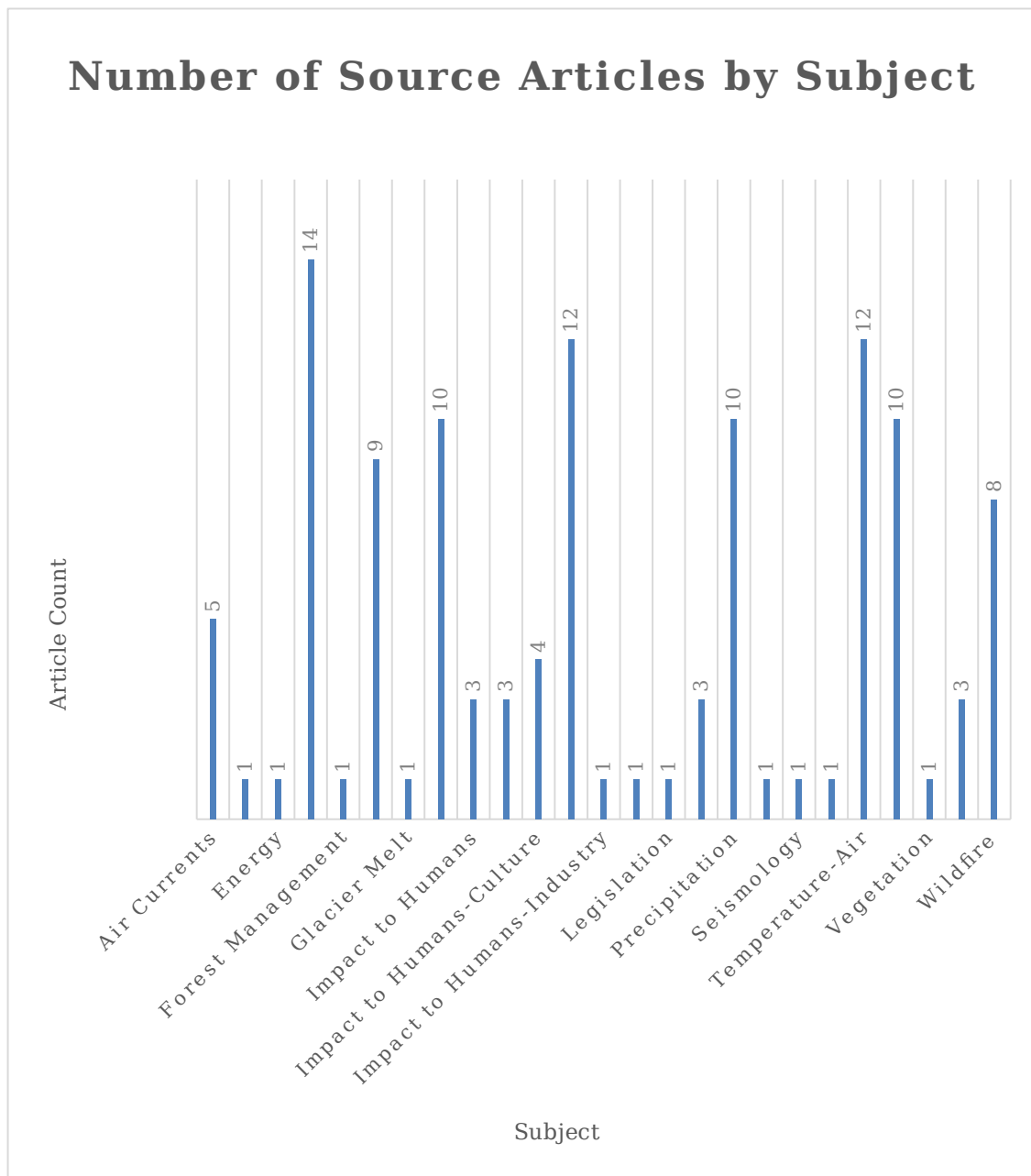


Figure 2. Bar chart showing the quantity of studies completed in each subject category.

