THE DIFFUSION OF FM RADIO STATIONS IN THE UNITED STATES 1937-1985

BY

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PREFACE

Overall, I would like to express my sincere thanks and appreciation to all of the faculty and staff of the OSU Geography Department for their friendship and assistance during my stay as a graduate student. Specifically, I wish to express my sincere gratitutde to my thesis advisor, Dr. Robert Norris, for his always positive outlook, timely comments, and always having the time to listen to the woes of a graduate student. My heartfelt thanks also goes to my other committee members, Dr. George Carney and Dr. John Rooney, for their earnest suggestions and encouragement during the thesis process. Special thanks to Dr. Steven Tweedie for his assistance and patience in trying to show a novice how a computer works. Additionally, I wish to express my gratitude to Gayle Maxwell for her suggestions and cartographic assistence and to Frances Hayes and Susan Schaull for their friendship and willingness to help someone who doesn't know how to type. Finally, an honest and sincere debt of gatitude goes to my fellow graduate students without whose comments, friendship, and support the program would have been much more difficult and far less enjoyable.

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CHAPTER I

INTRODUCTION

The diffusion of innovations across the landscape has been an important area of study in cultural geography. One innovation which has had a significant impact on American society has been commercial radio. Over the years commercial radio has expanded, become more diverse, and maintained a high degree of competition with other media including television (MacDonald, 1984). FM commercial radio has followed the same trends and, in recent years, has begun to amass a larger share of the total radio market (Hedges, 1986). Commercial FM radio began in 1937 (Kane, 1981) and has enjoyed an increasingly popular level of interest ever since. FM radio revenues have increased, more broadcasting facilities have been built, and formats have been diversified to cope with growing consumer interest (FCC, 1979).

Because of the increasing popularity of FM radio, and the lack of geographic research and understanding of the spatial aspects of its growth, this research is designed to help fill this void in the literature. The pattern and process of the spatial diffusion of commercial FM radio stations are studied.

Justification for Study

Principle literature about radio can be divided into two groups: technical and cultural. Much literature has been devoted to the operating principles (Camies, 1959), facilities and equipment (Ennes, 1974), and regulation (FCC, 1979; Taishoff, 1985). Cultural information has covered a wide range of topics, some of which include: types of listeners (Hedges, 1986), formats (Kass, 1979; MacDonald, 1984), regional surveys (Aduroja, 1979), listener locations (Major, 1981), and media comparisons (MacDonald, 1984). There is, however, little published material found relative to the locational patterns of radio stations and, more specifically, to FM stations in the United States. Several publications exist which identify where radio stations are located (FCC, 1979; Taishoff, 1985) but they offer no analysis of distributional patterns. Only two works were found which specifically addressed the spatial diffusion of radio stations (Bell, 1965; Carney, 1977). Other media, such as television, have been examined as to their spatial distributions (Inada, 1978; Brown, 1974). Significant gaps exist between Bell's thesis of 1965, Carney's paper of 1977, and the present. This research adds to the literature base and provides a vehicle for further comparisons of communications media. Moreover, an identification and evaluation of the growth process could

provide insight for the prediction of future FM station sites.

Problem Statement and Hypotheses

The major objective of this research is to analyze the spatial distribution of FM radio stations over time. More specifically, it addresses the following question: What is the spatial diffusion model most responsible for patterns of FM station locations in the United States? The first hypothesis to be tested is that the growth process was "diffusion" rather than a linear or random process. The second hypothesis to be tested is that the growth pattern followed the hierarchical diffusion process. This means that the largest population centers adopted the innovation first. Then, leapfrogging occurred between the large places, but in a descending order. Then, infiltration between smaller central places occurred in the final stages.

Scope

The study area includes the forty eight contigious states of the United States, Alaska, and Hawaii. No specific region is given preference over another. The time period studied encompasses the years since the innovation began to the present. Current data limitations finalized the time period as 1937 to 1985. The radio stations to be evaluated are commercial FM broadcasting stations and do

not include non-profit, public, or non-commercial religious stations. Those stations which have been assigned call letters and are licensed but not operating are not evaluated in this study. Moreover, no effort is made to determine the effect of those stations which, through failure or consolidation, have disappeared over time. Neither will this study evaluate such factors as marketing strategies, network structure, or regulation which influence the location of FM radio stations. Some important contributing innovations, such as stereo, and some of the effects of regulation are discussed along with the history of radio in Chapter III.

Definition of Terms

Within the text, certain terms are used which may be confusing to the reader or convey meaning not intended by the author. To avoid misunderstanding the following terms are defined: commercial radio, FM stations, FM, and AM. Commercial Radio refers to broadcasting stations which charge fees for advertising and other services. They are complete business entities generating a profit and may be affiliated with other stations or networks. The terms radio, station, or broadcasting are synonomous with the above. FM stations refers to those stations using the Frequency Modulation mode of transmission as opposed to the AM mode of transmission used by many other commercial stations. FM stands for Frequency Modulation which is a

transmission technique whereby the carrier signal remains constant in amplitude (power) but the frequency is varied by the applied sound (Ennes, 1974). AM stands for Amplified Modulation where the carrier signal is fixed in frequency but is increased or decreased in amplitude (power) by the applied sound (Ennes, 1974).

Methods of Data Collection and Analysis

Evaluation of the growth of FM radio stations in the United States encompassed five stages. The growth pattern was identified by cartographic analysis of a series of maps generated from the beginning of the time period to 1985. A map was generated for each decade and partial decade of the time period: 1930-39, 1940-49, 1950-59, 1960-69, 1970-79, 1980-85. Additionally, the mean areal centers of each decade were identified and mapped, a plot of each decade using place size by population as the dependent variable and the number of FM radio stations as the independent variable were generated, bar graphs, and a ranking of places by the number of radio stations per decade were evaluated. With the exception of the map analysis, all other procedures were cross referenced and merged with a data file known as 'PICADAD'. 'PICADAD' is a computer reference file compiled by the Bureau of the Census. It contains the names of locations throughout the United States with their associated geographic codes and coordinates. It also includes nineteen variables

(latitude, longitude, SMSA codes, keypoints) and the procedures for their computation and usage.

Having outlined the proposed research, a review of significant literature on spatial diffusion and radio is included for a more in-depth background of the subject. This review comprises Chapter II. Chapter III covers some of the history of radio. Chapter IV discusses the Methodology used in the study. Chapter V includes interpretations of the data analysis. A summary, conclusions, and recommendations are presented in Chapter VI.

CHAPTER II

LITERATURE REVIEW

The purpose here is to examine research which outlines the basic processes and concepts of how and why distributions occur across the landscape and how these processes relate to the innovation being investigated. To that end, the literature is examined in two stages. Research which investigates the processes of diffusion are reviewed first and then those studies more closely related to the specific topic of radio are analyzed.

Considerable literature has been devoted to spatial diffusion evaluating all manner of phenomena. Concepts relating to spatial diffusion stem from many sources. These concepts have been discussed in cultural and quantitative tones, not only by geographers, but by historians and economists as well. Spatial diffusion of innovations has been well represented by such authors as Hagerstrand, Brown, Berry, and Gould. Those studies which have examined spatial patterns in a more cultural vein include works by Zelinsky, Sauer, and Kniffen.

The Cultural Geography of the United States by Wilbur Zelinsky (1978) is a general outline of the cultural traits of American geography. In this work, Zelinsky describes the

development, migration movements, processes, patterns, regions, and structure of American culture. Zelinsky notes the importance of selected individuals and cultural traits which lead to or have led to change. Other important considerations are the long distance transfer of people and their cultural freight, the settler's response to environmental stimuli, cultural interchange, the diffusion of old and new ideas, and a continuing interchange with other parts of the world. Zelinsky divides the waves of migration in the United states into two periods: the colonial (1600-1775) and 1800 to 1978. Territorial patterns of ethnic groups within the period are disscussed with emphasis on the elements and processes affecting those patterns: distance decay, spatial friction, environmental affinity, and chain migration. Zelinsky describes the mechanisms of diffusion as: contagious diffusion, migration, and telecommunications. Moreover, he draws several conclusions relative to diffusion in the United States. Among these are: 1) cultural diffusion was carried out by settlers who established the first effective settlements in various parts of the country; 2) very few centers acted as hearths or funnels; 3) barriers may slow down but not stop superior technology; and 4) cultural preferences are difficult to assess or predict.

Carl Sauer parallels Zelinsky's ideas of interaction and migration when he reviews the origins and movement of agricultural phenomena on a world scale (Sauer, 1952). He

establishes culture hearths for the beginnings of agriculture: Southeast Asia for plants in the Old World, Northwest South America for plants in the New World, and Southwest Asia for herd animals. Sauer narrates the movement of various phenomena (seeds, plants, animals, and fire) from these hearth areas but does not empirically evaluate any of the processes involved.

"Folk Housing: The Key To Diffusion" by Fred Kniffen investigates folk housing as a measure to record settlement patterns. The types of housing are categorized as to origin, ethnicity, and type of construction. Source areas for the types of housing and the routes of diffusion are then identified and mapped. Source areas were: New England, Middle Atlantic, and the Lower Chesapeake Bay region. Paths of diffusion were north and northwest; west and south; and south, respectively. The purpose of this descriptive study was to distinguish the movement and occupance patterns from the source areas. This study emphasizes the ethnicity, type, and function of phenomena to establish patterns of origin and movement.

Nathan Rosenberg's Perspectives on Technology (1978) offers explanations on the growth of technology and innovative techniques from an economist's point of view. He indicates that scarcity and the relationship between the capital goods and consumer sectors are most influential in the spread of technology. A well developed capital goods industry is significant to the transmission of technology,

and motivation and financial incentive provide the pressure for firms to adopt an innovation. Rosenberg uses the steam engine and coke smelting processes as examples of innovations and states that diffusion is the mechanism of technological movement. He also offers some generalizations on the importance of diffusion. These are: 1) the consequences of technological changes are a function of the rate of their diffusion and not the date of first use; 2) one should not expect a smooth, uniform distribution of new innovations even if there are no barriers to impede communication or movement; and 3) the diffusion of all inventions is essentially economic. Moreover, Rosenberg acknowledges two principal characteristics of diffusion. First, there is an overall slowness to the spread of technology and wide variations occur in the rate of acceptance of different inventions. Secondly, he suggests that there may be numerous factors which could influence the rate of diffusion.

Peter Gould's Spatial Diffusion (1969) expands on some of the aforementioned theories in several areas. For instance, the types of diffusion are defined as: relocation: when a group of adopters move from one place and in time diffuse to a new set of locations; expansion: when one person who knows of an innovation tells another who does not, thus the total number of knowers becomes greater over time; contagious: one adopter tells another close by and the innovation spreads like a disease; and hierarchical:

where large cities or important people receive the innovation first and transmit it down a urban hierarchy from larger areas to smaller areas, leapfrogging some intervening places. Additionally, the barriers to diffusion are classified as: absorbing: an innovation is stopped cold and does not continue; reflecting: an innovation wave will hit, bounce off, and may continue in a different direction and the energy of the diffusion process will be intensified in the local area; permeable: allows part of the innovation wave to go through but generally slows the process; physical: at one time the most obvious of the barriers (mountains, deserts, oceans) were totally absorbing but because of modern technology they are becoming increasingly more permeable; and cultural: more subtle than most barriers and can take many forms (language, religion, politics). Gould indicates that the processes of diffusion take place at many geographic scales. He supports this premise with examples of "cones of resolution" at the micro and macro levels, i.e., Stafford Beer and Pennsylvannia townships. Gould concludes with some generalizations for further research. Some of these are: 1) the mean information field decreases with distance, 2) hierarchical diffusion is more common when the transmitting and receiving nodes are of greatly different sizes, 3) there may be more than one type of diffusion occurring at the same time, for example; Bell's thesis on the diffusion of radio and television stations; and 4) the testing of spatial models poses problems for applied mathematics.

Everett Rodgers repeats many of the concepts previously mentioned, but is more specific about some of the processes (Rogers, 1983). The adoption or acceptance process, for instance, is defined in five stages: awareness, interest, evaluation, trial, and adoption. Moreover, he identifies five catagories of adopters: innovators, early adopters, early majority, late majority, and laggards. Rogers states that a social system is also influenced by opinion leaders, change agents, and cosmopoliteness (the degree to which an individual's orientation is external to a particular social system). Rogers used truck farming in Ohio as a case study. He evaluated several variables and employed multiple correlation techniques to predict innovation behavior. From this case study a series of generalizations were produced. Some of them are: 1) innovativeness is related to modern rather than traditional orientation; 2) later adopters are more likely to discontinue an innovation than early adopters; and 3) awareness is much more rapid than adoption.

Torsten Hagerstrand has produced several significant studies relative to the investigation of spatial diffusion and is often cited within the discipline. Innovation as a Spatial Process (1967) is a study which evaluates general and agricultural innovations to analyze distributions in various areas of Sweden. The agricultural innovations were: subsidized pastures, Bovine TB control, and soil mapping. The general innovations were: postal services, automobiles, and telephone service. He also identifies such innovations

as tractors, indoor milling machines, and plumbing as complementary to the development of the aforementioned innovations. His principal method of evaluation was interpretation of grid and distributional maps of the patterns in the study areas. Hagerstrand offers much empirical data and produces several models to analyze the diffusional processes. Hagerstrand compares the diffusion process among the innovations and notes the similarities. Some of those similarities are: 1) clusters within distributions; 2) outward spread from some centers; and 3) densifying of initial acceptance areas. Hagerstrand suggests that economic and technical factors condition distributional patterns. Three stages of diffusion are also described: initial acceptance, radial dissemination from an origin, and saturation.

Hagerstrand discusses the function of communication via the private information field and employs migration and telephone service to evaluate the spatial characteristicts of information fields. A rank order of acceptance was investigated for TB controls and, though large farms grouped together, acceptance was not necessarily from the largest to the smallest. The concept of resistence is introduced and Hagerstrand states that acceptance does not occur until resistence is overcome. Another concept, the "neighborhood effect", is also discussed. This idea states that potential adopters closer to the origin will accept an innovation before those further away. Hagerstrand's research is a

primary source for diffusion studies and outlines many of the basic concepts in this field of geography.

Diffusion Processes and Location by Lawrence A. Brown (1968) identifies some types of diffusion (relocation, expansion) and six elements deemed essential to those processes. The six elements are: 1) area, 2) time, 3) the item being diffused, 4) places in which the item is located in time, 5) origins, and 6) paths of movement. Brown discusses some of the characteristics of these elements; such as stress, barriers, value-systems, and decision-making behavior. In addition, he proposes three models for consideration: the distance-biased net, spatial-temporal epidemiology, and the logistics curve.

Another study by Brown introduces the idea of a diffusion agent as the molder of market areas, hence, the influential force in the diffusion process (Brown, 1981). He examines the diffusion agent (a firm, group of entrepreneurs, or innovators) from the market and infrastructure point of view in a centalized, decentralized, and coordinating decentralized setting. This parallels Zelinsky's concept of selected individuals bringing about change. Brown employs models and empirical data from several case studies to support his discussion. The case studies include: agricultural innovations in Kenya, bank credit card adoption in the United States, and commercial dairying in Mexico. He suggests that there are more factors which could influence the diffusion process. The diffusion agent

concept may be more applicable to today's economic climate when one considers business research and strategies.

Spatial sequencing and central places of market regions are analyzed by Brain Berry in Geography of Market Centers and Retail Distribution (1967). This study employs the theories of Loesch and Christaller as conceptual bases. Berry identifies a hiearchy of central places: hamlet, village, town, small city, regional city, regional metropolis, and national metropolis. He explains the relationship between central places as market areas and indicates that there was interfilling between central market areas in an upward direction. Berry states that there are wide variations in the hierarchy and in the market areas due to several factors. Some of those factors are: 1) population density and growth, 2) competition, 3) demand, and 4) the system in which the diffusion process is operating. Berry offers several models and map analysis to support his investigation. Additionally, he discusses the role of cultural traits in bringing about changes in the timing, size, and structure of fairs and periodic markets.

