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CHAPTER I

CONCEPTUAL FRAMEWORK

The research reported here focuses on the relationship between age and the socio-economic structure of counties in California. Specifically, the problem is to determine whether the process by which an area's population undergoes aging influences the manner in which the area's socio-economic structure is modified. Two aging processes are identified, retirement and residual effects, and the variance in socio-economic change attributed to each effect is measured.

Significance of Aging in Contemporary Society

Research on aging comes at an appropriate time. It is well recognized that the population of the United States

is becoming older. Larger proportions of our population are concentrating in the older age groups. Moreover, if the current fertility rate has a prolonged history, the percentage of population in older age categories will increase above its current level.

This age shift has and will continue to be accompanied by numerous problems, problems that will significantly alter the structure of our society. In a society that has been "youth oriented," demographic shifts towards older age can seriously challenge existing values. Among the problems currently raised by a rising proportion of older residents are those associated with health care, forced retirement, and declining economic status of elderly residents forced to live on fixed income. An interesting and possibly prophetic trend accompanying these problems has been the increase in the political activism of older residents. The formulation of a group called the "Gray Panthers" personified the newly emerging activism. As the proportion of older residents increases this segment of the population can become an important force in the political process at both the local and national level.

Despite evidence that the United States population will continue to move towards an older age structure, our understanding of its implications is minimal. Only recently

has the government become aware of the importance of this shift. In struggle to formulate policies and new programs to assist the elderly, it is apparent that substantive research on the problem is sparse. This research hopes to add some insight into a void too long left uninvestigated.

Spatial Analysis of Population Attributes

Human population analysis is, by its very nature, a broad field for investigation. As a research topic it is not the exclusive dominion of a single discipline. Substantial contributions to population literature have come from anthropology, political science, sociology, psychology and geography. However, while the past work is voluminous, most of the research has centered upon numbers of inhabitants,[1] growth trends,[2] or analysis of demographic attri-

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[1]For example, see: A. P. Brigham, "The Population of New York State," Geographical Review, II (1916), pp. 206-207; Sten DeGeer, "A Map of the Distribution of Population in Sweden: Method of Presentation and General Results," Geographical Review, XII (1922), pp. 72-83; and C. E. Batschelet, "A Picture of the Distribution of Population in Pennsylvania," Geographical Review, XVII (1927), pp. 429-433.

[2]Examples of earlier studies are: Warren S. Thompson and R. K. Whelpton, "Changes in Regional and Urban Patterns of Population Growth," American Sociological Review, V (1945), pp. 921-929; Clyde F. Kohn, "Population Trends in the United States Since 1940," Geographical Review, XXXV (1945), pp. 98-106; and J. M. Gellette, "Some Population Shifts in the United States," American Sociological Review, VI (1941), pp. 619-628.

butes.[3] Bogue, in evaluating some of the past research, concluded: "Where intensive studies of particular aspects of population have been undertaken, too often the scope of the inquiry has continued to be largely historical and descriptive rather than analytical and explanatory,"[4] and that: "there is comparatively little intensive analysis of the distributional aspects of particular population events."[5]

This latter point, the spatial arrangement of phenomena, is a major concern of geographers.[6] However, spatial aspects of population events have not received the attention accorded other phenomena by geographers. Trewartha[7] indi-

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[3]Early works are represented by: T. J. Woofter, Race and Ethnic Groups in American Life (New York: McGraw-Hill Book Company, 1933); Philip M. Hauser, "The Labor Force as a Field of Interest for the Sociologist," American Sociological Review, XVI (1951), pp. 530-538; and W. J. Goode, "Problems in Post-divorce Adjustment," American Sociological Review, XIV (1949), pp. 349-401.

[4]Donald J. Bogue, "Population Distribution," in The Study of Population: An Inventory and Appraisal, ed. by Philip M. Hauser and Otis D. Duncan (Chicago: University of Chicago Press, 1969), p. 387.

[5]Ibid.

[6]Pattison has suggested that attention to spatial distributions has been a traditional hallmark of geography. See: William D. Pattison, "The Four Traditions of Geography," Journal of Geography, LXIII (1964), pp. 211-216.

[7]Glenn T. Trewartha, "A Case for Population Geography," Annals, Association of American Geographers, XLIII (1953), pp. 71-97.

cated that population geographers should do more than direct attention to the spatial distributions of the numbers of people. He suggested that more research be aimed toward the spatial distribution of population qualities. Trewartha also cautioned that "simple distribution patterns and arithmetic desities are scarcely sufficient to establish a field of population geography."[8]

In defining the frontiers of population research, James[9] called attention to the need for "the search for methods of revealing more clearly the dynamics of population change."[10] Following James, Ackerman[11] also noted that "geographers generally have devoted less of their efforts to distributional studies of specific demographic attributes beyond straight enumeration."[12] More recently,

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[8] Ibid., p. 88.

[9] Preston E. James, "The Geographic Study of Population," in American Geography: Inventory and Prospect, ed. by Preston E. James and Clarence F. Jones (Syracuse: Syracuse University Press, 1954), pp. 107-122.

[10] Ibid., p. 116.

[11] Edward A. Ackerman, "Geography and Demography," in The Study of Population, ed. by Philip M. Hauser and Otis D. Duncan (Chicago: University of Chicago Press, 1959), pp. 717-727.

[12] Ibid., p. 721.

Demko, et al.[13] have suggested that a definition of population geography might be:

> . . . that branch of the discipline which treats the spatial variations in demographic and non-demographic qualities of human population, and the economic and social consequences stemming from the interaction associated with a particular set of conditions existing in a given areal unit.[14]

Thus, these scholars seem to suggest that, while the geography of population quantities provides valuable insights, these insights can be further enhanced by attention to spatial aspects of population qualities.

Research Hypothesis

Human migration is an important form of spatial interaction. In this study, two types of migration that influence the proportion of persons age sixty-five and over were examined as they related to the impact of aged population on socio-economic structure.

Both the outmigration of younger population and inmigration of older population can affect the proportion of persons age sixty-five and older in a given population.

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[13]George J. Demko, Harold M. Rose and George A. Schnell, "The Geographic Study of Population," in Population Geography: A Reader, ed. by George J. Demko, Harold M. Rose and George A. Schnell (New York: McGraw-Hill Book Company, 1970), pp. 1-5.

[14]Ibid., p. 4.

The hypothesis for this study is that the impact of the aged population on the socio-economic structure may be distinctly different depending upon which of these two migration mechanisms has been responsible for the increase in the proportion of persons sixty-five and over.

Aging and Aged: Statement of Definition

"Aging and "aged" are two important but significantly different concepts that are central to this research. Aging, as defined here, is similar to the dynamic process of population change suggested by Breen. That is: ". . . aging is a process of change; it is not a state of being. It is itself a process without inherent qualities of goodness or badness. This statement of events, this continuous change, is that which we in general may understand as 'aging'."[15] An individual experiences aging through an accumulation of years; however, for the purposes of this study, aging of a population refers to the proportional increase in the number of persons sixty-five years old and older. Aged, on the other hand, is used in reference to people sixty-five years and over and also to population age

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[15]Leonard Z. Breen, "The Aging Individual," in Handbook of Social Gerontology: Societal Aspects of Aging, ed. by Clark Tibbitts (Chicago: University of Chicago Press, 1960), p. 147.

structures containing high proportions of such persons.[16]

Theoretical Framework

Population age-structure represents only one of numerous considerations in population geography. The purpose of this study, as stated above, is to examine the impact of the aging of a population as this impact is reflected in socio-economic characteristics. The treatment of a topic of such limited scope has not been unique among the sciences. For as Lazarsfeld noted: "No science deals with its objects of study in their full concreteness. It selects certain of their properties and attempts to establish relations among them."[17]

Age composition is an important element that can be

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[16]This connotation of aged is accepted in the literature. See: Ernest W. Burgess, "Aging in Western Culture," in Aging in Western Societies, ed. by Ernest W. Burgess (Chicago: University of Chicago Press, 1960), p. 4; Edward Rosset, Aging Process of Population, trans. by I. Doboza, R. Janikowsha, K. Kozlawska and W. Skibicki (New York: The Macmillan Company, 1964), pp. 10-14; and George A. Schnell, "Factors Affecting Recent Trends of the Aged Population: A Case Study," Aging and Human Development, I (1970), pp. 219-230. In this study, population structures that have a proportion of persons age sixty-five and over greater than 10 percent of the total population will be referred to as aged.

[17]Paul Lazarsfeld, "Evidence and Inference in Social Research," in Readings in the Philosophy of the Social Sciences, ed. by May Brodbeck (New York: The Macmillan Company, 1968), p. 609.

used to distinguish one population structure from another. Studies of age distributions (within a population or among several populations) form a major portion of the literature of fields such as sociology and demography.[18] An increasing awareness of the importance of old people is illustrated by the evolution of gerontology,[19] a field devoted exclusively to investigation of the problems associated with old age. Interest, then, in examining aged population is witnessed by a wide range of recently published research.[20]

While geographers have addressed research to some age-composition topics, the study of the older portions of population structures is one topic that has received little

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[18]Publications by sociologists are often found in the area of demography. For examples, see: Philip Hauser and Otis Duncan, eds., The Study of Population: An Inventory and Appraisal (Chicago: University of Chicago Press, 1959); Charles Nam, ed. Population and Society (New York: Houghton Mifflin Company, 1968); and Thomas R. Ford and Gordon DeJong, eds., Social Demography (Englewood Cliffs, New Jersey, 1970).

[19]For example, see: Clark Tibbitts, ed., Handbook of Social Gerontology: Societal Aspects of Aging (Chicago: University of Chicago Press, 1960).

[20]See: Sidney Goldstein, Consumption Patterns of the Aged (Philadelphia: University of Pennsylvania Press, 1960); L. E. Gallaway, "The Aged and the Extent of Poverty," Southern Economic Journal, XXXIII (1966), pp. 212-222; and Stephen M. Golant, The Residential Location and Spatial Behavior of the Elderly: A Canadian Example (University of Chicago, Department of Geography, Research Paper No. 143, 1972).

attention. This gap in the literature is being corrected, as Wilbur Zelinsky has noted: "Recently, a few geographers and demographers with a spatial bent have begun to realize that the geography of the aged is now sufficiently distinct from that of other age groups that its study may amply repay the investment of some time and effort."[21] If, indeed, the geography of the aged is different from that of other age groups, then, it is important that the dimensions of this deviation be examined. That such findings be added to our knowledge of population is important, since the functioning of complex social organizations is often based on data concerning population characteristics.

The research framework of this study is composed of three parts: (1) the conceptual model; (2) the mechanisms of population aging; and (3) the rational for hypothesizing that the impact of aged population upon socio-economic structure will differ according to the migration type responsible for the population aging.

The Conceptual Model

Possible modes for organizing study of population-structure elements have been suggested by Ford and DeJong:

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[21]Wilbur Zelinsky, "Toward a Geography of the Aged," Geographical Review, LVI (1966), p. 445.

> There are two basic approaches to analyzing relationships between social and cultural factors and population variables. Social and cultural factors may be viewed as independent variables that account for empirical regularities in population structure or process. The influence of social mobility on fertility illustrates this type of relationship. Much of the research in social demography has been of this type. But social demographers are not exclusively interested in the social and cultural determinents of population structure and process. Questions about the way changes in population affect various aspects of society and cultural factors are also important. From this view, social and cultural factors are treated as dependent variables with the intent of explaining how they are influenced by demographic factors.[22]

In essence, a population-structure element can assume a position of being either a dependent or independent variable within the context of the study framework.

A common characteristic of the studies cited earlier is that age-structure variables are considered as dependent variables. Thus, research questions are phrased in order to consider what factors might explain the evolution of a particular age-structure composition. Such a question might involve the attempt to identify what changes in an age-structure might be expected with a given change in a set of socio-economic variables. While these studies add to the understanding of the influence of various processes on population structure elements, a further dimension can

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[22]Thomas Ford and Gordon F. DeJong, eds., Social Demography (Englewood Cliffs, New Jersey, 1970), p. 5.

be obtained by considering age-structure variables as independent and examining their influence on socio-economic variables. As Beshers notes: "Until now we have treated the social variables as a given, but if knowledge of the population processes enabled us to predict the state of the social variables we would have a more complete theory, one capable of yielding much more interesting predictions."[23] Thus, aged population is a structure variable that may be examined from such a frame of reference, i.e., as being independent and capable of modifying a social structure.

Models have been an important addition to problem-solving methodology.[24] While the models used to conceptualize a problem vary in structural form, Haggett and Chorley suggest that all models have several common characteristics: (1) their formulation involves a highly selective attitude to information; (2) they are structured; (3) they are suggestive of further expansion; (4) they are approximations

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[23] James M. Beshers, Population Processes in Social Systems (New York: The Free Press, 1967), p. 163.

[24] For recent in depth treatment of models in geography, see: Richard J. Chorley and Peter Haggett, eds., Models in Geography (London: Methuen and Company, Ltd., 1967). In addition, an excellent guide for model construction is: Richard J. Chorley, "Geography and Analog Theory," Annals, Association of American Geographers, LIV (1964), pp. 127-137.

of reality; and (5) being different from the real world, they are in actuality analogies.[25] Thus: "Models are highly subjective approximations in that they do not include all associated observations or measurements, but as such they are valuable in obscuring incidental details and allowing fundamental aspects of reality to appear."[26] Conceptual models should also be so operationalized that they may be applied to the real world.

> Reapplication is a prerequisite for models in the empirical sciences. Although some mathematical model builders disclaim responsibility for the degree to which their idealizations may represent the real world, claiming that their responsibility is discharged completely and with honour if they avoid internal error; most geographical model builders would judge the value of a model almost entirely in terms of its reapplicability to the real world.[27]

A model may assume a number of forms, iconic, analog, or symbolic.[28] However, research models serve as a "strategy which helps in the selection and measurement of

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[25]Peter Haggett and Richard J. Chorley, "Models, Paradigms and the New Geography," in Models in Geography, ed. by Richard J. Chorley and Peter Haggett (London: Mathuen and Company, Ltd., 1967), pp. 22-23.

[26]Ibid., p. 22.

[27]Ibid., p. 24.

[28]For additional discussion on model types, see: David Harvey, Explanation in Geography (London: Edward Arnold, Ltd., 1969), see especially pp. 155-158.

the system variables and relationships we wish to study."[29] In such a case the model serves as a guide for the research. In addition to a specific form, the research model also has an environment. This environment may be defined as: ". . . the set of all objects a change in whose attributes effects the system and also those objects whose attributes are changed by the behavior of the system."[30]

The conceptual model of aged-impact shown as Figure 1.1 was the research guide of this study. The model consisted of three components: (1) input, (2) structure interaction, and (3) output. Input was defined as migration elements and biological elements; the structure interaction portion contained a population structure and a socio-economic structure within a given areal unit; and output was identified as a modified socio-economic structure resulting from the interaction between the population and socio-economic structures. Output from other systems (indicated by the broken circles) constituted important inputs but inputs that

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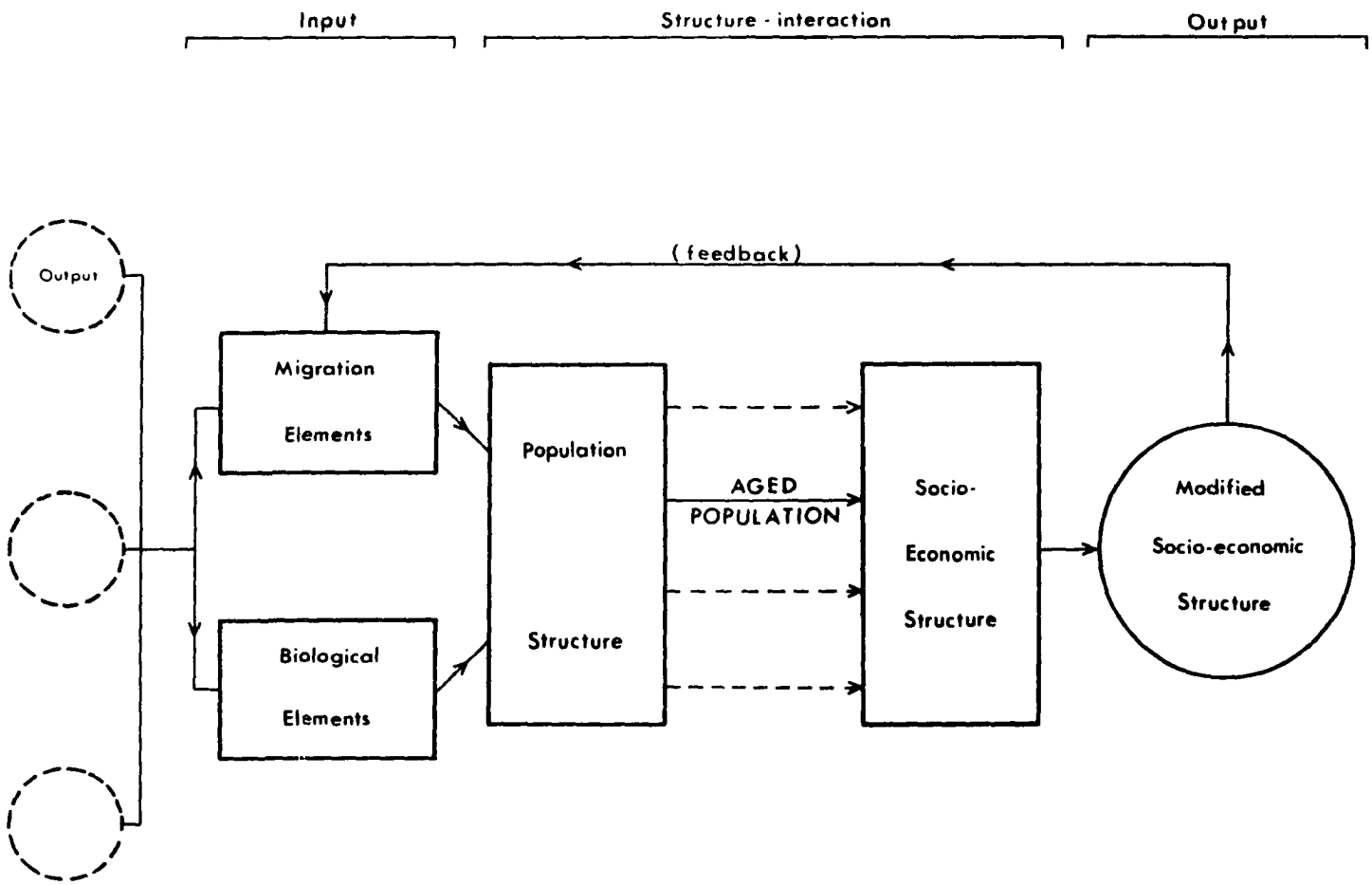
[29]Charles E. Rice, "A Model for the Empirical Study of a Large Social Organization," General Systems, Yearbook of the Society for the Advancement of General Systems Theory, VI (1961), p. 101.

[30]A. P. Hall and R. E. Fagen, "Definition of System," General Systems, Yearbook for the Society for the Advancement of General Systems Theory, I (1956), p. 20.



RESEARCH MODEL: AGED IMPACT

Figure 1.1

were not an immediate focus of the research model. These implied inputs were included in the model only to acknowledge that they exist as part of the total environment of this research model.[31]

The model focused upon two initial inputs that act upon a population age-structure in any given areal unit; these were migration and biological elements--fertility and mortality. While both inputs were likely to be influential in modifying an age structure, it was the migration components that were to be examined as the more significant of the teo element-sets. The biological factors, fertility and mortality, also exert an influence but over a greater span of time. Table 1.1 shows the death rates for California from 1950 to 1969. These rates would not seem to be as significant as migration in producing the degree of population aging that has occurred in the state during this same period among the counties' populations.

The inputs may produce a number of population-structure modifications such as change in sex and racial composition. However, for this research, the major structure change of concern was age structure modification as it was

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[31]Hall and Fagen suggest that output from another system may be included as part of another system. See: Hall and Fagen, "Definition of System," p. 20.

TABLE 1.1

CALIFORNIA DEATH RATES, 1950-1969
(per 1,000 population)

Year	Rate	Year	Rate
1950	9.3	1960	8.5
1951	9.3	1961	8.4
1952	9.4	1962	8.3
1953	9.1	1963	8.4
1954	8.7	1964	8.4
1955	8.8	1965	8.2
1956	8.8	1966	8.3
1957	8.7	1967	8.1
1958	8.5	1968	8.2
1959	8.4	1969	8.4

Source: State of California, California Statistical Abstract, 1970 (Sacramento: California State Printing Office, 1970), p. 11.

effected by migration.

The interaction of population-structure changes with socio-economic-structure variables was theorized as yielding a modified socio-economic structure. While population-structure change may have several dimensions, the focus of this research was on what socio-economic-structure modifications might be associated with change in the aged population composition of an area. Since a modified socio-economic structure acts as an input, a feedback loop was introduced in the model which connected the output with the model's

initial inputs.

"What distinguishes a geographer's approach to the model from that of others who study population?" is a question for consideration at this point. For the inputs and structure-interaction components described above are of equal interest to demographers, sociologists or population biologists; treatment of such topics by a geographer does not provide sufficient justification upon which to base a research project.

The answer to this posed question is found in the geographer's view of the model's output phase. "Geographers have long believed that correlations of spatial distributions and the processes by which such distributions occur and change, are among the most ready keys to understanding existing or developing life systems, social systems or environmental changes."[32] But: "It is not distributions themselves which excite geographers, but rather the fact that distributions vary in pattern and intensity from place to place."[33] Thus, the impact of change in population age-

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[32]National Academy of Sciences, The Science of Geography (Washington, D.C.: National Academy of Sciences, 1965), p. 1.

[33]Ronald Abler, John S. Adams and Peter Gould, Spatial Organization: The Geographers' View of the World (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971), p. 56.

structure upon socio-economic structure is likely to vary among various areal units. Therefore, the output phase of the model is identified not just as a modified socio-economic structure, but as also having a spatial component. Spatial arrangements and possible causes of these arrangements of modified socio-economic structure are the major concerns of this research on a geography of aged-impact.

Mechanisms of Aging

The age of an individual may be defined as the accumulation of years lived, while aging is the process of his aggregating these years. However, when total population rather than individuals is analyzed important distinctions must be considered.

> The age of a population, or an aggregation of persons, is not so simply determined. It may be conceived as either the aggregate age of all of its members, or by some measure of central tendency such as an arithmetic average or a median. The age of an aggregation of persons is also unique to a population and changes with the course of time. But unless the population is a closed one, this, subject neither to increase nor to decrease by reason of fertility, mortality, or migration, the age of a population does not necessarily increase over time.[34]

Thus, while aging is a non-reversible process with a single

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[34]Philip M. Hauser and Raul Vargas, "Population Structure and Trends," in Aging in Western Societies, ed. by Ernest W. Burgess (Chicago: University of Chicago Press, 1960), pp. 29-53.

individual, it is not necessarily the case with a population of individuals. With respect to the aging process, the individual is in a sense a closed system. The aging process, once begun, cannot be reversed and progresses until the death of the individual.

This reversibility versus non-reversibility of aging process is an important difference distinguishing an individual from a population. Human populations are not closed systems; rather, new members are added input while former members depart, and therefore a population's age may increase or decrease, depending upon the age of the added and departed members in relation to the remaining population. This addition and loss of members varies in time and space; it is the spatial characteristic that is of concern to the geographer.