This list of subjects into which to organize the citations of the OCAR 3 was created in order to examine which subjects were most heavily supported by cited research. The most heavily supported subjects were temperature of air and water with 12 and ten sources, respectively, fish and wildlife, hydrology, precipitation, impact to human health, and wildfire. The most common topic for source articles was fish and

wildlife. This makes sense because wildlife species can be the best indicators of threats caused by a changing climate. Though perhaps not the most important factor to look for when reporting on climate, the well-established field of wildlife biology yields many studies every year, so it makes sense that many of the sources available for OCAR 3 are focused on wildlife. Understandably, the temperature categories, hydrology, precipitation, and wildfire also were well-represented by close to ten studies each. These are some of the most common and traditional topics to examine when studying climate. Finally, it is encouraging to see that impact to human health was so well represented as a category with 12 article citations. This field is so integral to our well-being and survival, and human health can be negatively impacted by environmental pollutants and climate factors in ways scientists are only beginning to understand.

Some variables were only represented one time, such as CO₂ emissions (though it must be noted that emissions are a contributing factor in CMIP5 modeling, which will be discussed later), seismology, and sea level. It would be reassuring to see sea level and emissions measured or projected explicitly in more than one article each, but these issues were still fully addressed in the paper, and future emissions were projected by many of the studies as part of extensive CMIP5 modeling projects.

Grouping of Subjects in Two-Variable Studies

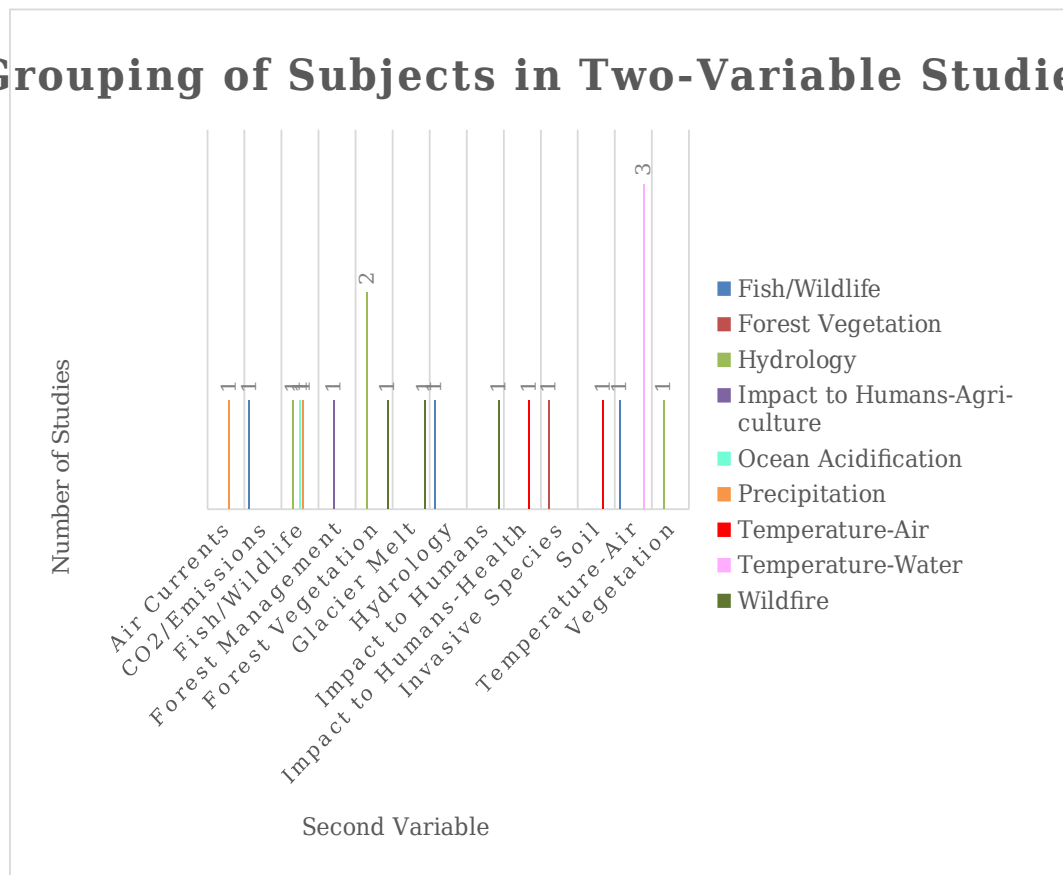


Figure 3. Bar chart showing combinations of subjects in two-variable studies

This bar chart shows each combination of variables in studies where two major climate variables were incorporated. The quantity of articles with each combination is also represented. Some combinations make obvious sense, such as temperature of air and water being represented together in three studies. It is very interesting to see which topics affecting or involving climate in the Pacific Northwest were combined in certain publications. After examining all of the data in this chart, it can be concluded that all combinations seem scientifically sound and are worthy contributions to OCAR 3.