Yehoshua Cohen examines planned regional shopping centers in the United States to demonstrate how an innovation spreads and some of the factors which influence the distributional pattern of that innovation (Cohen, 1978). His general findings indicate that market factors and their characteristics are associated with various aspects of the adoption process. In an urban market system, some market

factors explain differentials in time, magnitude, and intensity of adoption, but the effects of politics, entrepreneurship, and leadership are not accounted for. Cohen categorizes planned shopping centers as: neighborhood, community, and regional. Moreover, he indicates that neighborhood and hierarchical effects are very important to site location.

The Innovator's Situation by Frank Cancian (1979) introduces a different approach than has previously been discussed. Cancian relates risky, innovative behavior to social position. He offers the concept of economic rank and asks the question: Are higher ranking people more innovative than lower ranking people in the same system? There are three basic elements to his theory: 1) the inhibiting effect of rank, 2) the facilitating effect of wealth, and 3) the curvilinear effect. The inhibiting effect of rank means that high rankers have more to lose and will seek to maintain the status quo. The facilitating effect of wealth means that wealthy people are more educated, better informed, and better able to afford an innovation. The curvilinear effect predicts that the relationship between rank and innovation will be curvilinear with the behavior of adopters in the middle of the curve being more predictable than those at the ends. Rank, as defined by Cancian, is the position of an individual as he relates to other individuals within a communal hierarchy. It is not related to wealth or status. Cancian subjected several data sets containing various

agricultural phenomena from third world countries to statistical manipulation in support of his study. The farmers in the various communities were ranked as: low, low middle, high middle, and high. Cancian's findings suggest that the patterned relationships of rank and innovation hold across a number of different levels of wealth, but absolute wealth is a less useful indicator of differences between individuals in a system.

Mulligan and Reeves investigate the idea of using specific levels of functional employment to classify urban settlements (Mulligan and Reeves, 1986). Surveys containing employment data, such as the type of employment (mining, construction, etc.) and number employed were taken from forty settlements in Arizona and California. Data from the surveys were subjected to univariate and multivariate techniques to establish indices. Then rank, stepwise, and cluster analysis identified functionally similar groups by comparing the employment data from all sectors. This resulted in a classification by the highest number of settlements per function. For instance, 32 percent of the forty settlements evaluated were classified as trade and service centers. In summary, the authors suggest that their research should not be used to create a generalization about real processes, but rather to examine the structure and behavior of urban settlements.

The spatial distribution of a well known business entity, McDonald's, is investigated by George Aspbury in

Spatial and Temporal Diffusion of a Business Franchise (1985). Aspbury studies the spatial patterns of McDonald's establishments from its beginning in Chicago in 1955. He employs rank and correlation techniques of population and number of establishments over five year intervals to determine the diffusion processes. Aspbury's findings parallel Zelinsky's concept of selected individual and Brown's ideas on diffusion agents in different settings. Aspbury concludes that the expansion of the McDonald's franchise was both mononuclear and polynuclear. Because, on the one hand, the corporation guided the locations of establishments, but the diffusion process was also directly influenced by the local decision making of entrepreneurs as franchise holders. Aspbury also suggests that the diffusion process was essentially hierarchical in nature and simultaneously contagious within the principal SMSA of Chicago.

James Blaut's paper, "Two Views of Diffusion" (1979), compares the conceptual theories of cultural geographers such as Kniffen to the more quantitative approach used by Hagerstrand. Blaut states that the Hagerstrand approach is too narrow because it does not take into account all the cultural aspects of the diffusion process. It leads researchers to believe that a phenomenon can be explained in terms of a single diffusion process involving several discrete variables. Hagerstrand himself indicates that many factors are at work in the diffusion process. Blaut suggests

that many cultural elements can inhibit or enhance the process. Moreover, he indicates that economic factors do not always influence diffusion. For example, local adopters may have better knowledge of their environment and landscape than those who are outside trying to introduce an innovation. A case in point is the tobacco farmers of Puerto Rico who have steadfastly refused the advice of the United States to adopt contour drainage and cling to their method of diagonal criss-cross drains. The farmers know that contour drains have some advantages but they are cost prohibitive and can lead to land slippage. Blaut points out that in the non-Western world innovation is often rejected not because of a lack of knowledge, but because of incompatibility with the existing culture system. Blaut suggests that Kniffen's tradition of diffusion in its broadest and most culturally complex sense is the most adequate basis for diffusion theory. He also indicates that if formal models do not exist which encompass this process, then further research into the complexities of culture systems is necessary.

The focus of this review now turns to those sources more closely related to the topic of FM radio. Because of its novelty and usefullness, this innovation has been the subject of considerable research. Numerous publications have examined the theory, technical aspects, and operating principles of the broad spectrum of radio. Moreover, considerable literature has been devoted to the marketing

facets of the broadcasting industry. That research includes such topics as where the listeners are located, areas that are profitable, and types of listeners. The regulatory body of all communications, Federal Communications Commission (FCC), has generated a significant volume of information about licensing, formats, governing regulations, revenues, and some locational data. Additionally, significant work on the origin and history of radio broadcasting has been produced (Kane, 1981; FCC, 1979; Hybels, 1978; Lindsey, 1952). A large portion of research about radio centers on the consumer, that is the listener, and does not evaluate locational patterns. The spatial diffusion of a specific communications medium has few references and none were found relative to the spatial distribution of FM radio broadcast stations. Havig (1978) has indicated that research about radio has lagged because of the rapid rise of television.

Some of the literature examines the diffusional patterns of other media. An example of this is Inada's study of television stations in Japan (Inada, 1978). Inada states that hierarchical diffusion was the fundamental trend of site location. The station locations also coincided with the population rank of cities. Thus, station establishment filtered from the larger cities to small towns and villages. Other researchers have contributed to the literature base by investigating other facets of radio. Camies (1959) describes the operating principles of FM broadcasting and the differences between AM and FM. Hybels and Ulloth (1978)

offer a general overview of radio and television with some historical observations. Electronics and Radiocraft are two early publications which acknowledged FM broadcasting as a viable medium, reported its development, and stated that it would be a very popular innovation. The Journal of Popular Culture contains several different formats and some of the political and racial situations of radio during its early development (Havig, 1978). MacDonald (1984) reviews the status of radio as opposed to television and finds that radio is faring well against its video counterpart. MacDonald observes that radio has increased revenues and remained a versitile and well appreciated communications medium due, in part, to the increased popularity of FM since the 1960s. Hedges (1986) discusses the growing popularity, in recent years, of FM compared to AM. He states that FM has been steadily gaining more of a share of the radio market since its inception. Hedges primary focus, however, was on the consumer not on any locational process. Major (1981) and Bogue (1978) both conducted studies of a particular FM radio station in the Chicago area. They investigated the types of listeners and to what they listened. In addition, where listeners were located within the coverage area and how listening patterns had changed over time were also observed.

Human Spatial Behavior by Jakle, Brunn, and Roseman (1976) reported some of the social aspects of human behavior relative to geography and communications. To this end many topics were reviewed. Some of these included: stereotypes of

people and places, perceptions, spatial cues, mental maps, spatial interaction and movement, information flows, migrations, and communications. The most significant portion of this work was communications. The authors describe information flows as two-tiered: point to point (person to person), and point to area (mass media). The Gatekeeper model was used to illustrate one type of information flow. A gatekeeper is a person or organization which receives information then passes on only that information the gatekeeper feels is significant to a select group of receivers. Mass media communications are very important to information flows because they are numerous and varied and have a common point to area spatial structure. Moreover, there is a distinct spatial hierarchy with different media covering successively larger portions of the landscape. Mass media coverage areas are key elements in the flow of information. The levels of mass media are: 1) national : magazines, TV, radio stations; 2) regional : newspapers, radio, magazines; and 3) lowest level : local radio and TV, newspapers. Each medium has a hierarchy. Radio, for instance, has a three-tiered hierarchy. At the lowest level are numerous small stations (usually FM). Next, there are those stations (AM or FM) that encompass a large city and its surrounding area (San Francisco, New York). Finally, at the top of the hierarchy are the very powerful AM stations, such as WSM Nashville, Tennessee (50,000 watts). These powerful AM stations have different coverage areas during

the day than at night. The coverage area is greatly increased at night and can include several states and vast areas of the United States. Television, on the other hand, has two tiers: local and public service networks on UHF and nationwide networks on VHF. The print media is governed by its editorial and distributional policies and the transportation network that serves it. Sunday newspapers follow the classical urban hierarchical process (large cities to smaller places). It should be noted that rapid increases in technology have changed some of the structure and information flow of mass media (examples: RCA American Communications, satellite systems; Knight-Ridder Broadcasting Incorporated, cable television systems).

Bell's thesis of 1965, The Diffusion of Radio and Television Stations in the United States, examines the growth and pattern of distribution for each innovation. Bell investigates AM stations only for the period; 1919-1936. He maps the distributions for each year of the time period and analyzes the patterns generated by this procedure. In addition, rank correlation and frequency bar graphs are evaluated to determine the diffusion process. An analysis of the process encompassing the entire United States is not attempted. Bell does, however, offer several conclusions as to the pattern and type of distribution of the stations over time. For instance, the innovation began simultaneously on both the east and west coasts, moved directly inland, and then south. There were pockets of late

or laggard adoption: the upper penninsular of Michigan; parts of Georgia and Florida. The overall pattern of diffusion was down the urban hierarchy. But, distance from previous accepters, city function, and proximity to metropolitan cities tended to distort the idealized pattern. Moreover, Bell suggests that because of government intervention and early awareness of potential accepters before radio fully diffused, smaller places were more ready to adopt the innovation after fewer innovation years than would have been expected.

"From Down Home To Uptown: The Diffusion of Country-Music Stations in the United States 1971-74" discusses the diffusion of a radio broadcasting format, i.e., all-country music programming (Carney, 1977). Patterns of diffusion were analyzed cartographically and produced several determinations. First, there was more than one process which affected the diffusion patterns. In addition, although country music programming originated in large cites, the all-country music format for AM stations diffused from small towns of 25,000 or less up the urban hierarchy rather than down. This suggests a "reversed hierarchical" process. Migration was the mechanism by which the innovation spread from areas of the deep south to the south central states and later to the western and is a good example of how several processes coalesce to bring about a pattern which looks like simple diffusion. As previously mentioned, this writer found no specific reference to the spatial patterns of FM radio

stations. Of the literature reviewed, those works by Bell and Carney were most closely related to what this research is trying to accomplish.

CHAPTER III

HISTORY, CHARACTERISTICS, AND REGULATION OF RADIO

History

The existence of radio waves was predicted by James Clerk Maxwell, a Scottish physicist, in the 1860s. In 1886 Heinrich Rudolph Hertz, a German physicist, demonstrated that rapid variations of electric current could be projected into space in the form of radio waves similar to those of heat and light (Federal Communications Commission, 1979). It was Gugliemo Marconi who demonstrated the feasibility of radio. In 1899 he transmitted the first wireless signal across the English Channel, and in 1901 received the letter "S" broadcast from England to Newfoundland (Bell, 1965; FCC, 1979).

The first practical application of radio was for ship-to-ship and ship-to-shore telegraphic communication to improve maritime safety. The occurrence of the first voice broadcast is confused and subject to considerable debate, but regular AM voice broadcasting did not begin until after World War I (FCC, 1979). The first broadcasting station is also a contested point because early pioneering AM stations developed from experimental operations. Records of the

Department of Commerce indicate that WBZ-Springfield, Massachusetts, was issued the first broadcasting license on Sept. 15, 1921. Station KDKA-Pittsburg, Pennsylvannia, was not issued a license until Nov. 7, 1921, but it is acknowledged that this station provided regular service under experimental authorization long before that date,i.e., 1919 (FCC, 1977). It is similarly difficult to pinpoint the first FM broadcasting station. Edwin Armstrong successfully demonstrated FM transmission to RCA in 1934 (Hybels, 1978), but it was not fully developed until after World War II. The Federal Communications Commission authorized commercial FM broadcasting in January 1941 and fifteen stations were granted permits simultaneously. The first commercial license was issued to WSM-FM: Nashville, Tennessee, in May of 1941 and that station operated until 1951 (FCC, 1977). It must be noted ,however, that six stations were operating under construction permits prior to 1940 (Electronics, 1940). Of these stations, W1XOJ: Paxton, Massachusetts was granted the first permit to build an FM transmitting station in 1937. It went on the air with scheduled programming in May, 1939 and was a member of the Yankee Network (Kane, 1981). Today, there are more than 3700 commercial FM stations and approximately 1000 non-commercial radio stations in the United States (Taishoff, 1985).

Three developments occurred after World War II which greatly enhanced FM broadcasting. The first of these was the development of transistors in 1948. This allowed the

manufacture of transmitters and receivers with much greater portability and compactness. Additionally, the transistor was more reliable than vacuum tubes, hence, maintenance costs were reduced (FCC, 1977). The next event was the authorization by the FCC in 1955 to allow FM stations to provide "background" music for subscribers, such as stores, factories, and other businesses. Finally, in 1961 the FCC allowed FM stations to broadcast in stereophonic sound (FCC, 1977). Stereophonic transmission provided a more realistic musical quality and clearer reception. These last two policies gave FM an advantage over AM in a different market and in newer technology. It should also be noted that automobile manufacturers began installing FM stereo receivers in several models in the mid-sixties,i.e., General Motors in 1965 and Ford in 1964 (Bryan Motors, 1985; Owen Thomas Ford, 1985). This greatly increased the number and type of listeners, and the availability of FM programming.

Characteristics

The differences between the characteristics of AM and FM broadcasting are summarized in this section. This is done in order to distinguish between the principles of the two techniques, and to show why FM is the more desirable listening medium. AM stands for Amplitude Modulation and is the oldest of the two techniques. It is often referred to as Standard Broadcasting (FCC, 1977). This technique employs a carrier signal that is fixed in frequency (cycles per

second), but is increased or decreased in amplitude (modulation) by the applied sound (Ennes, 1974). The AM broadcast principle is not only used for radio, but also for the picture portion of television transmission and in international short wave service (FCC, 1977). AM still operates on the same low frequencies it was originally assigned: 535 to 1600 kilohertz. The transmission power range is from 250 watts to 50,000 watts. Thus, AM has a higher power output resulting in greater range and coverage than FM. There are two principal signals used by AM radio: groundwave and skywave. Groundwave is steadier, more reliable, and is called primary service (FCC, 1977). Skywave or "secondary service" is available only at night because the signal is reflected from the ionosphere. Skywaves can cover large distances and a licensed Class I (50,000 watt) station can have a coverage area of several states (Shroeder, 1985). This signal is subject to fading and varies with such conditions as time of day, weather, latitude, noise, and sunspot activity. Herein lies one of the primary limitations of AM broadcasting. AM signals respond to a large variety of unwanted interferences. Some of these extraneous signals, such as those generated by electronic equipment, are particularly troublesome in urban areas because of the large amount of equipment that is present (Camies, 1959). Moreover, AM transmission uses medium and long radio waves which limit the quality of sound reproduction that is possible (Camies, 1959). Finally, AM

signals can "bleed over" between channels which results in two stations being received on the same dial setting at the same time (Basore, 1986).

FM refers to Frequency Modulation. This technique keeps the carrier signal constant in amplitude, but the frequency is varied (modulated) by the applied sound (Ennes, 1974). FM signals are used in radio broadcasting and in the sound portion of television transmission (FCC, 1977). FM has a wider bandwidth than AM; 88-108 megacycles. This improves reception, eliminates unwanted interference, and enhances sound reproduction quality. In addition, it allows strong FM signals to swamp or eliminate weaker ones on the same setting so "bleed over" is minimized (Camies, 1959). The wider bandwidth and channels also greatly enhance the tonal range of FM. The maximum signal range for FM is 64 miles for a Class C station (FCC, 1977). Since FM signals are not reflected off of the ionosphere, FM stations can broadcast on the same frequency night or day without interference, unlike AM (FCC, 1977). AM and FM broadcast signals do not interfere with each other because they operate on widely separate bands. Modern FM transmission lends itself to the use of smaller, more compact antennas than AM. These antennas can be mounted on tall buildings, mountain tops, and existing antennas used for a variety of purposes (FCC, 1977; Camies, 1959). However, it should be noted that an important factor in FM transmission is antenna height above the surrounding terrain (Shroeder, 1986; FCC, 1977).