Several mechanisms working individually or in concert can induce population aging in a given areal unit: (1) a lowering of mortality; (2) a decrease in the birth rate; (3) the emigration of younger population; or (4) the immigration of older persons.[35] Although all can contribute

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[35]Ansley J. Coale, "How a Population Ages or Grows Younger," in Population: The Vital Revolution, ed. by Ronald Freedman (Garden City, New Jersey: Doubleday, 1964), pp. 47-58.

to aging, the two migration elements exert the greatest influence. Zelinsky states: ". . . mortality differentials are trifling as a causative factor of aging as compared with migration movements, and fertility differentials are only slightly more relevant."[36] Since migration usually involves a larger number of additions and/or subtractions than are effected by the biological factors, it is reasonable to assume that migration does cause populations to fluctuate more radically in age composition over shorter periods. Aging, then, may be stated as:

$$A = f(O_m, I_m, D_r, B_r)$$

where:

O_m = the emigration of younger population

I_m = the immigration of aged persons, defined as those sixty-five and older

D_r = the decrease in mortality

B_r = the decrease in fertility

Since migration is a key element in the population aging process, the function of migration needs further clarification. Various population processes are important

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[36]Wilbur Zelinsky, "Toward a Geography of the Aged," Geographical Review, LVI (1966), p. 445.

in the development of social organizations,[37] and migration is such a process.

Migration analysis has witnessed a variety of approaches. Some studies develop theoretical frameworks for migration study.[38] Other research analyzes migration and social change,[39] population projections,[40] or community change.[41] One of the largest portions of migration

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[37]For a detailed treatment of this topic, see: James M. Beshers, Population Processes and Social Systems (New York: The Free Press, 1967).

[38]For a classical treatise, see: E. G. Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society, LII (1889), pp. 241-301. Two more recent works are: William Petersen, "A General Typology of Migration," American Sociological Review, XXIII (1958), pp. 256-266; and Everett S. Lee, "A Theory of Migration," Demography, III (1966), pp. 47-57.

[39]See: W. Parker Mauldin, "Selective Migration from Small Towns," American Sociological Review, V (1940), pp. 748-758; and Donald J. Bogue, "The Quantitative Study of Social Dynamics and Social Change," American Journal of Sociology, LVII (1952), pp. 565-568.

[40]See: H. ter Heide, "Migration Models and Their Significance for Population Forecasts," Milbank Memorial Fund Quarterly, VII (1963), pp. 56-76; and Henry V. Stanbery, Some New Techniques of Area Population Projection; With Illustrative Projections of California's Population (Los Angeles: John Randolph Haynes and Dora Haynes Foundation, 1960).

[41]W. H. Harlan, "Community Adaptation to the Presence of Aged Persons: St. Petersburg, Florida," American Journal of Sociology, LIX (1954), pp. 332-339.

literature deals with its economic aspects.[42] There is substantial literature dealing with migration and its spatial ramifications.[43] Although most of the studies on migration have not treated migration and aged population, some interest in this topic is appearing in published research.[44]

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[42]Contributions to the study of migration and its economic ramifications come from a number of academic fields. For example, see: Carter Goodrich, Migration and Economic Opportunity (Philadelphia: University of Pennsylvania Press, 1936); Daniel O. Price, "Some Socio-economic Factors in Internal Migration," Social Forces, XXIX (1951), pp. 409-415; Robert Dorfman, "Economic Implications of an Aging Population: Review of the University of California Research Project," American Economic Review, XLIV (1954), pp. 634-679; Conrad Taeuber, "Economic and Social Implications of Internal Migration in the United States," Journal of Farm Economics, XLI (1959), pp. 1141-1151; Andrei Rogers, An Analysis of Interregional Migration in California (Berkeley: University of California, Center for Planning and Development, 1965); John B. Parr, "Outmigration and the Depressed Area Problem," Land Economics, XLII (1966), pp. 149-159; and L. E. Gallaway, "Aged and the Extent of Poverty," Southern Economic Journal, XXXIII (1966), pp. 212-222.

[43]For recent examples, see: Curtis C. Roseman, "Migration, The Journey to Work, and Household Characteristics: An Analysis Based on Non-Areal Aggregation," Economic Geography, XLVII (1971), pp. 467-474; Robert E. Norris, "Migration as Spatial Interaction," Journal of Geography, LXXI (1972), pp. 294-301; and Paul Schwind, Migration and Regional Development in the United States, 1950-1960 (Chicago: University of Chicago, Department of Geography, Research Paper 143, 1971).

[44]A recent example is: George A. Schnell, "Geographic Association Between Migration and Selected Aspects of Age Structure," Proceedings, Pennsylvania Academy of Science, XLIII (1969), pp. 153-156.

Age selectiveness of migration and its relationship to economic conditions are two topics that have been investigated theoretically and empirically. In his paper, "The Laws of Migration," Ravenstein cited economic conditions as a major factor in decisions to migrate.[45] Although noting that certain negative conditions in a given locale influence these decisions also, he felt that: ". . . none of these currents can compare in volume with that which arises from the desire inherent in most men to 'better' themselves in material respects."[46]

This same theme has been considered in more recent decades. Price notes that there is a degree of difficulty in studying reasons for migration, but that economic factors often play a major role in a decision to move.[47] He states that: "In general, people move in order to improve their circumstances, the most special reason being to improve economic circumstances."[48]

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[45]E. G. Ravenstein, "The Laws of Migration," Journal of The Royal Statistical Society, LII (1889), pp. 241-301.

[46]Ibid., p. 286.

[47]Daniel O. Price, "Some Socio-Economic Factors in Internal Migration," Social Forces, XXIX (1951), pp. 409-415.

[48]Ibid., p. 409.

Another researcher, Conrad Taeuber, also comments on the influence of economic conditions as significant forces in directing a migration stream: ". . . migration has been a major means whereby people respond to the frequent and marked differentials in economic opportunities in various parts of the country."[49] Although Taeuber, too, admits that certain other factors influence individual decisions to migrate, he feels that: ". . . the economy has relied on choices of individuals in search of better opportunities as a means of bringing people to the locations where they can take advantage of these superior opportunities."[50] In a similar vein, Lee makes the point that: "The efficiency of a migration stream varies with economic conditions, being high in prosperous times and low in times of depression."[51]

These studies illustrate some research that has coupled economic opportunity and migration. But those persons who seek material gain through migration are often the younger members of the labor force. Taeuber notes that

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[49]Conrad Taeuber, "Economic and Social Implications of Internal Migration in the United States," Journal of Farm Economics, Part II, XLI (1959), p. 1141.

[50]Ibid., p. 1143.

[51]Everett S. Lee, "A Theory of Migration," Demography, III (1966), p. 56.

this has been especially true among rural-farm populations: ". . . a large proportion of migrants from farms were young people ready to enter the labor market at their new locations."[52]

The aged portion of the population has been characterized as being less inclined to migrate. Evidence to the contrary is suggested by Hitt: "Available evidence, however, indicates that the elderly people have been migrating in considerable numbers. Their movement unquestionably has assumed genuine significance in some of the areas on the receiving end of the transfer."[53] In a more recent study on the distribution of the elderly, Schnell points out that: "Migration and its age selectiveness has been assumed to be the single most important factor in accounting for such local differences in the distribution of the elderly."[54] Schnell further reported in his study that migration of the elderly, rather than just emigration of

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[52]Conrad Taeuber, "Economic and Social Implications of Internal Migration in the States," loc. cit., p. 1145.

[53]Homer L. Hitt, "The Role of Migration in Population Change Among the Aged," American Sociological Review, XXI (1954), p. 94.

[54]George A. Schnell, "Factor Affecting Recent Trends of the Aged Population: A Case Study," Aging and Human Development, I (1970), p. 219.

youthful population, has changed the distribution of the elderly. Thus, an increase in the proportion of aged population in a given spatial unit may be the result of several age-specific migration streams. Migration, then, is considered to be a meaningful part of the conceptual framework of aged-impact analysis.

Impact of Aged Population

The impact of aged population in this study was approached through the analysis of the interaction between age-structure change and socio-economic-structure change. Such interaction has been documented in several works.[55] However, even though these studies directed attention to interaction between these two structures, often the emphasis was on the impact of the socio-economic change as such change influenced population structure. In this study the structures' positions have been reversed.

A characteristic common among the world's cultural groups is that most function as age-graded societies. That is, social, economic and personal interaction within the

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[55]For examples of these works, see: John J. Corson and John W. McConnell, Economic Needs of Older People (New York: The Twentieth Century Fund, 1965); and Ida Harper Simpson and John C. McKinney, eds., Social Aspects of Aging (Durham, North Carolina: Duke University Press, 1966).

context of the given society is based upon role allocation by age group. How precisely defined these roles are varies with the culture.

The collective behavior of aged population is, in part, a response to role-assignment based upon age-grouping. "Age, as reckoned by society, is a statement of behavioral expectations at given points in the life-span. These expectations relate less to the individual's ability to undertake a task than they do to society's definition of appropriate behavior for him as a member of a particular age group."[56] Thus, certain behavioral roles are expected of both individuals and age-groups in our society.

One such age-group role commonly assigned to the latter portion of the life-cycle is retirement. Upon reaching a given age (generally between sixty and sixty-five) the individual is expected to withdraw from the labor force and to assume the role-characteristics of retirement, however vague may be the definition of these characteristics.[57] In

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[56]Eugene A. Friedmann, "The Impact of Aging on the Social Structure," in Handbook of Social Gerontology: Societal Aspects of Aging, ed. by Clark Tibbitts (Chicago: University of Chicago Press, 1960), p. 120.

[57]Kurt W. Back, "The Ambiguity of Retirement," in Behavior and Adaptation in Late Life, ed. by Ewald W. Busse and Eric Pfeiffer (Boston: Little, Brown and Company, 1969).

general: "Employment and retirement practices call for decreasing participation of elders in the labor force."[58]

Whether the acceptance of the retirement role is voluntary or forced, for most aged persons the role directly affects their income. For many elderly, retirement means a reduction in income, thus creating an economic gap between the older and younger population.[59] "Low incomes, now the number one problem of the aged, are likely to persist."[60] Thus, at retirement the elderly person's relationship to his total environment (social, psychological and physical) is often couched in reference to his financial situation. Accordingly, Vance states that:

> Retirement from the labor force might well be accepted as the crucial act in determining the ecology of the aging. Here possibly for the first time in

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[58]John C. McKinney and Frank T. de Vyver, "Introduction," in Aging and Social Policy, ed. by John C. McKinney and Frank T. de Vyver (New York: Appleton-Century-Crofts, 1966), p. 3.

[59]Since the beginning of the 1960's this income gap has widened. See: Economics of Aging: Towards a Full Share in Abundance. Prepared by a Task Force (Dorothy McCamman, Juanita M. Kreps, James H. Schulz, Agnes W. Brewster, and Harold L. Sheppard) for the Special Committee on Aging, United States Senate, 91st Congress, 1st Session, March, 1969.

[60]Juanita M. Kreps, "Economics of Retirement," in Behavior and Adaptation in Late Life, ed. by Ewald W. Busse and Eric Pfeiffer (Boston: Little, Brown and Company, 1969), p. 72.

> their mature lives, individuals find themselves in the position where the place they reside is not determined by the requirements of the job. From now on they can be oriented to their own needs as consumers rather than to the demands the economy has placed upon them as producers. This is a situation which cuts both ways. If ever they wanted leisure to spend, they have it now. If ever they lacked money with which to spend leisure it is probable they will lack it now.[61]

With retirement often comes the re-evaluation of place utility. Factors that had been important at a particular location during the active working years, may no longer be considered significant. Thus: "The decision to move to a particular place is based upon knowledge of the place in which one lives at present and knowledge of the places to which one might move, that is, an evaluation of place utility for all those places for which one has information."[62] Upon retirement, then, some elderly will seek more attractive areas. Vance suggests: ". . . that migration of the aged is a function of economic position with the suggestion that the most likely migrants at older ages will be those with retirement incomes.[63] If this supposition

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[61]Rupert B. Vance, "The Ecology of Our Aging Population," Social Forces, XXXII (1954), pp. 330-335.

[62]Kevin R. Cox, Man, Location, and Behavior: An Introduction to Human Geography (New York: John Wiley and Sons, Inc., 1972), p. 80.

[63]Rupert B. Vance, "The Ecology of Our Aging Population," loc. cit., p. 331.

is correct, then migrating elderly are more likely to have retirement incomes that enable them to move in the first place and incomes that would allow them to become active consumers at their new locations.

On the other hand, areas where aging population structures have evolved by the outmigration of younger persons, the socio-economic structure characteristics are apt to exhibit less change. In such cases, the labor forces are likely to contain higher proportions of older workers than would be the case in retirement counties. Where such a situation exists, the older workers' continued active participation in the labor force may be due to economic necessity. Spengler has noted: ". . . that the older individual's demand for employment will be affected by the extent to which the purchasing power of his savings is diminished by uncompensated inflation."[64] The lack of opportunities that would lead the younger population to decisions to migrate may continue to cause hardships on the older population who remain. For: ". . . outmigration does not necessarily lead to prosperity, since the aggregate level of

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[64]Joseph J. Spengler, "Some Economic and Related Determinants Affecting the Older Worker's Occupational Role," in Social Aspects of Aging, ed. by Ida Harper Simpson and John C. McKinney (Durham, North Carolina: Duke University Press, 1966), p. 41.

services may fall, and since the migration tends to abandon the area to the least productive, especially the elderly."[65]

The aged are becoming a more significant component of the nation's population. Whether or not they may evolve characteristics of a distinctive minority group is currently being debated.[66] What is important at this juncture is that research be directed towards adding to our limited knowledge of what impacts might be associated with population aging. To this end this study was directed.

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[65]Richard L. Morrill and Ernest H. Wohlenberg, The Geography of Poverty (New York: McGraw-Hill Book Company, 1971), p. 58.

[66]For example, see: Erdman Palmore, "Sociological Aspects of Aging," in Behavior and Adaptation in Late Life, ed. by Ewald Busse and Eric Pfeiffer (Boston: Little, Brown and Company, 1969), especially pages 47 through 57.

CHAPTER II

METHODOLOGY

The research model developed in Chapter I is suitable for conceptualizing the study of aged-impact. Its function is to identify compositional elements and to suggest a structural arrangement of these elements. In addition, the model suggests how these several components may interrelate with each other. Such a research model requires a precise statement of methodology because the methods are not immediately evident within the model itself. The purpose of this chapter is to outline the methodological framework that is to be used to operationalize the relationships among the model elements.

The model-structure suggested the methodological sequence. First, the input element--migration--was examined with respect to its influence on inducing population structure aging. The second phase involved what was termed "change-linkage;" change in age structure was examined with respect to possible inducement of change in socio-economic

structure. More precisely, the first phase identified the migration mechanisms most responsible for population aging, i.e., in-migration of the aged versus outmigration of younger population. Phase two evaluated possible differences in socio-economic change that might be attributed to differences by which the aged population evolved.

Estimating Net Migration

Migration has been suggested earlier as possibly the more significant of the initial inputs that operate to modify a population age-structure. Therefore, prior to analysis of aged-impact, the dimensions of migration, as related to population aging, were examined.

Numerous techniques for estimating migration exist,[1] and were found to be most often used separately in migration analysis. Two of these methods, the vital statistics method and the forward survival rate method, were used in a combined approach for developing estimates of net migration[2] for this

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[1]See: C. Horace Hamilton, "Practical and Mathematical Considerations in the Formulation and Selection of Migration Rates," Demography, II (1965), pp. 429-443; and with F. M. Henderson, "Use of the Survival Rate Method in Measuring Net Migration," Journal of the American Statistical Association, XXXIX (1940), pp. 197-206.

[2]For explanatory discussion of each method, see Appendix A of this study.

study.

The vital statistics method is a technique that makes use of birth and death data;[3] the forward survival rate method is used for producing estimates of net migration for age cohorts. The vital statistics estimates were used as a check on the accuracy of the cohort estimates generated by the survival rate technique since the vital statistics estimates were assumed to be the more accurate of the two techniques because these were computed from actual birth and death data.[4] If the cohort estimates approached the vital statistics totals, then the chances of error in making inferences about the age of the migrants should be minimized. Bogue commented that: ". . . where vital statistics data are available, some greatly improved and more detailed results can be obtained by using methods simultaneously."[5]

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[3]The birth and death data are shown in the research model in Chapter I as the "biological elements." Thus, the inclusion of this technique allows for the introduction of the second initial input of the model.

[4]For an explanation as to why these two estimates may be different when applied to the same population, see: Jacob S. Siegel and C. Horace Hamilton, "Some Considerations in the Use of the Residual Method of Estimating Net Migration," Journal of the American Statistical Association, XLVII (1952), pp. 475-500.

[5]Donald L. Bogue, "Internal Migration," in The Study of Population, by Philip M. Hauser and Otis Dudley Duncan (Chicago: University of Chicago Press, 1969), p. 493.

The purpose of the first phase of analysis was to: (1) identify the evolution of the aged population structures in California; and (2) inquire into the role of migration as it influenced a population age-structure as implied in the research model. This first phase was considered to be a necessary step prior to aged-impact analysis.

Aged-Impact Analysis

The research model presented in Chapter I assumed interaction between a population age-structure and a socio-economic structure. The model also implied that aged population was but one of several possible population-structure modifications that might be involved in such interaction.

Data Format

The study of aged-population impact on a socio-economic structure was organized around two data matrices. One matrix contained population-structure variables; the second was composed of selected socio-economic variables. The variables in each matrix were derived by:

$$(1) \qquad PC_{ij} = \frac{RV_{ij}\,(t+1) - RV_{ij(t)}}{RV_{ij(t)}}\,(k)$$

where:

PC_{ij} = percent change in variable $\underline{i}$ for county $\underline{j}$

RV_{ij} = recorded variable i for county j

(t+1) = a latter decade

(t) = a preceding decade

k = a constant

The population-structure matrix will be referred to hereafter as the age-change matrix; the socio-economic-change matrix will identify the second set of variables.

The age-change matrix. The purpose of the age-change matrix was to establish basic dimensions of a population structure using an age criterion. For as Coulson has noted:

> The age structure of a population is a description of that population according to the age of each of its members. For practical purposes, five-year age groups are usually used; each member of the study population is assigned to the appropriate age group. The age structure of that population then becomes a description of the relative size of various age groups. Age structure will vary from one population over the course of time.[6]

The variables composing the age-change matrix were five-year age groups, commonly referred to as cohorts. The exact cohorts used in this study are shown in Table 2.1.

The research model implied that aged population was but one of several possible population-structure modifications that might occur as a result of the influence of the migration

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[6]Michael R. C. Coulson, "The Distribution of Population Age Structure in Kansas City," Annals, Association of American Geographers, LVIII (1968), p. 155.

and/or biological elements. While the concern of this study centered on the aged segment of a population structure, the entire age structure was incorporated into the impact analysis because single age segments are not isolated entities. Therefore, to consider only the aged population could magnify the chances of erroneous interpretation of aged-impact on a socio-economic structure.

TABLE 2.1

AGE COHORTS

0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75+

The socio-economic-change matrix. The second key matrix to be used in this study is a socio-economic-change matrix. The composition of this data-set differs from the age-change matrix in that no attempt is made to include all

possible variables that could be used to define a socio-economic structure. Rather, the matrix is circumscribed by selected variables, each of which may be sensitive to change in population-age structure.

The format of the data in the socio-economic-change matrix is the same as that of the age-change matrix. That is, each variable is expressed as a percentage of change in variable $\underline{i}$ for county $\underline{j}$, the format provided for by equation (1). In this way change in age structure and change in socio-economic variables have a common format, a desirable situation for later analysis of the two matrices.

The socio-economic-change matrix is specified by the eighteen variables listed in Table 2.2. The variables are chosen to identify three categories within the socio-economic structure that are assumed to be sensitive to population aging by the two migration types (from immigration of persons sixty-five and older or from the outmigration of younger population). These three categories are: (1) housing characteristics; (2) employment structure; and (3) sources of income within each areal unit. As noted above, all variables are expressed as percent change within a specific temporal dimension, the decade.

Housing characteristics are facets of socio-economic structures that have been successfully incorporated into a

TABLE 2.2

SOCIO-ECONOMIC VARIABLES

Variable Number	Title (Percent Change In)
1	Total housing units
2	The number of trailers
3	The number of owner-occupied housing units
4	The number of renter-occupied housing units
5	The number of females widowed
6	The number employed in services, except household
7	The number employed in sales
8	The number employed in transportation and other public utilities
9	The number employed in finance, insurance and real estate
10	The number employed in wholesale trade
11	The income from automotive sales
12	The income from gasoline service station sales
13	The income from apparel, accessory store sales
14	The income from furniture, home furnishings and equipment sales
15	The income from eating, drinking place sales
16	The income from lumber, building materials, and hardware sales
17	The income from food store sales

variety of studies. These data have been used as surrogate measures for the immediate living environment,[7] as variables in the analysis of spatial behavior of a particular age-group,[8] and as data in the examination of the spatial aspects of poverty.[9]

The inclusion of housing variables as a principal component of the socio-economic-change matrices is based on several conclusions drawn from other studies. First, the type and quality of housing for the elderly in California has been identified as varying significantly within the state.[10] Secondly, it has been shown that there has been a "decrease in the proportion of all potential elderly households living in the homes of relatives, from 22 percent in

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[7]David M. Smith, The Geography of Social Well-Being in the United States: An Introduction to Territorial Indicators (New York: McGraw-Hill Book Company, 1973).

[8]Stephen M. Golant, The Residential Location and Spatial Behavior of the Elderly (Chicago: University of Chicago, Department of Geography, Research Paper No. 143, 1972).

[9]Richard L. Morril and Ernest H. Wohlenberg, The Geography of Poverty in the United States (New York: McGraw-Hill Book Company, 1971).

[10]Rosabelle Price Walkley, Wiley P. Mangum, Jr., Susan Roth Sherman, Suzanne Dodds and Daniel M. Wilner, Retirement Housing in California (Los Angeles: University of California, Los Angeles, School of Public Health, 1966).

1950 to 15 percent in 1970"[11] in the United States. Lastly, in discussing the market for housing, it has been noted that: ". . . the 'market' for houses suited to the needs of the elderly is quite different from the market in which newly created households of younger couples shop."[12]

The housing component of the socio-economic-change matrix contains four variables. These are total housing units, the number of trailers, the number of owner-occupied housing units, and the number of renter-occupied housing units.

Upon reaching age sixty-five housing preferences of the elderly are those that have been developed prior to attainment of senior citizen status. Therefore: "The probability that senior citizens will make any substantial break from this housing pattern depends on three principal factors--their incomes or ability to pay for some improved type of housing, their preferences as to type of housing, and the nature of steps taken by private suppliers and public agencies to make improved housing available."[13]

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[11]Wallace F. Smith, Housing for the Elderly in California (Berkeley: University of California, Institute of Business and Economic Research, 1961), p. 2.

[12]Ibid., p. 2.

[13]Ibid., p. 3.

The specific variables chosen to represent the housing segment of the socio-economic matrices are those which might indicate a difference between population aging by the immigration of elderly population versus aging by the out-migration of younger population.

Four percent-change variables are incorporated in the socio-economic-change matrices related to housing. Percent change in total housing units (Variable 1) is used as a measure of private-public agency response to housing demand. In areas receiving older migrants, a higher positive percent-change in total housing units should be indicated that would be evident in the counties where residual population aging occurs. Variable 1 is therefore a general measure of the growth of housing.

The remaining three variables represent measures that define housing-type choices. Variable 2 (percent-change in the number of trailers) reflects the fact that an increasing amount of evidence indicates that older persons are purchasing mobile homes after retirement.[14] In an investigation of

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[14]A large proportion of the current literature dealing with the mobile home as a residence is industry-sponsored. However, an increasing number of studies are appearing that represent a more unbiased evaluation. For example, see: Robert E. Berney and Arlyn J. Larson, "Micro-Analysis of Mobile Home Characteristics with Implication for Tax Policy," Land Economics, XLII (November, 1966), pp. 453-463; Robert

retirement housing in California, one significant finding was that an increasing number of mobile home parks are oriented towards retired persons as dwellers.[15] However, an examination of the study data reveals that the majority of these facilities are developed or being developed in counties where inmigration of the elderly has been the major population aging mechanism.