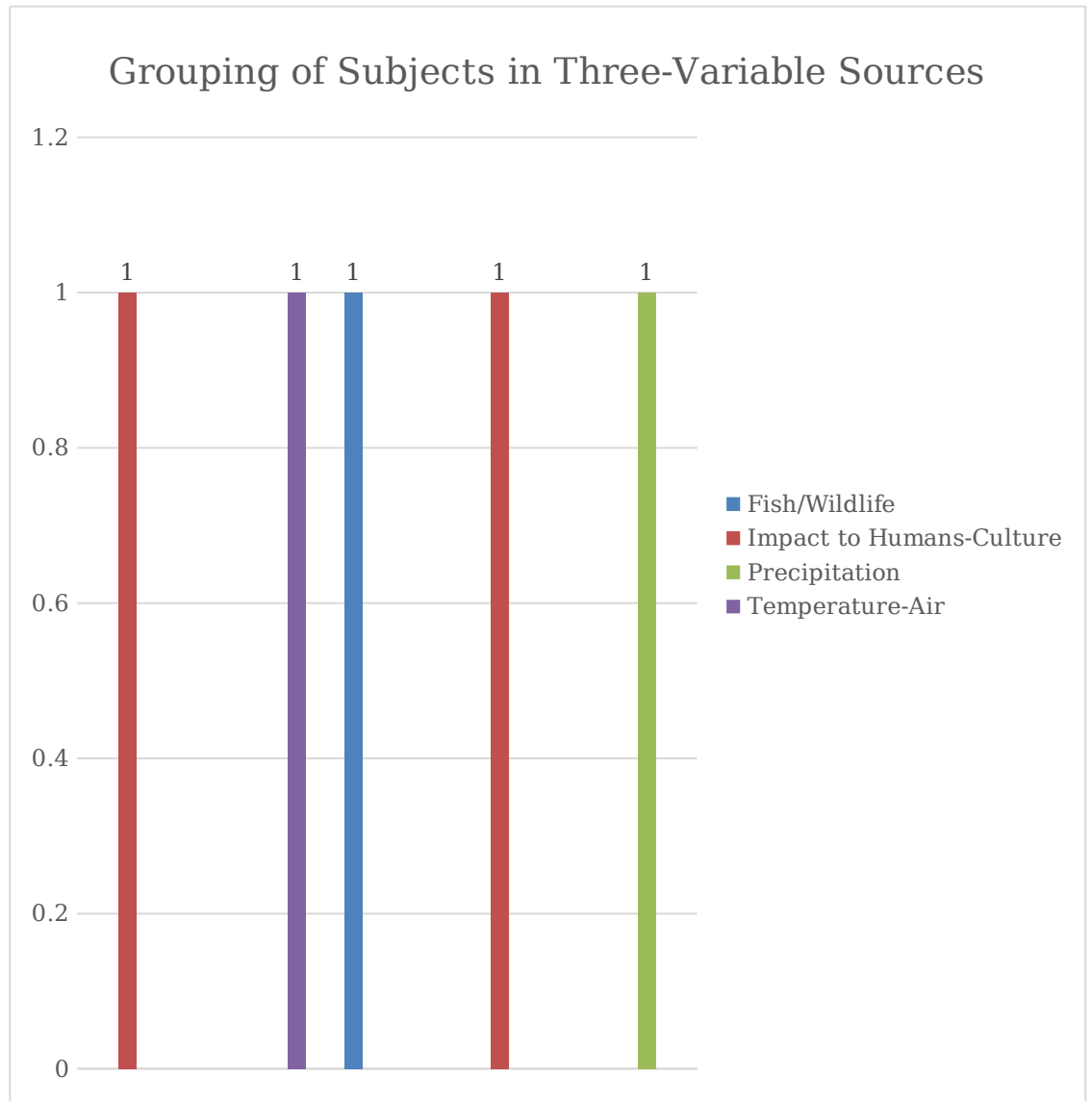


Figure 4. Chart showing combinations of topics from studies that examined three variables.

