

Constructing scientific narratives around the Dust Bowl: a network-based study of American scientist communities between the 1920s and 1950s

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Abstract. Though different societies have different environmental problems, they all face the same challenge of finding appropriate problem framings as well as feasible policy solutions. In the framing process, a scientific network emerges out of dynamic interactions among scientists from various backgrounds. And it is through this network that integration and synthesis of ideas and perspectives become possible. However, the possibility of forming a certain degree of scientific consensus is contingent on an array of social factors which include the number of participating disciplines, the degree of interdisciplinary interactions, and the structural pattern of the scientific network. By using discussion on the Dust Bowl in the United States in the 1930s as a case study, this study reveals how a unified scientific framing of environmental degradation problem was formed as a result of interdisciplinary interactions between three major disciplines—anthropology, ecology, and geography.

Keywords: Scientific network • interdisciplinary interaction • bridge community • the Dust Bowl • environmental degradation

1 Introduction

Environmental problems are not always easy to agree upon, especially when they are concerned with complex, large-scale socioecological systems that go beyond daily experiences. The possible emergence of a unified scientific problem framing often involves exchange of ideas across disciplines facilitated by dynamic interactions among scientists. The evolving interpretation of the Dust Bowl offers an interesting case study of this process. Back in the 1930s, the Dust Bowl—a series of dust storms—came into being in the United States “as fulvous dirt began to blow all the way from the plains to the East Coast and beyond” [1]. This unprecedented natural disaster seized the Americans by surprise and revealed to the public the severity of environmental degradation in the American West. To understand the causes of the dust storms, scientists from different backgrounds participated in the discussion. Most scientists came from the disciplines of geography, ecology, and anthropology. These scholars formed an intricate scientific network that greatly influenced historical interpretations of the Dust Bowl and the framing of environmental degradation problem in the American West.

Previous studies of the Dust Bowl mostly examined the scientific discussion by using qualitative analysis approaches [2, 3]. Few have explored the structural pattern of the related scientific network, not to mention its impact on historical environmental interpretations. What did the scientific network between the 1920s and 1950s look like? How did this scientific network influence the understanding of the dust storms and the framing of environmental problem back then? Focusing on these questions, this study endeavors to analyze the scientist network by applying social network analysis, and to reveal social factors that affected the exchange of ideas and the integration of scientific interpretations.

2 Research Data and Methods

Academic papers between the 1920s and 1950s were used to construct this scientific network. These papers were extracted from the database JSTOR, which contains a

collection of early academic publications, especially in the field of social sciences. Because scientists participated in the discussion were mainly from three disciplines—anthropology, geography, and ecology, the search of papers was limited to these three fields. In JSTOR, these fields are categorized as anthropology, geography & geology, and biological science.

Table 1. Sampling methods for the scientist network

Disciplines	Key-word sampling	No. of paper
Anthropology	(“grassland” or “prairie”) and (“destruction” or “degradation”)	41
Geography & geology	(“grassland” or “prairie”) and (“destruction” or “degradation”)	134
Biological science	(“grassland” or “prairie”) and (“destruction” or “degradation”)	627
Disciplines	Ego-centric sampling	No. of paper
Anthropology	“H. H. Barrows”, “Carl O. Sauer”, and	99
Geography & geology	“Arthur W. Sampson” and etc.	
Biological science		
Total	Excluding irrelevant papers (such as papers written by non-American scholars)	318

To identify all the relevant scholars, both keyword sampling and ego-centric sampling were combined. Considering the fact that discussion on the Dust Bowl was generally associated the problem of grassland degradation in academic literature, “grassland”, “prairie”, “destruction”, and “degradation” were selected as keywords for the keyword sampling. For ego-centric sampling, papers of important scholars were selected. The selection of egos was based on expert opinions in the three disciplines. In geography, Harlan H. Barrows and Carl O. Sauer are considered to be two prominent scholars

during that period. Harlan H. Barrows, in particular, was a member of the Great Plains Committee that investigated the Dust Bowl and wrote the report *The Future of the Great Plains* in 1936. Arthur W. Sampson was one of the pioneers in the field of rangeland management (grassland management) and his writing is believed to have great impacts on the scientific understanding of grassland systems. The ego-centric sampling allowed the inclusion of important scholars who might have indirectly influenced discussion of the Dust Bowl. The summary of keyword and ego-centric samplings are shown in Table 1.