Stations, therefore, have limitations as to power output relative to maximum antenna height. In other words, the greater the height of the antenna above the average terrain, the more the power must be reduced. AM transmission has few antenna restrictions relative to power output. There are limitations imposed for all antennas relative to height but most AM antennas are rarely over 1000 feet above the terrain (FCC, 1977).

Regulation

Diffusion of radio has been influenced, in part, by government policies. All of the policies and regulations which have influenced FM radio are not reviewed here. Rather, an outline of the history of the regulatory body of the industry (the FCC) and some of the more important decisions which have directly impacted FM radio are presented.

Prior to 1927, the radio broadcasting industry was in a chaotic state. Frequency jamming, channel jumping, and operating on prohibited wavelengths was common practice (FCC, 1977). The Radio Act of 1927 set up the Federal Radio Commission as the regulating body of the industry (Lindsey, 1952). This commission reorganized commercial broadcasting so that the public would receive the best possible service. The commission also imposed a series of regulations governing the granting of licenses to broadcasters. Additionally, radio stations were grouped into three

divisions: clear, regional, and local channels and a partial quota system based on population was introduced (Lindsey, 1952). In 1934, the Federal Radio Commission was reorganized and given its present name, the Federal Communications Commission. Television, then under development, was placed under its jurisdiction. In 1941, the FCC authorized the operation of FM transmissions. All radio station construction was frozen during World War II, but prewar stations served the public continously during this period (FCC, 1977). FM stations initially had letters and numbers intermixed, but in 1943 the present call letter system was adopted with the suffix "FM" to denote jointly operated stations (Basore, 1986). Because of skywave interference on the original FM band (42-50 MHz), FM was moved to its present and less vulnerable position in the radio spectrum (88-108 MHz) in 1945 (FCC, 1977). The FCC instituted a ban on new construction of all broadcast facilities from 1948 to 1952. This allowed development of new technology, such as transistors, but not the spread of stations (Hybels, 1978).

Some of those policies which have directly influenced the development of FM broadcasting follows. In 1955, FM stations were allowed to provide supplemental service to subscribers in the form of "background" music for offices, factories, and businesses. In 1961, FM began broadcasting in stereophonic sound (FCC, 1977). Both of these decisions allowed FM a more viable and stable position in the radio market relative to AM. The FCC, in 1962, divided FM

broadcasting into three zones within the United States. Zone I was 18 Northeastern states and the District of Columbia. Zone I-A was Southern California and Zone II was the rest of the country (FCC, 1977). The industry was also divided into three classes of commercial FM stations. Class A stations are assigned to all zones. Class B are assigned Zones I and I-A. Class C stations are assigned to Zone II. The power output for these classes are 3 kilowatts, 50 kilowatts, and 100 kilowatts, respectively (FCC, 1977). As previously mentioned, antenna height is important to FM transmission and the FCC did impose regulations limiting height relative to power output. The antenna height restrictions for the classes of stations are; Class A: 100 feet, Class B: 500 feet, Class C: 1000 feet (above average terrain) (FCC, 1977). A table assigning commercial FM channels to states and selected communities (similar to television channels) was adopted in 1963 (FCC, 1977). Moreover, joint operated AM stations in large cities cannot duplicate more than 50 percent of FM programming. The FCC was and still is seeking separate ownership of AM and FM facilities (FCC, 1977).

Even with the level of regulation previously discussed, there are ways to circumvent government policies. For instance, small, less powerful stations are established in small towns next to a large metropolis and broadcast into a segment of that metropolis. This captures part of the market already established by another station or network. Non-commercial stations establish low power operations and beam

programming directly into a larger market (Schroeder, 1986). The non-commercial operations are not watched as closely as the commercial facilities, even today. Non-commercial stations can buy "canned" or premade programming similar to major network programming and broadcast it at considerably lower cost. Finally, there is still much manipulation within the industry relative to antenna height and direction (Shroeder, 1986).

In summary, one can conclude that the effect of early regulation on the initial diffusion pattern of AM radio was minimal at best. As the number of stations increased, particularly FM, governmental influence was, to be sure, more pronounced. The overall distributional pattern of radio broadcasting may have been established with the early AM operations. In which case, the overall macro-pattern of diffusion would not have been significantly impacted by regulation (Bell, 1965). The spatial pattern of FM broadcasting was probably influenced by both the initial AM spatial pattern and government policy. How much effect these two elements had on the spatial diffusion of FM broadcasting is difficult to assess. In addition, there are other elements which may have had a more subtle impact on the diffusion process. Among them are: early joint ownership, operations which skirt regulations, market strategies, and entrepreneurship. Again, these elements are very difficult to assess and,in fact, may not be measurable.

CHAPTER IV

METHODOLOGY

The methods used to evaluate the data for this study include five principal techniques: cartographic interpretation, mapping areal centers, graphs comparing place size to the number of stations, frequency bar graphs of the number of stations per decade, and ranking the sites relative to the number of stations. The first procedure was to map the innovation as it was established for each decade of the time period. This was accomplished by locating each site of a commercial FM station and identifying the decade in which it was established from the primary source (Taishoff, 1985). That location was then fixed on a base map of the United States. A series of maps was generated (Figures 1-6); one for each decade and partial decade of the time period. These maps were analyzed individually and collectively to determine if a diffusion process had occurred. Figure 7 illustrates the number of stations established per state for the time period.

The next step was to produce a data file of the 2579 observations (sites) and 3711 commercial FM stations. The data file included the following variables: observations (number of sites), state, location, Dec30 (decade 1930s),

Dec40 (decade 1940s), Dec50 (decade 1950s), Dec60 (decade 1960s), Dec70 (decade 1970s), Dec80 (decade 1980-85), and total. This data file was merged with another file called 'PICADAD'. The 'PICADAD' file contained some of the variables of the original data file and others, such as place size, latitude, longitude, Standard Metropolitian Statistical Area (SMSA), SMSA size, and BEA. Statistical Analysis Systems (SAS) programming was used to compare and merge the two data sets by location. This resulted in the working data file for this study. The two data files did not merge exactly and the differences should be noted. Some locations in the original file were not in 'PICADAD' and some could not be matched because of syntax. Because of these conditions, 107 observations encompassing 114 radio stations were not included in the working file. The final working data file contained 2,472 observations and 3,597 radio stations. Most of the observations that were lost were single locations established during the 70s and 80s. The 'PICADAD' file located 96 percent of the original observations and 97 percent of the radio stations. The final working data file contained the following variables:

1) OBS: number of sites where stations were established.

2) ST: state where site was located.

3) NAME: name of city or town where stations were located.

4) LAT: degrees of latitude.

5) LONG: degrees of longitude.

6) D3: number of stations established at this site during 1930-39.

7) D4: number of stations established at this site during 1940-49.

8) D5: number of stations established at this site during 1950-59.

9) D6: number of stations established at this site during 1960-69.

10) D7: number of stations established at this site during 1970-79.

11) D8: number of stations established at this site during 1980-85.

12) PSIZE: size of NAME by population category;

0= 0 to 2,499.

2= 2,500 to 4,999.

3= 5,000 to 9,999.

4= 10,000 to 24,999.

5= 25,000 to 49,999.

6= 50,000 to 99,999.

7= 100,000 to 249,999.

8= 250,000 to 499,999.

9= 500,000 and above.

13) SMSA: four digit code for SMSA functions.

14) SMSASIZE: size of SMSA by population category.

1= less than 250,000.

2= 250,000 to 499,999.

3= 500,000 to 999,999.

4= 1,000,000 and above.

14) BEA: 3-digit code for each of 173 economic areas of the United States as defined by the Bureau of Economic Analysis. NOTE: The BEA variable was included in the data file but not used for analysis.

The 'PICADAD' file employed 1970 Census data, special census data, and 1977 Economic Census data as primary sources. An example of the data file and a table showing the differences between the original and working files appears in the Appendixes.

The next procedure was to map the areal centers of existing FM stations for each decade to show the growth over time. This process was done by computing the mean of the latitude and longitude variables for each decade using the PROC MEAN procedure in SAS. The mean was weighted to include all of the stations at each site by employing the PROC FREQ procedure in SAS. Each mean value of the latitude and longitude was then plotted on a base map of the United States and resulted in the map illustrated in Figure 8.

Graphs for each decade using PSIZE as the dependent variable and the number of stations as the independent variable were generated via the PROC PLOT step in SAS. Figures 9-15 illustrate the results of this procedure. Figure 15 is a summary of the entire time period and includes all the stations established during all of the decades. These graphs were generated in order to determine what type of diffusion had occurred during the establishment of the radio stations.

The next procedure was to develop bar graphs to better visually represent the data and to support the graphs generated in the previous step. In addition, the bar graphs illustrate which size places were established during the time period. All place sizes were not examined, only the largest, the smallest, and the larger limits of the size catgories. This was done to determine if the hierarchical process had actually occurred and to ascertain when most of the diffusion process took place. Figures 16-19 depict the results of this procedure.

Finally, the locations were ranked according to the number of stations at each site and only the largest SMSA's in the data file were used during this process. Tables 1-7 were produced. Table 7 is a summary of all of the decades. This technique was attempted in order to determine if a relationship exists between population size and the number of stations that were established at a site.

CHAPTER V

RESULTS OF ANALYSIS

The results of the procedures outlined in Chapter IV are examined as they were discussed. The interpretation of growth patterns for FM radio begins with Figure 1. This map illustrates those sites that had stations regularly operating in 1939. The six sites were Paxton, MA; Alpine, NJ; Meriden, CT; Springfield, MA; New York, NY; and Rochester, NY. The specific origin of the innovation was Paxton, MA, because it was issued the first construction permit. This map depicts the origin and region from which the FM broadcasting industry diffused.

Figure 2 illustrates the sites which established facilities during the years 1940-49. The pattern of distribution began to consolidate in the northeast, spread to the south and southeast, and established cores on the west coast. Most of the eastern metropolitan areas are represented, e.g., Boston, New York, Philadelphia. West coast urban areas included Seattle, Portland, San Francisco, and Los Angeles. The south and southwestern regions of the United States were represented by Dallas-Fort Worth, TX, and Tampa, FL. The far north and western interior had no sites where stations were built. The only exception to this was

Figure 1. Diffusion of FM Radio Stations: 1930-39

Figure 2. Diffusion of FM Radio Stations: 1940-49

Salt Lake City. The distribution of sites where stations were built seem to fall from the largest market areas with the greater number of stations to the smaller regional areas adopting less of the innovation. It should be noted, that World War II and a ban on the construction of new stations from 1948-52 had adverse affects on the spread of the innovation. 342 stations were established during this decade.

The distribution of the 264 FM stations established during 1950-59 is depicted in Figure 3. There was consolidation of the initial large SMSA's and a dispersion between these large SMSA's of lesser populated but still relatively significant places such as Syracuse, N.Y., Toledo, OH., and Orlando, FL. No development occurred in the northwest and little in the southwest though Phoenix, and Albuquerque did establish facilities during this decade. The smaller total number of stations for this decade was due to several factors. Among them were the ban on new construction from 1948-1952, poor economic conditions in the early fifties, and the effects of new technology (transistors).

During the decade of the sixties (Figure 4) considerable expansion of the innovation occurred. The largest number of facilities established (1,370) in the United States in a single decade occurred during this period. This large increase in the number of sites that began operations may be the result of several factors. Some of these were: new technology (transistors, integrated

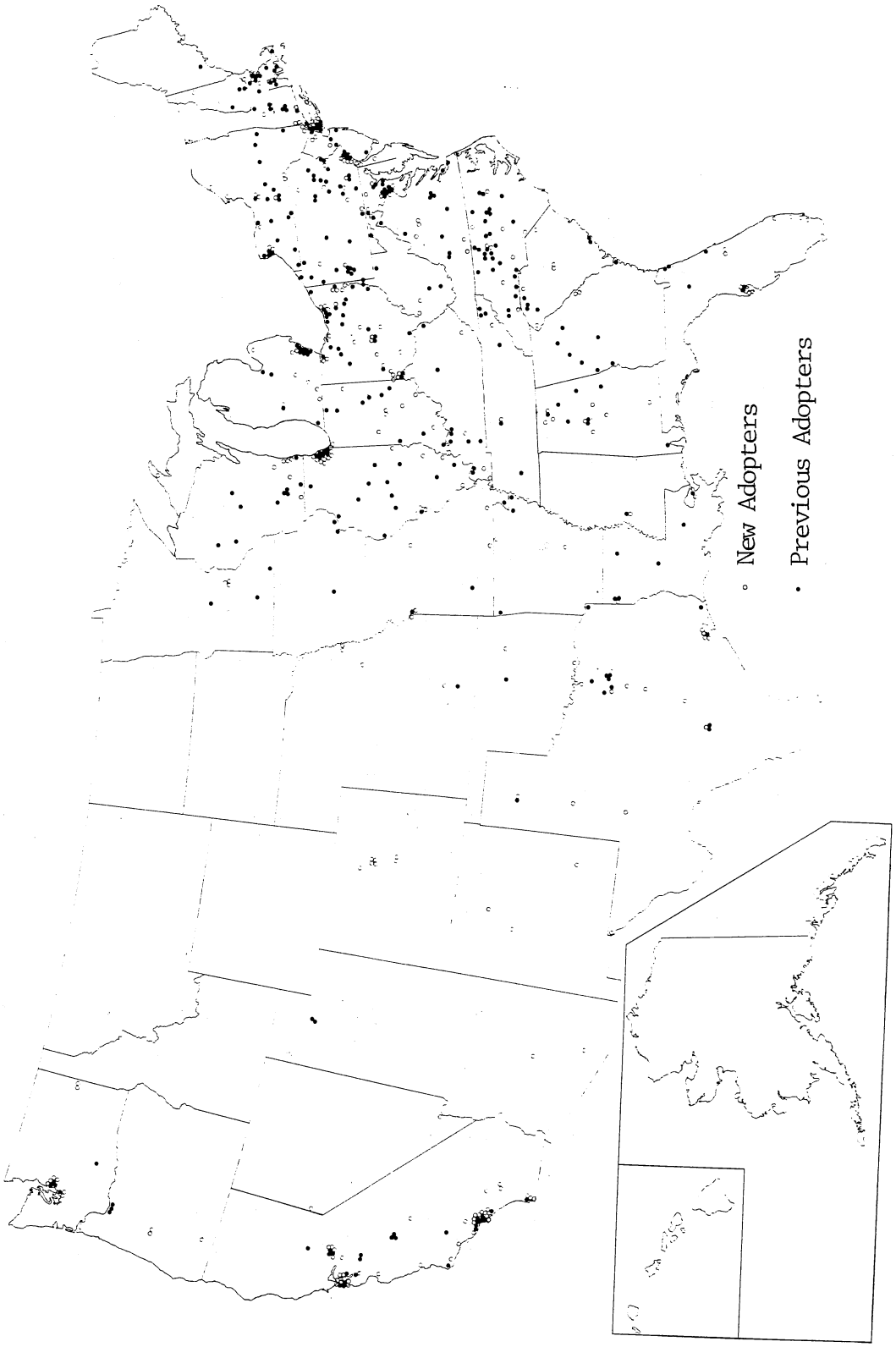

Figure 3. Diffusion of FM Radio Stations: 1950-59

Figure 4. Diffusion of FM Radio Stations: 1960-69

circuits); stereophonic sound reproduction; a better economic climate within the United States; and automobile manufacturers began offering FM stereo equipment in various models. There was more consolidation of the larger places (place size 5 or above) than in any other decade. Some SMSA's such as Oklahoma City established all of the initial operations at this time and did not appear again in the upper hierarchy. The larger northeastern and west coast SMSA's added new stations to their already existing sites. The interfilling that occurred during this decade seemed to be relatively even as far as new sites related to previously operating locations. The southeastern and midwestern regions of the country had a bit more development than the northeast. The western interior states began to establish facilities at this time (Montana, Idaho, North Dakota) and the south experienced high levels of interfilling in some states (Arkansas, Mississippi).