This figure shows each combination of variables yielded when a study included three variables together. Three was the most recorded for any individual study, so the most prominent study variables were recorded if more than three were included by the researchers. Like the previous chart, the combinations do make sense when considered against the connectedness of all climate and ecosystem phenomena. While it is often

easier to understand articles written with only one variable in mind (an example could be projected or measured increases in air temperature over time), these articles combine subjects in a way that reflects the sensitive interconnectedness of our natural world.

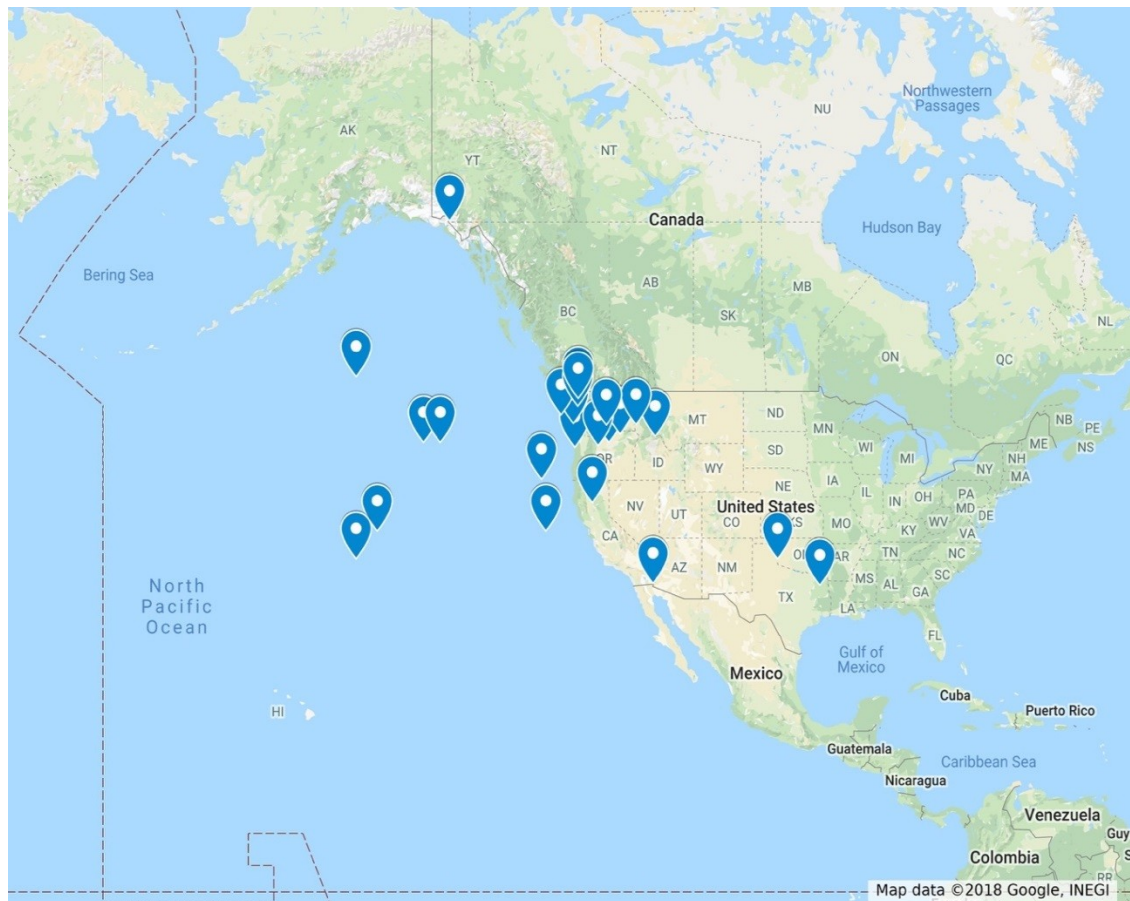


Figure 5. Map of geographic data included in studies in the sample

This map shows all of the cites that were represented in the random sampling. This map and the one following were created with 25 sets of data from 17 studies that included latitude and longitude of their study sites or areas. Including this information, while not necessary nor a requirement of the scientific community, can be helpful to the reader and can is incredibly helpful to researchers who may want to recreate or expand on the original experiment. While not necessary, I was surprised by the number of