Percent-change in the number of owner-occupied housing units (Variable 3) and percent-change in the number of rent-occupied housing units (Variable 4) represent the owner versus renter dichotomy. Elderly persons do represent a sizeable number of homeowners. "It is possible, however, that many elderly homeowners find themselves 'locked in' to their present arrangement because the market value of their home is less than its value to them as housing."[16] There-

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Mills French and Jeffrey K. Hadden, "An Analysis of the Disbrituion and Characteristics of Mobile Homes in America," Land Economics, XLI (May, 1965), pp. 131-139; and Robert Cassidy, "The Needed Revolution in Mobile Homes," Planning, XXXIX (December, 1973), pp. 12-18.

[15]Rosabelle Price Walkley, et al., Retirement Housing in California (Los Angeles: University of California, Los Angeles, School of Public Health, 1966); see especially pages 66-72.

[16]Wallace F. Smith, Housing for the Elderly in California (Berkeley: University of California, Institute of Business and Economic Research, 1961), p. 5.

fore, where aging of population has occurred by the out-migration of younger persons, there is apt to be less change in home ownership because these areas may lack suitable alternatives, thus forcing elderly owners to retain their homes. A reverse situation may be the case with respect to percent-change in renter-occupied units. Areas of inmigration of elderly persons may witness increased demand for units that may be rented.

Employment and sources of income within the county represent the second and third components of the socio-economic matrices. The employment segment is composed of five variables expressed as the percent-change in the number of persons employed in: services, except household (#6); sales (#7); transportation and other public utilities (#8); finance, insurance and real estate (#9); and wholesale trade (#10). The income sector is composed of variables that represent income from durable and nondurable goods. The durable class variables are: automotive sales (#11); furniture, home furnishings and equipment sales (#14); and lumber, building materials and hardware sales (#16). The nondurables are represented by: gasoline service station sales (#12); apparel, accessory store sales (#13); eating, drinking place sales (#15); and food store sales (#17).

While there exists conflicting opinions on the

precise nature of the spending habits of the elderly, there is agreement that: "Since the consumption patterns of older people generally vary from those of younger people, the increasing demands for goods and services by older people are having substantial impact upon business and industry."[17]

Differences may exist in the consumptive patterns of migrant and nonmigrant elderly and thus a difference in the impact on the socio-economic structure between areas that have aged by immigration of elderly population versus aging by loss of younger population. These differences could be based on the supposition examined in Chapter I (see supra, p. 29 and n. 63, p. 30) that the elderly who have migrated are more likely to have incomes that are more apt to allow them to continue to be active consumers than their nonmigrant counterparts. If such is the case, then areas that have aged by immigration of elderly should also witness increases in employment and sources of income within these communities.

Lastly, sex ratio differences may also exist between migrant and nonmigrant elderly population. Therefore, the percent-change in the number of females widowed (Variable #5)

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[17]Herman Loether, Problems of Aging: Sociological and Social Psychological Perspectives (Belmont, California: Dickenson Publishing Company, Inc., 1967), p. 103.

is included in the socio-economic-change matrices. It has been documented for the United States as a whole that: "In 1960 there were more than 4.5 million widows aged 65 and over, compared to about 1.3 million widowers in the same category."[18] Now, if one assumes that migrating elderly are likely to be older couples,[19] then in areas where population aging has been by means of the immigration of elderly population, the accumulation of elderly, widowed females is more likely than where aging has resulted from the out-migration of younger population.

Change-Matrix Analysis

The two change-matrices identified earlier in this chapter were composed of a number of variables, each variable representing only a small portion of the total change suggested by the entire matrix. However, these single observations may be grouped, thus identifying a fewer number of factors. Such collapsing of matrix variables will be accomplished by the application of principal component factor

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[18] Ibid., p. 100.

[19] Such an assumption seems logical when one considers that the death of a spouse requires adjustment in life-style but this adjustment may not include a radical change in residence for economic as well as psychological reasons. See: Loether, Problems of Aging: Sociological and Social Psychological Perspectives, especially Chapter 8.

analysis.[20]

> Factor analysis can be applied in order to explore a content area, structure a domain, map unknown concepts, classify or reduce data, illuminate casual nexuses, screen or transform data, define relationships, test hypotheses, formulate theories, control variables or make inferences.[21]

Thus, the first step in the study of the relationships between the two matrices will be to factor analyze each matrix in order to extract variable groupings or factors. These clusters will then be used in further analysis, because: ". . . factor analysis is seldom employed for statistical inference, although many social scientists consider it a statistical method."[22]

Change-linkage analysis. While the factor analysis of the two change matrices used in this study provides for

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[20]Several valuable references are available on factor analysis. For early works, see: Raymond B. Cattell, Factor Analysis: An Introduction and Manual for the Psychologist and Social Scientist (New York: Harper and Brothers Publishers, 1952); and Benjamin Fruchter, Introduction to Factor Analysis (Princeton, New Jersey: D. Van Nostrand Company, Inc., 1954. More recent treatment of the topic is found in: Harry H. Harman, Modern Factor Analysis (2nd ed.; Chicago: University of Chicago Press, 1967); and R. J. Rummel, Applied Factor Analysis (Evanston, Illinois: Northwestern University Press, 1970. A less technical but excellent introduction is: R. J. Rummel, "Understanding Factor Analysis," Journal of Conflict Resolution, XI (1967), pp. 444-480.

[21]R. J. Rummel, "Understanding Factor Analysis," p. 448.

[22]Ibid., p. 452.

the possible identification of factor dimensions, it is not likely to supply any knowledge about possible linkage between these factor-sets. The second phase of the matrices-analysis will attempt to establish a connection between change in age structure and change in socio-economic structure; the term change-linkage analysis is applied to this procedure.

Change-linkage analysis is to be executed using step-wise multiple correlation. The dependent variables are the factor scores for each county extracted from the data in each socio-economic-change matrix. The factor scores represent a composite index for variables within the given factor. As Rummel noted: "These composite variables made up of factor scores can be used in other analyses or as means of comparing cases on the factor."[23] The independent variables are the factor scores from the age-change matrix. By application of stepwise multiple correlation the independent variables (in this case age structure dimensions) will be introduced into the equation in the order that each contributes to reducing the amount of unexplained variation. Since the correlation model assumes that the predictor variables are independent of each other, orthogonal factor

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[23]R. J. Rummel, Applied Factor Analysis, p. 132.

rotation is to be employed in factoring the data matrices because it identifies uncorrelated variable clusters, thus, orthogonal factors have: ". . . amenability to subsequent manipulation and analysis."[24]

The Study Area

The State of California is currently struggling to solve a variety of man-land problems. Such questions as agricultural land preservation, distribution of water resources, adequate management of solid waste, problems of air and water pollution and protection of open space for recreation are among key issues being dealt with by local and state decision-makers. Many of these issues are related to the distributional pattern and growth characteristics of the state's population.[25] In order to make the necessary planning decisions needed to cope with these problems, state and local agencies will require research

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[24] Ibid., p. 388.

[25] For an excellent overview of the distributional character of California's population, see: Howard F. Gregar, "Spatial Disharmonies in California Population Growth," Geographical Review, LIII (1963), pp. 100-122. A summary of problems can be obtained from two useful publications: Samuel E. Wood and Alfred E. Heller, California Going, Going..., (Sacramento: California Tomorrow, 1962); and Samuel E. Wood and Alfred E. Heller, The Phantom Cities of California (Sacramento: California Tomorrow, 1963).

data that can be used to guide implementation of courses of action taken to deal with these problems.

A phenomenon increasingly evident in rural America and one of particular concern in California is the growth of "second home" communities.

> Much of rural America is experiencing a surge of urbanization as a result of the boom in recreational land development. The subdivision of farms, woodlands, shorelands and deserts into recreational lots and leisure home communities is having a wide range of urban impacts on rural areas--on their natural environments, on their economies, and on the general social and political character of rural life itself.[26]

These are the "seasonal cities" of California.[27] "Probably the most striking aspect of this urbanization process is that leisure homes tend to become first homes over time, sometimes more quickly than expected."[28]

Throughout rural California these leisure home communities have become peopled predominantly by retired persons, or lots are purchased as sites for later retirement by urban dwellers. The morphology of the communities varies

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[26]David R. Mosena and Frank J. Popper, "Leisure Homes Urbanize the Countryside," Planning, XXXIX (August, 1973), p. 18.

[27]Samuel E. Wood and Alfred E. Heller, The Phantom Cities of California (Sacramento: California Tomorrow, 1963), p. 51.

[28]David R. Mosena and Frank J. Popper, "Leisure Homes Urbanize the Countryside," p. 19.

from single-family residences to large condominiums and mobile parks designed and advertised exclusively for adults.

Knowledge of the impact of aged population can be a valuable planning tool. Currently a number of California counties are faced with the need to provide adequate services to growing leisure communities or to plan for those which are being proposed by land developers. Thus, knowledge of the impact of aged population on socio-economic structure can be of immediate value to local decision-makers throughout California.

CHAPTER III

MIGRATION INDUCED AGING

The hypothesis was set forth in Chapter I that the impact of aged population varied according to the migration form by which a population aged. To test such a hypothesis it is necessary to examine the degree of population aging among the fifty-eight counties of California. Secondly, the input element--migration--in the model is surveyed with respect to its possible influence upon age-structure to determine the relationship between net migration patterns and the aging process.

Population Aging in California: Overview

The coefficient of old age[1] was used as the device for identification of population-structure age. This coefficient was expressed as:

$$W_{65+} = \frac{{}^{1}65+}{L} \text{ (k)}$$

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[1]Edward Rosset, Aging Process of Population, translated by I. Doboza, R. Janikowska, K. Kozlawsha and W. Skibicki (New York: The MacMillan Company, 1964), p. 10.

where:

W_{65+} = coefficient of old age

1_{65+} = number of persons age sixty-five and over in the county

L = total population of the county

k = constant

For each county a coefficient was calculated for four decades, 1940 to 1970, in order to add temporal breadth. These coefficients for each decade are shown in Table 3.1.

TABLE 3.1

COEFFICIENTS OF OLD AGE, 1940-1970

County	Year			
	1940	1950	1960	1970
U.S.	6.85	8.14	9.04	9.89
STATE	8.34	8.52	8.81	9.09
Alameda	8.52	8.64	9.15	10.00
Alpine	7.12	9.96	11.58	10.92
Amador	9.12	10.84	12.73	13.64
Butte	9.73	10.58	13.29	14.17
Calaveras	9.67	10.85	14.56	16.31
Colusa	8.95	9.69	11.61	11.65
Contra Costa	5.15	4.07	5.52	6.93
Del Norte	10.01	8.76	5.76	9.50
El Dorado	9.03	10.09	8.46	9.72
Fresno	6.40	6.86	8.06	9.08
Glenn	8.77	9.11	10.52	12.64
Humboldt	8.46	7.85	6.88	8.67
Imperial	3.05	4.17	7.00	7.42
Inyo	6.81	6.72	9.57	11.59
Kern	4.00	4.83	6.34	7.94

TABLE 3.1--Continued

COEFFICIENTS OF OLD AGE, 1940-1970

County	Year			
	1940	1950	1960	1970
Kings	5.06	5.84	8.00	7.01
Lake	12.60	14.71	19.92	22.92
Lassen	4.23	5.38	9.06	9.08
Los Angeles	8.50	9.09	9.00	9.23
Madera	4.81	6.15	8.00	10.97
Marin	7.21	7.35	6.00	7.34
Mariposa	7.40	12.17	14.00	16.31
Mendocino	9.91	9.58	9.00	11.05
Merced	5.12	5.70	6.00	7.35
Modoc	6.49	6.41	9.00	11.90
Mono	5.00	6.62	6.00	6.52
Monterey	5.45	5.54	6.00	7.44
Napa	12.57	12.31	14.00	13.47
Nevada	7.31	11.82	15.00	16.91
Orange	9.23	9.71	6.00	6.95
Placer	7.56	10.56	11.00	10.23
Plumas	4.52	6.10	8.00	10.56
Riverside	8.45	9.82	10.00	13.12
Sacramento	7.00	7.63	6.00	7.04
San Benito	8.08	8.97	10.00	10.34
San Bernardino	8.45	8.72	8.00	9.52
San Diego	9.41	8.06	7.00	8.73
San Francisco	8.15	9.55	12.00	13.92
San Joaquin	7.37	7.76	9.00	10.21
San Luis Obispo	9.34	10.31	11.00	12.30
San Mateo	5.83	6.26	6.00	7.62
Santa Barbara	7.53	9.20	9.00	9.10
Santa Clara	9.20	8.89	6.00	6.06
Santa Cruz	12.58	14.83	19.00	16.63
Shasta	5.69	7.19	7.00	8.91
Sierra	8.09	10.41	7.00	12.75
Siskiyou	6.54	8.11	9.00	11.33
Solano	6.25	4.89	11.00	6.67
Sonoma	10.96	11.03	12.00	12.82
Stanislaus	7.66	8.42	10.00	10.24
Sutter	6.88	7.20	8.00	8.37

TABLE 3.1--Continued

COEFFICIENTS OF OLD AGE, 1940-1970

County	Year			
	1940	1950	1960	1970
Tehama	10.82	10.30	10.00	11.61
Trinity	8.99	10.05	6.00	10.18
Tulare	5.55	6.65	8.00	9.95
Tuolumne	9.91	11.43	12.00	12.44
Ventura	5.78	6.65	7.00	6.69
Yolo	8.11	7.81	7.00	3.24
Yuba	7.05	7.43	7.00	6.68

Source: Computed by the author.

A brief examination of Table 3.1 revealed several general points. First, population aging for the state had been a very gradual process. Between 1940 and 1970, the coefficient for the entire state rose from 8.34 to only 9.09. This probably was a reflection of the fact that the migration streams to the state during these decades had been dominated by younger, job-seeking migrants. Secondly, population aging was not a continuous process in all counties since 1940. One group of county populations that could be distinguished had experienced a gradual increase in the proportion of persons age sixty-five and older, a pattern similar to that of the state as a whole; Alameda, Kern, Merced, Monterey, San Mateo and Sutter Counties represented such a trend. A

reverse course was evident in the figures for Yolo and Yuba Counties; the direction was one of a gradual decline in the coefficient. In addition, several other counties witnessed a period of increased aging, then a sharp decrease in one decade followed by an increase. This situation was evident in the data for Del Norte, Modoc and Trinity Counties. A final observation was that, of the fifty-eight counties, thirty-seven reached the highest coefficient in 1970.

Using the computed coefficients of old age as an index, a sequence of maps was prepared and appears as Figures 3.1, 3.2 and 3.3. (See Appendix B for a reference map of county location and identification). By the end of the decade 1920-1930, the distribution of counties with older age structures[2] is shown in Figure 3.1a. Immediately north of San Francisco Bay and located in the Coast Ranges, three counties, Lake, Napa and Sonoma, formed the only contiguous district. Two isolated counties, Del Norte on the California-Oregon border, and Tehama, athwart the northern portion of the Sacramento Valley, comprised the remainder of the distribution north of San Francisco. One additional coastal county, Santa Cruz, completed the distribuion of older

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[2]Older age structure is defined here as those counties with a coefficient greater than 10.00 which is above the state figure of 8.34.

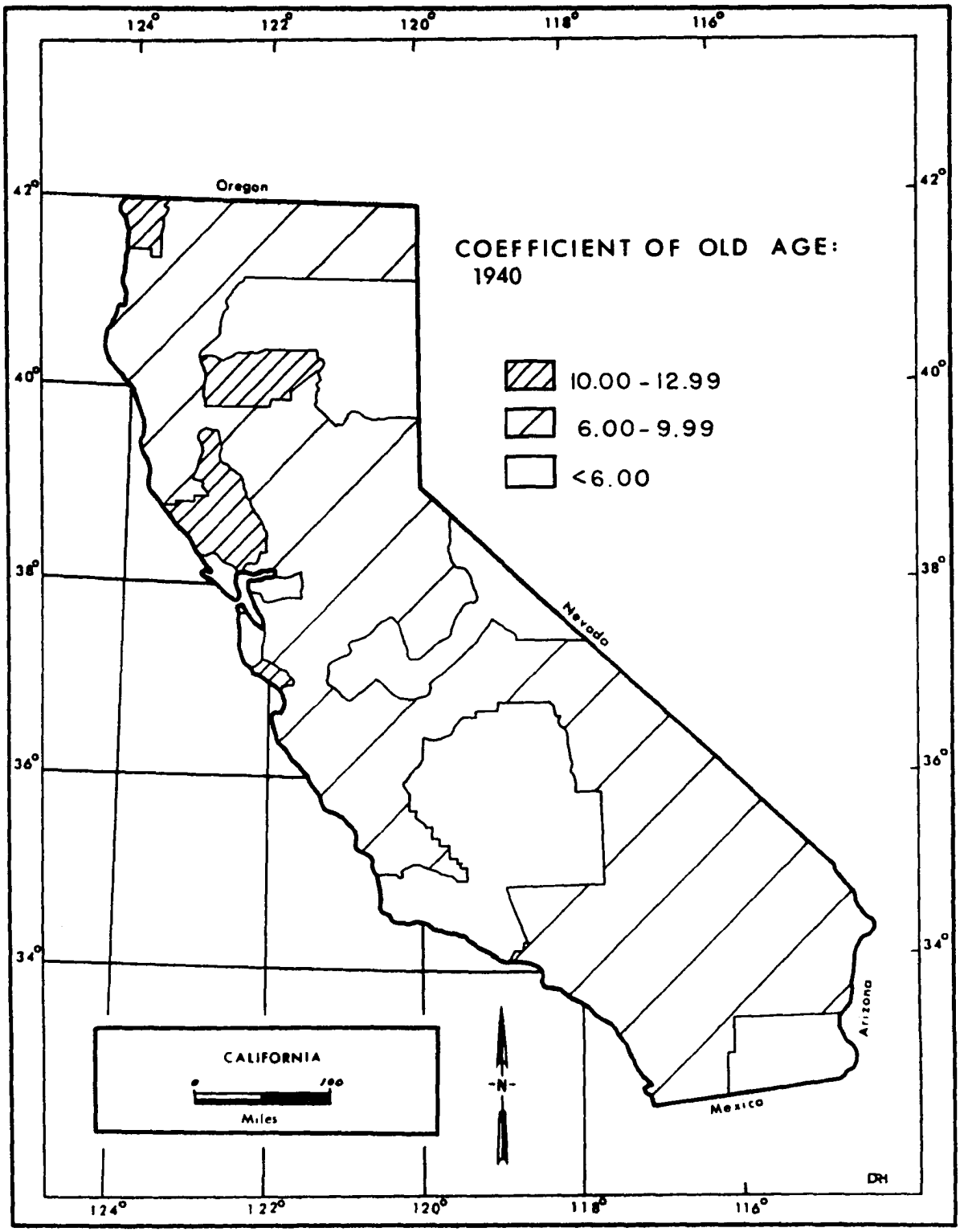
124°
122°
120°
118°
116°
42°
40°
38°
36°
34°
Oregon
Nevada
Arizona
Mexico
COEFFICIENT OF OLD AGE:
1940
10.00 - 12.99
6.00 - 9.99
<6.00
CALIFORNIA
0
100
Miles
-N-
DH

Figure 3.1a

population. The remaining county populations, as can be seen in Table 3.1, had coefficients equal to or less than the state coefficient and these population age structures were considered "young."

By 1950, the map (Figure 3.1b) revealed several significant changes from the previous decade's distribution of older age-structures. The three-county region north of San Francisco remained intact, but Lake County had become the "aged core."[3] South of San Francisco, Santa Cruz County also experienced additional aging of the population nearly equal to the increase in Lake County. Perhaps of greater significance was the evolution of a group of counties east and north of the Lake County group. This group extended from Mariposa northward along the Sierra Nevada, then swung northwestward to its terminous, Trinity County, in the Coast Ranges. (This group was to become increasingly important in the last two decades.) Finally, San Luis Obispo County emerged with an older population, isolated along the Central Coast.

With the passing of the 1950's, the regional pattern evident at the beginning of the decade became more distinct.

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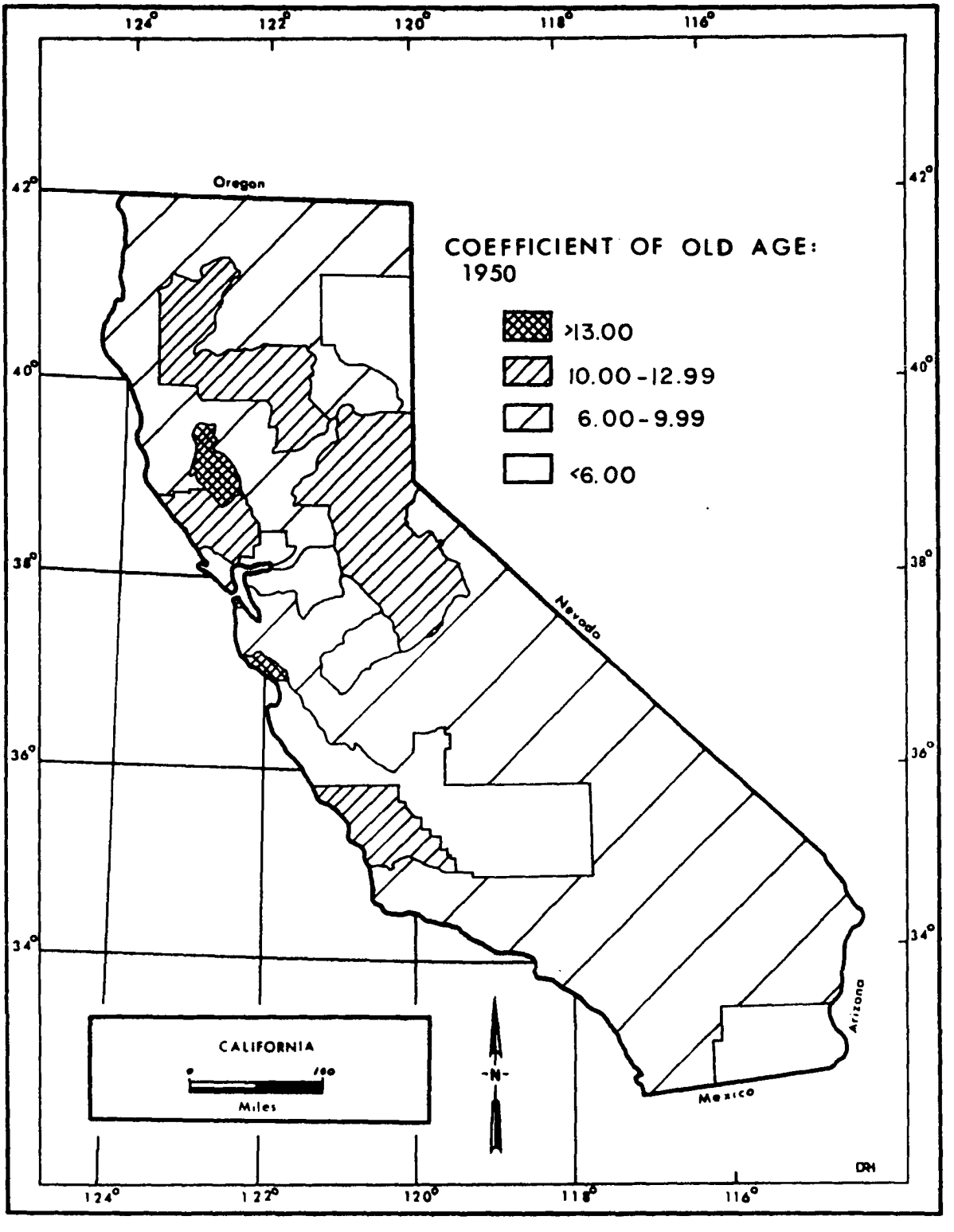
[3]Lake County's coefficient increased from 12.60 to 14.71, while Sonoma's rose from 10.96 to only 11.03 and Napa's declined slightly, 12.57 to 12.31.