During the seventies (Figure 5) a reduction in the number of stations established at new places occurred. The total number of new adopters for this decade was 1,172. There was considerably less consolidation of very large SMSA's and much smaller places began to adopt the innovation. The distribution of these smaller locations between the previously established large ones seems to be relatively even with the exceptions of Nevada, Alaska, and Hawaii. The eastern United States has a higher level of new adopters but this is commensurate with the higher population levels in this region for the period.

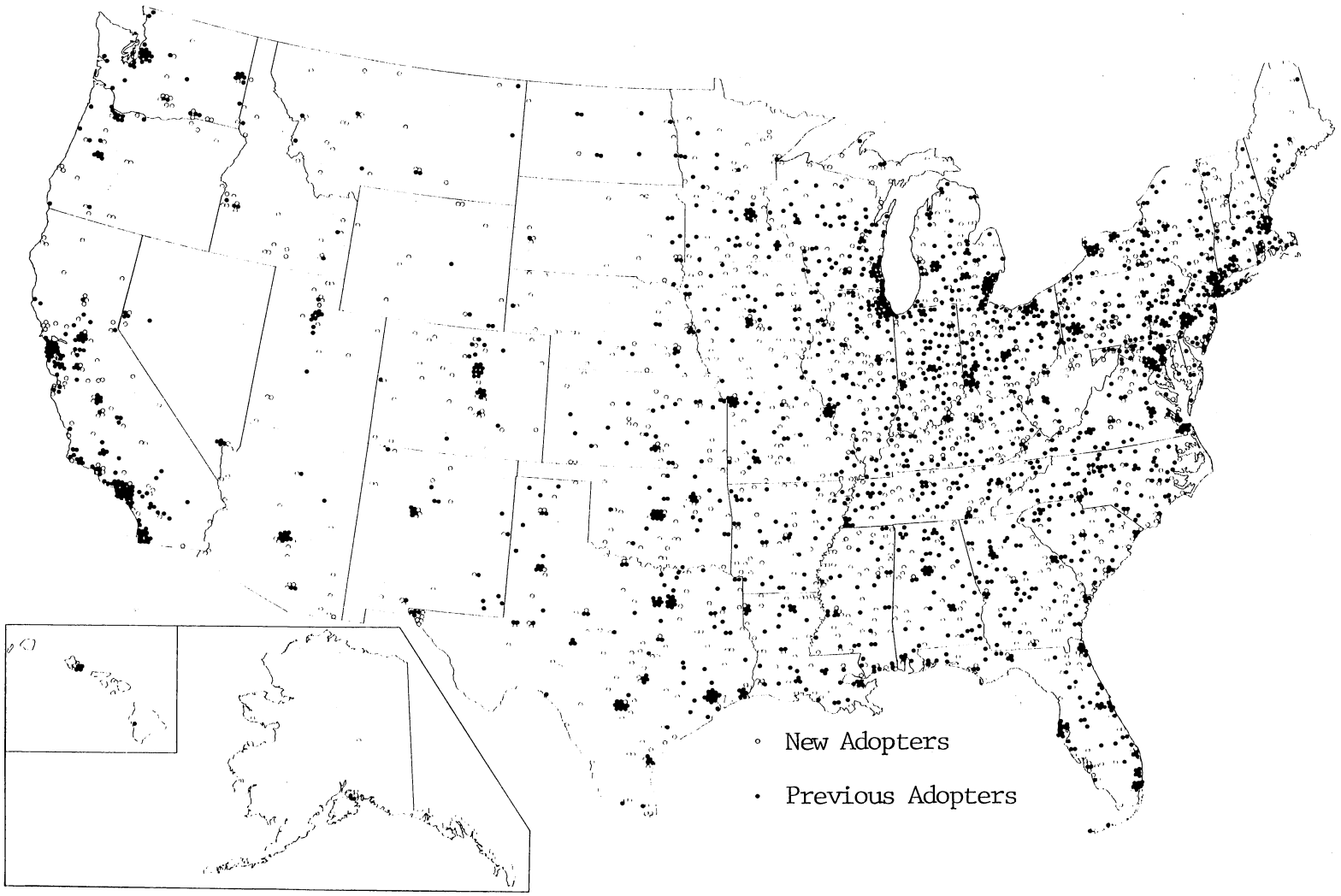

Figure 5. Diffusion of FM Radio Stations: 1970-79

Figure 6 depicts a similar pattern as previously discussed. There are fewer new adopters in large places and many more new adopters in much smaller locations. There were 537 new adopters for this half-decade. If one predicts from that figure for the whole decade, there may be 1,074 new adopters by the end of the period.

In summary, cartographic analysis indicates that the phenomenon diffused from the northeast to the midwest, south , and west coast during the 1940s. Clustering occurred around the initial large SMSA's in the northeast and new adoptions in smaller SMSA's in the midwest and Middle Atlantic regions. In the 1950s, there were more new adopters in the larger places and new adopters in the south and southwestern regions. A significant increase in the number of new adopters occurred in the 1960s with a pronounced intensification of all the larger market areas in all regions. There was some clustering in the smaller SMSA's in most regions and interfilling by even smaller sites between the previous adopters, most notably in the eastern portion of the country. The 1970s were characterized by fewer new adopters in the higher ranked cities and much more interfilling of new adopters between previous ones in the smaller places. In 1980-85, the pattern was similar to the 1970s, but there were more new adopters in smaller places and the new adopters in SMSA's was reduced still further. Figure 7 illustrates the total number of FM stations in each state through 1985.

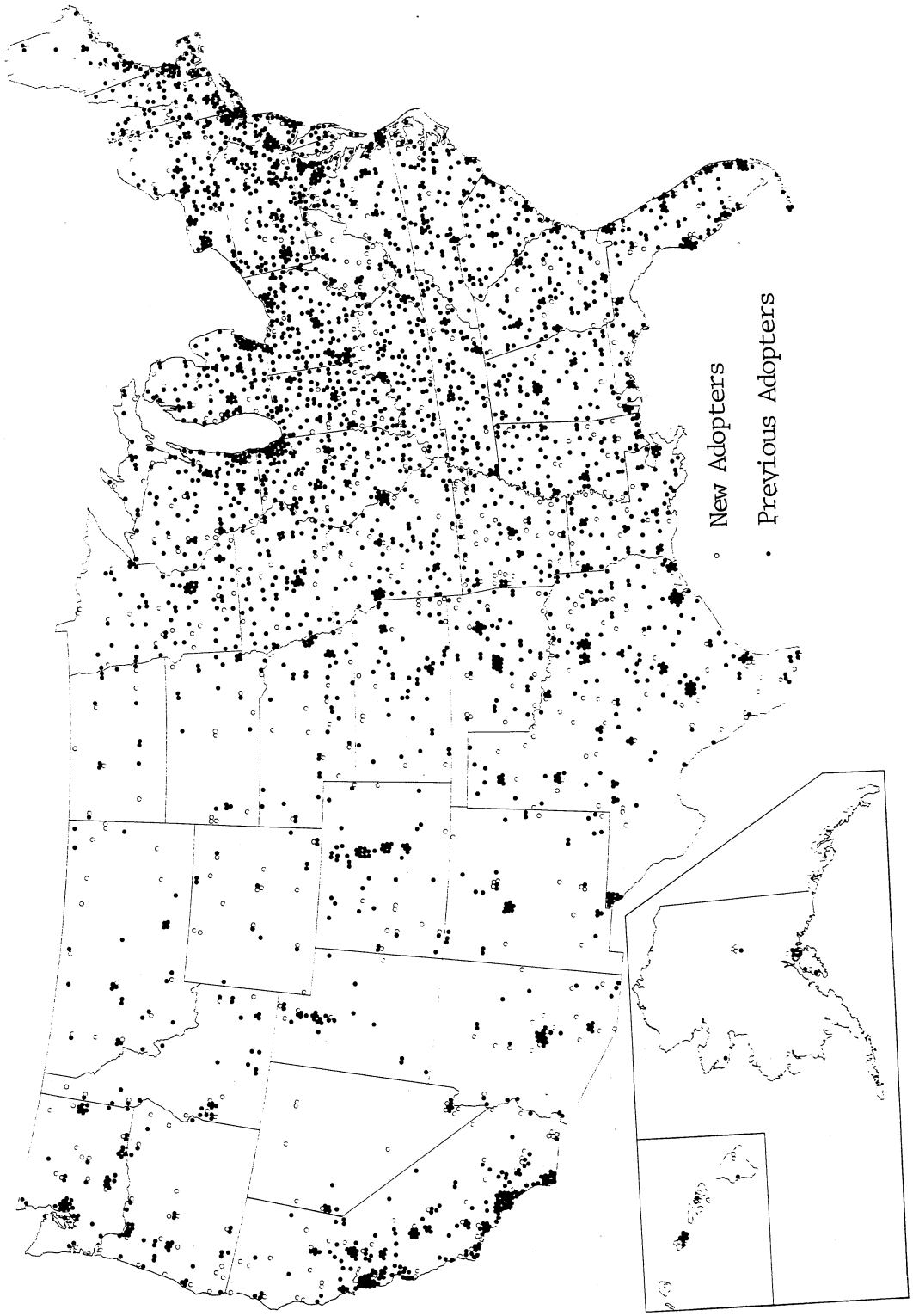

Figure 6. Diffusion of FM Radio Stations: 1980-85

Figure 7. Number of FM Radio Stations per State: 1985

The mapping of areal centers resulted in the distribution shown in Figure 8. The areal centers for each decade are illustrated and the map shows how the innovation diffused across the landscape. The center of origin in 1939 was near Poughkeepsie, NY. From this point, the innovation moved in a southwestern path to a position, in the 1940s, northwest of Louisville, KY. The innovation moved further west in the 1950s, establishing a position some 120 miles southwest of St. Louis, MO. The path of movement changed direction slightly during the 1960s. The direction turned toward the east slightly and to the south, centering 70 miles due south of St. Louis. The innovation moved due west for the next two decades (1970s and 1980s) establishing centers west of St. Louis and in Ellsworth County, KS, respectively. This map indicates that the innovation diffused south and west during the 1940s and maintained a westwardly direction for the remainder of the time period. The areal centers maintained positions between 37 and 38 degrees of latitude throughout the time period. This is probably due to the equal pull of the north and south rate of adoption. There is slightly more movement toward the south in the 1960s, 1970s, and 1980s because of the increased rates of adoption in southern states of Georgia and Florida and in the southwestern states of Texas and Arizona. The western movement is due to the high rate of continuous adoption in California and Washington and the addition of new adopters in Alaska and Hawaii beginning in the 1960s.

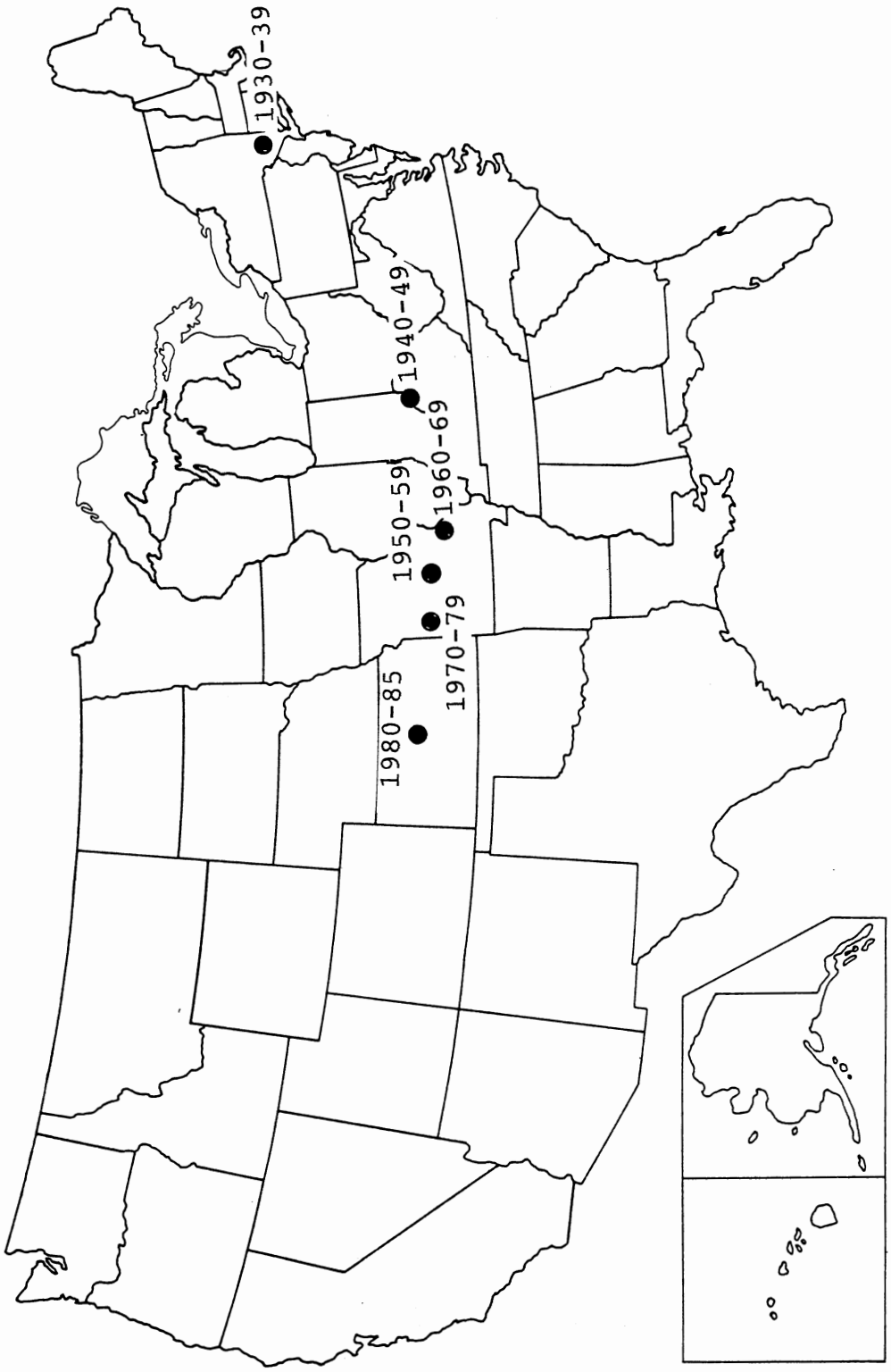

Figure 8. Diffusion of Areal Centers: 1937-1985

The plot graph technique yielded Figures 9-15. Figure 9 illustrates that six stations were established at six different sized places. Most of the facilities were settled in the upper half of the place size limits in the 1940s (Figure 10). The curve indicates that more stations were established in large places than in smaller ones. Figure 11 depicts the same general tendency as in Figure 10 with more new adopters in the larger size categories. In Figure 12 there are more new adopters in smaller places with more than half of the stations in the smaller population size (3-6) places. In the 1970s (Figure 13), there is a pronounced downward curve toward the smaller places. There were more new adopters in the bottom half (0-4 psize) of the graph than in the top half. A positive trend toward smaller places is shown for the first half of the 1980s (Figure 14). The curve suggests that saturation may be close at hand because over 60 percent of new adopters were located in psize 3 and below. Figure 15 is a summary of all the decades of the time period. The curve is hierarchical in nature, but is somewhat distorted because the number of smallest places is only slightly larger than the number of the largest places.