studies that did not include any coordinates for study. I think that this is a good practice and makes the results a little more reputable. Someone wanting to use a climate modeling program or to repeat or expand on one of the studies in this report would need to contact the researchers for each report and try to discern whether their original data is available for reference. This issue is avoided when the specific location is denoted in the study publication.

For a report focused on Oregon, this data does encouragingly appear clustered in the northern part of the state and in Washington. Some of the outlier points in Texas and the Pacific Ocean represent the center points of map data from studies which chose to examine either the United States as a whole, or temperatures of seas surface and air over the Pacific Ocean, an area which drives the climate of the western half of Oregon.

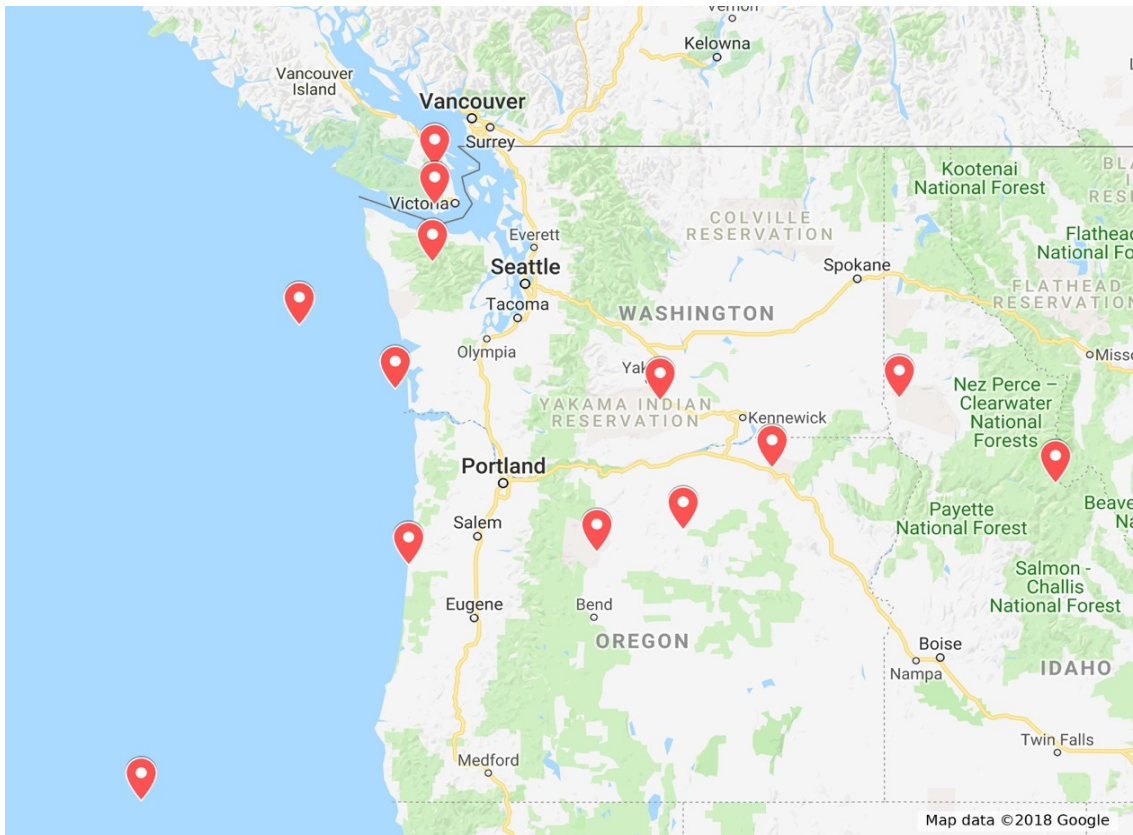


Figure 6. Same map as Figure 5, zoomed in to showcase Pacific Northwest United States.