The search yielded a total of 318 papers. And from the collected paper, 301 authors were extracted. A relation matrix was constructed to record citation relations among the extracted authors. An author-to-author network was drawn with authors represented as nodes in the networks and their citations and references between each other as directed links. Excluding isolated nodes, the main component of network contained 267 authors and 944 links. The visual portrayal of the scientific network is shown in Fig. 1. The layout was produced using the standard spring embedder algorithm in the Organization Risk Analysis software [4]. Different disciplines were distinguished by colors. The ecologist group was marked in green, the geographer group in red, and the anthropologist group in blue.

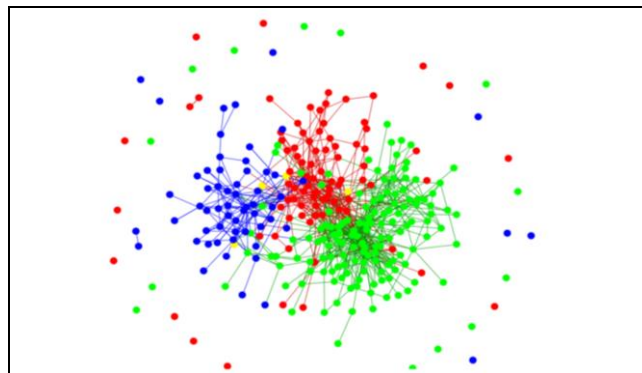


Fig. 1. Visual portrayal of the scientific network between the 1920s and 1950s

3 Results and Discussions

3.1 Presence of Geographers as a Bridge Community

The mapping of the scientific network in Fig. 1 reveals that there was one group of geographers (in red) positioned themselves in the middle of ecologists and anthropologists. This position suggests back then the geographer group probably acted as a bridge community inside the scientific network. The presence of this bridge community can be measured in a quantitative way using block model in social network analysis. Block model is one of the ways of measuring interdisciplinary interactions by considering each disciplinary group as one block and calculating the total numbers of links within and between all the blocks [5]. The normalized results are shown in Table 2, with the numbers illustrating the normalized frequency of the disciplines in the columns cited by the disciplines in the rows. According to the block model, anthropologists cited geographers (0.0029) more often than they did to ecologists (0.0014), and in a similar manner, ecologists cited geographers (0.0058) more often than they did to anthropology (0.0010). These numbers indicate that proportionally anthropologists and ecologists learned more from geographers than from one another. In other words, to a certain degree, the communication between anthropologists and ecologists was quite limited, and geographers acted as a bridge community and facilitated the flow of ideas between the two groups.

Table 2. Block model

	Anthropology	Ecology	Geography
Anthropology	0.0308	0.0014	0.0029
Ecology	0.0010	0.0210	0.0058
Geography	0.0017	0.0026	0.0259

The evolution of the scientific network over time was illustrated in Fig. 2. By the year 1940, scholars that participated in the discussion were mainly from geography and

ecology. And in the following decade, more anthropologists joined the discussion. During the period between the 1920s and 1950s, the status of geographers remained central, spanning between the other two groups—the clusters of anthropologists and ecologists.

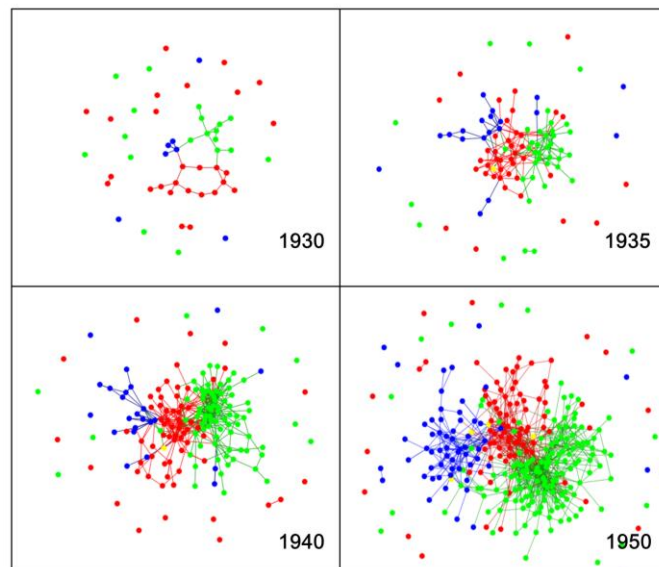


Fig. 2. Development of the scientific network over time

3.2 History of Interdisciplinary Interactions

What facilitated the development of geographers as a bridge community in the American scientific network? And how did this network affect scientific interpretations of the Dust Bowl? To answer these questions, a historical review of interdisciplinary interactions among the three disciplines is indispensable for understanding the historical context in which the network was embedded.