The frequency bar graph technique (Figures 16-19) visually represents the data examined during the study and supports the graphs in the previous discussion. Figure 16 depicts the number of largest places (psize 9) per decade. The heaviest levels of adoption in the biggest places occurred in the 1940s, 1950s, and 1960s with a dramatic drop

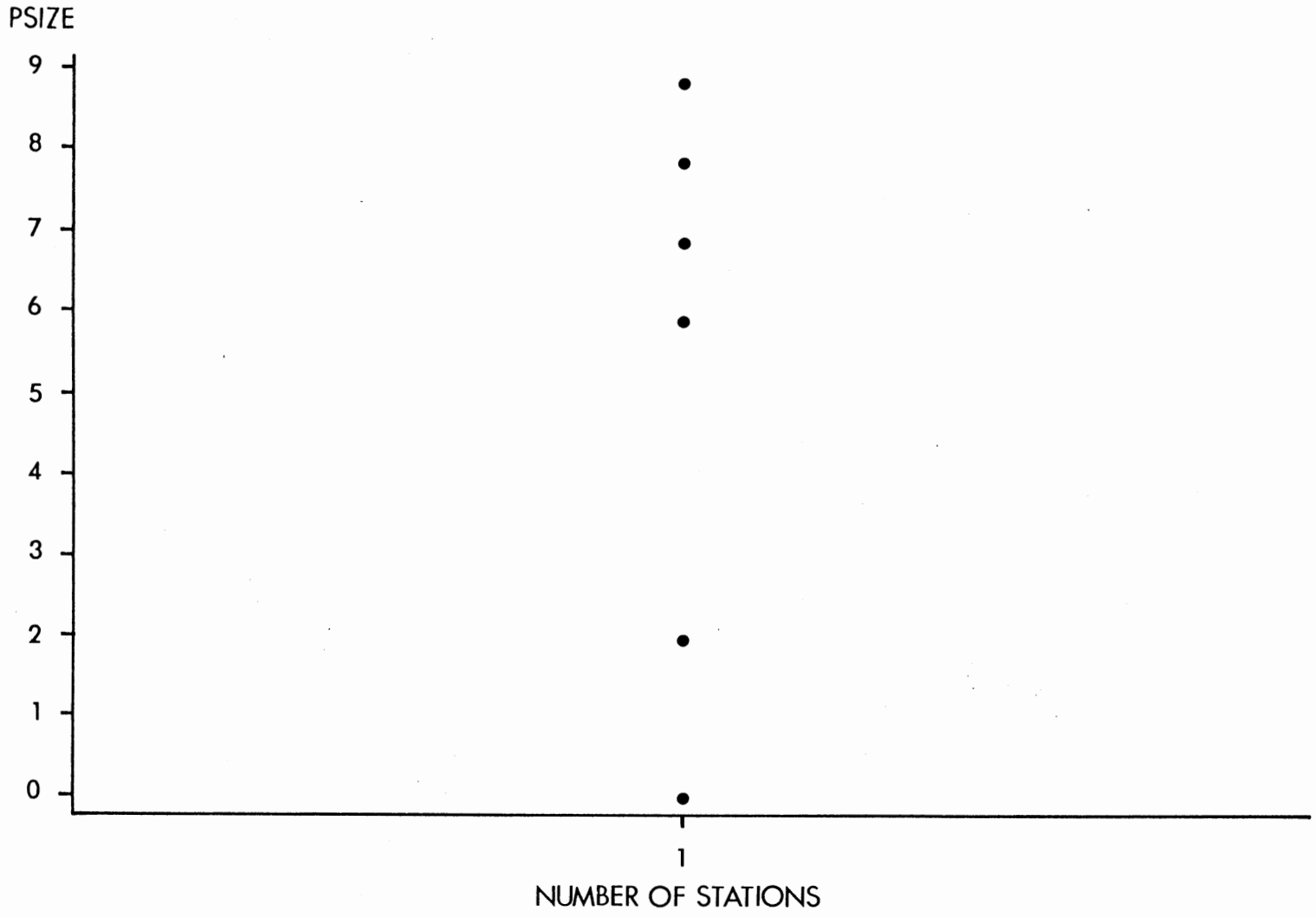

Figure 9. Graph of Place Size vs Number of Stations: 1930-39

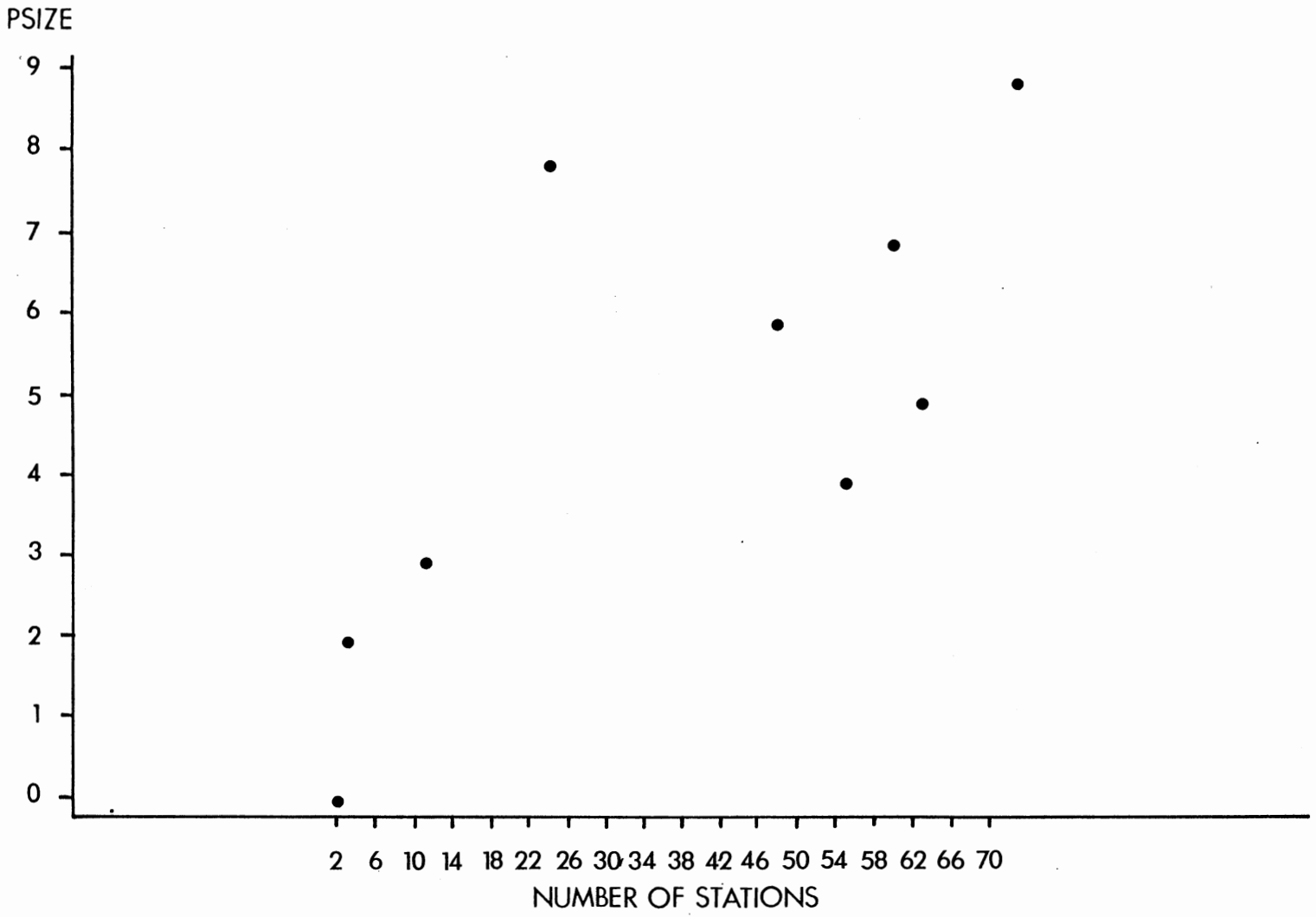

Figure 10. Graph of Place Size vs Number of Stations: 1940-49

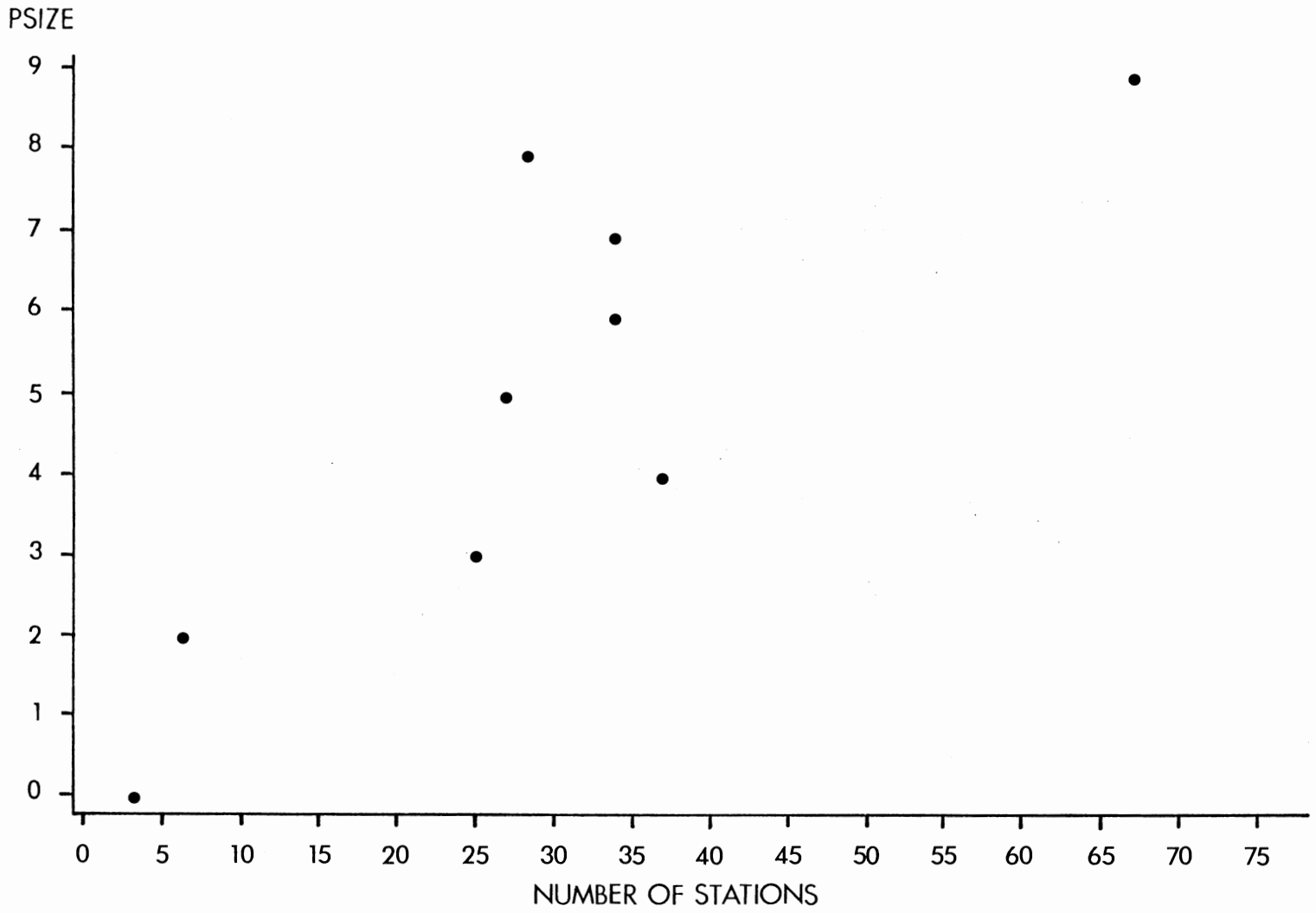

Figure 11.1 Graph of Place Size vs Number of Stations: 1950-59

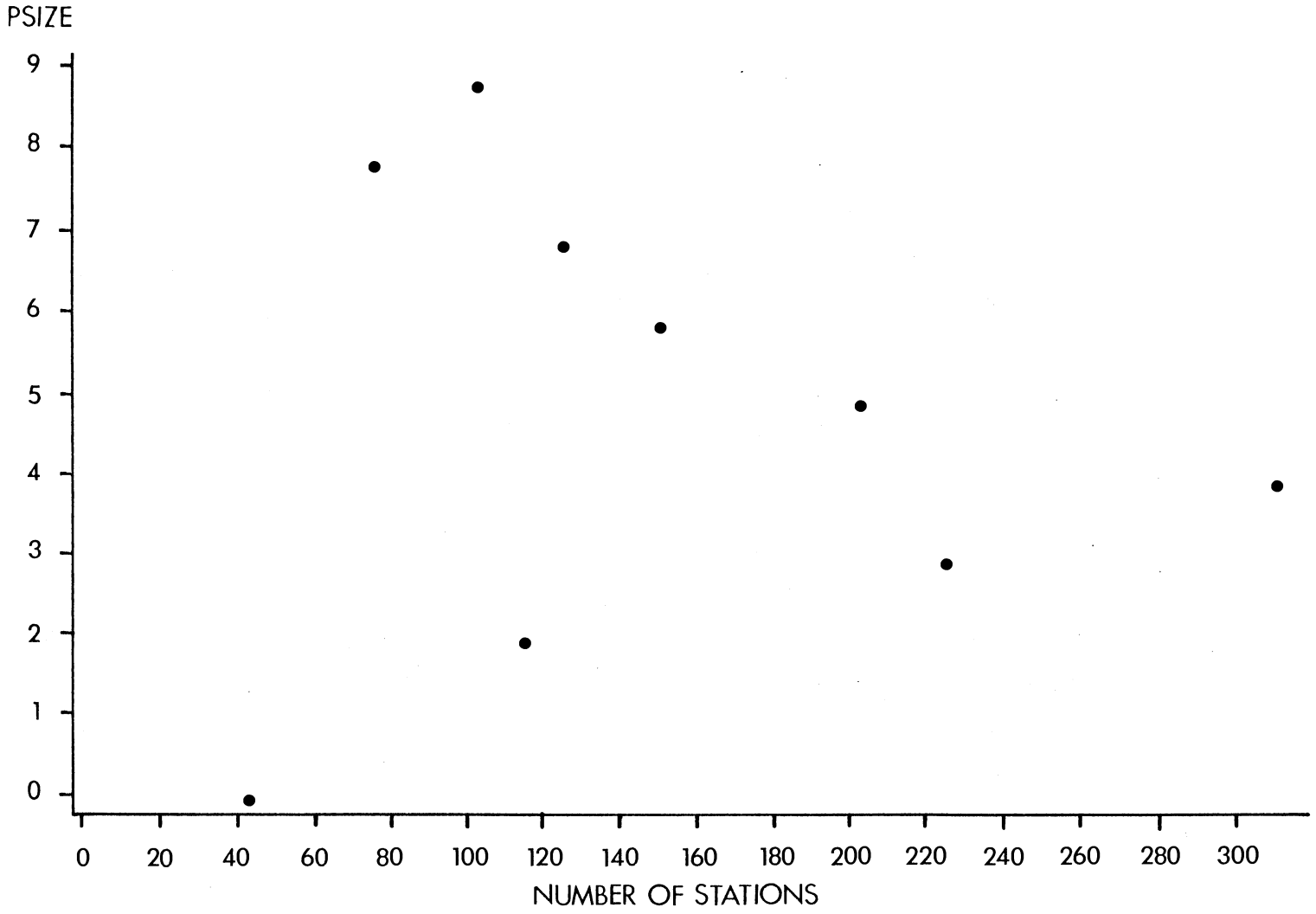

Figure 12. Graph of Place Size vs Number of Stations: 1960-69

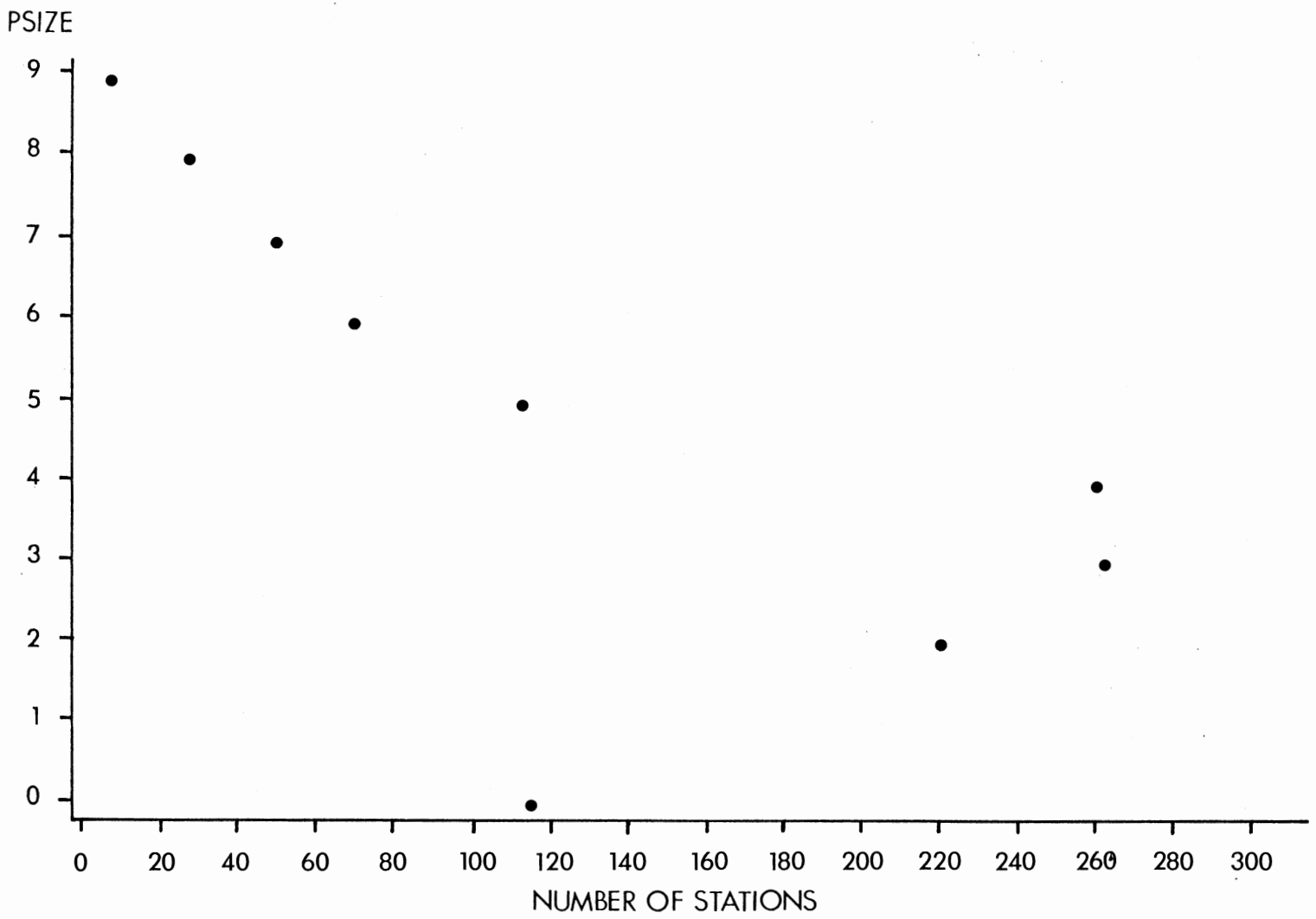

Figure 13. Graph of Place Size vs Number of Stations: 1970-79

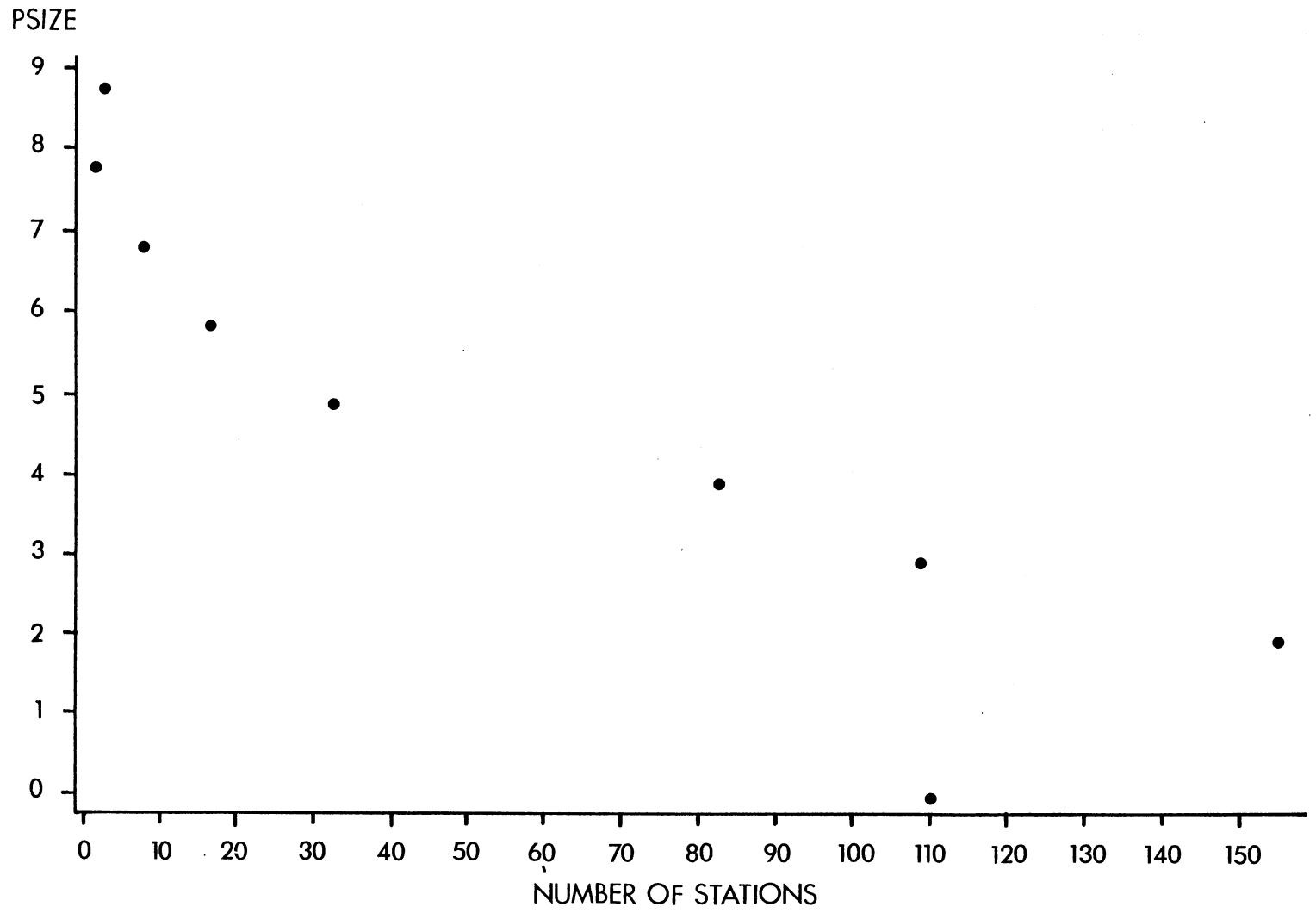

Figure 14. Graph of Place Size vs Number of Stations: 1980-85

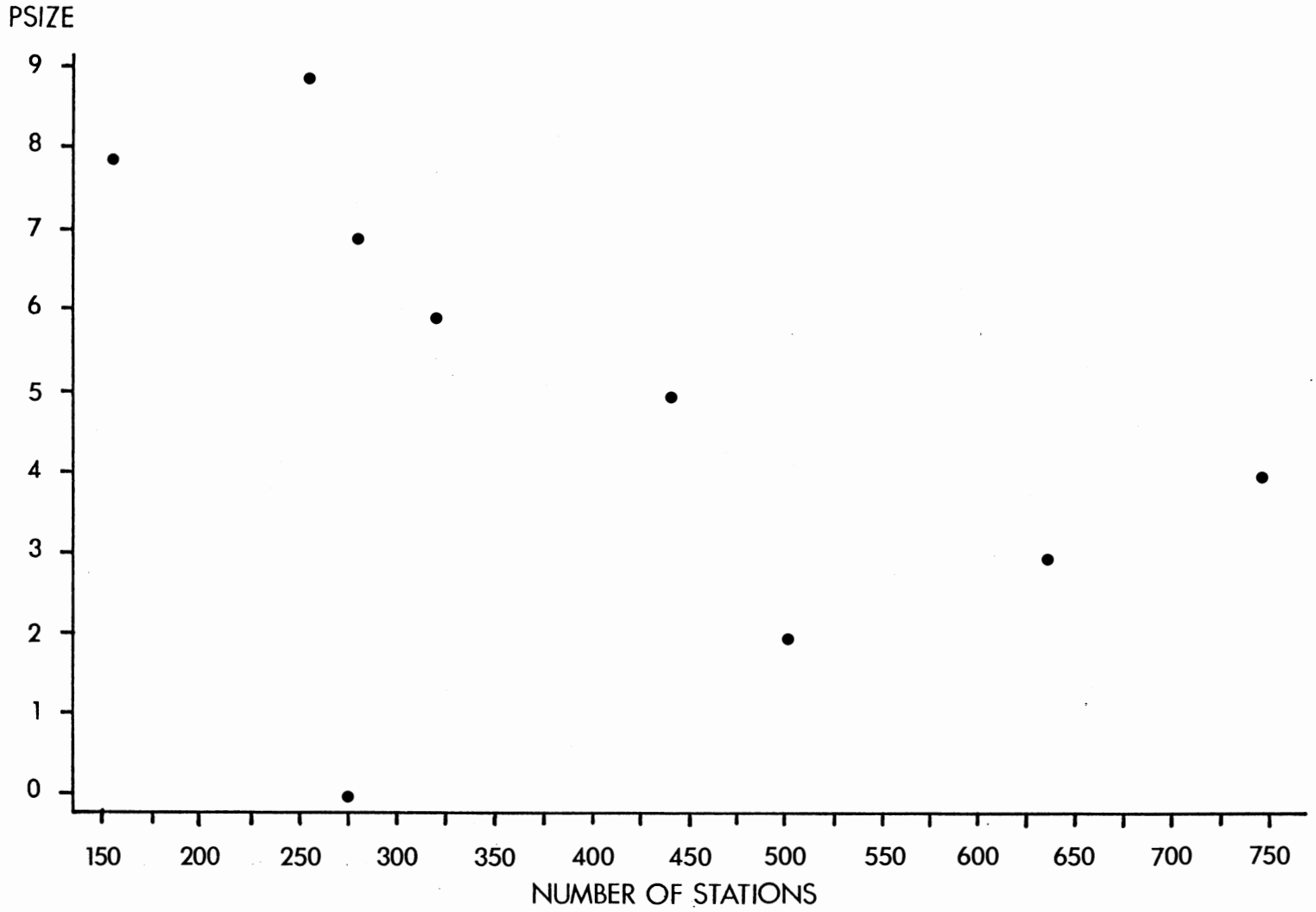

Figure 15. Graph of Place Size vs Number of Stations: 1937-1985