This second map is a zoomed-in view of the Pacific Northwest region showcasing location data collected from the random sampling. This view is a little more relevant than looking at all the data points at once, because it shows the study cites that are in the state of Oregon. Overall, it is difficult to draw conclusions from the geographic subset of data within this thesis project with so few articles having provided data. Still, it is evident that studies were conducted on tribal lands, the coasts of Oregon and Washington, and in the northern part of the state the most. What seems to be missing most obviously are any sampling locations in Eastern Oregon, a dry area with important desert and grassland biomes yet much lower population than the western half of the state. While the authors of OCAR 3 do discuss the Eastern Oregon region, it

seems important that there should be studies from this area on the map. It is essential to mention that it is entirely possible more studies from the complete list of citations were conducted here. It is also possible that there were studies from the random sample conducted here that did not include coordinate data in their publication.

Overall, this data is integral to understanding where the climate data concerning Oregon is coming from and how Oregon and the Pacific Northwest fit into a larger global crisis. One suggestion I would have for future Oregon Climate Assessment Reports is that they consider creating a map like this, to add an element of consideration for evaluating the range and reliability of their course materials. This is also a great way to expose natural areas or communities of people who may be subject to increased problems caused by climate change but that have not had studies conducted at or near their locations.

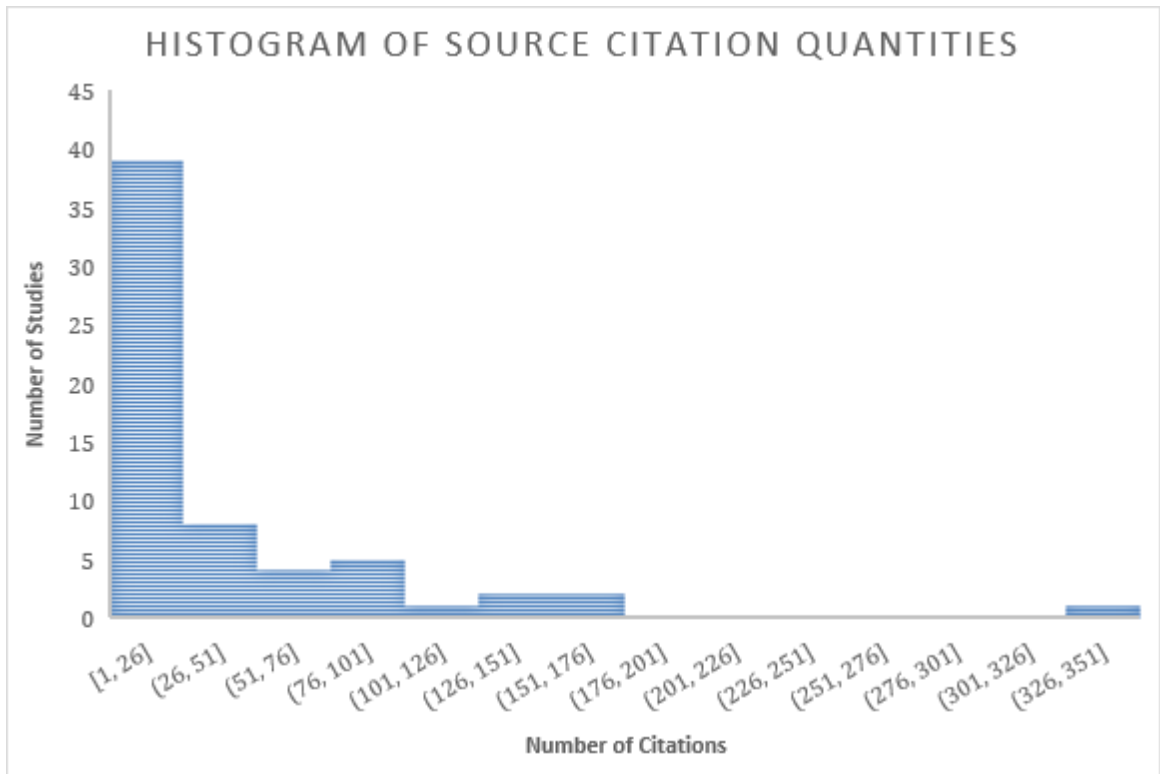


Figure 7. Histogram of number of citations per article.