124°
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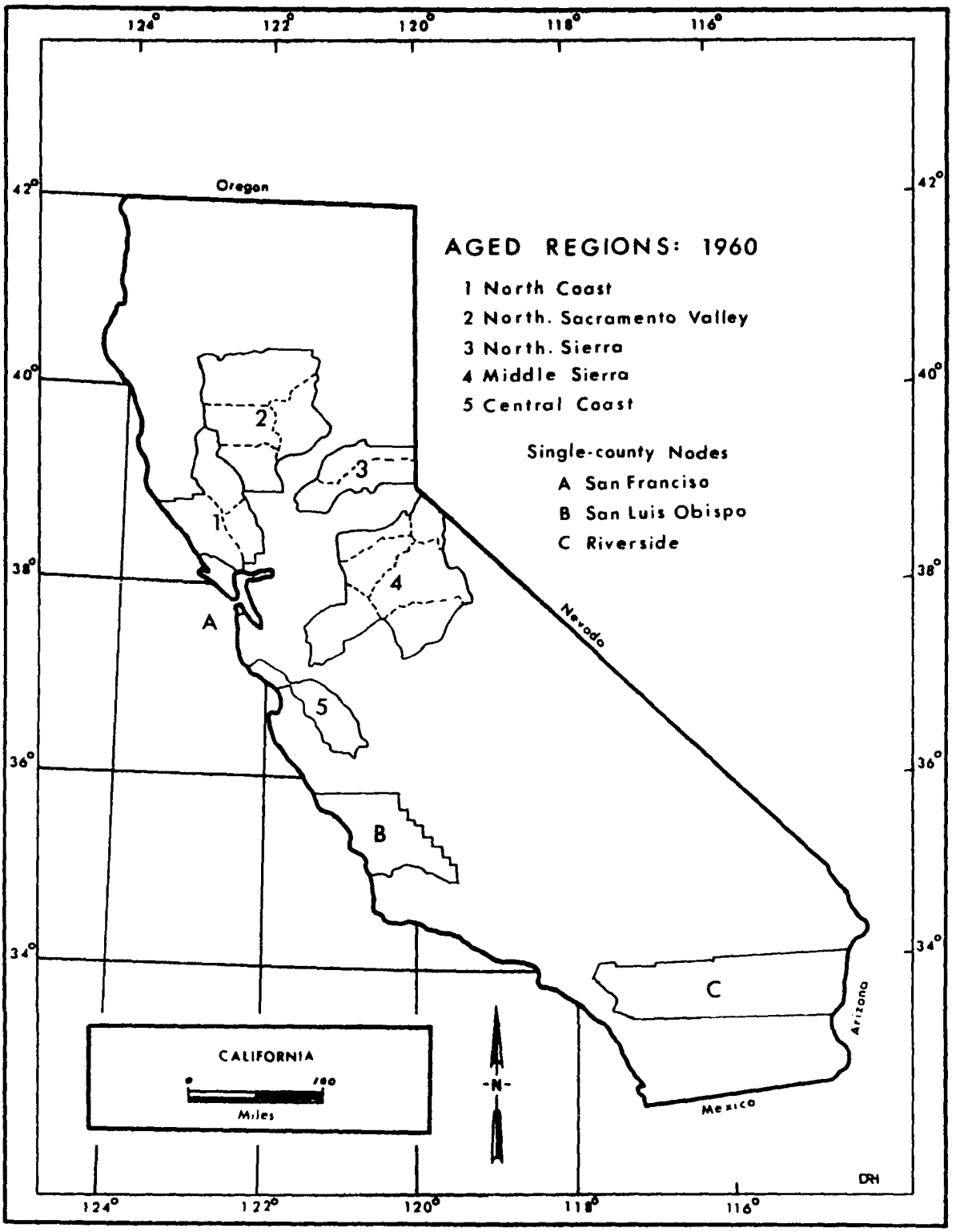
34°
Oregon
Nevada
Arizona
Mexico
COEFFICIENT OF OLD AGE:
1950
>13.00
10.00-12.99
6.00-9.99
<6.00
CALIFORNIA
0
150
Miles
-N-
DH

Figure 3.1b

As shown by Figure 3.2, five clusters of counties, with older population age structures, could be recognized: (1) North Coast; (2) Northern Sacramento Valley; (3) Northern Sierra Nevada; (4) Middle Sierra Nevada; and (5) Central Coast. In addition, the distribution included three single counties, San Francisco, San Luis Obispo and Riverside Counties.

Figure 3.3 portrays the distribution of older population age structures by 1970. The spatial distribution was found to be one composed of two elements: (1) five multi-county regions and (2) five single counties.

Although the county regions in 1970 generally resembled those identified in 1960, some changes should be noted. First, the North Coast Region still contained the 1960 core of Lake, Napa, and Sonoma Counties but because Solano's coefficient decreased from 11.00 in 1960 to 6.67 in 1970, this county was not included. Instead, Mendocino County became part of this region. Secondly, a similar realignment occurred in the Middle Sierra Nevada with the elimination of Stanislaus and the inclusion of Madera along the region's southern margin. A third modification over the 1960 regional scheme involved the Northern Sierra Nevada. Here Placer County was not included, due again to a reversal


124°
122°
120°
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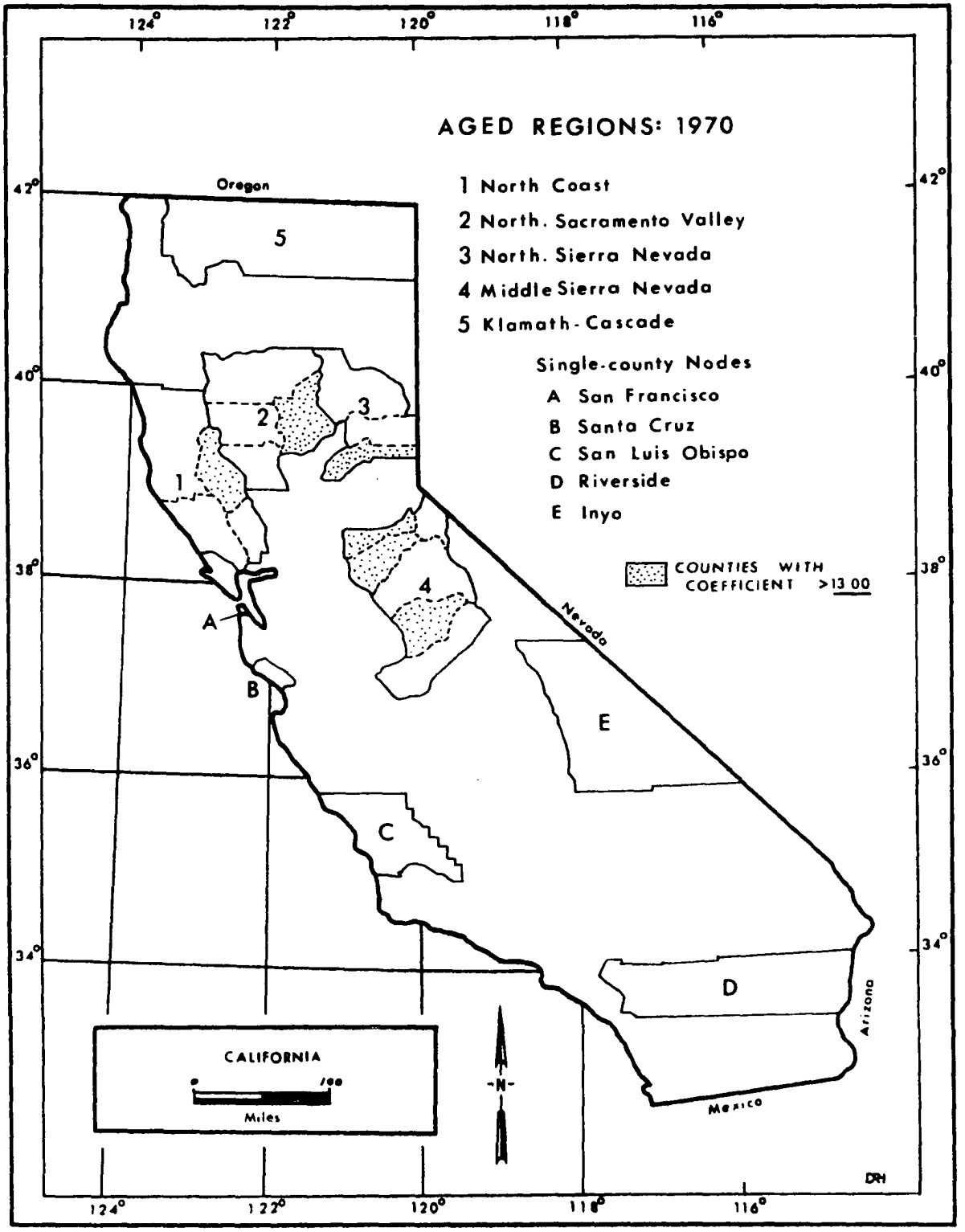
116°
42°
40°
38°
36°
34°
Oregon
AGED REGIONS: 1960
1 North Coast
2 North. Sacramento Valley
3 North. Sierra
4 Middle Sierra
5 Central Coast
Single-county Nodes
A San Franciso
B San Luis Obispo
C Riverside
Nevada
Arizona
Mexico
CALIFORNIA
Miles
-N-
DH

Figure 3.2


AGED REGIONS: 1970
1 North Coast
2 North. Sacramento Valley
3 North. Sierra Nevada
4 Middle Sierra Nevada
5 Klamath-Cascade
Single-county Nodes
A San Francisco
B Santa Cruz
C San Luis Obispo
D Riverside
E Inyo
COUNTIES WITH COEFFICIENT >13.00
Oregon
Nevada
Arizona
Mexico
CALIFORNIA
Miles
-N-
DH
124°
122°
120°
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42°
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38°
36°
34°

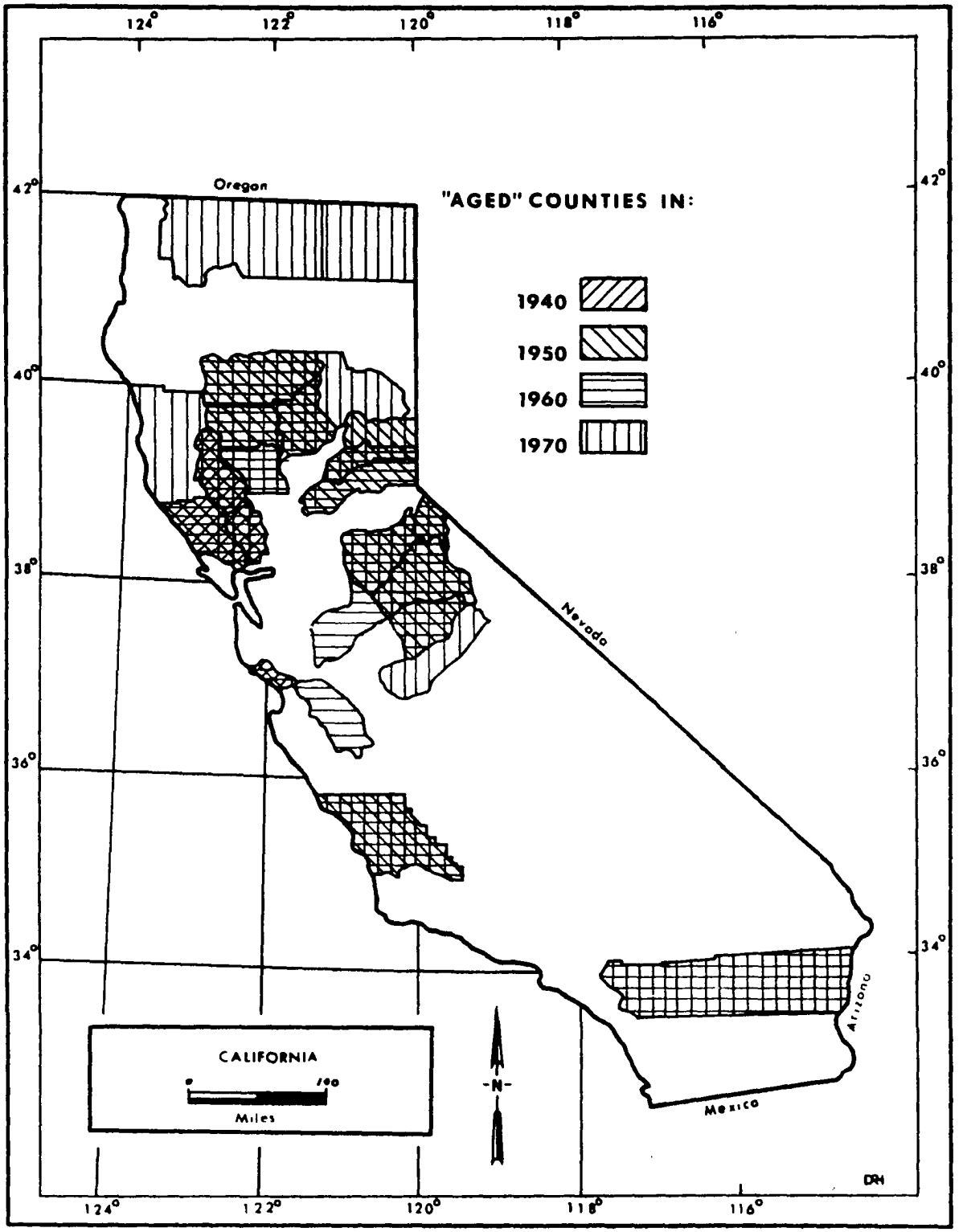
Figure 3.3

in the aging indicated by the decrease of its coefficient. The Northern Sierra region was thus shifted northward to encompass Plumas and Sierra Counties. A final change was the evolution of a new region along the northern margin of the state, the Klamath-Cascade. In addition to these modifications, five single counties were identified.

Another point was apparent from Figure 3.3. All of the regions except the Klamath-Cascade had a core of at least one county with a coefficient greater than 13.00; these were considered to be counties with exceptionally aged population structures.

Interpretation

The evolution of the spatial distribution of population aging in California between 1940 and 1970 (Figure 3.4) suggested two conclusions. One, the foundation of the spatial distribution evident in 1970 appeared to have been formulated during the period between 1940 and 1950. It was during this decade that California experienced a large influx of population. A large proportion of this influx was drawn to the state's two leading industrial and commercial conurbations, the San Francisco Bay area and to the Los Angeles Lowlands and littoral south to San Diego. As one state historian has noted: "So far as numerical growth was concerned, the


124°
122°
120°
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42°
40°
38°
36°
34°
Oregon
"AGED" COUNTIES IN:
1940
1950
1960
1970
Nevada
Arizona
Mexico
CALIFORNIA
0
100
Miles
-N-
DRH

Figure 3.4

forties thus were far and away the prize of all decades."[4] While migration to the urban centers attracted persons from other portions of the country, census reports also reveal that younger population within the state was also moving to these same urban centers.[5]

The movement of young population within the state to the urban setting seemed to be reinforced by a second observation. The spatial distribution of counties with older population structures were predominantly rural, north-state counties. This would su[illegible]tween 1940 and 1950, the increased proport[illegible]xty-five and older was primarily the r[illegible] young people, many of whom were [illegible]ght employment in the expanding ci[illegible]es in the urban areas.

Since 1950, popul[illegible] in California has been the result of two migration factors, the increasing immigration of persons age sixty-five and older and the continued rural to urban migration of younger members of the labor force. These two forms of spatial interaction will be

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[4]John W. Caughey, California (2nd. ed.; Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1953), p. 567.

[5]See: Warren S. Thompson, Growth and Changes in California's Population (Los Angeles: Haynes Foundation, 1955).

forties thus were far and away the prize of all decades."[4] While migration to the urban centers attracted persons from other portions of the country, census reports also reveal that younger population within the state was also moving to these same urban centers.[5]

The movement of young population within the state to the urban setting seemed to be reinforced by a second observation. The spatial distribution of counties with older population structures were predominantly rural, north-state counties. This would suggest that between 1940 and 1950, the increased proportion of persons age sixty-five and older was primarily the result of outmigration of young people, many of whom were in the armed forces or sought employment in the expanding civil and defense industries in the urban areas.

Since 1950, population aging in California has been the result of two migration factors, the increasing immigration of persons age sixty-five and older and the continued rural to urban migration of younger members of the labor force. These two forms of spatial interaction will be

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[4]John W. Caughey, California (2nd. ed.; Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1953), p. 567.

[5]See: Warren S. Thompson, Growth and Changes in California's Population (Los Angeles: Haynes Foundation, 1955).

treated in greater depth elsewhere in this study.

Results of Cohort-Migration Analysis

While the coefficient of old age identified the variation in the proportion of persons age sixty-five and over for each county population, it did not indicate the process most likely responsible for changes in proportions of aged persons. To account for such change, cohort migration analysis was applied.

Of the two input elements specified by the research model (Chapter I), migration was suggested as possibly being the more significant in regards to population aging. The migration analysis was accomplished by application of the procedures outlined in Appendix A. The purpose of this analysis was to establish which populations had aged due to the immigration of the aged and which had experienced aging due to the outmigration of younger population. Availability of these data was critical since the research hypothesis advanced was that the impact of aged population upon socio-economic structure varied according to the migration type that had produced the increase in the proportion of aged population.

The analysis of estimates of cohort migration suggested two distinct mechanisms had been responsible for the

increase in the proportion of aged persons among the county populations. One mechanism was identified as inmigration within the older cohorts with limited change in the younger segment of the population pyramid. This process was termed the retirement effect. Populations characterized by this "effect" were those where at least 25 percent of the in-migration estimate was accounted for in the cohorts from age sixty and older.[6]

A second form of migration-induced aging was detected in the cohort estimates. This process was the outmigration from the younger cohorts. The term suggested here was the residual effect. This "effect" was identified with populations where the outmigration from the cohorts 0-59 accounted for more than 50 percent of the total estimated net migration with little or no change indicated for the older cohorts.

While the residual effect category seemed justified from the examination of cohort estimates, the retirement effect[7] was assumed to be associated with inmigration of elderly persons. As a check on the validity of such an

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[6]The lower limit of age sixty was used because persons in the cohort 60-64 would enter the 65+ cohort during the decade.

[7]No distinction is implied as to whether retirement may be forced or voluntary.

interpretation, the percent of males age sixty-five and over in the labor force was compared for residual and retirement counties. The rationale was that migrants age sixty-five and older would be less apt to be seeking employment, thus counties experiencing such immigration would have lower percentages of older males employed than populations associated with aging by the residual effect.[8]

For the two decades used in this study (1950-1960 and 1960-1970) eight county populations were identified with the retirement effect. The counties and labor force data are shown in Table 3.2. The percentage of older males in the labor force for the state was 28.1 for 1950-1960 and 21.8 percent for 1960-1970. Examination of the percentages for the "retirement effect" counties revealed that each had a lesser percentage of older males employed than the state figure. In addition, the residual effect counties were found to have older males employment percentages either close to the state percentage or higher by two to four percentage

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[8]Such a hypothesis has been tested in other studies. For example, see: John J. Corson and John W. McConnell, Economic Needs of Older People (New York: The Twentieth Century Fund, 1956), especially Chapter 3; and Juanita M. Kreps, "Employment Policy and Income Maintenance for the Aged," in Aging and Social Policy, ed. by John C. McKinney and Frank T. de Vyver (New York: Appleton-Century-Crofts, 1966).

points.

In addition to the retirement and residual effects, a third effect was evident in the cohort migration data. This category, the coupled effect, was identified as out-migration from the younger cohorts accompanied by inmigration within the older cohorts. While this effect was not as strongly evident, its occurrence suggested that in the future this effect might become significant in the population aging of the state's population.

TABLE 3.2

PERCENT OF MALES AGE SIXTY-FIVE AND OLDER IN RETIREMENT EFFECT COUNTIES IN LABOR FORCE 1950-1960 AND 1960-1970

County	% of Males Over 65 in the Labor Force	
	1950-1960	1960-1970
Butte	20.9	12.8
Calaveras	*	20.0
Lake	18.3	13.4
Mariposa	*	12.4
Napa	16.5	14.4
Nevada	*	15.0
San Luis Obispo	23.1	*
Santa Cruz	26.9	*
STATE	28.1	21.8

*Indicates that county was not part of retirement effect category in that decade.
Source: Computed by the author.

In the application of this effect classification scheme to the empirical data, it was observed that while some county populations reflected a dominant migration pattern that could be readily identified by one of the effect-categories, others appeared to exhibit one effect but also displayed a minor influence from one of the other categories. Where such a situation occurred, the county population aging was classified according to the dominant effect-category.

Spatial Distribution of Migration-Induced Aging

Population aging in California during the two decades focused upon in this study resulted from two migration effects, the retirement effect and the residual effect. The spatial distribution of this migration-induced aging of population was an example of what Cox called "place utility and life-cycle status." That is: "What is valued by a retired person may not be valued by a younger person who has to think of a place to work as well as of leisure time and amenity."[9]

The retirement effect. The distribution of counties whose population aging was due to the retirement effect, as

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[9]Kevin R. Cox, Man, Location, and Behavior: An Introduction to Human Geography (New York: John Wiley and Sons, Inc., 1972), p. 66.

indicated by the analysis of cohort migration, is shown in Figures 3.5 and 3.6. For both decades these counties exhibited two common locational characteristics. First, all occupied a peripheral location with respect to the major population core area of the state and were predominantly rural in their own settlement pattern. Secondly, all had relative ease of accessibility to urban centers such as the San Francisco Bay area cities, Sacramento or the urbanized Los Angeles Lowlands. Thus, these counties offered the amenities of rural, small town residence coupled with access to urban areas with their wider range of cultural, leisure and service activities. While these same amenities might also be attractive to younger population, these counties offered a more restricted range of employment opportunities for younger persons. However, with retired persons, limited job availability would be less important in consideration of place utility.