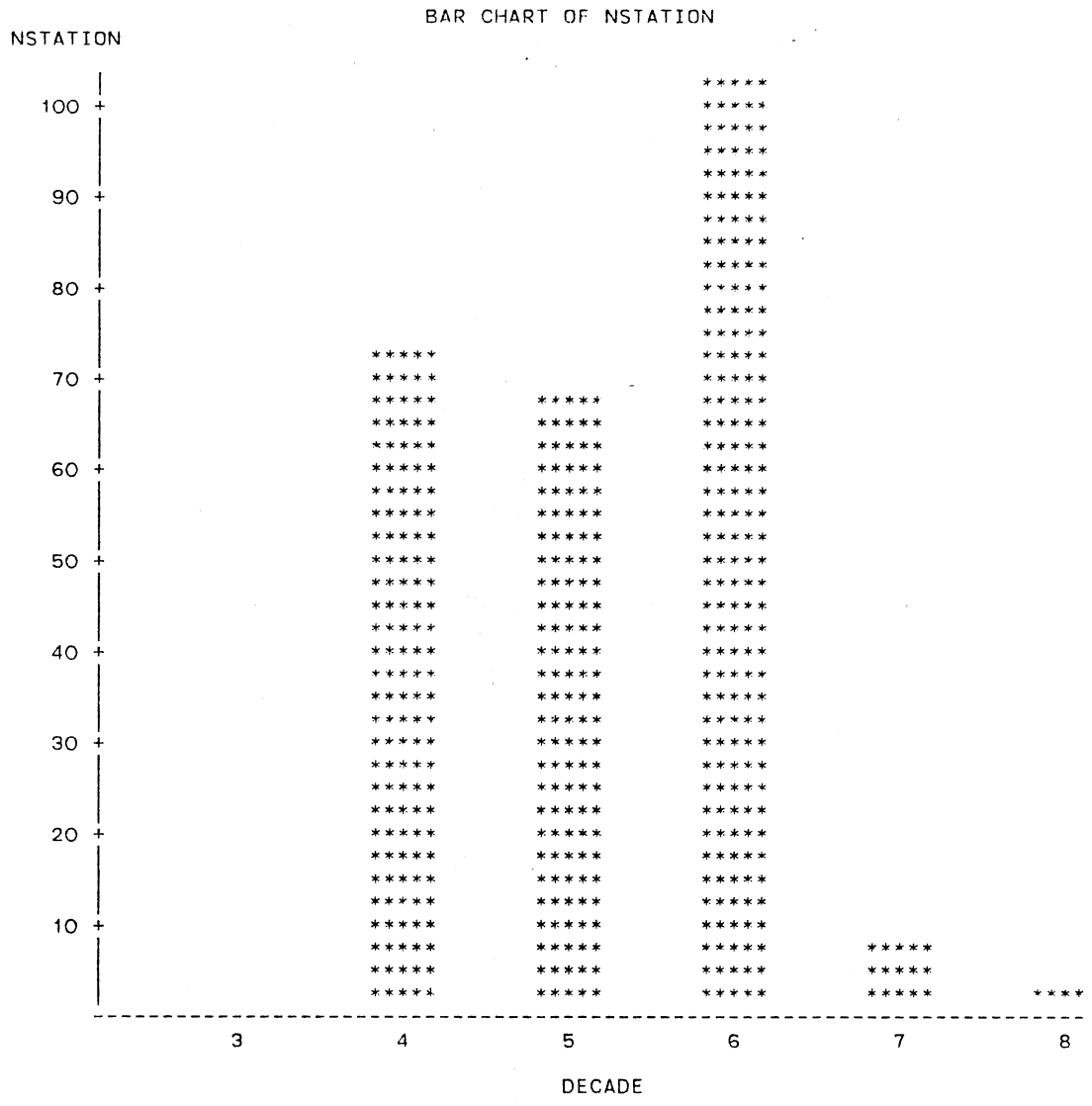

Figure 16. Graph of Largest Places (psize 9) per Decade

in the 1970s. It should be noted that the 1930s is not represented on these graphs because of the small number of observations (six). Figure 17 illustrates the number of stations established in the smallest sized locations (psize 0). The rate of adoption in the smallest places increased in the last three decades with substantial increases in the 1970s and 1980s. Figure 18 reflects the number of new adopters in the metropolitan areas (psize 5-9) per decade. This chart suggests that the highest level of adoption in the urban areas occurred during the 1960s and declined considerably thereafter. Figure 19 is a summary of all the decades of the time period. The chart indicates a slow start in the 1940s and 1950s, a marked increase in the number of adopters in the 1960s with a gradual decrease in the size of places in the 1970s and 1980s. This chart suggests that the innovation followed the hierarchical model and the innovation may be approaching saturation.