The last piece of data I collected for each article was the number of times it was cited by other peer-reviewed studies within the large database of Web of Science. This gives a good indication about whether an article is more prominent within the scientific community, or whether it is less widely read. This is not necessarily a good indicator of an article’s importance for understanding climate, but the quantity of citations does a good job identifying how well-regarded a publication is within its field. The left skew of this histogram reveals that the researchers utilized studies that were relevant to the Third Oregon Climate Assessment Report and not simply articles that were cited hundreds of times. With the specificity of the study they conducted, finding only sources that were very popular would not leave them with many source options or

produce a well-informed report. Interestingly, the outlier is a 2015 article about global vulnerability forest die-off which has been cited 346 times by other papers.

CMIP5 Modeling

Twenty-four studies out of the sample, or 24%, utilized computer modeling rather than physical data collection to provide data. A surprising number of these studies rely on the CMIP5 climate computer model for simulating and projecting climate changes and patterns. While these studies apply a valuable and advanced method of scientific research, it is interesting that they do not take physical measurements from the area of study. One benefit to using the CMIP5 model is that it simulates the whole globe at once. In this way, the researcher can focus on whatever section is of interest (in this case, the Pacific coast of North America) and have a large-scale image of the forces driving climate change at one specific locus.

CMIP5, which stands for Coupled Modeling Intercomparison Project is a climate model developed between 2011 and 2013. It is created by the Working Group on Coupled Modelling (WGCM) of the World Climate Research Programme (WCRP), the same group responsible for creation of the IPCC. Their goal is to foster international cooperation in the creation of advanced computer modeling programs that will help nations anticipate and make decisions about their climate futures (Working Group on Coupled Modeling).

The studies that utilized climate modeling technology were distinct for two reasons. One is that they did not provide coordinates for specific areas from where data was originally sampled, nor did they provide any coordinates for where their modeling software focused most heavily. This is largely due to the second distinction, which is

that these studies most often looked at the climate patterns of the entire globe at once, mapping patterns of air movement over all of the earth's oceans, where air streams are most active and temperature fluctuations the most consequential. These two distinctions make modeling projects essential to the study of Earth's changing climate and, at the same time, difficult when studying a particular small region, as small-scale conclusions are difficult to draw from such a broadly focused article.

On Meta-analysis

The Third Oregon Climate Assessment report is an application of meta-analysis to a subject that is integral to study for the health and wellbeing of the people of Oregon. It combines varied study areas within environmental science across multiple disciplines, such as geology, medicine, and ecology.

Meta-analysis in *The Handbook of Meta-analysis in Ecology and Evolution* is understood to be a statistical methodology in which groupings of datasets from different sources are analyzed. This mathematical combination is what unlocks new findings and key results that could not be drawn from one dataset alone. In this sense, OCAR 3 is perhaps not a "true" meta-analysis, at least not in the way that the authors and editors of *Handbook of Meta-analysis* define it. They consider meta-analysis to be the application of statistical analysis to compare data or metadata from two or more studies. The goal of this kind of meta-analysis is to evaluate and compare the reach, publication bias, scope, or margin of error, among other factors, of the studies in question. It can also be utilized to reach new discoveries utilizing datasets that were not originally collected in one study.

OCAR 3 does not use this exact kind of meta-analysis and is probably best defined as a literature review and synthesis of datasets. Such a research synthesis is not made less important by the fact that it is less statistically technical. In fact, the structure of OCAR 3 means that it is capable of having a much larger scope than most of the studies exemplified by the authors of *Handbook of Meta-analysis*. In chapter 14 of the book, authors Michael D. Jennions et al. Compare two studies, one examining CO₂ levels in photosynthetic plants and one researching reproductive rates of different groups (Jennions et al. 2013). These studies had different effect sizes, so the authors of these chapters utilized meta-analysis to statistically determine which publication effectively had a greater reach. They are looking, in their chapter, for ways to determine publication bias. More specifically, they want to determine the ways in which the reputation of a particular journal of publication can affect whether one study is more widely read or distributed than another study, assuming the studies are of equal importance. This is not the intent of OCAR 3. The report is produced specifically for the use of policymakers and the general public. Its goal is not to evaluate a few studies against each other, but rather to paint a large picture of regional climate overall. This is why some of the methods utilized for meta-analysis in the *Handbook* might not be applicable to the authors of OCAR 3.