The residual effect. The locational pattern of the counties where population aging was the result of outmigration of the younger population suggested factors that might account for this form of aging. Residual population aging in both decades occurred in counties that had an even greater peripheral location with respect to urban centers (Figures

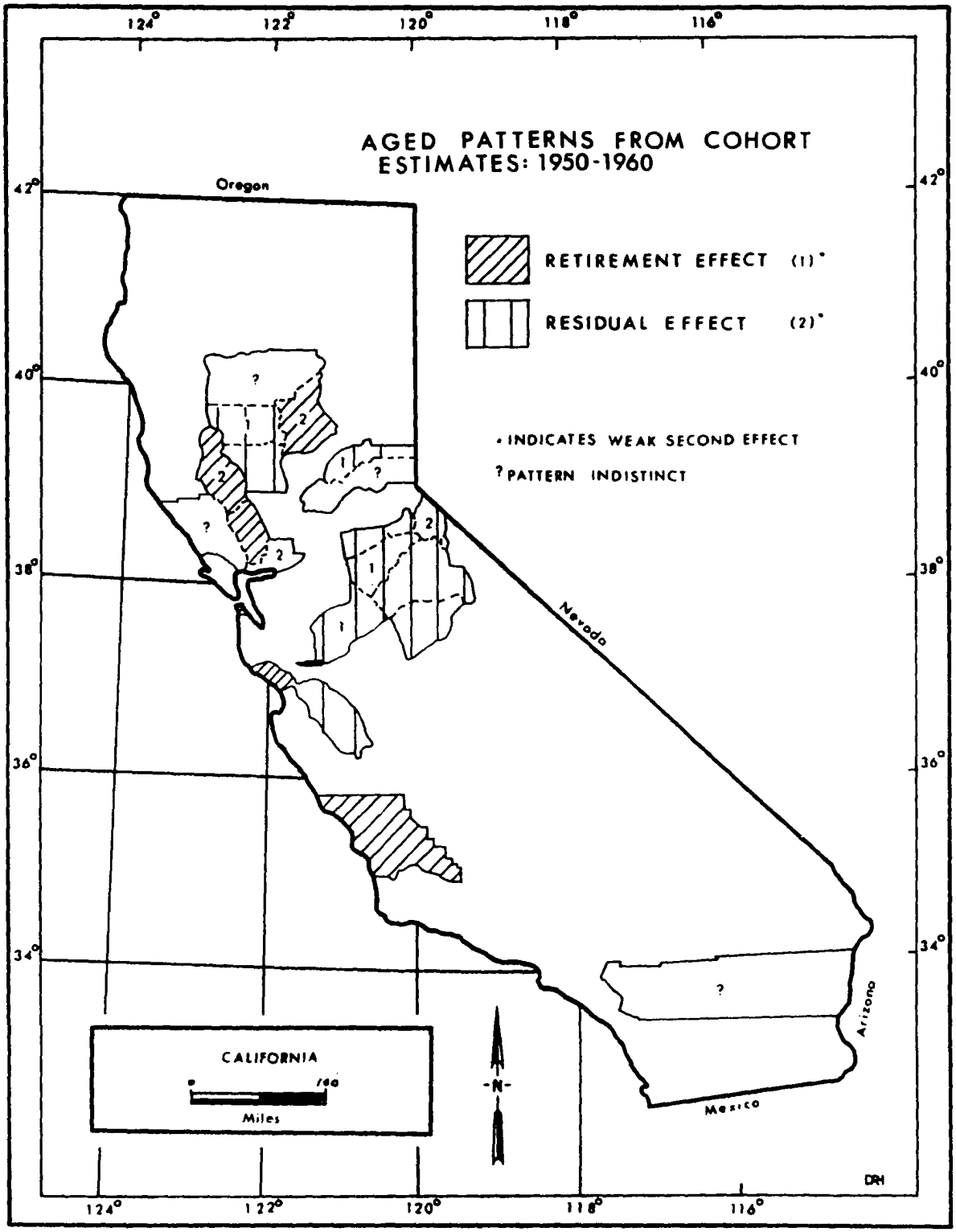
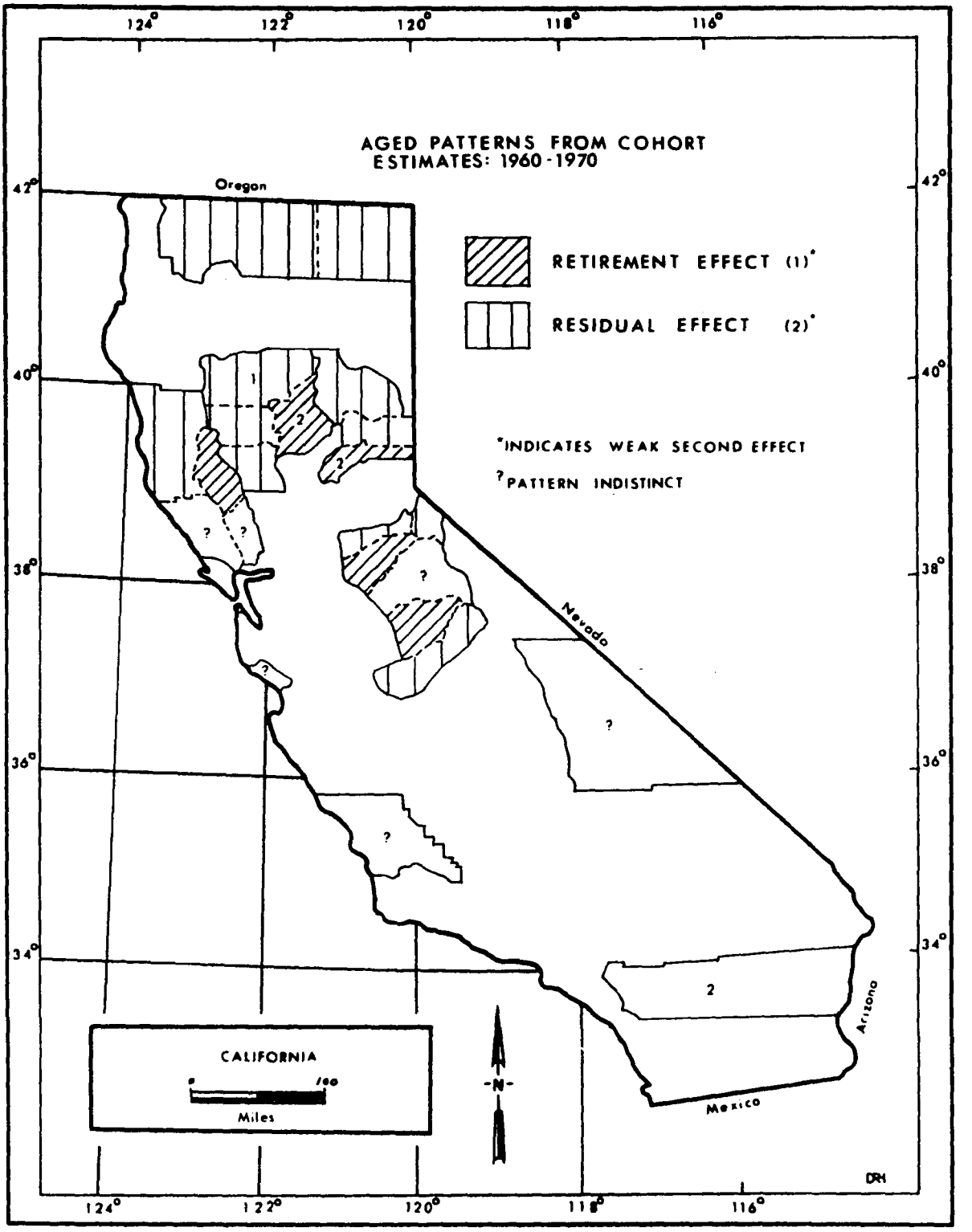

AGED PATTERNS FROM COHORT ESTIMATES: 1950-1960
RETIREMENT EFFECT (1)*
RESIDUAL EFFECT (2)*
* INDICATES WEAK SECOND EFFECT
? PATTERN INDISTINCT
Oregon
Nevada
Arizona
Mexico
CALIFORNIA
Miles
-N-
DRH
124°
122°
120°
118°
116°
42°
40°
38°
36°
34°

Figure 3.5


AGED PATTERNS FROM COHORT ESTIMATES: 1960-1970
RETIREMENT EFFECT (1)*
RESIDUAL EFFECT (2)*
*INDICATES WEAK SECOND EFFECT
?PATTERN INDISTINCT
Oregon
Nevada
Arizona
Mexico
CALIFORNIA
Miles
-N-
DRH
124°
122°
120°
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38°
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34°

Figure 3.6

3.4 and 3.6). This fact is especially evident in the distributional pattern for 1960-1970. Why these particular populations aged due to the residual effect could be found in the economic history of the counties. The foundation of economic activity among these counties has long rested upon the primary sector. Agriculture and grazing, lumber and mining have been the traditional employers within these counties. As has been the case in other areas of the United States, these activities no longer offer employment opportunities in the number necessary to support an expanding labor pool of young people. Thus, coupled with rural isolation, limited economic opportunity has resulted in the outmigration of the younger population and with this outmigration, population aging has resulted from the residium of older persons.

Summary

The purpose of this chapter has been to review the role of migration as a factor in population aging and to establish the location of such aging within the study-area of California before proceeding to examine the impact of aged population on the socio-economic structure.

Several conclusions were evident from the analysis. These conclusions concerned: (1) the spatial evolution of

aging patterns in California during the two decades; and (2) the identification of the migration mechanisms possibly responsible for these distributions; and (3) population aging as a dynamic process in the population geography of the state.

Historical evidence has established the fact that California has been a destination for a series of migration waves from a variety of origins and for an equal variety of reasons. The state, though, as a single unit has not seemed to have experienced a marked tendency towards aging of its population structure. As noted in Table 3.1, the coefficients of old age did identify a gradual aging trend, increasing from 8.34 in 1940 to 9.09 by 1970.

As was suggested in the opening portion of this chapter, the evolution of aged population seemed to be associated with the counties comprising the northern one-half of the state, except for the isolated counties noted in the southern sector. With the exception of San Francisco County, the aged regions did suggest rural relatedness and proximity to urban centers.

In attempting to identify possible causes of the aging within the counties' population structures, the vehicle of cohort migration analysis was used. Some counties ex-

perienced a residual effect, a trend towards outmigration of younger population with little change in the older segment of the age structure. The retirement effect seemed to be most responsible in another group, while still others seemed to be influenced by the immigration of older persons accompanied by an indicated emigration among the younger cohorts, the coupled effect.

The analysis suggested a final point. Aging was not a continuous process. In some instances, an aged population appeared to be developing and then a change in the image of a county's place utility occurred and a reversal in the aging process took place, thus, population aging has been a dynamic process.

The application of the coefficient of old age made it possible to identify the spatial distribution of population aging in the study-area. To this locational aspect, the analysis of cohort migration estimates allowed inferences to be made regarding how these populations had aged. From these cohort estimates it was found that where aging had occurred, two migration patterns were evident: (1) the immigration of older persons (retirement effect); and (2) the outmigrationof younger population (residual effect). Knowledge of the spatial distribution of these two "effect" types was necessary before the impact of aged population upon socio-economic structure could be examined.

CHAPTER IV

THE IMPACT OF AGED POPULATION

EMPIRICAL RESULTS

The relationship between age-structure change and migration was examined in Chapter III. The results of this analysis yielded two migration effects responsible for inducing population aging. These effects were identified as the residual effect and the retirement effect. Together these migration elements composed the impact phase of the research model outlined in Chapter I.

The research hypothesis framed in Chapter I stated that the impact of aged population upon socio-economic structure will vary according to the migration effect responsible for the population aging. The purpose of this chapter is to present the findings of the examination of the relationship between change in socio-economic structure and change in age structure. Such analysis formed the structure-interaction portion of the model and, in turn, bore directly upon the research hypothesis advanced above.

Dimensions of the Socio-Economic-Change Matrices

The socio-economic structure within any spatial unit is composed of a great variety of individual variables each of which identifies a varying fractional portion of the total structure. In order to evaluate relationships between socio-economic structure and other phenomena, it was necessary to take this variety of single variables and produce a collective measure of the socio-economic structure which could then be used to represent these individual variables.

Factor Analysis Results

The socio-economic-change matrices identified in the research model were specified by eighteen variables. These variables were chosen as measures of three broad sectors of the total socio-economic structures: (1) housing characteristics; (2) employment structure attributes; and (3) income source traits. Each variable was expressed in the original data as percent change.

From these original data identification of variable-cluster dimensions within the socio-economic-change matrices were obtained by using a factor analysis solution. Factors extracted in a varimax rotation were labeled according to the aggregation of variables with loadings on the individual

factors greater than .40. These factors were then used as a substitute measure of the socio-economic structure.

The 1950-1960 matrix. Application of a varimax solution to the 1950-1960 data extracted three factors in the order each contributed to the percent of total variance within the original data after rotation.

Factor I, accounting for 25.28 percent of the total variance, was composed of seven variables (Table 4.1) with loadings greater than .40. These variables were percent change in: (1) renter-occupied housing units; (2) the number of non-whites; (3) the number of persons employed in services; (4) employment in sales; (5) total number of housing units; (6) income from food store sales; and (7) females widowed. The loading of percent change in females widowed (.91) seemed inconsistent with the other variables, but this change variable was probably related to general population increase.

After rotation, Factor II accounted for 13.48 percent of the total variance. This factor was composed of four percent-change variables with loadings greater than .40: (1) percent change in the number of trailers; (2) percent change in income from gasoline sales; (3) percent change in the number of persons employed in finance, insurance and real estate. This aggregation of variables

TABLE 4.1

ROTATED FACTOR LOADINGS
(Socio-economic-Change, 1950-1960)

Variables (% Change in:)	Factors I	II	III
Renter-Occupied Housing Units	.96		
Females Widowed	.91		
Number of Non-whites	.78		
Number Employed in Services	.76		
Number Employed in Sales	.67		
Total Housing Units	.47		
Food Store Sales	.44		
Number of Trailers		.90	
Gasoline Sales		.60	
Eating, Drinking Place Sales		.56	
Number Employed in Finance; Insurance; Real Estate		.55	
Automobile Sales			.65
Furniture Sales			.63
Number Employed in Transportation; Public Utilities			.61
Number Employed in Wholesale Trade			.53
Apparel Sales			.42
% Total Variance	25.28	13.48	13.01
Eigenvalue	4.55	2.43	2.34

Source: Computed by author.
Note: Only loadings greater than .40 are shown.

suggested a service-convenience sales dimension.

Employment-durable retail sales was the dimension identified by Factor III. The variables loading on this factor greater than .40 were found in the original data to be increasing negative values. Thus, counties with high factor scores on this factor had experienced declines in the number employed in the two employment activities and variation in their retail sales.

Collectively the three factors extracted from the 1950-1960 data accounted for 51.8 percent of the variance in the original data. Two factors, I and II, identified structures that had witnessed economic expansion during the decade. Factor III defined an opposite dimension, that of economic decline.

The 1960-1970 matrix. The results of the factor analysis of the 1960-1970 socio-economic-change matrix are summarized in Table 4.2. From the varimax rotation of the eighteen original variables, three factors were extracted which collectively accounted for 64.9 percent of the variance within the data.

Factor I was composed of an aggregation of variables that again suggested urbanization. However, this factor accounted for 30.26 percent of the total variance whereas

TABLE 4.2

ROTATED FACTOR LOADINGS
(Socio-economic-Change, 1960-1970)

Variables (% Change in:)	Factors I	II	III
Number Employed in Transportation; Public Utilities	.80		
Number of Non-whites	.80		
Renter-Occupied Housing Units	.66		
Number Employed in Sales	.64		
Food Store Sales	.63		
Eating, Drinking Place Sales	.57		
Number Employed in Finance; Insurance; Real Estate	.55		
Gasoline Sales	.43		
Total Number of Housing Units		.96	
Number Employed in Services		.91	
Number of Females Widowed		.83	
Owner-Occupied Housing Units		.78	
Furniture Sales			.94
Apparel Sales			.86
Automobile Sales			.59
% Total Variance	30.26	21.90	12.80
Eigenvalue	3.65	3.40	2.27

Source: Computed by author.
Note: Only loadings greater than .40 are shown.

the same dimension in 1950-1960 accounted for 25.28 percent of the total variance. This increase in accounted variance was taken to imply that while the factor was important in the 1950-1960 data, it was of greater significance in the latter decade.

The rotated factor accounting for the second largest percent of total variance (21.90) was composed of four variables with loadings greater than .40: (1) percent change in the total number of housing units (.96); (2) percent change in the number employed in services (.91); (3) percent change in the number of females widowed (.83); and (4) percent change in owner-occupied housing units (.78). Together the variables defined what is termed here a stable residence dimension.

The third rotated factor pattern accounted for 12.80 percent of the total variance. The variable-aggregation of this factor again defined a retail sales dimension. The factor was specifically circumscribed by three income-source variables: (1) percent change in income from furniture sales; (2) percent change in income from apparel sales; and (3) percent change in income from automobile sales.

In summary, changes in socio-economic structure were hypothesized as being dependent functions of age-structure

change. The factoring of the socio-economic-change matrices provided quantitative dimensions to serve as dependent variables representing socio-economic-structure change.

Dimensions of the Age-Change Matrices

Before testing the relationships between the dependent variables (socio-economic factors) and the independent variables of age-changes, quantitative dimensions were also required for age-change. These were obtained again by application of the factor model.

The research model (Chapter I) identified population structure as a key component in the structure-interaction phase of that model. However, a population structure is defined by a series of demographic attributes. For this research, though, age-structure change was the attribute of central focus.

The age-change matrices used age cohorts as variables. These variables were again expressed in the original data as percent change. The age-change matrix for each decade contained fourteen cohorts: 0-4; 5-9; 10-14; 15-19; 20-24; 25-29; 30-34; 35-39; 40-44; 45-49; 50-54; 55-59; 60-65; and 65 and older.

Factor Analysis Results

Age-structure change data for the fifty-eight counties were subjected to a varimax factor solution in order to derive composite quantitative statements similar to those identified for the socio-economic structures. The factors after rotation were again labeled according to the aggregation of variables with loadings on each factor greater than .40.

The 1950-1960 age-change matrix. Three factors with eigenvalues greater than unity were extracted from the 1950-1960 age-change data. These factors are shown in Table 4.3 in the order each contributed to the total variance within the original data after rotation.

Factor I accounted for 21.78 percent of the total variance. This factor was composed of six cohort-variables with loadings greater than .40. The positive loadings suggested a young family change.[1] The cohorts 30-34 and 35-39 were suggestive of a parental component with young children (0-4 and 5-9). The negative loadings of the cohorts 65+ (-.78) and 60-64 (-.76) identified aging areas.

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[1]This life-cycle factor is similar to a dimension identified by Janson in his study of Swedish urban spatial structure. See: Carl-Gunnar Janson, "A Preliminary Report on Swedish Urban Spatial Structure," Economic Geography, XLVII (June, 1971), pp. 249-257.

TABLE 4.3

ROTATED FACTOR LOADINGS
(Age-Change, 1950-1960)

Variables	Factors		
	I	II	III
5-9	.73		
35-39	.67		
30-34	.51		
0-4	.46		
50-54		.81	
55-59		.65	
45-49		.57	
65+	-.78		.65
60-64	-.76		.62
% Total Variance	21.78	20.64	16.98
Eigenvalue	3.04	2.89	2.38

Source: Computed by author.

The bi-polar nature of the factor illustrated rather clearly the dichotomy occurring in the age change in some counties. Thus, counties undergoing an increase in the young family life cycle have had a decline in the older age categories. Conversely, where the proportion of older residents have increased there has been a decline in the number of families in the child rearing stages, a change that could result from either inmigration of the elderly, the retirement effect, or outmigration of young families, the residual effect.

A second factor dimension was late middle age (Factor II). This factor was composed of three variables: 50-54 (.81); 55-59 (.65); and 45-49 (.57). This factor accounted for 20.64 percent of the total variance after rotation.

Two cohort-variables had high positive loadings on Factor I. This aggregation defined an aged component and the factor accounted for 16.98 percent of the total variance. Counties with high positive factor scores on this dimension were those that had experienced increases in the number of aged persons during the decade.

The three age-change factors extracted from the 1950-1960 data collectively accounted for 54.9 percent of the total variance within the original data. These factors suggested that three stages in the population life cycle had dominated the state's population age-structure during the decade: (1) young families with young children; (2) late middle age; and (3) the aged.

The 1960-1970 age-change matrix. The 1960-1970 age-structure change data yielded four dimensions which together accounted for 64.6 percent of the total variance in the original data. These factors are shown in Table 4.4.

The factor accounting for the greatest percent of the total variance (17.45) was Factor II. The variable

TABLE 4.4

ROTATED FACTOR LOADINGS
(Age-Change, 1960-1970)

Variables	Factors			
	I	II	III	IV
50-54	.88			
55-59	.56			
45-49	.54			
0-4	-.83			
60-64		.86		
65+		.73		
25-29			.83	
20-24			.47	
35-39				.80
30-34				.76
5-9	-.51			.41
% Total Variance	17.45	17.05	15.96	14.14
Eigenvalue	2.44	2.39	2.23	1.98

Source: Computed by author.

aggregation again identified a late middle age dimension with high positive loadings for the cohorts 50-54, 55-59 and 45-49. However, unlike the 1950-1960 factor, bipolarity was evident by the high negative loadings of young children. This factor suggested areas where age-change was most dominated by older couples with no children or families with grown children.

The second most significant factor defined aged population. The variables loading on this dimension were identical to the 1950-1960 factor. The percent of total variance

accounted for by Factor I was 17.05.

Factor III, young adult, was the third most significant life cycle dimension. The factor suggested young married couples and young single persons were more evident in the 1960-1970 age structure than had been the case in the previous decade.

Factor IV accounted for 14.14 percent of the total variance and again identified a young family dimension. It may be noted, however, that this life cycle factor was less significant in this decade than had been the case in the 1950-1960 period.

Change-Linkage Analysis of Structure Interaction

The factor analytic approach applied to the socio-economic-change matrices and to the age-change matrices yielded only dimensional patterns within these data-sets. Factoring, however, did not suggest any possible relationship that might exist between change in a population age-structure and change in a socio-economic structure. The search for such possible relationships between the two structures did rely, though, upon the findings obtained by factor analysis.

Relationships of greatest interest to geographers are those which vary in space. Thus, when the distribution

of two phenomena are similar a relationship may be suggested. "That is, if two things are regularly found together at the same location we may strong suspect that there is a relationship between them."[2]

A variety of investigative techniques is available for analysis of relationships between areally related data. "Traditionally, geographers have compared patterns on maps, either by placing them side by side or overlaying them upon one another, to examine the degree of correspondence and to make some subjective judgements as to the strengths of the relationships between them."[3] However, while visual comparison of mapped data may suggest that spatial relationships exist, it is not possible to precisely evaluate the strength of such relationships by visual inspection. Measuring the strength of these associations is based upon the ability to accurately measure both the dependent and independent variables and to then relate these measurements one with the other. In addition, the problem of visual comparison is compounded when the research attempts to relate more than one independent variable to the dependent variable.

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[2]Ronald Abler, John S. Adams and Peter Gould, Spatial Organization: The Geographer's View of the World (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971), p. 115.

[3]Ronald Abler, et al., Spatial Organization, p. 120.

The factors extracted from the socio-economic-change and age-change matrices served as measures of the dependent and independent data-sets. Thus, the question was: "how much of the variation in socio-economic Factor A might be attributed to the variation in age-structure factors and which age-structure factors seem to account for the greatest portion of the variation in Factor A?"

The analysis of the spatial relationships between the dependent variables (socio-economic factors) and the independent variables (age-change factors) was made by application of two techniques. First, maps showing the distributional pattern of the dependent and independent variables were prepared. Secondly, the strength of the areal association of these distributions were tested using stepwise multiple correlation. The maps provided a visual presentation of the data while the correlation model suggested which age-structure factors seemed to account for the greatest amount of the spatial variation in the dependent variable.

Structure-Interaction: 1950-1960

Application of the factor model to the socio-economic-change matrix resulted in the extraction of three factors. These factors were labeled: (1) urbanization; (2) service-convenience sales; and (3) employment-durable retail sales.

From the age-change data for the same decade, three factors were identified. In the order each contributed to accounting for the total variance in the data these were: young family; late middle age; and aged. These three factors became the independent variables (X) in the multiple correlation analysis.

Urbanization. An examination of Figure 4.1 shows that the counties with high urbanization factor scores were those containing or adjacent to the state's largest urban centers, namely Los Angeles and San Francisco. A second positive association was noted in the Great Valley centering on Sacramento and adjacent El Dorado County. These areas have been recognized in other studies as urbanizing regions.[4]

Figure 4.1 also indicates the distribution of negative loadings on the urban growth factor. This distribution was found to be associated with counties occupying the northeastern and mountainous east central portion of the state, i.e., the isolated rural centers in the state.

The remaining portion of the distribution was composed of counties with factor scores that ranged from .99 to -.99. This seemed to represent a transition between the

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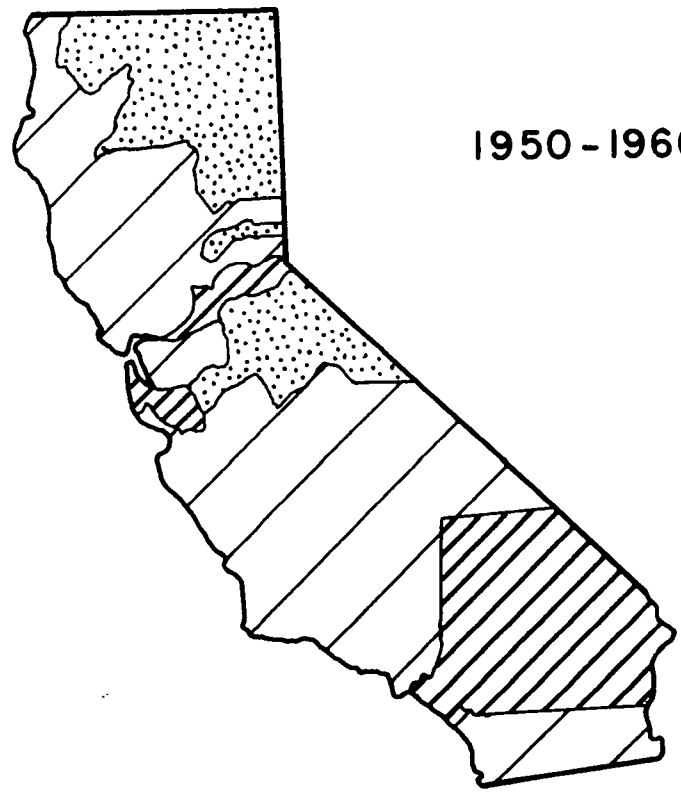
[4]Howard F. Gregor, "Spatial Disharmonies in California Population Growth," Geographical Review, LIII (1963), pp. 100-122.