The ranking of sites by the number of stations established in the various place size categories is shown in Tables 1-7. Table 1 depicts the six stations operating in 1939. Of the six, only two, Alpine and Paxton, were not SMSA's. The general pattern is from larger places to smaller places. Table 2 illustrates a similar tendency. The largest SMSA's adopted more of the innovation for the decade. Some of the smaller SMSA's (Paducah, KY) begin to appear and the larger western areas (Seattle) are represented. Table 3 indicates that the more heavily populated SMSA's adopted the

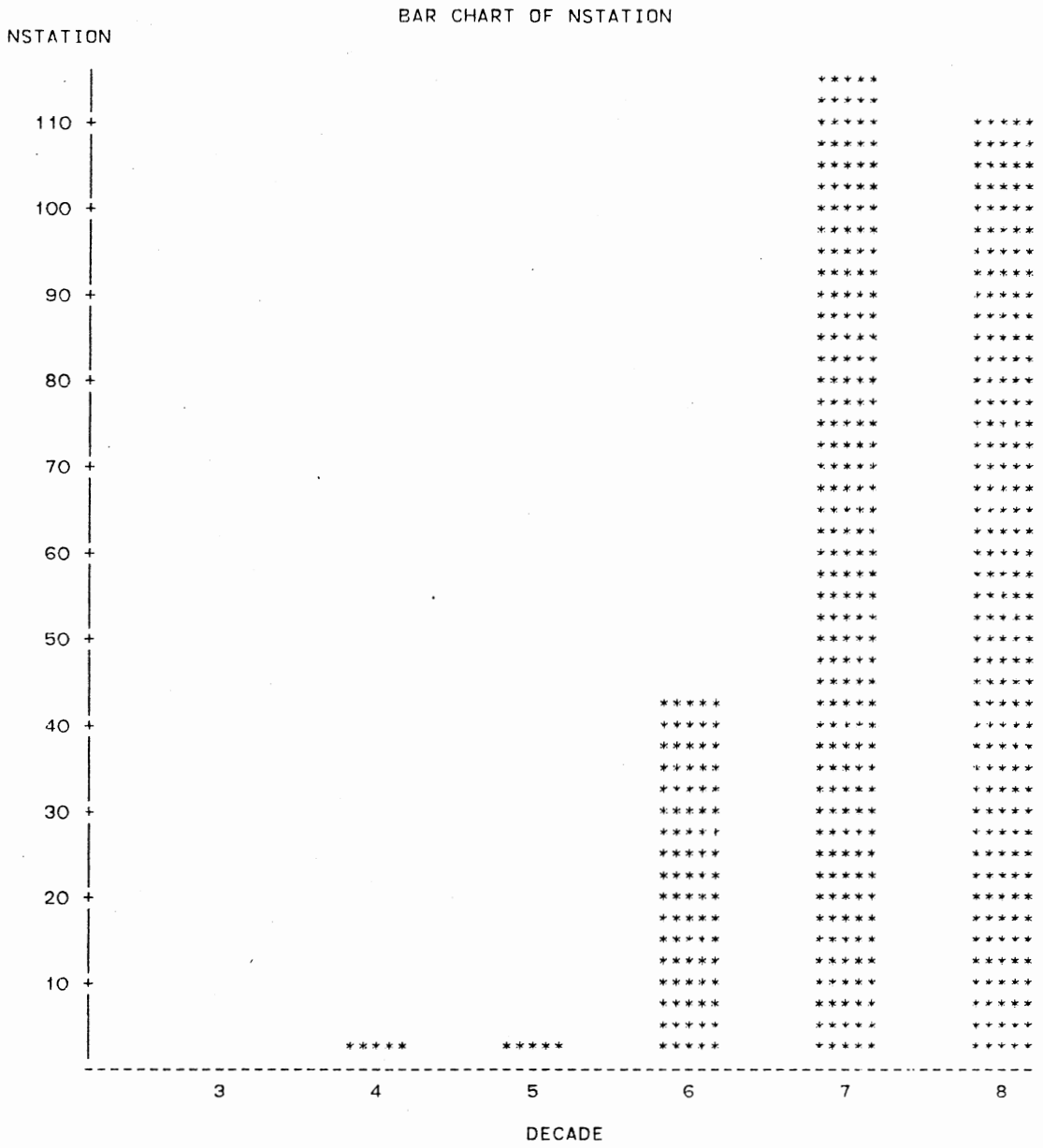

Figure 17. Graph of Smallest Places (psize 0) per Decade

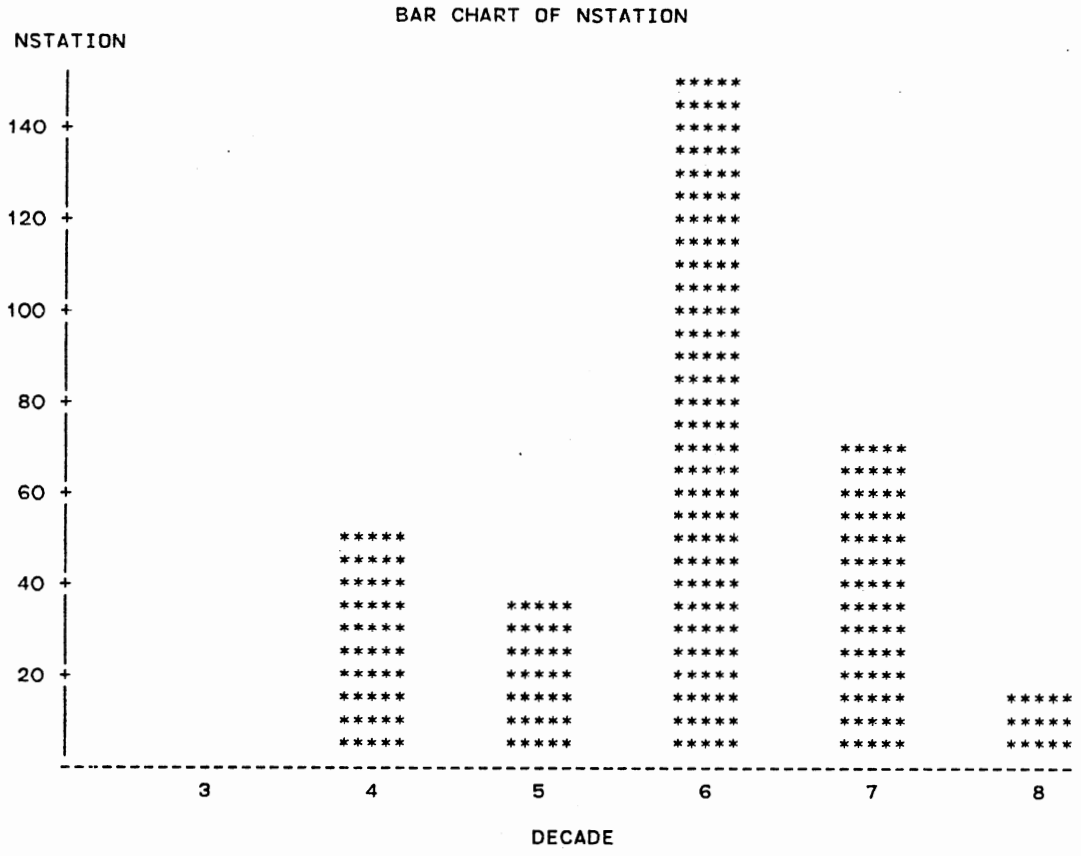

Figure 18. Graph of Larger Places (psize 5-9) per Decade

Figure 19. Summary of Locations (all sizes) per Decade

TABLE I

RANKING BY NUMBER OF STATIONS
1939

OBS	NAME	PSIZE	D3
1	MERIDEN	6	1
2	PAXTON	2	1
3	SPRINGFIELD	7	1
4	ALPINE	0	1
5	NEW YORK	9	1
6	ROCHESTER	8	1
7	ANCHORAGE	5	.
8	BETHEL	0	.
9	FAIRBANKS	4	.
10	HOMER	0	.
11	JUNEAU	3	.
12	KENAI	2	.
13	NOME	0	.
14	NORTH POLE	0	.
15	SOLDOTNA	0	.
16	WASILLA	0	.
17	YAKUTAT	0	.
18	ABBEVILLE	2	.
19	ALBERTVILLE	3	.
20	ALEXANDER CI	4	.
21	ANDALUSIA	4	.
22	ANNISTON	5	.
23	ARAB	2	.
24	ASHLAND	0	.
25	ATHENS	4	.
26	ATMORE	3	.
27	AUBURN	4	.
28	BAYMINETTE	3	.
29	BIRMINGHAM	8	.
30	BREWTON	3	.

TABLE II

RANKING BY NUMBER OF STATIONS 1940-49

OBS	NAME	PSIZE	D4
1	DETROIT	9	8
2	WASHINGTON	9	7
3	LOS ANGLES	9	6
4	NEW YORK	9	5
5	CHICAGO	9	5
6	PHILADELPHIA	9	5
7	PITTSBURGH	9	5
8	SAN FRANCISC	9	4
9	BOSTON	9	4
10	CLEVELAND	9	4
11	FRESNO	7	3
12	SACRAMENTO	8	3
13	HARTFORD	7	3
14	RALEIGH	7	3
15	BUFFALO	8	3
16	PORTLAND	8	3
17	DALLAS	9	3
18	RICHMOND	7	3
19	SEATTLE	9	3
20	MADISON	7	3
21	SPRINGFIELD	7	2
22	BIRMINGHAM	8	2
23	MODESTO	6	2
24	JACKSONVILLE	9	2
25	TAMPA	8	2
26	QUINCY	5	2
27	OWENSBORO	6	2
28	PADUCAH	5	2
29	NEW ORLEANS	9	2
30	SHREVEPORT	7	2

TABLE III

RANKING BY NUMBER OF STATIONS 1950-59

OBS	NAME	PSIZE	D5
1	LOS ANGLES	9	9
2	CHICAGO	9	8
3	SAN FRANCISC	9	6
4	NEW YORK	9	5
5	PHILADELPHIA	9	4
6	SACRAMENTO	8	4
7	SEATTLE	9	4
8	HOUSTON	9	4
9	DENVER	9	4
10	CLEVELAND	9	3
11	SAN DIEGO	9	3
12	MINNEAPOLIS	8	3
13	MILWAUKEE	9	3
14	BUFFALO	8	2
15	CINCINNATI	8	2
16	COLUMBUS	9	2
17	KANSAS CITY	9	2
18	SYRACUSE	7	2
19	TOLEDO	8	2
20	YOUNGSTOWN	7	2
21	TACOMA	7	2
22	RIVERSIDE	7	2
23	COLORADO SPR	7	2
24	WILMINGTON	6	2
25	ORLANDO	6	2
26	ST PETERSBUR	7	2
27	AUGUSTA	6	2
28	INDIANAPOLIS	9	2
29	OMAHA	8	2
30	BINGHAMTON	6	2

innovation at higher levels per site during this decade. Smaller SMSA's appear in the southern (Augusta, GA., Orlando, FL.) and western (Sacramento) regions. In addition, heavily populated SMSA's in the central western (Kansas City) regions depict increased levels of adoption. The decade of the 1960s (Table 4) was the most expansive one of the time period. The table suggests that more and different sized places adopted the innovation at increased rates particularly in the southern and western regions. The early adopters, that is, the initial metropolitan SMSA's consolidated their previously established sites during this decade. But smaller and more diverse SMSA's begin to emerge (Oklahoma City, Albuquerque, Colorado Springs). Most SMSA's adopted more of the innovation per site in all regions, over all, than in any other period. Table 5 indicates a significant decrease in the adoption rate for the larger places. Only two different size 9 places appear (New Orleans, Jacksonville, FL.) and they are not at the top of the rank structure. Eight of the top ten locations for this decade are the smaller SMSA's in the western and southwestern regions. In addition, much smaller non-SMSA sites (Clarksburg, West Virginia) begin to adopt the innovation and the number of adoptions per site is considerably reduced. Table 6 follows the same general scheme as the previous table. The larger places move down the hierarchy with much smaller locations adopting fewer stations per site while moving up the hierarchy. The western

TABLE IV

RANKING BY NUMBER OF STATIONS 1960-69

OBS	NAME	PSIZE	D6
1	OKLAHOMA CIT	8	8
2	SAN DIEGO	9	7
3	DETROIT	9	7
4	HOUSTON	9	6
5	SAN ANTONIO	9	6
6	ST LOUIS	9	6
7	DENVER	9	5
8	MILWAUKEE	9	5
9	KANSAS CITY	9	5
10	GRAND RAPIDS	7	5
11	PHOENIX	9	5
12	PITTSBURGH	9	5
13	PORTLAND	8	5
14	DALLAS	9	5
15	SALT LAKE CI	7	5
16	MEMPHIS	9	5
17	NEW YORK	9	4
18	SEATTLE	9	4
19	MINNEAPOLIS	8	4
20	BUFFALO	8	4
21	COLORADO SPR	7	4
22	BALTIMORE	9	4
23	FORT WORTH	8	4
24	ROCHESTER	8	4
25	ALBUQUERQUE	7	4
26	TULSA	8	4
27	ATLANTA	8	4
28	NORFOLK	8	4
29	MONTGOMERY	7	4
30	SOUTH BEND	7	4

TABLE V

RANKING BY NUMBER OF STATIONS 1970-79

OBS	NAME	PSIZE	D7
1	EL PASO	8	5
2	YAKIMA	5	4
3	PUEBLO	6	4
4	SANTA ROSA	6	4
5	ALBUQUERQUE	7	3
6	SAVANNAH	7	3
7	ANCHORAGE	5	3
8	TUSCON	8	3
9	VALDOSTA	5	3
10	AMARILLO	7	3
11	CLARKSBURG	4	3
12	MIAMI	8	2
13	AUSTIN	8	2
14	JACKSONVILLE	9	2
15	DES MOINES	7	2
16	LOUISVILLE	8	2
17	NEW ORLEANS	9	2
18	LINCOLN	7	2
19	FRESNO	7	2
20	MOBILE	7	2
21	JACKSON	7	2
22	FORT SMITH	6	2
23	LITTLE ROCK	7	2
24	PENSACOLA	6	2
25	CEDAR RAPIDS	7	2
26	BOISE	6	2
27	TOPEKA	7	2
28	PORTLAND	6	2
29	BILLINGS	6	2
30	ALBANY	7	2

TABLE VI

RANKING BY NUMBER OF STATIONS 1980-85

OBS	NAME	PSIZE	D8
1	SANTE FE	5	3
2	FAIRBANKS	4	3
3	ELIZABETH CI	4	2
4	ALAMAGORDO	4	2
5	WOODWARD	3	2
6	LAREDO	6	2
7	LAS VEGAS	7	2
8	PALM SPRINGS	4	2
9	ENID	5	2
10	CASPER	5	2
11	JUNEAU	3	2
12	GUNNISON	2	2
13	HILO	5	2
14	LAHAINA	2	2
15	COVINGTON	2	2
16	FORT SCOTT	3	2
17	PHILLIPSBURG	2	2
18	INTERNATIONA	3	2
19	SIDNEY	2	2
20	ELKO	3	2
21	PIERRE	3	2
22	SPEARFISH	2	2
23	MONAHANS	3	2
24	YAKIMA	5	1
25	ANCHORAGE	5	1
26	ALBANY	7	1
27	RICHLAND	5	1
28	COLUMBIA	6	1
29	GREAT FALLS	6	1
30	MISSOULA	5	1

and southern influence is well represented, but if the table were to include all the single adoptions at the smaller locations, considerable interfilling would be observed. The last table (Table 7) is a summary of all the decades of the time period. It indicates that the locations with the greatest levels of population and population increase over time adopted more of the innovation per site throughout the time period. As the population expanded and moved south and westward, the FM broadcast industry followed and established facilities in the large metropolitan market areas. The innovation was then adopted by smaller places in smaller quantities.

TABLE VII

RANKING BY NUMBER OF STATIONS 1939-1985

OBS	NAME	PSIZE	SD
1	DETROIT	9	16
2	LOS ANGLES	9	16
3	NEW YORK	9	15
4	CHICAGO	9	14
5	SAN FRANCISC	9	13
6	PHILADELPHIA	9	12
7	WASHINGTON	9	11
8	SAN DIEGO	9	11
9	HOUSTON	9	11
10	SEATTLE	9	11
11	PITTSBURGH	9	10
12	CLEVELAND	9	10
13	EL PASO	8	9
14	OKLAHOMA CIT	8	9
15	PORTLAND	8	9
16	SACRAMENTO	8	9
17	SAN ANTONIO	9	9
18	DENVER	9	9
19	BUFFALO	8	9
20	ALBUQUERQUE	7	8
21	ST LOUIS	9	8
22	MINNEAPOLIS	8	8
23	BALTIMORE	9	8
24	MILWAUKEE	9	8
25	KANSAS CITY	9	8
26	DALLAS	9	8
27	YAKIMA	5	7
28	BOSTON	9	7
29	PHOENIX	9	7
30	JACKSONVILLE	9	7

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The objective of this research was to determine the spatial pattern of FM radio broadcasting stations over time (1939-85) in the United States; trace the movement of the innovation; and determine the diffusional process which most influenced the distribution pattern of this phenomenon. To this end, a series of procedures was evaluated to accomplish the aforementioned objectives. Among these were: cartographic analysis, areal center movement, plot and bar graph interpretation, and rank structure evaluation.