As previously mentioned, the Third Oregon Climate Assessment Report is a report more legible by the average layperson with at least some higher education rather than geared toward the most intelligent climate data scientists. This is not an accident. Policymakers are some of the main and most important readers of this report, and they will be of future reports by the OCCRI as well. It is important that they be able to easily

read and understand these findings, since the hope is that the report's findings will influence their future policy proposals and decisions. Some of the sample sources were written with so much technical language, that even I had a more difficult time interpreting them. In the same vein as the OCAR 3 publication, the goal of this thesis paper is that it is readable by all and not just those with strong scientific backgrounds.

Legal/Public Policy Considerations

To reiterate, Oregon House Bill 3543 from 2007 created the Oregon Climate Change research institute and is the reason for the publication of the Third Oregon Climate Assessment Report. While this legislation follows suit of national U.S. legislation on climate reporting as well as international standards created by the IPCC, one major criticism I have is that there is no accompanying legislation that dictates what the Oregon House must do with the reports it receives. Currently, it is likely that OCAR 3 and preceding reports may inform specific decisions made on energy or state forestry initiatives, there is no law that states carbon tax, alternative energy programs, or conservation plans must be introduced into Oregon's legislation based on the results of the OCCRI biannual reports, and I believe that this should be so. To create a legal system more inclined to be a failsafe for Oregon in the face of continued climate change and pollutive consumption practices would be an excellent step in continuing the fight for a healthier ecosystem. The conclusions of the report clearly state that Oregon's citizens will be vulnerable to increased health problems, destruction of housing, and other natural disasters in a future with a warmer regional climate, so it is somewhat baffling that the State Legislation does not evidently intend to use the data and reports synthesized by OCCRI to make meaningful changes. As it stands, the mandate creating

the Oregon Climate Change Research Institute exists more as a gesture of good intentions regarding climate responsibility but lacking any accountability for legal action to occur. I think that this practice will have to change before environmental regulations of lasting substance can be created. If Oregon's Congress gave more weight to the finished report, rather than leaving ideas of change up to the governor's office alone, we could see regional climate data make a shift toward indication of a healthier regional and global ecosystem in the future.

Limitations/Continued Questions

It is important to acknowledge the limitations of this study. First of all, four sources out of the 100 randomly sampled were not available from either the UO libraries database or the Web of Science database. The cause for these missing reports is unknown, and though it was a small number, it is still a factor that affects the results. Sample citation articles being unavailable could certainly contribute to an unintended form of sampling bias.

Another improvement that could be made to the sampling methodology used here would be to increase the sample size. Studying 50%, or even all of the citations used in OCAR 3 would better represent the quality and locations of these studies. As a whole, the goal would still be to analyze the way that the Oregon Climate Change Research Institute reports climate in Oregon.

Lastly, it would be interesting to select two or more publications out of the 362 cited and conduct a more statistical meta-analysis. Using the methodology outlined in *Handbook of Meta-Analysis in Ecology and Evolution*, one could explore the

relationship between two sets of data, perhaps concerning subjects like forest vegetation or hydrology that were among those most widely studied.

Conclusion

In a time where much of society willfully disbelieves the fact that humans are accelerating climate change at an unsustainable pace, working on this project felt timely and important. The greatest lesson I've learned is that to review and question the way we research and draw conclusions is one of the most important parts of conducting and publishing scientific research. The struggle for more funding to complete more research and to eventually implement findings of that research into ecological restoration projects or forays into alternative energy is an incredibly difficult and time-consuming one. Time which we hardly have enough of, as all of this work is a race against increasing temperatures and changing landscapes already well underway. My goal in engaging in this research was to ask whether we are being careful and thorough enough, even in our home state, with our research that could dictate the global environmental future. I believe the answer to that question is yes, but the follow-up needs to come from our elected officials to act on the data being produced. It is simply not enough to be aware of how our regional climate is changing without making changes for the better. We have the means and methods, we all must now choose to act.

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