1950-1960

URBANIZATION

Positive Loadings >1.00

Negative Loadings > -1.00

.99 to - .99

AGE-STRUCTURE FACTORS

Young Family

Late Middle Age

Aged

(< .99 on the factors)

Figure 4.1

areas that had experienced urban growth and those where negative loadings suggested a distinct lack of association with this factor.

A visual comparison of the urban growth distribution and the distribution of the three age-structure variables revealed that a general correlation might exist. The counties that exhibited high positive loadings on urban growth tended to load on the young family factor. A second general overlap between the two distributions was noted between counties with negative loadings on urban growth and the distribution of the late middle age and aged factors.

A more precise statement of the relationship between the distribution of the urban growth dimension and the three age-structure variables was obtained by application of stepwise multiple correlation, the results of which appear as Table 4.5. The multiple correlation results indicated a positive correlation (.81) between the urban growth factor and the three age-structure dimensions. The coefficient of multiple determination (R^2) suggested that together the age-structure factors accounted for 68 percent of the variation in the urban growth factor.

Of greater importance was the order in which the age-structure variables were added to the correlation equation.

TABLE 4.5

MULTIPLE CORRELATIONS BETWEEN URBANIZATION AND AGE-STRUCTURE FACTORS FOR ALL COUNTIES 1950-1960

Step	Variable Added	Beta Coefficient[a]	R	R^2
1	Young Family	.2348	.57	.33
2	Late Middle Age	.1996	.75	.56
3	Aged	.1243	.81	.66

[a]The tendency for low values of the Beta Coefficients is due to the narrow range of the original variables used in the correlation model. See: Mordecai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis (3rd ed.; New York: John Wiley and Sons, Inc. 1959), p. 197.

The results in Table 4.5 revealed that the young family factor alone accounted for one-half of the total explained variation in the urban growth dimension ($R^2 = .33$). This finding also seemed to validate the map comparisons reported above. Examination of the original data showed that counties which had sustained the greatest increases in urban growth also witnessed the greatest increases in the young family age-structure dimension.

Upon closer examination of the maps in Figure 4.1 it was observed that several counties which loaded highly on urban growth had high positive loadings on the aged factor. To validate this observation the residuals from regression

were employed. The spatial distribution of such residuals can more precisely indicate where associations between the socio-economic-structure factor and the age-structure factors had been closest or where such associations were least accurate. For as Thomas noted: "The map of residuals from regression shows the spatial distribution of that part of the total magnitude of the dependent variable which is associated with phenomena other than those included in the analysis."[5]

For the purpose of residual examination, the basic residual ($Y_{cn} - Y_n$) was standardized using the standard error of the estimate. These residuals were then mapped, and appear as Figure 4.2.

The residuals identified eight counties where the age-structure factors had not adequately accounted for the areal variation in urban growth. For five counties, Butte, Lake, Napa, Santa Cruz and San Luis Obispo, the age-structure factors were found to have underestimated the degree of urban growth that occurred during the decade. These five counties had been identified as having aged as a result of the retire-

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[5]Edwin Thomas, "Maps of Residuals from Regression," Spatial Analysis: A Reader in Statistical Geography, ed. by Brian J. L. Berry and Duane F. Marble (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968), p. 334.

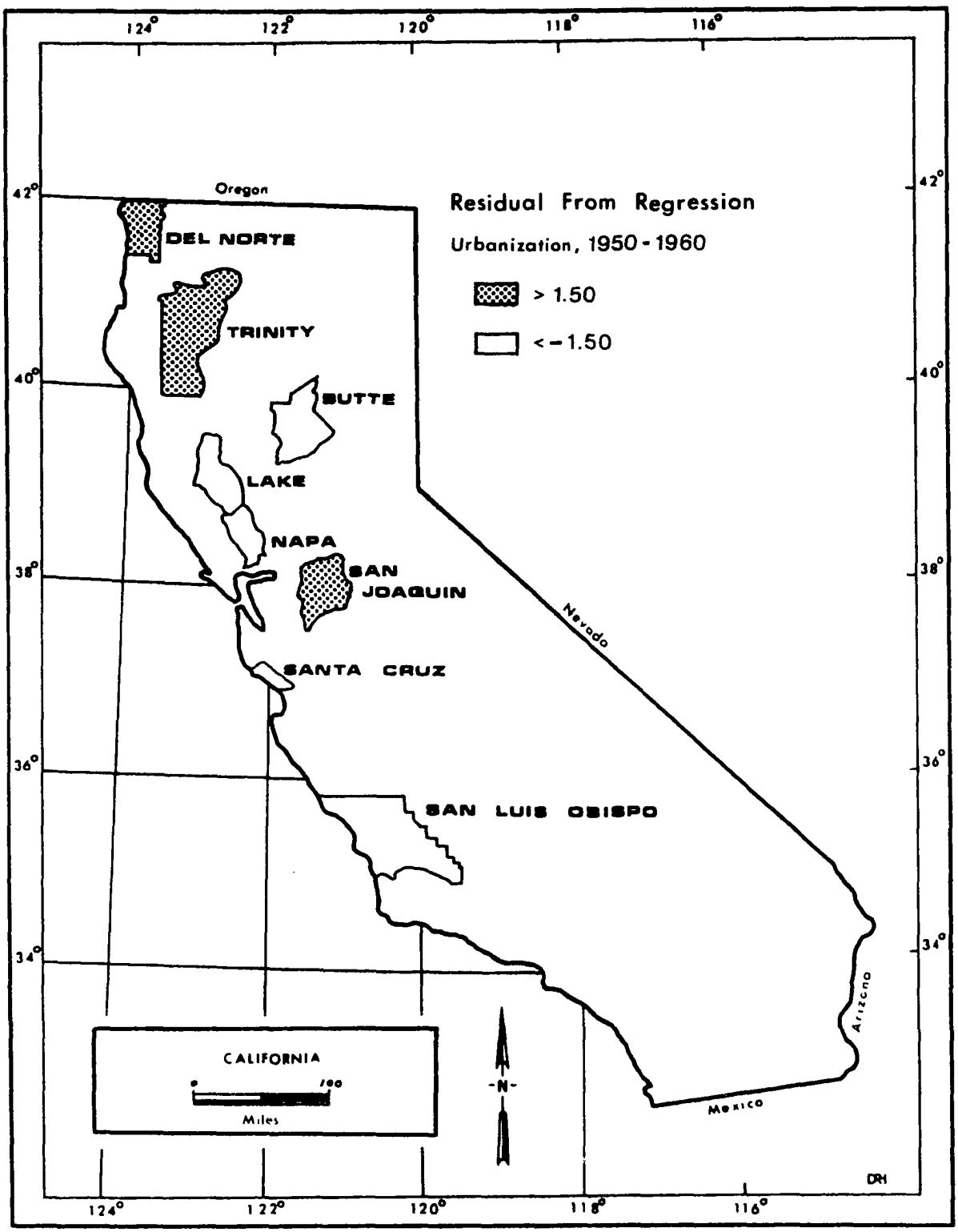
124°
122°
120°
118°
116°
42°
40°
38°
36°
34°
Oregon
Residual From Regression
Urbanization, 1950 - 1960
> 1.50
< -1.50
DEL NORTE
TRINITY
BUTTE
LAKE
NAPA
SAN JOAQUIN
SANTA CRUZ
SAN LUIS OBISPO
Nevada
Arizona
Mexico
CALIFORNIA
0
100
Miles
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Figure 4.2

ment effect. (See Chapter III).

The retirement effect (inmigration of persons age sixty-five and older) and the residual effect (outmigration of younger population) were found to be associated with nineteen counties in the 1950-1960 period. "How much of the variation in urban growth might be attributed to the age-structure factors among the counties having aged due to the two migration effects?" An answer to this question was sought by applying the multiple correlation model to the nineteen counties that had been identified as having aged during the decade.

The results of the correlation analysis for the nineteen counties are shown in Table 4.6. Two significant facts seemed evident. First, the three age-structure variables accounted for 89 percent of the variation in the urban growth dimension among the nineteen counties whereas these same variables accounted for only 68 percent for the entire state. This suggested that urban growth seemed to be more closely related to age-structure changes among the counties that had experienced population aging between 1950 and 1960. Secondly, while urban growth for the state had been associated with the young family dimension, the aged factor entered the multiple correlation equation as the most significant age-change variable.

Based upon the multiple correlation results, the conclusion was that urban growth during the 1950-1960 period in California was significantly related to age-structure changes. However, the findings seemed to point to the fact that counties whose population aged by the retirement effect had experienced urban growth characteristics in their socio-economic structures to a greater degree than had been the case in the counties where aging was associated with the residual effect.

TABLE 4.6

MULTIPLE CORRELATION BETWEEN URBANIZATION AND AGE-STRUCTURE FACTORS FOR AGED COUNTIES 1950-1960

Step	Variable Added	Beta Coefficient	R	R^2
1	Aged	.2920	.91	.82
2	Late Middle Age	.1425	.92	.85
3	Young Family	.0625	.94	.89

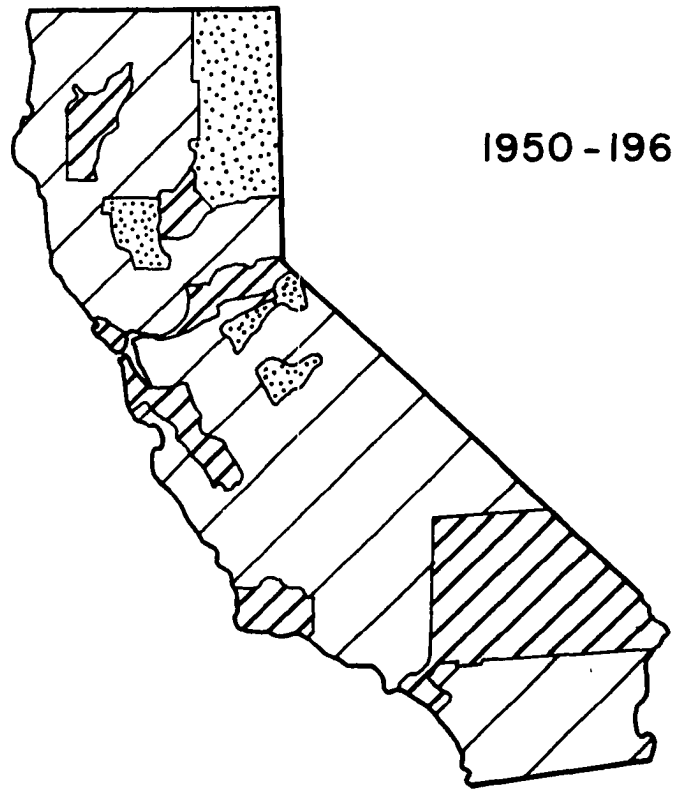
From the results presented here it appeared that urban growth, as such growth was indicated by the socio-economic variables, occurred in two types of areas in the 1950's: (1) areas dominated by inmigration of young families; and (2) areas that had experienced inmigration of per-

sons age sixty-five and older.

Service-convenience sales. The second socio-economic-change factor extracted from the 1950-1960 data was a service convenience sales dimension. The distribution of factor loadings is shown in Figure 4.3.

From the spatial distribution shown in Figure 4.3, the factor appeared to be positively associated with the major population centers of the state. This was particularly evident in the San Francisco Bay area and Orange and San Bernardino Counties, both of which lie adjacent to the conurbation situated in the Los Angeles Lowlands. In addition, positive loadings greater than 1.00 were associated with both Sacramento and El Dorado Counties east of San Francisco Bay. The negative loadings indicated an orientation towards the rural, more isolated areas of the state, with the exception of the Sacramento Valley Counties of Glenn and Colusa. The remainder of the state varied in loadings from .99 to -.99.

A visual interpretation of both maps in Figure 4.3 proved less revealing than had been the case for urban growth. The service-convenience sales factor appeared positively correlated with young family in the San Francisco Bay district and more so in the areas adjacent to the Los Angeles lowlands. The remaining positive loadings occurred where



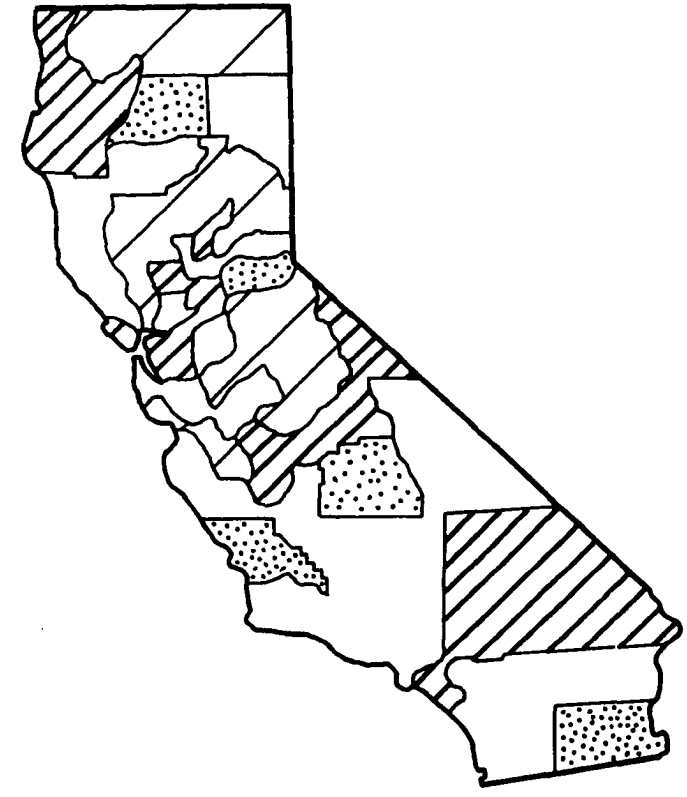
1950 - 1960

SERVICE-CONVENIENCE SALES

Positive Loadings > 1.00

Negative Loadings > -1.00

.99 to -.99



AGE - STRUCTURE FACTORS

Young Family

Late Middle Age

Aged

(<.99 on the factors)

Figure 4.3

late middle age and some aged were also evident.

With the negative loading distribution, the aged factor visually appeared to provide the best correlation. This was evident in the cases of Alpine, Amador, Colusa, Glenn and Modoc Counties.

Examination of the relationship between service-convenience sales and the age-structure factors by multiple correlation reinforced the interpretation derived from the visual inspection of the mapped data (Figure 4.3); the association was small[6] and consequently there seemed to be little or no effect on the sales because of aging.

Employment-durable retail sales. A third socio-economic factor identified from the factor analysis of the socio-economic-change matrix was labeled employment-durable retail sales. This factor was composed of an aggregation of five variables with factor loading greater than .40. (See Table 4.1).

Based upon positive and negative factor scores, two locational categories could be identified (Figure 4.4). First, the counties with positive loadings were prediminantly located in the rural, mountainous portion of the state;

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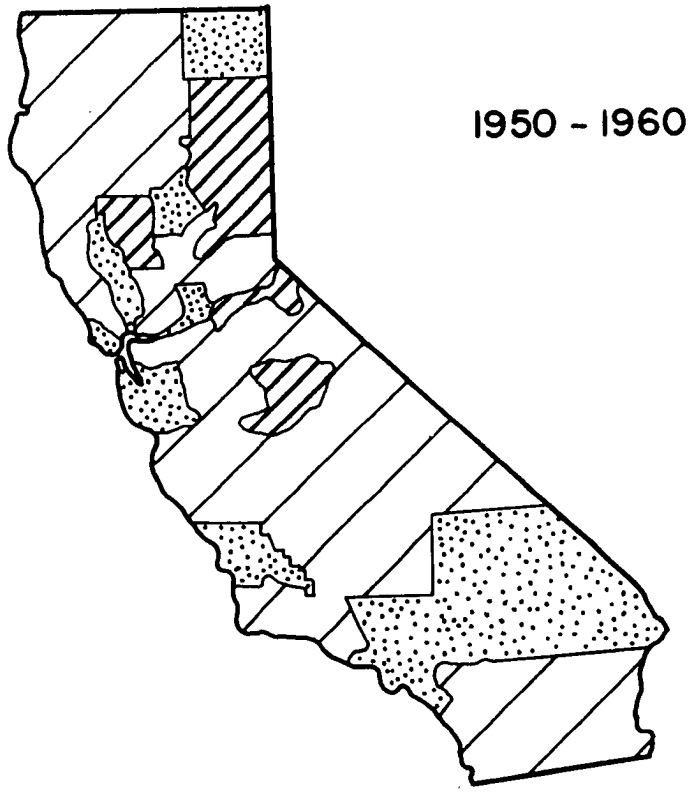
[6]The computed coefficient of multiple correlation for all counties was .39; the coefficient for only the nineteen counties with aged population age-structures was .54.



1950 - 1960

EMPLOYMENT; DURABLE RETAIL SALES

Positive Loadings > 1.00

Negative Loadings > - 1.00

.99 to -.99

AGE - STRUCTURE FACTORS

Young Family

Late Middle Age

Aged

(< .99 on the factors)

Figure 4.4

two exceptions were Colusa and Glenn in the Sacramento Valley. The second group of counties had negative factor scores greater than 1.00. As can be seen in Figure 4.4, these counties were located adjacent to the key urban centers of the state.

Upon a visual comparison of the two maps tentative conclusions were suggested with reference to the correlation between employment-durable retail sales and the age-change factors. The positive loadings seemed to be correlated with areas dimensioned by the aged factor pattern; the negative loadings exhibited a tendency to correlate with the young family and late middle age. Thus, some visual correlation could be detected between the socio-economic factor and the age-change variables.

The amount of variation in the employment-durable retail sales variable correlated with variation in the age-change factors was statistically examined using stepwise multiple correlation. These results are shown in Table 4.7.

Together the age-change factors accounted for 38 percent of the variation in the employment-durable retail sales factor for this period. The single age-change variable that alone accounted for the largest proportional share of the explained variation was the aged dimension. From these

TABLE 4.7

MULTIPLE CORRELATION BETWEEN EMPLOYMENT-DURABLE RETAIL SALES AND AGE-STRUCTURE FACTORS ALL COUNTIES 1950-1960

Step	Variable Added	Beta Coefficient	R	R^2
1	Aged	.2428	.45	.21
2	Late Middle Age	.1916	.57	.33
3	Young Family	.1159	.61	.38

results the inference might be made that as the proportion of aged persons increased employment-durable retail sales resulted. However, further inspection of Figure 4.4 indicated that such a broad interpretation of the correlation results would be questionable because some county age structures that had experienced an increase in the proportion of aged persons had loaded negatively on this factor.

While a variety of factors contribute to the state of an area's economic health,[7] it was apparent that age-change was an important consideration in relation to the employment-durable retail sales factor. In order to explore further the relationship between the aged factor dimension and the

[7]See: John H. Thompson, Sidney C. Sufrin, Peter R. Gould and Marion A. Buck, "Toward a Geography of Economic Health: The Case of New York State," Annals, Association of American Geographers, LII (March, 1962), pp. 1-20.

employment-durable retail sales factor, a map of residuals from regression was employed. (Figure 4.5). The residuals revealed that the expected value of employment-durable retail sales had been overestimated in the five counties where aging had occurred by the retirement effect.

The analysis was carried a step further. Did the age-change variables contribute significantly to the explained variation of the employment-durable retail sales factor among the nineteen counties that had been identified as having experienced population aging during the decade?

Using the data for the nineteen counties, stepwise multiple correlation was again applied. The three age-change variables entered the equation in the same order as they had before, however collectively they accounted for a greater percentage of the explained variation ($R^2 = .67$) among the nineteen counties. More significantly, the aged dimension accounted for 55 percent of the variation, whereas this factor accounted for only 21 percent of the explained variation for the entire state. (Table 4.8).

The high negative residuals shown in Figure 4.5 involved Lassen and Modoc Counties in the northeast and the counties of Alpine and Tuolumne in the Sierra Nevada. In these four cases the residuals suggested that the age-structure

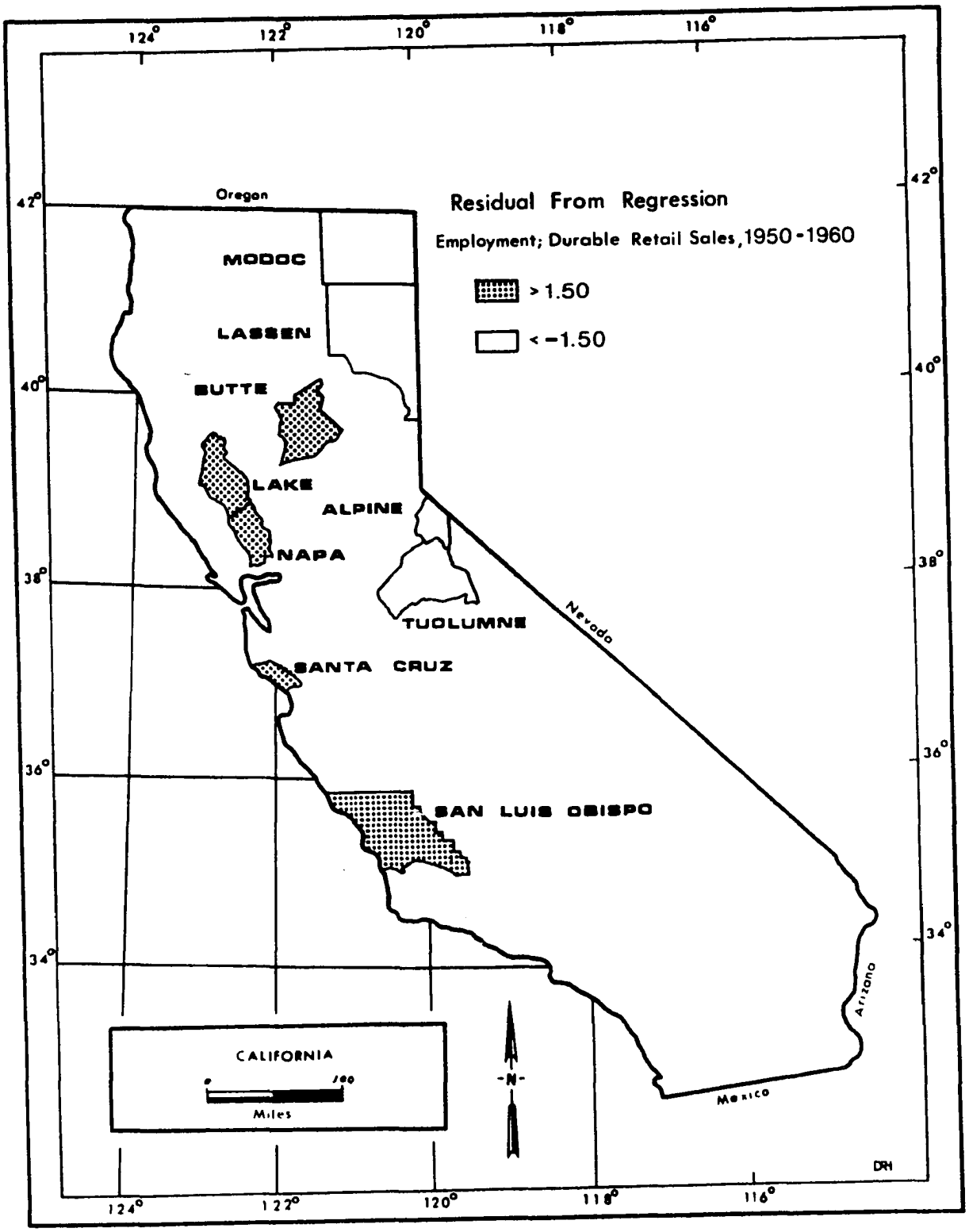

Residual From Regression
Employment; Durable Retail Sales, 1950-1960
> 1.50
< -1.50
Oregon
MODOC
LASSEN
BUTTE
LAKE
ALPINE
NAPA
TUOLUMNE
SANTA CRUZ
SAN LUIS OBISPO
Nevada
Arizona
Mexico
CALIFORNIA
Miles
-N-
DRH
124°
122°
120°
118°
116°
42°
40°
38°
36°
34°

Figure 4.5

TABLE 4.8

MULTIPLE CORRELATION BETWEEN EMPLOYMENT-DURABLE RETAIL SALES AND AGE-STRUCTURE FACTORS FOR AGED COUNTIES 1950-1960

Step	Variable Added	Beta Coefficient	R	R^2
1	Aged	.2117	.74	.55
2	Late Middle Age	.1885	.77	.59
3	Young Family	.1143	.82	.67

factors underpredicted the degree of employment-durable retail sales. In these four counties factors other than age-structure change seemed more likely to have influenced economic conditions. Precisely what other factors were involved was not immediately evident. For Lassen and Modoc Counties, though, Lantis has noted that: "This area has not shared the population growth of the state."[8] He observed that several characteristics have been common in this sector of the state: decline of rural population, limited economic opportunity due to the stabilization of the lumber industry, and consolidation of smaller ranches.[9] "Consequently, most

[8]David W. Lantis, Rodney Steiner and Arthur E. Karinen, California: Land of Contrast (2nd ed.; Belmont, California: Wadsworth Publishing Company, Inc., 1970), p. 36.