Conclusions

The spatial diffusion of FM broadcasting began in the northeast in 1939 near New York City. The innovation diffused south and west in the 1940s and 1950s descending downward in the urban hierarchy. The decade of the 1960s was a pivotal time for this phenomenon because more stations were accepted in more places than at any other time. This was probably due to complementary technological achievements, a better economic climate, and population expansion and movement. Smaller cities of the eastern

regions of the United States continued to adopt the innovation, but there were increasing establishment of sites southward and westward. This may have been caused, in part, by migration to places like Florida and the Gulf Coast areas. The 1970s saw a continuation of westward diffusion as areas such as Los Angeles, Phoenix, Dallas-Fort Worth, and Honolulu exerted their influence on the diffusion process. Both SMSA and non-SMSA sized places adopted reduced numbers of the innovation per site. The 1980s, so far, have shown a marked decrease in the number and rate of adoption. This suggests that the innovation may be approaching the saturation point. The diffusion pattern followed the hierarchical model, but was distorted from the ideal in the 1950s and 1970s. This may have been caused by contagious diffusion, particularly in the cosmopolitan areas which adopted the innovation at an early stage. The author agrees with Bell, whose study this research parallels, and other researchers who suggest that there may be limitless factors and different processes at work simultaneously during the diffusion process. Contagious diffusion was not analyzed during this study. No effort was made to determine specific effects or to measure contagion, but it must be accepted, however, that contagious diffusion was a factor in the movement and spatial pattern of this innovation. The influence of such metropolitan areas as New York, Los Angeles, and Dallas-Fort Worth upon their smaller neighbors and surrounding regions should not be discounted. Moreover,

relocation diffusion may also have been a contributing factor in the spread of radio stations. Adopters may have moved from the initial eastern regions to the west coast and southwestern regions, particularly, in the early stages of this diffusion. This author supports the premise that other processes, particularly contagion, are often additional and important parts of the total diffusion process.

Recommendations

There are many areas of study as yet unexplored involving the spatial diffusion of communications media. A comparison of the spatial patterns of the AM and FM modes of transmission might reveal similarities which might support the theory that the macro pattern of radio in the United States was predetermined by the early patterns of AM development. Further research of the two techniques could indicate in which regions of the United States the AM and FM market areas were concentrated. Subsequent research could determine the factors responsible for adoption of either AM or FM. Further research of the types of listeners could provide insight as to why one particular technique is more popular than another. Further study of the types of programming could show why some regions of the United States prefer certain types of music (country,pop). This research could be expanded to examine the factors that influence the choices of the listener and why some formats are so much more popular than others. Another area of study could be the

role of networks in determining what people listen to and what programming is made available to the consumer. Another topic of research is the non-commercial aspects of the communications industry, both in radio and in television. Non-commercial stations could be identified and mapped to determine where they are and in what regions are particular formats represented. For instance, are all the non-commercial religious stations in the southeast? This area of study may be more attuned to cultural preference than others because non-commercial stations are not as economically motivated as commercial stations. Similar studies of broadcast and cable television could demonstrate which of the two techniques was growing and which influences the industry more. Finally, comparison research of non-commercial radio and television stations might reveal areal contrasts and similarities which could prove beneficial in evaluating future locations, regional types, and the general tone of broadcasting in the United States.

SELECTED BIBLIOGRAPHY

Abler, Ronald, John S.Adams, and Peter Gould. Spatial Organization: The Geographer's View of the World. New Jersey: Prentice-Hall, Inc., 1971.

Adler, Henry L., and Edward B.Roessler. Introduction to Probability and Statistics. 5th ed. San Francisco: W.H. Freeman and Company, 1972.

Aduroja, Elias Ishola. "Broadcasting in Nigeria: A Survey of the Radio, Television, and Film Industries." (M.S. Thesis, Oklahoma State University, 1979.)

Aspbury, George F. "Spatial and Temporal Diffusion of a Business Franchise." Geographical Perspectives , 13.55 (1985), 83-94.

Basore, Bennett. Personal interview. Stillwater, Oklahoma, 30 July 1986.

Bell, W. "The Diffusion of Radio and Television Broadcasting Stations in the United States." (unpub. M.A. Thesis, Pennsylvania State University, 1965.)

Berry, Brian J.L. Geography of Market Centers and Retail Distribution. New Jersey: Prentice-Hall Inc., 1967.

Blalock, Hubert M. Jr. Social Statistics. 2nd ed. U.S.A.: R.R. Donnelley and Sons, 1979.

Blaut, James M. "Two Views of Diffusion." Annals of the Association of Amerian Geographers. 67.3 (1977) 343-49.

Bogue, Donald J. "Radio: Classical Music WEFM Chicago." Report to the Chicago Communications Center. Illinois: University of Chicago, 1973.

Brown, Lawrence A. Diffusion Proccesses and Location. Philadelphia: Regional Science Institute, 1968.

--- Innovation Diffusion: A New Perspective. New York: Methuen, 1981.

Bryan Motors. Personal interview. Stillwater, Oklahoma, November, 1985.

Camies, B.S. Principles of Frequency Modulation. England: Chapel River Press, 1959.

Cancian, Frank. The Innovator's Situation. California: Stanford University Press, 1979.

Carney, George O. "From Down Home to Uptown: The Diffusion of Country-music Radio Stations in the United States." Journal of Geography 76 (1977) 104-116.

---. "Spatial Diffusion of the All-Country Music Radio Stations in the United States, 1971-74." John Edwards Memorial Foundation Quarterly , 13 (1977), 58-66.

Cohen, Yehoshua S. Diffusion of an Innovation in an Urban System. Illinois: University of Chicago Press, 1972.

Ennes,H.E. AM-FM Broadcasting Equipment, Operations, and Maintenance. Indiana: Howard W. Sams and Company Inc., 1974.

Federal Communications Commission. FCC Bulletin #3 Washington,D.C.: U.S. Govt. Printing Office, 1977.

---. ---. ---. FCC Bulletin #6 Washington,D.C.: U.S.Govt. Printing Office, 1979.

---. ---. ---. FCC Bulletin #9 Washington, D.C.: U.S. Govt. Printing Office, 1977.

---. ---. ---. News Washington, D.C.: U.S. Govt. Printing Office, 1979.

"Frequency Modulation: A Revolution in Broadcasting?" Electronics 13 (1940) 10-11.

"Frequency Modulation." Electronics , 14 (1941), 40-46.

Gould, Peter R. Spatial Diffusion. Commission on College Geography: Research Paper No. 4. Washington, D.C.: Association of American Geographers, 1969.

Haring, L. Lloyd, and John Lounsbury. Introduction to Scientific Geographic Research. 3rd ed. U.S.A.: William C. Broron Company, 1983.

Hagerstrand, Torsten. Innovation Diffusion as a Spatial Process. Trans. Allen Pred. Illinois: University of Chicago Press, 1967.

Havig,Alan. "Beyond Nostalgia: American Radio as a Field of Study." Journal of Popular Culture , 12:2 (1978), 218-227.

Hedges, Michael.. "Radio's Life and Styles." American Demographics , 8.2 (1986), 32-35.

Hybels, Saundra, and Dana Ulloth. Broadcasting: An Introduction to Radio and Television. New York: D. Van Norstrand and Company, 1978.

Inada, Michihiko. "Diffusion Process of TV Stations in Japan." Tokyo Metropolitan University Geographical Report , 13 (1978), 77-86.

Jakle, John A., Stanley Brunn and Curtis C. Roseman. Human Spatial Behavior. Massachusettes: Wadsworth Publishing Co. Inc., 1976.

Kane, Joseph N. Famous First Facts. 4th ed. New York: H.W. Wilson CO., 1981.

Kniffen, Fred. "Folk Housing: Key to Diffusion." Annals of the Association of American Geographers , 55.4 (1965), 549-77.

Lindsey, C.F. Radio and Television Communication. New York: McGraw Hill Inc., 1952.

MacDonald, J-Fred. "Radio: Medium is Alive and Well in the Age of Video." Advertising Age , 55.59 (1984), 11-14.

Major,John K. "Where Listeners Live." Journal of Advertising Research , 21.4 (1981), 71-76.

"Month in Review." Radiocraft , 11 (1940), 455-505.

Mulligan, George F., and Richard W. Reeves. "Employment Data and the Classification of Urban Settlements." The Proffesional Geographer , 38.4 (1986), 349-58.

Owen Thomas Ford. Personal interview. Stillwater, Oklahoma. November, 1985.

Rogers, Everett M. Diffusion of Innovations. 3rd ed. New York: Free Press, 1983.

Rooney, John F. A Geography of American Sport: From Cabin Creek to Anaheim. Addison-Wesley Publishing Co., 1974.

Rosenberg, Nathan. Perspectives on Technology. New York: Cambridge University Press, 1976.

Sauer, Carl O. Agricultural Origins and Dispersals. New York: George Grady Press, 1952.

Schroeder,D. Personal interview. Stillwater, Oklahoma, 26 March 1986.

Taishoff,Sol. ed. Storer Communications. Yearbook 1985. Washington, D.C.: Lawrence B. Taishoff, 1985.

U.S. Bureau of Census. Picadad Reference File. Geography Division. Washington: U.S. Govt. Printing Office, 1978.

Zelinsky, Wilbur. The Cultural Geography of the United States. New Jersey: Prentice-Hall, Inc., 1978.

APPENDIXES

APPENDIX A

EXAMPLE OF WORKING DATA FILE

APPENDIX A

EXAMPLE OF WORKING DATA FILE

OBS	ST	NAME	LAT	LONG	D3	D4	D5	D6	D7	D8	PSIZE	SMSA	SMSASIZE	BEA
1	AK	ANCHORAGE	61.218	149.892	0	0	0	2	3	1	5	380	1	172
2	AK	BETHEL	60.792	161.750	0	0	0	0	0	1	0	0	0	172
3	AK	FAIRBANKS	64.847	147.720	0	0	0	0	0	3	4	0	0	172
4	AK	HOMER	59.645	151.550	0	0	0	0	1	0	0	0	0	172
5	AK	JUNEAU	58.330	134.485	0	0	0	0	0	2	3	0	0	172
6	AK	KENAI	60.550	151.266	0	0	0	0	1	0	2	0	0	172
7	AK	NOME	64.500	165.417	0	0	0	0	1	0	0	0	0	172
8	AK	NORTH POLE	64.750	147.350	0	0	0	0	1	0	0	0	0	172
9	AK	SOLDOTNA	60.483	151.050	0	0	0	0	0	1	0	0	0	172
10	AK	WASILLA	61.695	149.459	0	0	0	0	0	1	0	0	0	172
11	AK	YAKUTAT	59.550	139.733	0	0	0	0	0	1	0	0	0	172
12	AL	ABBEVILLE	31.487	85.267	0	0	0	1	0	0	2	0	0	40
13	AL	ALBERTVILLE	34.267	86.208	0	1	0	0	0	0	3	3440	2	47
14	AL	ALEXANDER CI	32.937	85.963	0	1	0	0	0	0	4	0	0	40
15	AL	ANDALUSIA	31.307	86.483	0	0	1	0	0	0	4	0	0	40
16	AL	ANNISTON	33.655	85.827	0	1	0	0	0	0	5	450	1	45
17	AL	ARAB	34.317	86.495	0	0	0	0	1	0	2	3440	2	47
18	AL	ASHLAND	33.273	85.837	0	0	0	0	0	1	0	0	0	45
19	AL	ATHENS	34.802	86.972	0	0	1	0	0	0	4	3440	2	47
20	AL	ATMORE	31.025	87.490	0	0	0	1	0	0	3	0	0	39
21	AL	AUBURN	32.607	85.483	0	0	0	1	0	0	4	0	0	43
22	AL	BAYMINETTE	30.883	87.773	0	0	0	1	0	0	3	5160	2	137
23	AL	BIRMINGHAM	33.512	86.807	0	2	1	3	1	0	8	1000	3	45
24	AL	BREWTON	31.108	87.068	0	0	0	0	1	0	3	0	0	39
25	AL	BUTLER	32.090	88.218	0	0	0	0	1	0	0	0	0	136
26	AL	CARROLLTON	33.262	88.095	0	0	0	0	1	0	0	0	0	45
27	AL	CHICKASAW	30.762	88.075	0	0	0	0	0	1	3	5160	2	137
28	AL	CLANTON	32.842	86.633	0	0	1	0	0	0	3	0	0	45
29	AL	CULLMAN	34.175	86.842	0	1	0	1	0	0	4	0	0	45
30	AL	DECATUR	34.603	86.978	0	0	1	1	0	0	5	0	0	47
31	AL	DEMOPOLIS	32.513	87.835	0	0	0	0	1	0	3	0	0	136
32	AL	DOTHAN	31.223	85.393	0	0	0	2	0	0	5	0	0	40
33	AL	ENTERPRISE	31.312	85.852	0	0	0	1	1	0	4	0	0	40
34	AL	EUFAULA	31.893	85.147	0	0	0	1	0	0	3	0	0	40
35	AL	EVERGREEN	31.433	86.953	0	0	0	0	0	1	2	0	0	137
36	AL	FAIRHOPE	30.522	87.903	0	0	0	1	0	0	3	5160	2	137
37	AL	FAYETTE	33.685	87.830	0	0	0	0	1	0	2	0	0	45
38	AL	FLORENCE	34.800	87.675	0	0	0	1	0	0	5	2650	1	47
39	AL	GADSDEN	34.018	86.018	0	0	0	1	0	0	6	2880	1	45
40	AL	GENEVA	31.038	85.872	0	0	0	1	0	0	2	0	0	40
41	AL	GREENVILLE	31.828	86.630	0	0	0	0	1	0	3	0	0	40
42	AL	GUNTERSVILLE	34.350	86.303	0	0	0	1	0	0	3	3440	2	47
43	AL	HALEYVILLE	34.227	87.620	0	0	0	0	1	0	2	0	0	45
44	AL	HAMILTON	34.142	87.988	0	0	0	1	0	0	2	0	0	45
45	AL	HUNTSVILLE	34.732	86.587	0	0	1	1	1	0	7	3440	2	47
46	AL	JACKSON	31.515	87.890	0	0	0	1	0	0	3	0	0	137
47	AL	JASPER	33.833	87.278	0	0	0	1	0	0	4	1000	3	45
48	AL	MOBILE	30.688	88.043	0	1	0	2	2	0	7	5160	2	137
49	AL	MONROEVILLE	31.522	87.325	0	0	0	1	0	0	2	0	0	137
50	AL	MONTGOMERY	32.382	86.308	0	0	0	4	0	0	7	5240	1	40
51	AL	MUSCLE SHOAL	34.746	87.649	0	0	0	1	0	0	3	2650	1	47
52	AL	ONEONTA	33.948	86.473	0	0	0	1	0	0	2	0	0	45
53	AL	OZARK	31.458	85.642	0	0	0	2	0	0	4	0	0	40
54	AL	PRATTVILLE	32.463	86.475	0	0	0	0	1	0	4	5240	1	40
55	AL	REFORM	33.380	88.015	0	0	0	0	1	0	0	0	0	45

APPENDIX B

DIFFERENCES BETWEEN ORIGINAL AND WORKING DATA FILE

APPENDIX B

DIFFERENCES BETWEEN ORIGINAL AND WORKING DATA FILE

	ORIGINAL	WORKING	DIFFERENCE
1930-39 (D3)	6	6	0
1940-49 (D4)	342	339	-3
1950-59 (D5)	264	261	-3
1960-69 (D6)	1370	1348	-22
1970-79 (D7)	1172	1125	-47
1980-85 (D8)	557	518	-39
TOTAL	2579	2472	-107

Note: Figures denote number of stations.

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