In the United States, the years between the 1920s and 1950s were a historical period characterized by active intellectual exchanges. The three disciplines—geography, ecology and anthropology—had all experienced interdisciplinary interactions with other fields. The relationship between ecologists and geographers started to surface in

the late 1910s, when scholars from both sides explicitly discussed the potential contribution of the other discipline to their own domain. Moore included in his Presidential Address to the Ecological Society of American in 1919 that “Geography, insofar as it is the study of man in relation to his environment, is human ecology” [6]. On the other side, Dryer, as the president of the Association of American Geographers, delivered a Presidential Address in the same year pointing out that “ecology may do for human geography as much as geology has done for physical geography”[6]. All these suggest a growing interest among ecologists and geographers in the work of one another.

The connection between anthropology and geography, on the other hand, was rather implicit. The theoretical exchanges between the two disciplines intensified around the 1920s and 1930s, which some scholars believe was partly because of the personal connections developed between geographer Carl O. Sauer and two Franz Boas’ former students—anthropologists Alfred L. Kroeber and Robert Lowie—in the University of California, Berkeley [7]. They worked together to provide combined seminars and field studies, and even discussed the possibility of a joint department [8]. The collaboration between anthropology and geography at the UC Berkeley in the 1920s and 1930s is considered to have left a rich intellectual legacy for students graduating from the program, with the genealogy continued to Julian Steward and other scholars [8].

3.3 Development of Historical Narratives

The interdisciplinary interactions provided the historical context for the development of the scientific network that spanned three disciplines—anthropology, geography and ecology. Out of this network emerged the historical narrative concerned with the Dust Bowl. The three disciplines gave their own interpretations of the environmental problem, and quite interestingly, they tended to frame the problem in a similar way.

Let’s look at the explanation given by ecologists and anthropologists. American ecologists focused on negative environmental impacts of the practices of early immigrant farmers, arguing that improper farming techniques of this community was the root cause of the environmental problem. The typical argument given by ecologists can be illustrated by the following statement—“extensive cultivation during the past dec-

ade has enormously increased the proportion of cultivated land to native prairie thereby increasing run-off and the hazards of dust storms” [9]. Anthropologists, however, concentrated on the practice of another social group—that is production activities of the American Indians. From this perspective, they interpreted the environmental problem as the result of replacement of traditional practices of indigenous communities. Their studies stressed that the American Indians had developed much more complicated ecological knowledge than the later immigrants. As argued by Delabarre and Wilder, the lands of Indians differed “wholly from that of fields in which any kind of white men's crops have been grown” [10].

Geographers also developed their explanation of the Dust Bowl. In 1945, one geographer Russell Lord commented on the environmental history of the American West: “Only yesterday in terms of historic time the North American continent was an Indian paradise. Here was a vast and fruitful land, clad with a robe of plants that had protected it for millions of years. Suddenly this body of land was thrown open to land-hungry immigrants from Europe. With a rush we took it and beat upon it hungrily, wave by wave...we seized upon and bared American soil for what we called “cultivation.” In countless places we thinned our topsoil to half or less than half its former depth and productivity” [11].

It seems that the interpretations of the Dust Bowl by the three disciplines, though different in their perspectives, framed the environmental problem in quite a similar way. They all appreciated traditional practices of the American Indians as environmental friendly, or at least less destructive, and accused the later immigrants of improper farming. This framing was characterized by a contrast between the past and the present, and between the American Indians and the later immigrants. The emergence of a unified scientific framing might be explained by the broker position of geographers who facilitated the exchange of ideas between ecologists and anthropologists and helped to produce a certain degree of consensus. It is through the dynamic interactions among scholars in the network the scientific framing of the Dust Bowl finally took shape.

4 Conclusion

Diverse views and knowledge(s) shaped the understanding of the Dust Bowl. Between the 1920s and 1950s, ecologists, anthropologists and geographers all participated in the discussion of the Dust Bowl. It is found that the interdisciplinary interactions as well as the emergence of geographers as a bridge community had led to the formation of a unified historical framing of environmental degradation problem in the American West. In the historical narrative, American Indians were viewed as the stewards of nature, whereas the immigrant farmers were seen as ignorant destroyers whose unquenchable greed broke the subtle balance between human nature. This study calls for further exploration and analysis of bridge communities in the scientific networks to better understand the process of consensus-building.

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