[9]Ibid.

of the hamlets are stagnant."[10]

The multiple correlation suggested that employment-durable retail sales had been age-structure change related for the period 1950-1960. Further, the analysis indicated that change in the proportion of aged persons directly affected the distribution of this socio-economic factor. However, the residuals from regression indicated that where aging had occurred as the result of the retirement effect, the correlation model overpredicted the expected level of employment-durable retail sales. This was interpreted as evidence to suggest the conclusion that the population aging by the retirement effect produces a different impact from that induced where population aging was the result of the outmigration of younger population (residual effect).

Structure-Interaction: 1960-1970

The socio-economic-change matrix for 1960-1970 yielded three rotated factors that collectively accounted for 64.9 percent of the total variance within the data. These factors were: (1) urbanization; (2) stable residence; and (3) retail sales. These factors were used again as the dependent variables.

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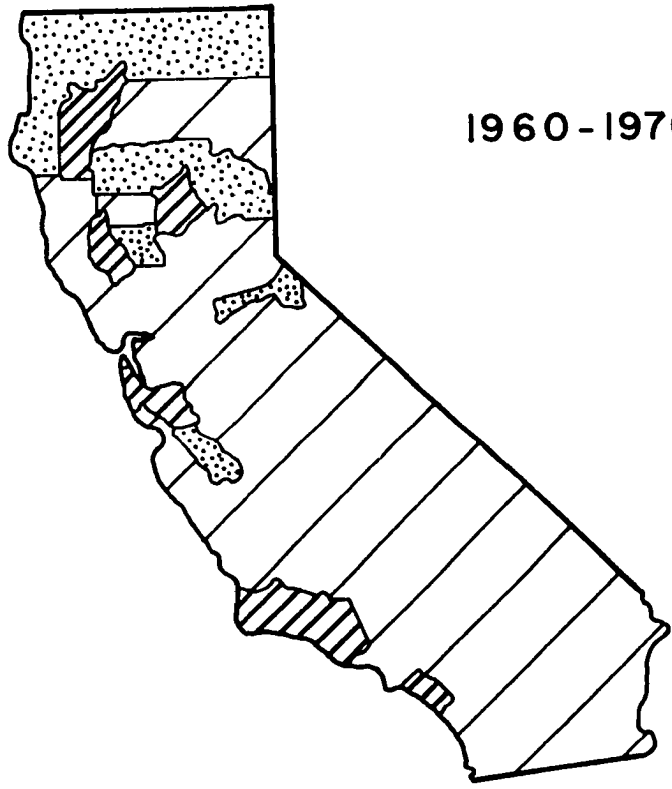
[10] Ibid.

The factor model extracted four dimensions from the age-change matrix. These were: late middle age, aged, young adult, and young family. These four factors were used as the independent variables in the stepwise multiple correlation routine.

Urbanization. The distribution of positive loadings on the urbanization dimension greater than 1.00 revealed two different groups. Three counties in Northern California, Butte, Lake and Trinity, composed the first group. The second was a group of coastal counties south of San Francisco Bay, Santa Clara, San Mateo, Santa Barbara, Ventura and Orange. With the exception of San Benito County in the central coast area, the negative loadings greater than 1.00 on the urbanization factor were counties in the extreme northern and eastern portion of the state.

A visual comparison of the urbanization distribution and the distribution of age-structure factors (Figure 4.6) suggested that for the 1960-1970 period a weak correlation might exist. However, it was not clear as to the amount of variation in the socio-economic variable that might be explained by the four age-change factors.

The correlation results between the urbanization dimension and the age-change factors are given in Table 4.9.



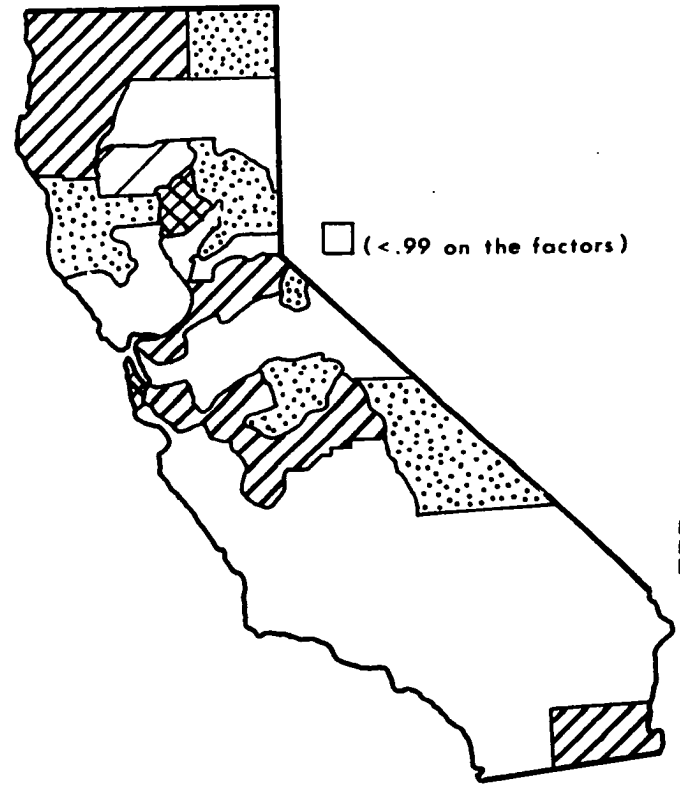
1960-1970

URBANIZATION

Positive Loadings >1.00

Negative Loadings > -1.00

.99 to -.99



(<.99 on the factors)

AGE-STRUCTURE FACTORS

Late Middle Age

Aged

Young Adult

Young Family

Figure 4.6

TABLE 4.9

MULTIPLE CORRELATION BETWEEN URBANIZATION AND AGE-STRUCTURE FACTORS FOR ALL COUNTIES 1960-1970

Step	Variable Added	Beta Coefficient	R	R^2
1	Late Middle Age	.2631	.29	.08
2	Young Family	.1892	.36	.13
3	Young Adult	.1204	.39	.15
4	Aged	.0916	.40	.16

The coefficient of multiple correlation was found to be only .40, thus the four age-structure factors seemed to account for only 16 percent of the variation in the urbanization dimension. Therefore, there seemed to be little association between urbanization and age-structure change.

The locational character of the urbanization dimension suggested that the variation was more closely linked to economic activities and to population attributes other than age-structure change. The high loadings in the San Francisco Bay area were likely a result of increased suburban development along the west shore of the bay and to the expansion of aerospace manufacturing and research facilities in this area. For the three northern counties with positive loadings, factors such as rural to urban migration of resident

population, inmigration of new residents from within the state and from other areas of the country and the growth of tertiary activities associated with tourism may have accounted for the indicated urbanization. Trinity County's loading on urban growth suggested additional variables for consideration: improved accessibility provided by State Route 299 linking the county with the coast and the Sacramento Valley and the impact of state and federal activities with reference to water and hydroelectric power projects in the county.

The south coast counties' urbanization was the result of the growth of cities such as Santa Barbara, Ventura, and Oxnard which experienced growth as destinations for outmigrants from the more congested Los Angeles Lowlands to the south. Growth in Orange County would be even more closely linked to suburban expansion due to its proximity to the large urban centers in adjacent Los Angeles, Riverside and San Bernardino Counties.. In these particular counties, the impact of federal military and aerospace spending would be an important consideration.

In the analysis of aging and migration in Chapter III, twenty-three counties were identified as having significantly increased in the proportion of aged persons during the period

between 1960 and 1970. Using these twenty-three counties as observations, variation in urbanization was examined in conjunction with the four age-structure-change factors, the results of which are shown in Table 4.10.

Whereas the correlation results between urbanization and the age-structure variables had not provided sufficient basis upon which to accept the statement of age-change relatedness for the state, this was not the case for the analysis of the twenty-three aged counties. The correlation model suggested that 55 percent of the variation in urban growth was accounted for by the four age-structure variables. The two age-change variables that contributed to reducing the greatest proportion of the unexplained variation were late middle age and aged which together accounted for 48 percent of the variation in urbanization.

While the age-structure change factors appeared to be better predictor variables of urbanization in the aged counties, it was not possible to distinguish between areas that had aged by the retirement effect and those that had aged due to the residual effect. The results from the correlation analysis suggested only that the aged in both residual effect and retirement effect counties had been urban

TABLE 4.10

MULTIPLE CORRELATION BETWEEN URBANIZATION AND AGE-STRUCTURE FACTORS FOR AGED COUNTIES 1960-1970

Step	Variable Added	Beta Coefficient	R	R^2
1	Late Middle Age	.2761	.58	.34
2	Aged	.2081	.69	.48
3	Young Family	.0902	.73	.54
4	Young Adult	.0763	.74	.55

oriented in their choice of residence.[11]

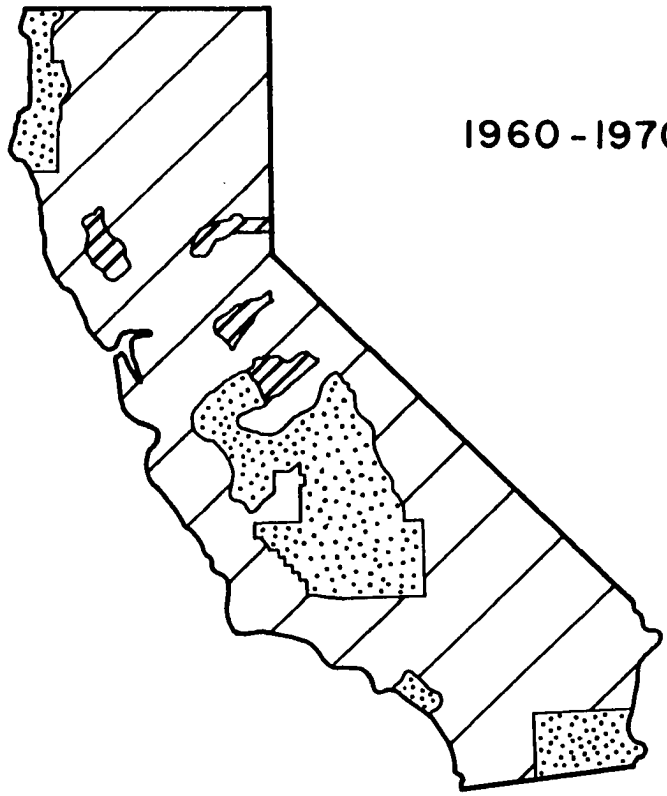
Stable Residence. The second most significant socio-economic factor extracted from the 1960-1970 matrix was a dimension whose aggregation of variables and location suggested growth in areas with an early settlement history. Counties that had high positive factors scores on this dimension had experienced increases in: the total number of housing units; the number of persons employed in service; the number of females widowed; and the number of owner-occupied housing units.

[11]The concentration of elderly persons in smaller urban centers has become an increasingly common phenomenon in the United States, and a subject that is receiving more exposure in the mass media. For example, see: Ted Sell, "Small Town, U.S.A.--Haven for the Elderly," Los Angeles Times, April 11, 1973, p. 1.

The first map in Figure 4.7 shows the distribution of this factor. The majority of counties had factor scores between .99 and -.99. The counties with positive factor scores were: Lake, Nevada, Calaveras and Mariposa. These were all counties where population aging was related to the retirement effect. The negative loadings were associated with counties located from Imperial and Orange in the extreme south to Del Norte and Humboldt along the northern coast. The largest area of negative loadings consisted of counties primarily within the San Joaquin Valley.

When this residence variable and the four independent variables were subjected to the stepwise multiple correlation routine using all fifty-eight counties as observations, the resultant $R = .54$ and $R^2 = .29$ seemed to indicate that stable residence was age-structure change related.

The analysis by multiple correlation was again performed using the twenty-three counties identified as having had significant increases in the proportion of persons age sixty-five and over during the decade. In this analysis the four independent variables accounted for 70 percent of the explained variation. (Table 4.11). The aged factor accounted for 47 percent and together with the late middle age factor the amount of explained variation rose to 54 percent.



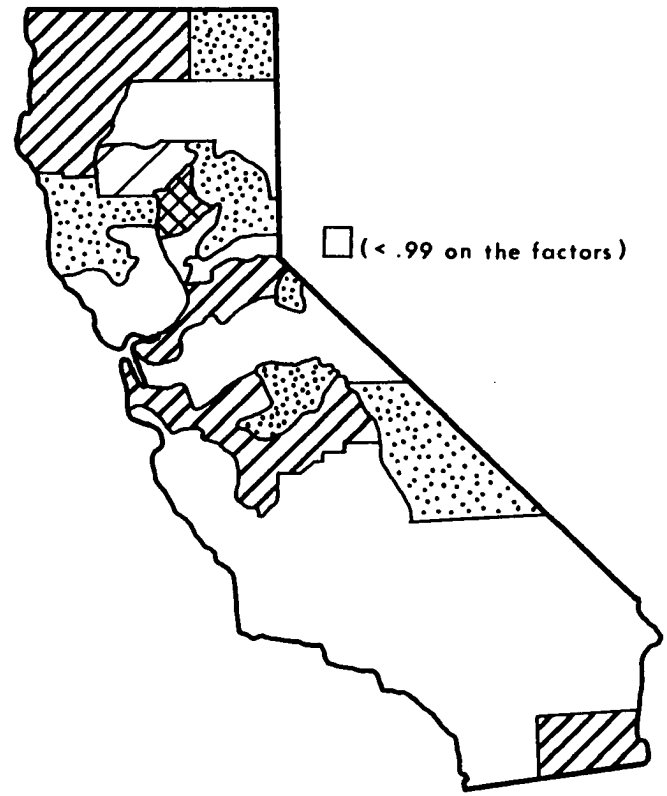
1960 - 1970

STABLE RESIDENCE

Positive Loadings > 1.00

Negative Loadings >-1.00

.99 to - .99



(< .99 on the factors)

AGE - STRUCTURE FACTORS

Late Middle Age

Aged

Young Adult

Young Family

Figure 4.7

TABLE 4.11

MULTIPLE CORRELATION BETWEEN STABLE RESIDENCE AND AGE-STRUCTURE FACTORS FOR AGED COUNTIES, 1960-1970

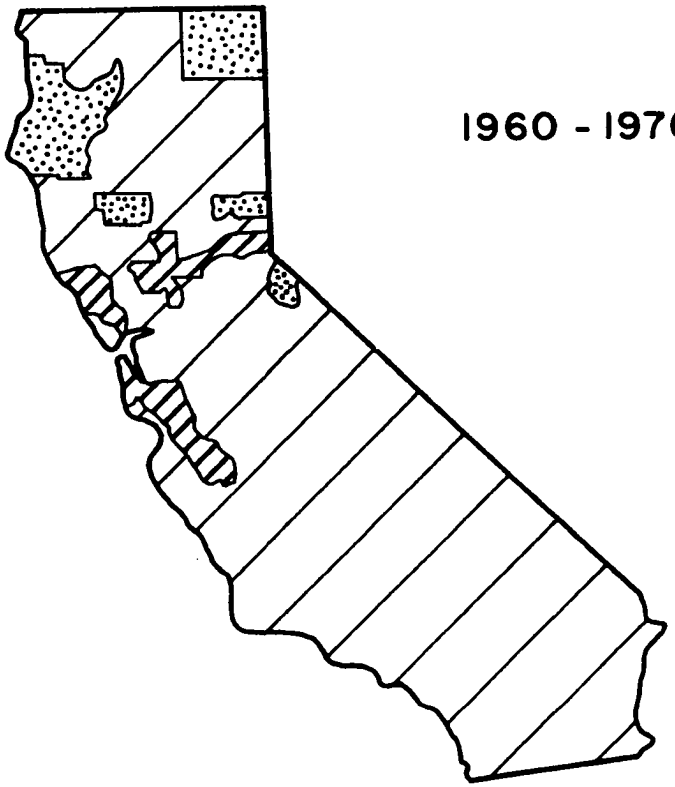
Step	Variable Added	Beta Coefficient	R	R^2
1	Aged	.1903	.60	.47
2	Late Middle Age	.1762	.74	.54
3	Young Family	.1034	.80	.64
4	Young Adult	.0815	.84	.70

Based on the coefficient of multiple determination, the stable factor's variation was in part influenced by age-structure variation during the decade.

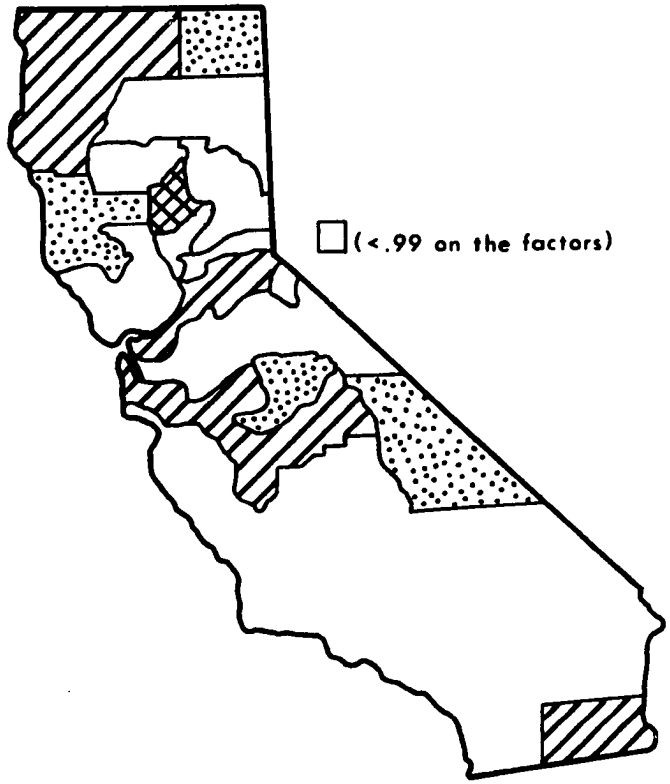
Any conclusion that the impact of aged population would vary according to the migration effect responsible for population aging could only tentatively be advanced in the case of the stable dimension.

Retail sales. The final factor extracted from the 1960-1970 socio-economic-change matrix defined a retail sales dimension similar to that identified in the 1950-1960 data. The distribution of this factor is portrayed in Figure 4.8.

An examination of the location of the counties with positive factor scores greater than 1.00 showed an orientation towards an urban focus. As can be seen in Figure 4.8,



1960 - 1970



RETAIL SALES

Positive Loadings >1.00

Negative Loadings >-1.00

.99 to - .99

Figure 4.8

AGE-STRUCTURE FACTORS

Late Middle Age

Aged

Young Adult

Young Family

two such clusters are evident, one adjacent to San Francisco, the other in the Sacramento Valley.

Counties with negative factor scores (scores greater than -1.00) were scattered throughout the northern portion of the state. The six counties shown in the figure were rural, more isolated and had experienced less general population growth than other areas of the state.

Application of the stepwise multiple correlation model revealed that only a weak relationship seemed to exist between the distribution of the retail sales dimension and the distribution of the age-structure factors. This finding held true when all counties were used as observation units and when the twenty-three aged counties were tested. Retail sales appeared (as was the case for 1950-1960) to be related to general population growth factor rather than being age-specific.

Application of Dummy Variables

The research hypothesis advanced earlier (see supra, p. 3) was that the impact variation of aged population on the socio-economic structure may be dependent upon which of two migration flows has been responsible for the increased proportion of persons age sixty-five and older. Based upon the examination of cohort-migration data (Chapter III) these two

migration elements were: (1) the inmigration of older persons or the retirement effect and (2) the outmigration of younger population or the residual effect.

To compare the effect of in versus out migration required: (1) selection of county populations to be used, (2) conversion of nominal variables (in this case two migration categories) to quantitative data and (3) analysis of these data. The selection of county populations to be used in this phase of the study was based upon the work presented in Chapter III. That is, examination of cohort migration allowed identification of county populations that had aged. For the decade 1950-1960, thirteen counties aged due to migration; five aged by the retirement effect; eight aged from the residual effect. A total of nineteen county populations exhibited aging between 1960 and 1970 with six ty retirement and thirteen by the residual pattern.

Conversion of the nominal migration categories to quantitative data was accomplished by using a binary or dichotomous dummy variable.[12] Where aging had occurred due

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[12]A general review of the technique of using dummy variables can be extracted from: Daniel Suits, "The Use of Dummy Variables in Regression Equations," Journal of the American Statistical Association, LII (1957), pp. 548-551; and J. Johnston, "Extensions of the General Linear Model," Econometric Methods (2nd. ed.; New York: McGraw-Hill Book Company, 1960). For a more rigorous treatment, see: N. R.

to retirement the value of 1 was assigned; populations that had aged due to outmigration were assigned a zero. Table 4.12 illustrates this value-assignment. As shown, Butte, Lake and Mariposa Counties experienced population aging due to the retirement effect, thus, the value of their dummy variable was unity. On the other hand, three county populations aged due to the residual effect and a zero was assigned.

TABLE 4.12

SELECTED COUNTIES AND DUMMY MIGRATION VARIABLE

County	Migration Related Aging Effect (Chapter 3)	Dummy Migration Variable
Butte	Retirement	1
Colusa	Residual	0
Glenn	Residual	0
Lake	Retirement	1
Mariposa	Retirement	1
Modoc	Residual	0

The analysis portion of this segment of the research was based upon the multiple regression equation

(1) $$Y = a+b_1X_1+b_2X_2+ \cdots b_kX_k+e$$

For each decade, the dependent variables (Y) were the socio-

Draper and H. Smith, Applied Regression Analysis (New York: John Wiley and Sons, Inc., 1966), especially pages 134-141.

economic factor scores derived in previous analysis of the socio-economic-change matrices. For 1950-1960, these rotated factors were urbanization, service-convenience sales and employment-durable sales. Factor analysis on the 1960-1970 data yielded factors of urbanization, stable residence and retail sales. The independent variables (X) were the aged factor score, the dummy migration variable and an interaction variable represented as the cross-product of the aged factor score and the dummy migration variable. These data produced a modified equation

(2) $$Y = a+b_1X_1+c_1D_1+d_{11}X_1D_1$$

where:

X_1 = aged factor score

D_1 = dummy migration variable

X_1D_1 = cross-product interaction variable

c_1 = dummy variable beta coefficient

d_{11} = interaction variable beta coefficient

For a population that aged due to the residual effect, $D_1 = X_1D_1 = 0$, thus the equation was reduced to

(3) $$Y = a+b_1X_1$$

However, in cases where population aging appeared to have resulted from the retirement effect, a modified form of equation (2) was applied in the form of

(4) $$Y = (a+c_1) + (b_1+d_{11})X_1$$

Here, a modified intercept $(a+c_1)$ and slope (b_1+d_{11}) were used to define the relationship between X_1 and the socio-economic factor score (Y).

The results of the dummy migration variable analysis are summarized in Table 4.13. For the 1950-1960 period substantial difference between inmigration and outmigration is evident. The intercept and slope values for all socio-economic dependent variables indicate this difference. The greatest difference appears in the results. However, the relationship between the two migration types and the 1960-1970 socio-economic factors do not seem to support the hypothesis of differing impacts based on the two migration categories. As can be seen, there is a difference in intercept values, but the slope values which indicate the ratio of change between X and Y are very close.

These results taken with the findings presented earlier seem to indicate that the impact of aged population did vary in the 1950's depending upon which migration type induced the aging. However, during the following decade, such a variation in impact of aged population was much less dependent upon the migration mechanism which had induced the aging.

TABLE 4.13

COMPARISON OF INTERCEPT AND SLOPE VALUES
FOR INMIGRATION AND OUTMIGRATION

Socio-economic Dimensions	Inmigration		Outmigration	
	Intercept $(a+c_1)$	Slope (b_1+d_{11})	Intercept (a)	Slope (b_1)
1950-1960				
Urbanization	-.56158	1.05632	.39591	-.13179
Service-Convenience Sales	.21788	.44730	.44143	-.19201
Employment-Durable Sales	.71508	-.30064	.69571	-.08882
1960-1970				
Urbanization	.96742	-.08492	.34392	-.08376
Stable Residence	.56071	-.04069	.79459	-.04018
Retail Sales	.19540	.15405	.38621	.15590

Source: Computed by author.

Summary

The factor analytic model applied to the socio-economic-change matrices and to the age-structure change matrices yielded dimensional variables in the form of orthogonal factors. These factors were then used as dependent variables (socio-economic factors) and age-change variables as independent variables in stepwise multiple correlation, the purpose of which was to seek to identify what changes in a socio-economic structure might be attributed to changes in age-structure. The age-structure change of interest was change in the proportion of persons age sixty-five and older and more specifically, the change in the proportion of persons in this age category as a result of the retirement effect versus the residual effect.

The factor model isolated three factors from the 1950-1960 socio-economic data matrix: (1) urbanization; (2) service-convenience sales; and (3) employment-durable sales. From the 1960-1970 matrix, three factors were also identified and were labeled: (1) urbanization; (2) stable residence; and (3) retail sales.

The urbanization factor, identified in the data for both decades, was found to be related to age-structure changes in the 1950-1960 period. As the analysis showed,

the greatest proportion of the variation in the state was accounted for by the young family factor. However, residuals from regression suggested that counties that had aged due to the retirement effect also exhibited urban growth. It was found in examination of the counties which had been identified as having large proportional increases in the number of aged persons that the retirement effect seemed to be associated with urban growth more so than where aging had been the result of the residual effect.

The urbanization factor for 1960-1970 was found to be less related to age-structure change than had been the case for 1950-1960 within the state as a whole. However, among the counties with aged populations, there was a stronger correlation, but the research failed to identify differences between the retirement effect and the residual effect.

In both decades, a retail sales factor was isolated. In neither period, however, was any significant relationship established between the spatial variation of this socio-economic dimension and the age-change factors. The analysis suggested instead that this sales dimension was more closely related to variables such as proximity to urban centers, variation in employment opportunities, variation in social stratification or to other general population variables related to the variation in growth.

Service-convenience sales was found to possibly be age-structure change related. The single age-change factor of greatest significance was the aged factor. However, the correlation analysis greatly overpredicted the expect value of this variable in counties that had aged due to the retirement effect. Thus, simply an increase in the proportion of aged population did not result in economic decline; rather, the retirement effect counties exhibited a reverse tendency.

No significant relationship was confirmed between the stable factor and the age-structure change factors for the state for 1960-1970. In analysis of the data using the counties with aged population structures, a stronger relationship was suggested. However, no significant difference could be detected between residual effect counties and retirement effect counties.

In summary, age-structure changes appeared to have a more significant effect on the spatial variation of socio-economic change in the 1950's in California than such changes did during the 1960's. Population changes are a dynamic set of processes; the differing results obtained for the two decades illustrated this point.[13]

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[13]This dynamic nature of population processes is becoming even more evident where California's population is concerned. The traditional indicators of population conditions

"In our groping for geographic understanding we shall often be more than content if we can postdist--that is, find relationships and models that clarify our understanding of developments in the past."[14] Thus, questions regarding the impact of aged population are likely not to have specific answers but rather such impact will vary with changes in temporal and spatial scales. Of this the researcher must be aware if his analyses are to add to our understanding of such phenomena in time and space.

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in the state are not as valid as they have been in past years. See: Ray Hebert, "State Population Growth Pattern Puzzles Experts," Los Angeles Times, May 28, 1973.

[14]Ronald Abler, et al., Spatial Organization, p. 112.

CHAPTER V

CONCLUSIONS

The findings of this study suggest that the consideration of age structure elements in conjunction with socio-economic variables can add a valuable dimension to the study of population in general and to the understanding of the influence exerted by population qualities in particular. From these results two sets of conclusions emerged. The first group was related specifically to the population geography of the study area. The second set pertained to the research design--the conceptual model and the methodology for the implementation of that model.

Aged Impact: The Case of California

Increase in the proportion of persons age sixty-five and older is an important age-structure change that has been occurring in California. This aging process appears to have become most pronounced during the 1940's and has continued to the present time.

Analysis of cohort migration estimates suggests that

the structural and spatial distribution of persons age sixty-five and over is the result of two dominant migration "effects." The retirement effect is identified as the in-migration of persons sixty-five and older. Of the two aging mechanisms, the retirement versus the residual, the retirement effect was found to have the most restricted spatial distribution in comparison to the residual effect--the out-migration of younger population. This residual effect has been most evident in rural, northern counties where primary economic activities form the basis of employment opportunities.

Examination of the spatial distribution of each of these "effects" produced several conclusions regarding the input element of migration. First, the populations that aged by the retirement effect have been those located outside the larger urban centers of the state, but in counties accessible to these centers. Secondly, population aging has spread north and east from San Francisco Bay since 1950. Thirdly, the residual effect was most evident in counties that had the least accessibility to major population centers of the state.

"Does the impact of retirement-effect aging differ from that of residual-effect aging?" was the focal question of this study. The analysis of the 1950-1960 data revealed

that such a difference in impact did exist. In counties where population aging had resulted from the retirement effect, a positive association with the urbanization dimension was detected. These counties exhibited characteristics in socio-economic structure similar to those associated with the growing metropolitan centers adjacent to San Francisco and Los Angeles. In the counties where population aging has been indicated as resulting from the residual effect economic decline was experienced.

The spatial variation in two 1960-1970 socio-economic-change factors was found to be related to variation in age-structure changes among the nineteen counties with older population structures. However, the analysis failed to discern any significant difference between residual and retirement aging-impact.

The search for a possible explanation for the difference in results between the impact of residual and retirement aging in 1950-1960 and those for 1960-1970 led to two avenues of speculation. First, it would appear that those older persons who retired in California during the 1950-1960 period and migrated to retirement-effect counties were in a better financial position than older populations in the residual-effect counties. However, by the 1960-1970 decade, such financial contrasts may have been lessened due to im-

proved old age assistance programs administered by state and federal agencies, with assistance available to elderly persons in the more isolated rural areas. A second possible explanation may be that the socio-economic structures of the counties may have become less age-change sensitive than was the case in 1950-1960. Both are likely to have been important factors in explaining the difference in impact results for the two decades.

Aged Impact: The Research Design

The testing of the conceptual model and its methodological framework in California has suggested a second set of conclusions:

1. The study of the impact of aged population should be approached through consideration of the total population age structure. Therefore, measures, such as the coefficient of old age, that provide descriptive indexes of only a portion of that structure are of usefulness only during the early phases of research.

2. The investigation of the influence of aging and migration proved helpful later in the interpreration of the analysis of structure-interaction. This was especially true when interpreting the residuals from regression. It is thus concluded that attention to the input phase of the model can

provide valuable additional insight for use in the latter stages of analysis of population-quality research.

3. The methodology suggested by this study allows for the consideration of both population structure dimensions and socio-economic-structure dimensions and provides a framework for determining these measures.

4. The research design is not limited to any single scale of study. Rather, with adjustment for study-area size, the model may find application from the urban neighborhood to the national scale.

5. The research model has been applied in this study to a single population structure component. However, the model might be equally useful in consideration of other population qualities such as the impact of sex composition or ethnic composition on socio-economic structures.

6. The use of the factor analytic approach provides descriptive statements about a large number of variables but statements that may be used in additional statistical analysis. This particular feature is useful when both description and further analysis are required.

Future Avenues of Research

This study has treated a population quality--age-structure change--as an independent variable, and in doing

so it has been somewhat exploratory in both the conceptual framework and in the methodological approach. While the actual findings and their interpretation are applicable to the case of California, these results suggested that future study of aged impact may add valuable insights to population studies in other states.

From this research, future energies might be directed towards further study of the input element of migration as a population aging mechanism. Attention should also be focused on the possible application of aged impact in the areas of social organization planning; to economic ramifications or to interdisciplinary studies such as political behavior analysis.

One immediate need would be to test the research design at several scales of analysis. These levels of aggregation could be chosen from the use of minor civil divisions or single urban center districts to a selected sample of counties within the entire United States. Such scale-change testing would allow more accurate inferences to be developed about aged impact.

Population qualities, like quantities, are important elements in the geographic personality of locations. The study of the temporal and spatial variations in such qualities can provide more complete understandings in population geography.

APPENDIX A

METHODS FOR MIGRATION ESTIMATES

The estimates of net migration used in this study were based upon two widely used techniques, the vital statistics method and the forward survival rate method. The former procedure is applied to establish estimates for a total given population; the latter is used to estimate net migration by age groups (cohorts).

The vital statistics method. The vital statistics method is a technique that estimates net migration using census enumerations of population and birth and death data. Computing these estimates is as follows:

(1) $$M = (P_t - P_o) - (B - D)$$

where:

M = the estimate of net migration

P_t = a more recent census population

P_o = a previous census population

B = the number of births during the intercensal period

D = the number of deaths during the intercensal period

The first step involves subtracting the total population (P_o) of the earlier decade from the total population (P_t) of the latter decade. From this residual ($P_t - P_o$) the change resulting from natural increase-decrease (B - D) is subtracted. The final figure is the estimated change in population attributed to migration; a negative result would be interpreted as outmigration and a positive one as inmigration.

The forward survival rate method. The forward survival rate method of estimating net migration is used with age cohorts. For each cohort in a population age structure an estimate of net migration is obtained by applying the equation:

(2) $$M_{for} = P' - rP$$

where:

M_{for} = the estimate of net migration

P' = the population of the cohort in a latter decade

r = the computed forward survival rate

P = the cohort population from the preceding decade

To illustrate (P') and (P) using the Census for 1950 and 1960, (P') would be, for example, the cohort 20-24 in 1960, but in 1950 this age group was enumerated as the cohort

10-14; thus, (P) would be the population of the cohort 10-14 in the Census of 1950.

Before estimates of cohort migration can be calculated using equation (1), a table of survival rates must be generated. These rates may be computed from some base population in this manner:

(3) $$r = \frac{\text{cohort population 20-24 in 1960}}{\text{cohort population 10-14 in 1950}}$$

These rates are then substituted for (r) in formula (2). After an estimate of net migration is prepared for each cohort, all can be summed resulting in an additional estimate of net migration for each county.

Choice of survival rates. As noted above, survival rates may be computed using several population bases. Therefore, in using equation (3), the choice of base population must be carefully made.

Since the total estimated net migration for each county compiled from totaling the cohorts should approximate the estimates calculated by the vital statistics method, it may be necessary to prepare two survival rate tables and two sets of migration estimates using national, state or regional populations as bases. This procedure allows the choice of cohort estimates that approaches as closely as possible the vital statistics estimates. This step is considered neces-

sary, since the vital statistics estimates are assumed to be the more accurate of the two techniques because they are computed from actual birth and death data.

For the estimates of net migration used in this study (Chapter III) two tables of survival rates were prepared, one using the national population as a base and the other using the state population.[1] These rates were generated using equation (3). The rates were then substituted for (r) in formula (2). Tables A.1 and A.2 show the rates established for each base population.

The choice of survival rates was based upon a test of simple correlation between the vital statistics estimates and those estimates generated by summing the cohorts where the estimates were based upon the forward survival rate method for all fifty-eight counties. The rationale was that the higher the coefficient of correlation, the closer the survival rate estimates came to approximating the vital statistics estimates that had been prepared using actual birth and death data. The results of this testing procedure are contained in Table A.3. Based on the test results, the rates from the national population were chosen to be used in equation (2).

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[1]Because the literature was not clear regarding which base population to use, both state and national populations were examined.

TABLE A.1

COHORT FORWARD SURVIVAL RATES COMPUTED FROM THE UNITED STATES POPULATION

Cohort		1950-1960	1960-1970
0-4	10-14	1.0355	1.0230
5-9	15-19	1.0040	1.0202
10-14	20-24	.9667	.9760
15-19	25-29	1.0212	1.0194
20-24	30-34	1.0449	1.0582
25-29	35-39	1.0267	1.0218
30-34	40-44	1.0094	1.0026
35-39	45-49	.9806	.9707
40-44	50-54	.9606	.9572
45-49	55-59	.9554	.9166
50-54	60-64	.8700	.8970
55-59	65-69	.8638	.8293
60-64	70-74	.7755	.7621
65+	75+	.4337	.4607

Computed by the author.

TABLE A.2

COHORT FORWARD SURVIVAL RATES COMPUTED FROM THE CALIFORNIA POPULATION

Cohort		1950-1960	1960-1970
0-4	10-14	1.2899	1.1093
5-9	15-19	1.2931	1.1375
10-14	20-24	1.5067	1.2279
15-19	25-29	1.6135	1.3299
20-24	30-34	1.4410	1.2396
25-29	35-39	1.3032	1.1317
30-34	40-44	1.2090	1.0847
35-39	45-49	1.1265	1.0336
40-44	50-54	1.0750	1.0104
45-49	55-59	1.0488	.9601
50-54	60-64	.9764	.8532
55-59	65-69	.9825	.8781
60-64	70-74	.8836	.8221
65+	75+	.4877	.5055

Computed by the author.

TABLE A.3

SIMPLE CORRELATION BETWEEN FORWARD SURVIVAL RATE MIGRATION ESTIMATES AND VITAL STATISTICS ESTIMATES

Decade	Base Population	
	National	State
1950-1960	.98904	.81004
1960-1970	.99151	.87511

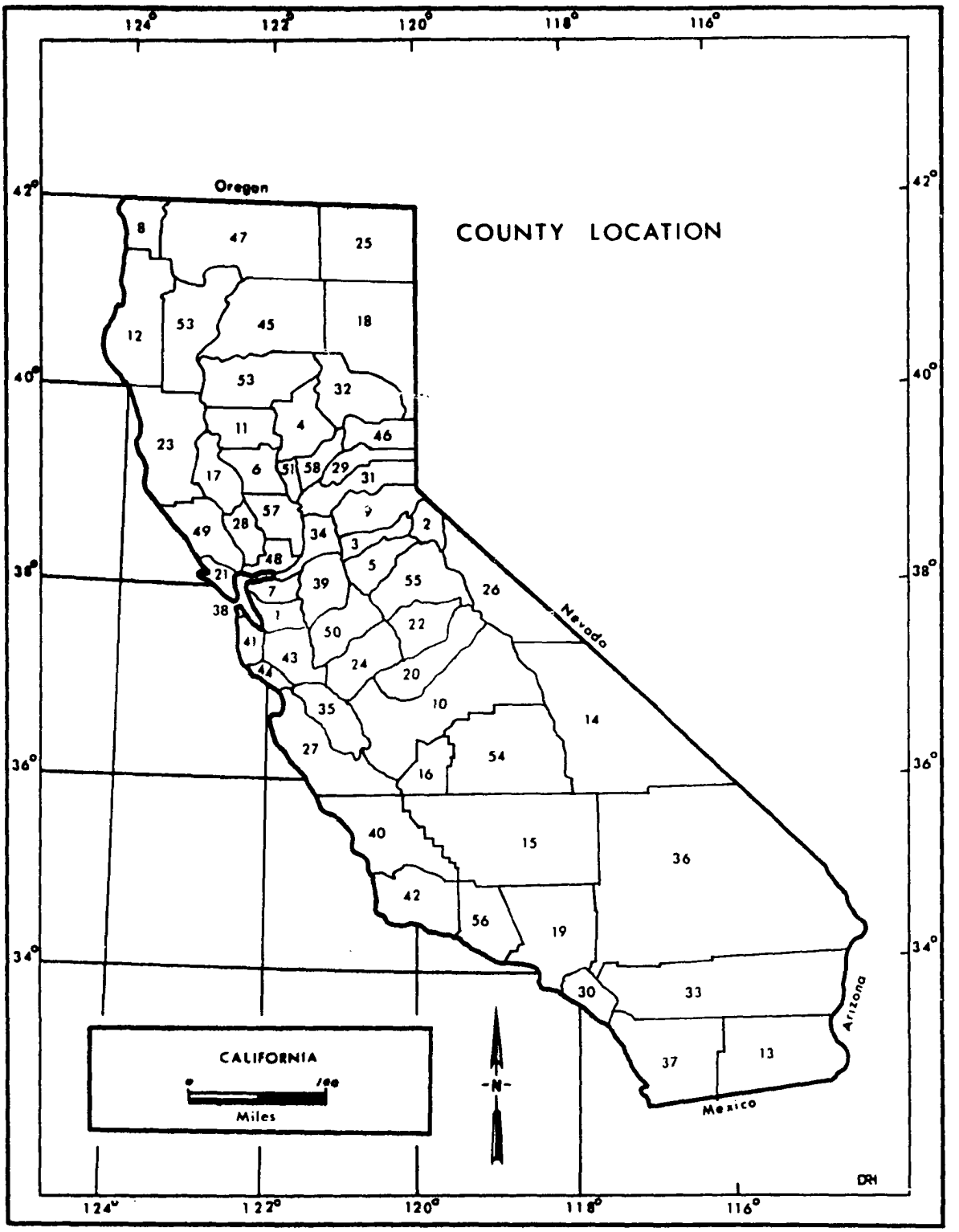
Computed by the author.

APPENDIX B

COUNTY LOCATION

Map Number	County
1	Alameda
2	Alpine
3	Amador
4	Butte
5	Calaveras
6	Colusa
7	Contra Costa
8	Del Norte
9	El Dorado
10	Fresno
11	Glenn
12	Humboldt
13	Imperial
14	Inyo
15	Kern
16	Kings
17	Lake
18	Lassen
19	Los Angeles
20	Madera
21	Marin
22	Mariposa
23	Mendocino
24	Merced
25	Modoc
26	Mono
27	Monterey
28	Napa
29	Nevada
30	Orange
31	Placer
32	Plumas

Map Number	County
33	Riverside
34	Sacramento
35	San Benito
36	San Bernardino
37	San Diego
38	San Francisco
39	San Joaquin
40	San Luis Obispo
41	San Mateo
42	Santa Barbara
43	Santa Clara
44	Santa Cruz
45	Shasta
46	Sierra
47	Siskiyou
48	Solano
49	Sonoma
50	Stanislaus
51	Sutter
52	Tehama
53	Trinity
54	Tulare
55	Tuolumne
56	Ventura
57	Yolo
58	Yuba


COUNTY LOCATION
Oregon
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Arizona
Mexico
CALIFORNIA
Miles
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122°
120°
118°
116°
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40°
38°
36°
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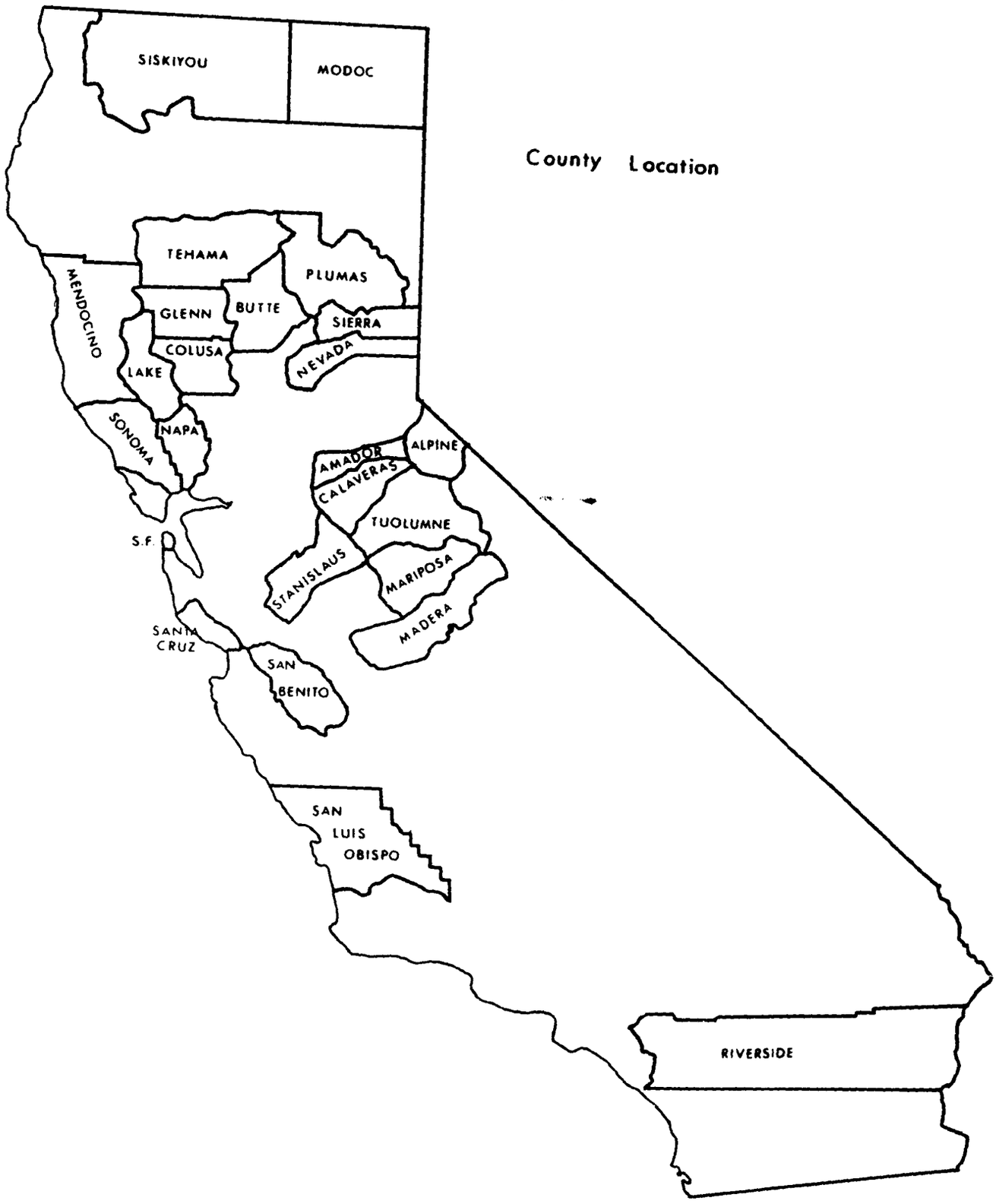
APPENDIX C

The following map shows the location of the counties which exhibited aged population characteristics for the decades discussed in this research.

County Location



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